Hazardous materials management plans and procedures

Policy

Management plans and procedures outline instructions for the safe acceptance, collection, receipt, storage, disposal and public access for drillcore and other samples containing hazardous materials.

Scope

Hazardous materials include drillcore and other samples containing radioactive minerals and/or asbestiform minerals and also other geological samples that may be hazardous under certain circumstances (for example, oxidising or inflammable sulfides).

The management plans and procedures including exposure levels specified in this document are directed towards the GSNSW core libraries' specific needs to minimise the exposure of people to radioactive core and other hazardous materials, and to minimise the possible risk that may ensue from exposure to these materials.

Links to Safety Management Plans and Safe Work Procedures

The following resources provide access to the full texts of the management plans and procedures:

- Safety Management Plan – Naturally Occurring Asbestos – Final.doc
- Safe Work Methods Statements – Naturally Occurring Asbestos Final.doc
- Radiation Management Plan – W B Clarke Londonderry NSW Jul 2014 v1.1.docx
- Safe Handling of Naturally Occurring Radioactive Material August 2014 v1.4.docx

These management plans and procedures include the following details:

a) Naturally occurring asbestos:

- Definition of asbestiform varieties of mineral silicates
- Exposure standard of 0.1 fibres/ml of air measured in a person's breathing zone over an 8 hour shift
- Effects on health
- Risk management including identifying naturally occurring asbestos in core samples
- Asbestos register, warning signs, segregation and containment,
- Work permit, air monitoring
- Reporting and records management
- Working with samples containing naturally occurring asbestos
- Disposal
- Responsibilities
- Managing incidents
- Site Safety Rules, WHS training
- Safe Work Method Statements

b) Radioactive core:

- Responsibilities of employees and visitors
- Regulatory authority
- Sources of exposure to radiation
- Receiving and handling of core samples of radioactive drillcore
- Storage of radioactive drillcore
- Radiation monitoring
- Criteria for acceptance or rejection of offers of core containing naturally occurring radioactive material
- Dose assessment
- Training
- Record keeping
- Emergency information and procedures
- Transport of core

Legislation

The following relevant legislation and guidelines apply to managing asbestiform minerals in the workplace, including transport, handling, storage and disposal:

Acts and Regulations

- Work Health and Safety Act 2011,
- Work Health and Safety Regulation 2011.

Codes of practice

- How to manage and control asbestos in the workplace
- How to safely remove asbestos
- How to manage work, health and safety risks,
- Managing the work environment and facilities,
- Work health and safety consultation, coordination and cooperation.

Guides

- Naturally occurring asbestos fact sheet
- Working with asbestos guide
- Asbestos blueprint for NSW

The relevant legislation and Codes of Practice that apply to uranium exploration resulting in radioactive core and other samples transport, handling, storage and disposal are as follows:

- *Mining Act 1992*
- *Mining Legislation Amendment (Uranium Exploration) Act 2012*
- *Protection of Environment Operations Act 1997*
- *Water Management Act 2000*
- *Work Health and Safety Act 2011*
- *Mine Health and Safety Act 2004*
- *Environmental Planning and Assessment Act 1979*
- *Radiation Control Act 1990*
- *NSW Radiation Control Amendment Act 2010*
- *NSW Radiation Control Regulation 2013*
- *Dangerous Goods (Road and Rail Transport) Act 2008*
- Codes of Practice for the Safe Transport of Radioactive Material (2008)
- APRANSA Code of Practice and Safety Guide http://www.arpansa.gov.au/pubs/rps/rps9.pdf

Naturally occurring asbestos

The Safety Management Plan and Safe Work Method Statements provide detailed and comprehensive information on handling and processing drillcore known or thought to contain asbestiform minerals. These documents are to be read by companies offering such drillcore to the core library.

Naturally occurring radioactive material (NORM)

Procedures

1. Offer and receipt of new core

An offer of any new core to the core library must declare on the Core Offer Sheet any core known or believed to be radioactive. A spreadsheet giving actual contact dose rate levels and any assays for uranium must be supplied on page 2 of the sheet.

Any core with a measured dose rate above 75 µSv/h (when 50 cm from the largest surface of the core tray) will not be accepted for storage at the W B Clarke Geoscience Centre.

2. Categorisation of drillcore samples

All drillcore samples received by the W B Clarke Geoscience Centre shall be surveyed for radioactivity using a radiation dose rate meter, with measurements in micro-Sieverts per hour (µSv/h) taken at 5cm and 50 cm from the largest surface of the core tray.

The survey meter shall be passed slowly down the centre (long axis) of the core tray at approximately 5 cm above the core tray. If the dose rate at any point 5 cm from the surface of the core tray exceeds 0.25µSv/h above background, the drillcore sample will be considered to contain NORM.

If the drillcore sample has been found to contain NORM then that core tray will be categorised by measuring the dose rate at 50 cm from the largest surface of the core tray.

The categories are as follows:

Category	**Dose rate at 50 cm (µSv/h)**
Negligible	<2 µSv/h
Low	>2 µSv/h and <25 µSv/h
Medium	>25 µSv/h and <50 µSv/h
High	>50 µSv/h and <75 µSv/h
Risk	>75 µSv/h*

*Any drillcore sample with a measured dose rate above 75 µSv/h (at 50 cm from the largest surface of the core tray) will not be accepted for storage at the W B Clarke Geoscience Centre.

The core shall be categorised as per the table above and treated accordingly. The Radiation Safety Officer will confirm any measurements above 75 µSv/h.

The core will be assessed as ‘friable’ or ‘non-friable’. For the purposes of this document, ‘friable’ will include core that is prone to dusting. Friable core shall be flagged on the radioactive drillcore sample inventory.

The Core Offer Sheet shall be completed for any core scanning above 2 µSv/h. This will record all labels, storage actions and database entries required.

3. Existing core

Core that has not been scanned for radioactivity may be scanned when it is next laid out for inspection. The relevant departmental geoscientist shall record which core has been scanned and whether the core is radioactive or not.

4. Sampling of core

The GSNSW core libraries will not cut any radioactive drillcore. If a company wishes to cut and sample the core, it must be transported by the company off-site to an approved facility.

Core to be cut becomes the responsibility of the company undertaking the task. It is the company’s responsibility to meet the requirements of all relevant legislation covering transport and handling of radioactive core.

5. Register of staff and visitors

All staff working at the core library must read and acknowledge the contents of this document. Staff are required to re-read and re-sign after any amendments to the document.

All visitors to the core library who inspect or are involved in the handling of radioactive core must read and acknowledge the contents of this document. This acknowledgement shall be for the duration of the current inspection.

Registers of these processes are to be maintained by the Manager Core Library.

6. Transport of radioactive core

Transport must comply with the Code of Practice for the Safe Transport of Radioactive Material (2008).

7. Databases

Updating of the Core Library Database will be the responsibility of the relevant departmental geoscientist.

SAFETY MANAGEMENT PLAN
naturally occurring asbestos

(Asbestos Management Plan)

Disclaimer

This asbestos Safety Management Plan is based on legal requirements and WorkCover and other guidance material. It includes some of your obligations under Work Health and Safety legislation that WorkCover administers. To ensure you comply with your legal obligations you must refer to the appropriate Acts and Regulations.

Although every effort has been made to ensure that this publication is current, it may refer to WorkCover administered legislation that has been amended or repealed.

When reading this publication you should always refer to the latest laws *AND SEEK APPROPRIATE LEGAL ADVICE IF NECESSARY*. Information on the latest laws can be obtained from WorkCover.

Contents

1. INTRODUCTION

The Geological Survey of New South Wales of the Department promotes exploration for minerals, coal and hydrocarbons in NSW by acquiring drillcore samples and operating storage facilities for those samples.

Drillcore that contains naturally occurring asbestos (NOA) will be ranked in the same manner as all other drillcore offered to the Department. The procedures for ranking drillcore are laid out in the Drillcore acceptance, disposal and access policy and procedures. Drillcore containing NOA that is ranked highly according to this scoring system will need to be retained for future explorers/scientists to inspect.

This asbestos management plan applies to the Londonderry Core Library facility and its purpose is to ensure that all practicable steps are taken to eliminate the risk of exposure to asbestos for personnel, including visitors to the site.

To accomplish this, the asbestos management plan specifies work practices and procedures to ensure the appropriate implementation of risk control strategies, and a method to monitor and review these risk control strategies.

The *Work Health and Safety Regulation 2011* (NSW) requires the risks to health and safety from asbestos, including naturally occurring asbestos, be managed and a written plan (Asbestos Management Plan) be prepared for the workplace. This plan must be made available to, and understood by, all personnel handling drillcore containing NOA.

Reviews

The asbestos management plan must be maintained and kept up to date.

NSW Trade & Investment and or the Geological Survey of NSW will review this asbestos management plan at least once every 5 years. More frequent reviews and revisions will take place in response to organisational or legislative changes or if the plan is no longer adequate for managing naturally occurring asbestos at the facility. The reviews will be undertaken in consultation with management and relevant staff.

Acts and Regulations

- *Work Health and Safety Act 2011*,
- *Work Health and Safety Regulation 2011*.

Codes of Practice

- How to manage and control asbestos in the workplace
- How to safely remove asbestos
- How to manage work, health and safety risks,
- Managing the work environment and facilities,
- Work health and safety consultation, coordination and cooperation.

Guides

- Naturally occurring asbestos fact sheet
- Asbestos at Work
- Asbestos Blueprint for NSW

Meaning of key terms[1]

Asbestos
asbestiform varieties of mineral silicates belonging to the serpentine or amphibole groups of rock-forming minerals, including actinolite asbestos, grunerite (or amosite) asbestos (brown), anthophyllite asbestos, chrysotile asbestos (white), crocidolite asbestos (blue) and tremolite asbestos

Competent person
person who has acquired, through training, qualification or experience, the knowledge and skills to carry out the task

Exposure standard (maximum)
for asbestos is a respirable fibre level of 0.1 fibres/ml of air measured in a person's breathing zone and expressed as a time weighted average fibre concentration calculated over an eight-hour working day and measured over a minimum period of four hours in accordance with:

- the Membrane Filter Method
- a method determined by the relevant regulator

Naturally occurring asbestos (NOA)
natural geological occurrence of asbestos minerals found in association with geological deposits including rock, sediment or soil

Persons Conducting a Business or Undertaking (PCBU)
individual person or an organisation conducting a business or undertaking

Effects on health

Asbestos is formed in fibre bundles and, as it is further processed or disturbed, the fibre bundles become progressively finer and more hazardous to health. The small fibres are the most dangerous. They are invisible to the naked eye and, when inhaled, penetrate the deepest part of the lungs (respirable fibres).

Significant health risks may arise from the inhalation of airborne asbestos fibres. Compared with straight amphibole fibres, such as amosite and crocidolite, chrysotile fibres are curly and less likely to penetrate the deepest parts of the lung.

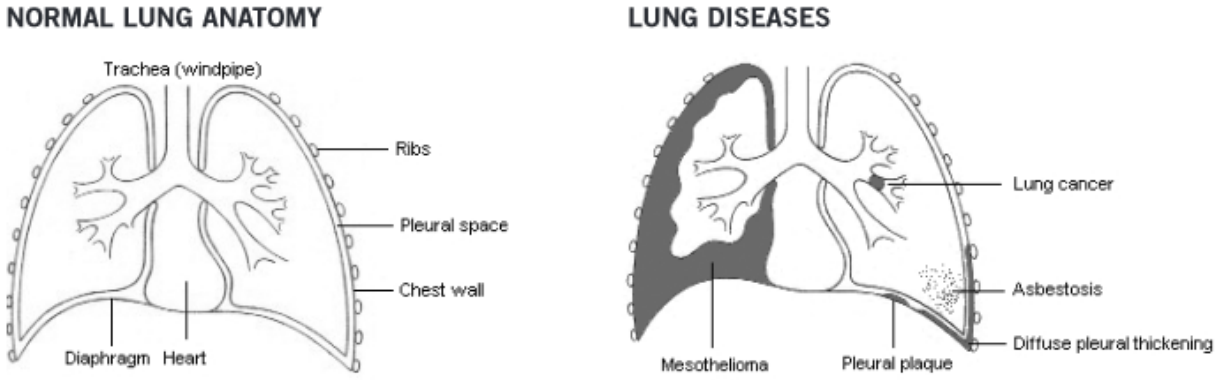
Breathing in fibres brings a risk of asbestosis, lung cancer and mesothelioma. Evidence suggests that asbestos also causes gastrointestinal and laryngeal cancers in humans. Usually, asbestos-related diseases have a delay or latency period of 20 to 40 years between first
exposure and the onset of symptoms and detection of the disease. Asbestos-related diseases can appear or progress after a person is no longer exposed.

Asbestosis is the scarring of lung tissue that can result from the inhalation of substantial amounts of asbestos over a period of years. It results in breathlessness that may lead to disability and, in some cases, death. Minor changes in X-ray images may be detected for many years without any symptoms of asbestosis or progression of the disease.
Lung cancer risk is related to the amount of fibre that is breathed in and is much higher in those who also smoke tobacco.

[1] NSW WorkCover Code of Practice: How to manage and control asbestos in the workplace – December 2011

Mesothelioma is a cancer of the pleura (outer lung lining) or the peritoneum (the lining of the abdominal cavity). The risk of mesothelioma is less with chrysotile than with other types of asbestos.
Both pleural and peritoneal mesothelioma can result from exposure to amosite and crocidolite.
Exposure of humans to chrysotile alone has caused few pleural mesotheliomas, and has never produced peritoneal mesothelioma without exposure to either amosite or crocidolite. Mesothelioma rarely occurs less than 15 years from first exposure, with most cases occurring at least 30 years later.

As for many cancer-causing substances, no safe level of exposure for lung cancer or mesothelioma has been identified. However, the amount of asbestos fibre in the air that people inhale is the important factor in determining the level of health risk. The highest risks involve inhaling air that contains a high concentration of asbestos fibre.



2. RISK MANAGEMENT

2.1 Identifying naturally occurring asbestos in the workplace.

In the Londonderry core library there is potential exposure to NOA from new drillcore and that already stored in the facility.

Assessment

a) New drillcore samples:
- The organisation which offers core will be responsible for identifying asbestos.
- The hazardous nature of the drillcore will be indicated on the Core Offer Sheet when core is offered to the Department.

b) Existing drillcore samples:
- The map attached as Annex 1 – Location map of naturally occurring asbestos in NSW will be used to identify drillcore samples originating from locations identified as having a potential for asbestos type minerals.

Controls

a) Drillholes where NOA has been positively identified
- Drillcore that has been identified as containing NOA on the Core Offer sheet or identified in existing drillcore by a competent person or by methods such as Polarising Light Microscopy (PLM) and Dispersion Staining (DS) will be moved to the hazardous materials area of the core library.
- These drillholes will be identified on the Asbestos Register maintained at the core library and in the Department's database.
- Cutting of these drillholes will be prohibited on site.

b) Drillholes that have been identified as potentially containing NOA

- This drillcore will be identified in the Department's database.
- A warning that the core may contain asbestos will be displayed in the Department's Geoscientific Data Warehouse.
- Any person inspecting this drillcore will be asked to complete and sign the induction for handling NOA.
- These drillholes will be left in situ, with all trays covered by appropriate lids. They can only be moved with the authority of the Manager Core Library and following recommended processes outlined in relevant Safe Work Method Statements.

2.2 Asbestos Register

The Code of Practice – How to manage and control asbestos in the workplace does not require an asbestos register for naturally occurring asbestos. However, the presence of naturally occurring asbestos in drillcore stored in an area where people work may present an occupational risk. Therefore the Asbestos Register will contain a list of the drillholes where NOA has been positively identified.

To satisfy the requirements of the Code of Practice:
The register will include:

- The date that the drillcore containing asbestos was identified,
- The location, type and condition of the drillcore,
- Dates and results of any testing that was carried out and names of the persons undertaking testing.

The register will be updated:

- When additional naturally occurring asbestos is identified or introduced,
- When core containing naturally occurring asbestos is removed, disturbed, accessed, sealed or enclosed.

The register will be reviewed when the asbestos management plan is reviewed. The Manager Core Library and/or a competent person should carry out a visual inspection of the drillcore listed as containing NOA to determine its condition and revise the register as appropriate.

2.3 Warning signs

All warning signs will comply with *AS 1319 - Safety Signs for the Occupational Environment*

Any areas of a workplace that potentially contain naturally occurring asbestos will be signposted with warning signs to ensure the asbestos is not unknowingly disturbed without the correct precautions being taken. The signs will be weatherproof, constructed of light-weight material and adequately secured. Signs will be placed at all the main entrances to the work areas and should be generally in accordance with the following:

Where direct marking of asbestos is not possible, identifying the presence and location of naturally occurring asbestos to workers and others will be achieved by implementing an induction system that ensures anyone inspecting the core is aware that the drillcore contains asbestos that has been positively identified.

The presence and location of the naturally occurring asbestos will be entered on site plans and the Asbestos Register which will be accessible to all workers.

2.4 Segregation and containment

Core samples where naturally occurring asbestos has been positively identified will be:

- stabilised by wrapping them with 200 µm polythene,
- logged in the Asbestos Register
- segregated in the Hazardous Materials area of the facility.

Release of airborne asbestos is further minimised by safe work processes including:

- Wetting surfaces to reduce the dust levels;
- Ensuring that all cutting of drillcore containing asbestos is done off site at approved facilities.
- Preventing the spread of contamination by using wash down facilities;
- Providing information to, and training and supervision of, all workers potentially at risk;
- Using PPE where indicated.

2.5 Naturally occurring asbestos induction

All visitors who view core that potentially contains NOA will first need to undergo an induction before proceeding with any work, testing or movement of core.

Before granting approval to work, the Core Library staff must confirm that the person has sufficient qualifications, skills, knowledge and training to undertake the inspection safely. The Manager Core Library or another competent person must review the relevant Safe Work Method Statements with the person wishing to undertake the inspection and the person must sign to say that they understand and will abide by the safety procedures.

All work must be in accordance with relevant Safe Work Method Statements and the results of the testing, whether the sample does or does not contain naturally occurring asbestos, must be recorded in the database.

2.6 Asbestos fibre air/dust monitoring protocol

An asbestos fibre air/dust monitoring protocol, as set out below, has been implemented to ensure that the asbestos fibre levels generated at the site do not exceed the Asbestos Impact Assessment Criterion level of 0.01 fibres/ml. This protocol complies with the Safe Work Australia Code of Practice *How to Manage and Control Asbestos in the Workplace* page 25: 'Ongoing management of NOA may be determined with the aid of an air monitoring program to access asbestos exposure levels and specific risk control measures'.

- A baseline air monitoring program was carried out by Safe Environment on 12 February 2015 to assess asbestos exposure levels and determine if the existing control measures are effective. Actions and control measures will be implemented in accordance with Table 1 of the *Code of Practice – How to safely remove asbestos.*

- The air monitoring program included areas where testing/sampling is conducted.
- Results from the air monitoring samples were <0.01 fibres/ml of asbestos.
- The results from the survey indicate that current control measures are effective and no new control measures are necessary.
- Further monitoring will be carried out as required (every three months during construction of stage 5, biannually after that).
- Baseline dust monitoring was conducted by Test Safe Australia on 16 April 2014 with a follow-up survey on 10 December 2014.
- Analysis of the dust indicated that no asbestos was detected by Polarising Light Microscopy (PLM) and Dispersion Staining (DS).
- The results indicate that the current control measures employed at the facility are effective and no changes to operational processes are required.

Results of air/dust monitoring were provided to the following persons:
- workers at the workplace,
- health and safety representatives for the workplace,
- those conducting business or undertakings at the workplace and others at the workplace.

2.7 Health monitoring, reporting and records management

The *Code of Practice – How to safely remove asbestos* and the *WHS Regulation 2011* require that health monitoring is provided for asbestos-related work where there is a risk of exposure while carrying out the work. Currently, air and dust monitoring reports have confirmed that there is no risk of exposure, therefore health monitoring is not required at this time.

Should health monitoring be required in the future, it will be undertaken in conformance with the *WHS Regulation 2011* and *the Code of Practice – How to safely remove asbestos* .

2.8 Working with samples that contain naturally occurring asbestos

All work must be performed in accordance with relevant Safe Work Method Statements and in a manner that limits dust generation. Visitors to the core library wishing to inspect drillcore that is known to contain or potentially contains NOA will be required to undergo the core library induction for naturally occurring asbestos.

Control measures will follow the recognised hierarchy of controls:
1. Eliminating the risk (e.g. removing the asbestos);
2. Substituting for the risk, isolating the risk or applying engineering controls (e.g. enclosing, encapsulating, sealing or using certain tools);
3. Using administrative controls (e.g. Safe Work Method Statements);
4. Using Personal Protective Equipment (PPE) when handling confirmed NOA.

A combination of these controls may be required to adequately manage and control asbestos.

The Manager Core Library will ensure that safety equipment including PPE and respiratory protection is regularly checked, serviced and replaced as needed to ensure the health and safety of workers, clients and others in the workplace.

Release of airborne asbestos will be minimised by adhering to safe work processes including:
- wetting surfaces to reduce the dust levels,
- suppressing, containing and extracting dust,
- preventing the spread of contamination by using wash down facilities,
- providing information to, and training and supervision of, all workers potentially at risk, using PPE where indicated.

2.9 Disposal

Removal and disposal of asbestos will be in accordance with the *Code of Practice: How to safely remove asbestos.*

Individual components and wiping rags must be placed in plastic bags and each bag tied separately before placing them in the container. Disposal bags need to be heavy duty (200 µm), made of clear plastic and marked with the label *'Caution asbestos – Do not open or damage bag. Do not inhale dust'.*

Asbestos waste awaiting disposal must be stored in closed containers (for example, 60 or 200 litre steel drums with removable lids or a sealed skip).

Asbestos waste must be transported and disposed of in accordance with the NSW Environment Protection Authority (EPA) requirements. Asbestos waste can only be disposed of at a site licensed by the EPA and it must never be disposed of in the general waste system.

3. PEOPLE WITH HEALTH AND SAFETY RESPONSIBILITIES

The *WHS Act 2011* requires all persons who conduct a business or undertaking to ensure, so far as is reasonably practicable, that workers and other persons are not put at risk from work carried out as part of the business or undertaking. The WHS Regulations include specific obligations to manage and control asbestos and asbestos-containing material (ACM) at the workplace. These are summarised in the following table.

Duty holder	Responsibilities
Persons conducting a business or undertaking (PCBU)	**Control risk of exposure** • Ensure, so far as is reasonably practicable, that exposure of a person at the workplace to airborne asbestos is eliminated, except in an area that is enclosed to prevent the release of respirable asbestos fibres and negative pressure is used. If this is not reasonably practicable, the exposure must be minimised so far as is reasonably practicable, • ensure the exposure standard for asbestos is not exceeded at the workplace.
	Health monitoring • ensure health monitoring is provided to a worker who is carrying out licensed removal work, other ongoing asbestos removal work or asbestos-related work and there is risk of exposure when carrying out that work, • ensure the health monitoring is carried out under the supervision of a registered medical practitioner and information as specified in the WHS Regulations is provided to that medical practitioner, • pay all expenses for health monitoring, obtain reports and keep records of all health monitoring.
	Training and use of equipment • ensure that information, training and instruction provided to a worker is suitable and adequate and that it is provided in a way that is readily understandable by any person to whom it is provided, • ensure that, if a worker is either carrying out asbestos-related work or may be involved in asbestos removal work, they are trained in the identification and safe handling of asbestos and ACM and suitable control measures • for workers who carry out work where NOA is likely to be found, training must be provided on hazards and risks associated with it.
	Controlling the use of equipment • do not use, or direct or allow a worker to use, certain equipment on asbestos and ACM
	Asbestos-related work • assume, if there is uncertainty as to whether work is asbestos-related work, that asbestos is present or arrange for an analysis of a sample to be undertaken to determine if asbestos or ACM is present, • give information as specified in Regulation 480 of the WHS Regulations to a person who is likely to be engaged to carry out asbestos-related work (i.e. the health risks and health effects associated with exposure to asbestos and the need for, and details of, health monitoring of a worker carrying out asbestos-related work), • ensure the asbestos-related work area is separated from other work areas at the workplace, signs are used to indicate where the asbestos-related work is being carried out and barricades are used to delineate the asbestos-related work area, • ensure a competent person carries out air monitoring of the work area if it is uncertain whether the exposure standard is likely to be exceeded, • ensure that asbestos waste is contained and labelled in accordance with the *Code of Practice: How to safely remove asbestos* before it is removed, and is disposed of as soon as practicable,

Duty holder	Responsibilities
	• ensure, where personal protective equipment (PPE) is used and contaminated with asbestos, that PPE is sealed, decontaminated, labelled and disposed of in accordance with the WHS Regulations. If this is not reasonably practicable, the PPE must be laundered in accordance with the WHS Regulations. PPE that is not clothing and cannot be disposed of must be decontaminated and kept in a sealed container until it is reused for the purposes of asbestos-related work.
Persons conducting a business or undertaking (PCBU)	**Identifying or assuming asbestos or ACM** • ensure, so far as is reasonably practicable, that all asbestos or ACM at the workplace is identified by a competent person or assume its presence, • identify asbestos or ACM by arranging a sample to be analysed.
	Indicating presence and location • ensure the presence and location of asbestos or ACM identified (or assumed to be identified) at the workplace is clearly indicated (by a label if reasonably practicable).
	Asbestos Register • ensure an Asbestos Register is prepared, maintained, reviewed and kept at the workplace. It must be readily available to workers, their health and safety representatives and other persons, • ensure, when management or control of the workplace is relinquished, a copy of the Asbestos Register is given to the person assuming management or control.
	Asbestos management plan • ensure, where asbestos has been identified at the workplace, that an asbestos management plan is prepared, maintained and reviewed. It must be accessible to workers, health and safety representatives and others.
	Naturally Occurring Asbestos (NOA) • manage the risks associated with NOA at the workplace and, where identified at the workplace or likely to be present, ensure that a written asbestos management plan is prepared, maintained and reviewed.
	Demolition and refurbishment work • not applicable
Manager Core Library	• maintain the workplace in a safe condition, • be involved in the promotion and implementation of the asbestos safety management plan, • train staff and others in the safe performance of their assigned tasks, • apply available resources to meet health and safety commitment, • implement this asbestos safety management plan within their area of responsibility, • notify the PCBU if additional resources are required.
Staff and others	• follow, abide and cooperate with the asbestos safety management plan, • report all known or observed hazards to the Manager Core Library, • ensure that their actions or inactions do not place themselves or others at risk.

4. COMMUNICATION AND CONSULTATION

The WHS Regulation and *Code of Practice – WHS consultation, cooperation and coordination* requires that the PCBU must consult with workers who are (or are likely to be) directly affected by a health and safety matter.

Consultation must occur when:

- identifying hazards and assessing risks arising from the work carried out or to be carried out,
- making decisions about ways to eliminate or minimise those risks,
- making decisions about the adequacy of facilities for the welfare of workers,
- proposing changes that may affect the health or safety of your workers, and
- making decisions about procedures for consulting with workers; resolving health or safety issues; monitoring health of your workers; monitoring the conditions at the workplace and providing information and training for workers.

Consultation with workers and their health and safety representatives is a critical part of managing work health and safety risks.
Consulting with and involving workers in the identification and safe handling of asbestos can assist in ensuring that safety instructions and safe work practices are complied with.
Health and safety representatives must have access to relevant information on matters that can affect the health and safety of workers, for example asbestos exposure data and the Asbestos Register.
Consultation should occur with a person who may be affected by any maintenance and service work that might disturb asbestos. People performing the work must receive all necessary training and access to the Asbestos Register, and the work should be documented and supervised.
The Manager Core Library will ensure that there is a communication process implemented and that communication and consultation is relevant and meaningful.
Communication meetings will be minuted and minutes made accessible.

5. MANAGING INCIDENTS

Baseline air monitoring was conducted by Safe Environment on 12 February 2015. The result of analysis indicated that no asbestos was detected by Polarising Light Microscopy (PLM) and Dispersion Staining (DS). The result indicates that the current control measures employed at the facility are effective and no changes to operational processes are required.

The Manager Core Library will ensure that there is a preventative maintenance program in place to check and maintain cutting and sampling equipment, PPE and dust suppression and extraction systems.

All hazards including equipment and systems failures, non-compliance with Safe Work Method Statements, release of dust from core that potentially contains naturally occurring asbestos, etc. will be reported on a hazard report form. The completed hazard report form will be provided to the Manager Core Library as soon as is practicable and as a minimum, before end of shift.

In the event of an incident where workers, clients or others have been, or may be, exposed to naturally occurring asbestos dust, the Manager Core Library will arrange for repeat air and personal monitoring.
The Manager Core Library will ensure an incident notification is submitted through the Department's online incident notification system.
Workers and others who may be at risk will be directed to discuss the matter with their treating doctor.

In the event of contamination

- Facilities are provided to decontaminate workers, equipment and the contaminated items.
- Contaminated items must be decontaminated before removal from the work area.
- If material contaminated with asbestos is to be removed from the work area, it must be sealed within a container, which is decontaminated and labelled to indicate the presence of the asbestos and disposed of at a licensed disposal facility as soon as is practicable.
- If personal protective equipment used in asbestos-related work is to be removed from the work area for disposal, it also must be sealed within a container, which is decontaminated and labelled to indicate the presence of the asbestos and disposed of at a licensed waste facility as soon as reasonably practicable.

In accordance with Table 1 of the *Code of Practice – How to safely remove asbestos*, the following actions will be observed.

Action level	Control	Action
<0.01 fibres/ml	No new control measures are necessary	Continue with control measures
0.01 fibres/ml to 0.02 fibres/ml	1. Review	Review control measures
	2. Investigate	Investigate the cause
	3. Implement	Implement controls to eliminate or minimise exposure and prevent further release
>0.02 fibres/ml	1. Stop (removal) work	Stop (removal) work
	2. Notify regulator	Notify WorkCover by phone (13 10 50) followed by fax or written statement that work has ceased and including the results of the air monitoring
	3. Investigate the cause	Conduct a thorough visual inspection of the enclosure (if used) and associated equipment in consultation with all workers involved with the (removal) work
	4. Implement controls to eliminate or minimise exposure and prevent further release	Extend the isolated/barricaded area around the removal area/enclosure as far as reasonably practicable (until fibre levels are at or below 0.01 fibres/ml), wet wipe and vacuum the surrounding area, seal any identified leaks (e.g. with expandable foam or tape) and smoke test the enclosure until it is satisfactorily sealed
	5. Do not recommence (removal) work until further air monitoring is conducted	**Do not recommence until fibre levels are at or below 0.01 fibres/ml**

6. SITE SAFETY RULES

- Comply with reasonable direction from the PCBU and Manager Core Library whilst on site;
- Comply with Asbestos Safety Management Plan;
- All workers, clients and contractors must complete a site induction before commencing work;
- Staff, clients and others who may be exposed to core or dust that contains, or is likely to contain, naturally occurring asbestos will have access to the Asbestos Safety Management Plan, the Asbestos Register (database) and Safe Work Method Statements;
- Staff, clients and others who may be exposed to core or dust that contains, or is likely to contain, naturally occurring asbestos will receive appropriate training, instruction and supervision;
- Only those receiving an induction from the Manager Core Library are permitted to work with core that contains or is likely to contain naturally occurring asbestos;
- Do not undertake inspections or other work on core that contains, or is likely to contain, naturally occurring asbestos unless you have the required knowledge, training, competencies, qualifications and skills to undertake the work safely;
- All work must be in accordance with safe work procedures;
- Wear PPE as required and as directed. PPE requirements are documented in safe work procedures and by site signage;
- Use PPE in accordance with manufacturer's instructions;
- Report any incidents, dangerous events, injuries, systems failures and other hazards to the Manager Core Library immediately;
- Do not walk through barricaded areas or those areas signposted as being restricted;
- Maintain site equipment, resources and amenities in a clean and hygienic state;
- **WHEN IN DOUBT, ASK THE MANAGER CORE LIBRARY FOR ASSISTANCE.**

7. WHS TRAINING

Using the Asbestos Management Plan and relevant Safe Work Method Statements as a resource, staff, clients and others who may be exposed to core or dust that contains, or is likely to contain, naturally occurring asbestos will receive the training detailed in the table below.

Training will be provided by the Manager Core Library or by another competent person.
The person receiving the training will acknowledge that they have been provided with and understood the training and will abide by the safe work methods by signing the last page of the Safe Work Method Statement – Naturally Occurring Asbestos.

Records of all training must be kept while the worker is carrying out the work and for five years after. These records must be available for inspection by WorkCover on request.

Training topic	Information location
An overview of the purpose of the training;	
The health risks of naturally occurring asbestos;	Asbestos Safety Management Plan - Page 5
Naturally occurring asbestos, its types and likely presence in the core library;	Asbestos Safety Management Plan – Page 6, Database,
Roles and responsibilities under the asbestos management plan;	Asbestos Management Plan – Page 11,
Where the Asbestos Register (database) is located, how it can be accessed and how to understand the information contained in it;	Database
Processes and Safe Work Method Statements to be followed to prevent exposure, including from any accidental release of airborne asbestos;	Asbestos Management Plan – Pages 6 – 11 Safe Work Method Statements
Where applicable, the correct use of PPE including respiratory protective equipment (RPE);	Safe Work Method Statements
The implementation of control measures and safe work methods to eliminate or minimise the risks associated with asbestos exposure;	Asbestos Management Plan Safe Work Method Statements.
Exposure standard and control levels for asbestos	Asbestos Management Plan – Page 14
Results and purpose of any exposure monitoring or health monitoring that may occur.	Asbestos Management Plan – Page 8

8. SAFE WORK METHOD STATEMENTS (SWMS)

Preparation of a SWMS involves identifying potential hazards, assessing their risk and identifying and recording controls to eliminate, or minimise, the risk to worker safety.

Developing SWMS

- Observe the task being assessed a number of times and where possible observe the task being performed by different workers to establish variations in work methods.
- Document the task process step by step.
- Once the task has been broken down into its separate parts, each step is evaluated to identify hazards associated with the process.
- Assess the hazards by use of the Risk Matrix (on the SWMS) to determine whether the step presents a high, medium or low risk. Document the risk rating.
- Document the control options or preferred safe method for conducting the task. Control options must be based on the Hierarchy of Controls.
- Review the SWMS at induction and during tool box talks. Obtain sign offs from all workers.

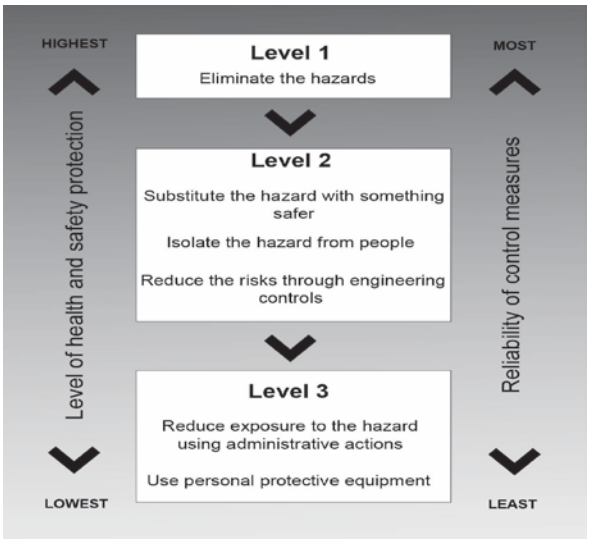
Evaluation of the SWMS

SWMS will be evaluated on how well High and Medium risk hazards have been identified for the work activity undertaken, and whether the control options documented in the SWMS have eliminated the potential hazard or minimised the risk of injury.

Risk Matrix

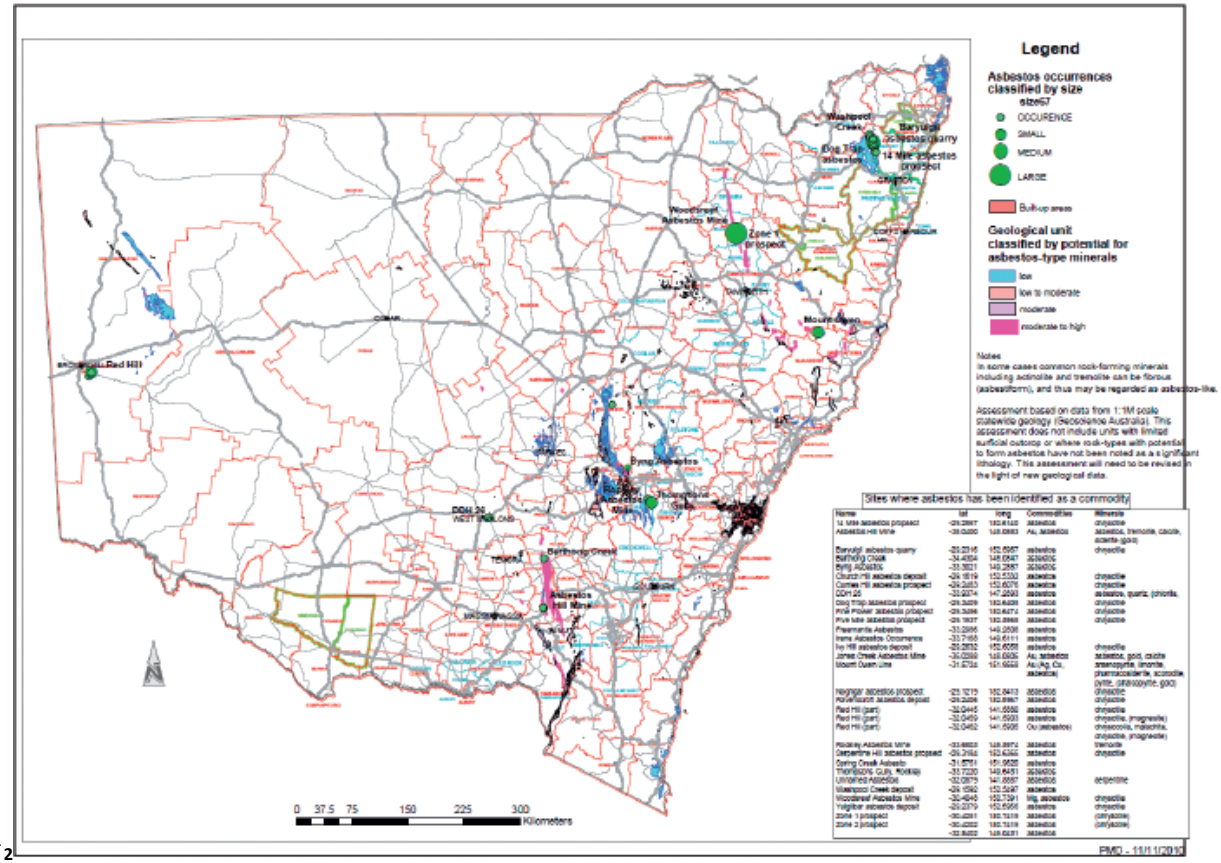
Probability - Likelihood		Severity - Consequences			
		1	2	3	4
		Kill or Disable	Serious injury - long term illness	Medical treatment - several days off	Minor first aid
A	Very likely - could happen anytime	1A	2A	3A	4A
B	Likely - could happen sometime	1B	2B	3B	4B
C	Unlikely - could rarely happen	1C	2C	3C	4C
D	Very unlikely - could happen, but probably never will	1D	2D	3D	4D

Hierarchy of Controls



The Asbestos Management Plan and SWMS will be amended as required and reviews will be undertaken at least every 5 years. More frequent reviews will be done when controls are deemed to be no longer effective, or in the event of an incident involving exposure to naturally occurring asbestos.

Appendix 1 – Location map of naturally occurring asbestos in NSW[2]



[2] Asbestos Blueprint – A guide to roles and responsibilities for operational staff of state and local government, November 2011

Form

Health & Safety Unit
Tel: 02 6391 3585 Fax: 02 6391 3507

Safe work methods

Job Task Summary: **Naturally occurring asbestos**	**Document reviewed by:**	
	Branch name:	
	Site location:	
	Date:	**April 2015**

How to complete the form:

1. Discuss with relevant workers the steps, and associated hazards, risks and controls
2. In the 'Procedural steps', list the work steps in sequence of how they will be carried out
3. In the 'Possible hazards', list the hazards and risks for each step
4. In 'R1' rate the risk without controls using the risk matrix (see page 7)
5. In the 'Safety controls' list how the hazards will be controlled and who is responsible to implement
6. In 'R2' rate the risk with controls (residual risk) using the risk matrix (see over page)
7. Specify other requirements for the task
8. Each person involved with this task must sign acknowledging that they have understood the steps

R1 Risk without controls / **R2** Risk with controls

Procedural step(s)	Possible hazard(s)	R1	Safety control(s)	R2	Person responsible
Accepting core into library	Naturally occurring asbestos in core is not identified	2B	• Core or other samples that are known or suspected to contain hazardous materials must be identified and the hazardous nature specified on the Core Offer Sheet by the organisation which offers the core.	2D	Submitting organisation, Manager Core Library
Existing drill core samples		2B	• Core samples originating from locations identified as having a potential for asbestos-type minerals will be identified on the data base maintained by the Core Library staff.	2D	Manager Core Library
Provide adequate training to all employees, clients and others prior to allowing access to or sampling of core that contains naturally occurring asbestos	Inexperienced / untrained persons undertaking work on core that contains naturally occurring asbestos	2B	• All workers must be provided with information and training on asbestos hazards, its presence and safety procedures. • Training will be provided in accordance with the Safety Management Plan for Naturally Occurring Asbestos. • The Manager Core Library or another competent employee must induct the person wishing to undertake core inspections and ensure that the person signs that they understand and will abide by the safety procedures. • Training will include the correct use and fit of Personal Protective Equipment (PPE) and Respiratory Protective Equipment (RPE), tools and equipment. • RPE training must include: - the importance of correct facial fit - how to test & check correct fit - the correct method for using respirators	2D	Manager Core Library

Procedural step(s)	Possible hazard(s)	R1	Safety control(s)	R2	Person responsible
			- procedures for regular cleaning, inspection and maintenance of respirators - guidelines on when to stop asbestos-related work and leave the area if workers think their RPE is not working correctly. • **REPORT ALL HAZARDS TO THE MANAGER CORE LIBRARY.**		
Storing core where naturally occurring asbestos has been positively identified	Naturally occurring asbestos in core is not adequately contained	2B	• Core containing (or potentially containing) naturally occurring asbestos must be identified. • Core containing naturally occurring asbestos is: - recorded in the Asbestos Register. - wrapped in 200 µm polythene. - segregated to the Hazardous Materials Area of the Core Library.	2D	Manager Core Library
	Uncontrolled or unauthorised access to Hazardous Materials Area	2B	• Only trained staff have access to the Hazardous Materials Area. • Asbestos warning signs are displayed. • "Restricted Area"/"Authorised Personnel Only" signage is displayed.	2D	Manager Core Library
Restricting access to core that contains naturally occurring asbestos	Unauthorised / inexperienced / untrained persons accessing or sampling core	2B	• The Manager Core Library must give approval before proceeding with any work or movement of core that contains naturally occurring asbestos. • Dates and results of any inspections and names of the persons undertaking inspections are to be recorded on the data base.	2D	Manager Core Library
Preventing or minimising airborne asbestos fibres	Inhaled /respired dust containing asbestos	2B	• Dry core that is known to contain naturally occurring asbestos WILL NOT be worked on. • Wet the core using a surfactant or wetting agent such as detergent water. • If using a bucket of water, do not resoak used rags in the bucket, as this will contaminate the water. Instead, either fold the rag so a clean surface is exposed or use another rag. • Vacuum core. • Perform the task in a controlled environment (e.g. ventilated enclosure).	2D	Manager Core Library, Persons working on or near core that contains naturally occurring asbestos
Tools and equipment	Processes generating dust containing asbestos	2B	• Manually operated (non-powered) hand tools should be used wherever possible. • If powered tools are required, low-speed, battery powered tools should be used with wet methods for dust control. • Battery powered tools should be fitted with a Local Exhaust Ventilation (LEV) dust control hood wherever possible. • If an LEV dust control hood cannot be attached and other dust control methods (including pastes and gels) are unsuitable then shadow vacuuming should be used. • Where power tools with dust suppression/extraction are used, exposure monitoring should be carried out to ensure the controls are effective in reducing the dispersal of fibres.	2D	Manager Core Library, Persons working on or near core that contains naturally occurring asbestos

Procedural step(s)	Possible hazard(s)	R1	Safety control(s)	R2	Person responsible
			• Tools and equipment (including power tools and brooms) which cause the release of asbestos fibres may be used if they are enclosed and/or designed to capture or suppress asbestos fibres. For example: - enclosing the tool or equipment - using the tool or equipment within an enclosed removal area - using controls such as extraction ventilation with suitable filtration.		
Inspection and maintenance of equipment	Faulty equipment	2B	• Ventilation extraction systems and other safety equipment including PPE and RPE should be regularly checked, serviced and replaced as needed to ensure the health and safety of employees, clients and others in the workplace.	2D	Manager Core Library
Using appropriate Personal Protective Equipment (PPE)	Inappropriate PPE PPE not used properly PPE not maintained	2B	**Disposable coveralls** • Should be made from material capable of providing adequate protection against fibre penetration. • Fitted hoods should be worn over the straps of respirators and loose cuffs should be sealed with tape. • No open pockets and / or Velcro fastenings. • Disposable coveralls rated type 5, category 3 (prEN ISO 13982 – 1) or equivalent. **Footwear and gloves** • Boots without laces such as gumboots are required. • If boot covers are worn, they should have anti-slip soles. • Safety footwear must be decontaminated before being removed from the asbestos work area or sealed in double bags, the exterior of which is decontaminated, for use only on the next asbestos related task. • The use of protective gloves should be determined by a risk assessment. If significant amounts of asbestos fibres are likely, gloves should be disposable. Be aware that protective gloves can be unsuitable if dexterity is required. **Respiratory Protective Equipment (RPE)** • The type of RPE selected will depend on the nature of the work, the probable maximum concentrations of asbestos fibres and any personal characteristics of the wearer that may affect the facial fit (e.g. facial hair, glasses etc). • RPE should comply with *AS/NZS 1716-2003 Respiratory Protective Devices* and be selected, used and maintained in accordance with *AS/NZS 1715-1994 Selection, Use and Maintenance of Respiratory Protective Devices*. RPE must always be worn under fitted hoods. Face pieces should be cleaned and disinfected. • Records of all respirator issues, uses and maintenance must be up to date.	2D	Manager Core Library, Persons working on or near core that contains naturally occurring asbestos
Decontaminating and cleaning PPE	Exposure to asbestos fibres during decontamination	2B	• Coveralls (which are disposable) should be used as protective clothing unless it is not reasonably practicable to do so. • **Contaminated protective clothing must not be laundered in homes.** • Any clothing worn under coveralls must be disposed of or suitably bagged for	2D	Manager Core Library, Persons working

Procedural step(s)	Possible hazard(s)	R1	Safety control(s)	R2	Person responsible
	and cleaning Ineffective decontamination		laundering as asbestos-contaminated clothing. • Asbestos fibres must be prevented from being transported outside the workplace by thoroughly vacuuming asbestos fibres from clothes using an asbestos vacuum cleaner or, depending on the level of contamination and risk, a water spray bottle or damp cloths. • Asbestos vacuum cleaners should: - comply with *AS/NZS 60335.2.69:2003 Household and similar electrical: Particular requirements for wet and dry vacuum cleaners, including power brush, for industrial and commercial use (IEC 60335-2-69 Ed 3.2 MOD).* - not be used on wet materials or surfaces. - only be emptied in a controlled environment, using appropriate PPE and RPE and in accordance with manufacturer's instructions. - be de-energised and cleaned externally with a wet cloth after each use. • The asbestos vacuum cleaner: - attachments with brushes should not be used as they are difficult to decontaminate. - filters should conform to *AS 4260-1997 High efficiency particulate air (HEPA) filters – Classification, construction and performance*. - bags, wet cleaning cloths and filters should be double bagged, labelled and disposed of as asbestos waste. • Household vacuum cleaners must never be used where asbestos is or may be present, even if they have a HEPA filter. • Any gloves used must be disposed of as asbestos waste. • RPE should be used until all contaminated disposable coveralls and clothing has been vacuum cleaned and/or removed and bagged for disposal and personal washing has been completed. • RPE should be properly stored when not in use.		on or near core that contains naturally occurring asbestos
Decontaminating tools and cleaning up the work area	Exposure to asbestos fibres during decontamination and cleaning Ineffective decontamination	2B	There are two types of decontamination processes: 1. Wet decontamination, or wet wiping, involves using damp rags to wipe down contaminated areas. Rags should only be used once, although they may be refolded to expose a clean surface. The rags should be used flat and should not be wadded. If a bucket of water is used, the rags should not be re-wetted in the bucket as this will contaminate the water. If the water is contaminated, it must be treated as asbestos waste. Care should be taken to avoid any potential electrical hazards when using this procedure. 2. Dry decontamination involves carefully rolling or folding and sealing plastic sheeting and/or vacuuming the asbestos removal area with an asbestos vacuum cleaner. Dry decontamination should only be used where the wet method is not suitable or poses a risk due to hazards such as electricity or slipping.	2D	Manager Core Library, Persons working on or near core that contains naturally occurring asbestos

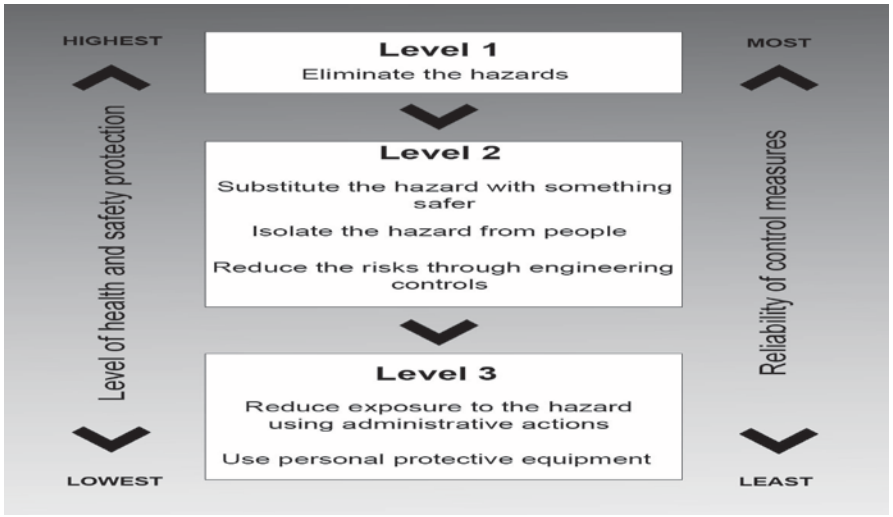
Procedural step(s)	Possible hazard(s)	R1	Safety control(s)	R2	Person responsible
			Contaminated items, tools, equipment and clothing must not be removed from the asbestos work area unless they have been decontaminated or contained. If an item is not able to be decontaminated, or is not suitable for decontamination, it should be placed in a sealed container and disposed of in accordance with the WHS Regulations. The sealed container must be decontaminated before it is removed from the asbestos removal work area. • Wear appropriate PPE and RPE whilst cleaning up. • Compressed air, water hoses and aerosol cans must not be used to clean asbestos dust as they will disperse large numbers of fibres into the air. • De-energise electrical tools and equipment. • All tools used during asbestos work should be fully dismantled (where appropriate), cleaned under controlled conditions and decontaminated using either the wet or dry decontamination procedures described above before they are removed from the removal work area. The method chosen will depend on its practicality, the level of contamination and the presence of any electrical hazards. • If using a spray bottle to damp down, it is important to only use a gentle misting spray as a coarse spray will disperse the asbestos fibres into the air. • If the equipment cannot be decontaminated, or are to be used on other asbestos related work, they should be: - tagged to indicate asbestos contamination - double bagged in labelled bags before removing from the asbestos work area. • Place disposable items (gloves, coveralls, damp cloths and drop sheet) into a rubbish bag, then seal the bag in a suitable asbestos waste container (e.g. 200µm plastic bags or a drum, bin or skip lined with 200 µm plastic sheeting). • Wash hands using water and soap. • Keep RPE on until the cleanup is complete. • Follow a decontamination procedure (personal washing) after finishing the task.		
Personal decontamination	Ineffective decontamination	2B	• Personal decontamination involves the removal of all visible asbestos dust/residue from PPE and RPE. Personal decontamination must be undertaken each time a worker leaves the asbestos work area and at the completion of the asbestos related work. Personal decontamination should be done within the asbestos work area. • Asbestos-contaminated PPE must not be transported outside the asbestos work area except for disposal purposes. Before work clothes and footwear are removed from the asbestos work area for any reason, they should be thoroughly vacuumed with an asbestos vacuum cleaner to remove any asbestos fibres and the footwear should also be wet wiped.	2D	

Procedural step(s)	Possible hazard(s)	R1	Safety control(s)	R2	Person responsible
			• RPE should be used until all contaminated disposable coveralls and clothing have been vacuum cleaned and/or removed and bagged for disposal and personal washing has been completed. Any PPE used while carrying out asbestos work must not be taken home by a worker. • **Personal hygiene and careful washing with water and soap are essential. Particular attention should be paid to the hands, fingernails and face** • Signage explaining personal decontamination must be displayed in the work area.		
Waste containment and disposal	Insufficient planning for waste containment and disposal	2B	• In accordance with the *Code of Practice – How to safely remove asbestos,* there must be a documented waste disposal plan developed prior to any work or sampling involving core containing naturally occurring asbestos. • The plan must specify the exit path through the building, the method and who will transport the waste and the location of the licensed asbestos waste disposal site. Note that removal of asbestos waste should take place outside normal working hours. • The disposal process must eliminate the release of airborne asbestos fibres by ensuring: - bagged asbestos waste is securely packaged in labelled containers - waste containers are secure during transport - the method of unloading the waste prevents tearing of the plastic lining at the licensed asbestos waste disposal site - the asbestos waste must be disposed of as soon as reasonably practicable.	2D	Manager Core Library

WHS RISK MATRIX

Probability - Likelihood		Severity - Consequences			
		1	2	3	4
		Kill or Disable	Serious injury - long term illness	Medical treatment - several days off	Minor first aid
A	Very likely - could happen anytime	1A	2A	3A	4A
B	Likely - could happen sometime	1B	2B	3B	4B
C	Unlikely - could rarely happen	1C	2C	3C	4C
D	Very unlikely - could happen, but probably never will	1D	2D	3D	4D

Hierarchy of controls



OTHER JOB REQUIREMENTS

<table>
<tr><td colspan="2">List staff skills/competencies and licences required for safe job performance:
• Training and competence in SWMS</td><td colspan="4">List items of plant/equipment/tools required:</td></tr>
<tr><td colspan="2">Relevant codes of practice, legislation standards or critical risk controls that may be applicable:
• Work Health & Safety Act 2011.
• Work Health & Safety Regulation 2011,
• Code of Practice – How to manage and control asbestos in the workplace,
• Code of Practice – How to safely remove asbestos,
• Code of Practice – How to manage WHS Risks,
• Code of Practice – WHS Consultation, coordination and cooperation,
• Code of Practice – Managing the work environment and facilities,</td><td colspan="4">Maintenance checks, site/workplace inspections required:
• Preventative maintenance,
• Monthly workplace inspections (must be documented),
• Daily visual inspections,
• Machinery inspections and maintenance as per manufacturer’s instruction,</td></tr>
<tr><td colspan="2" rowspan="2">Additional approvals, certificates, WorkCover approvals/permits required e.g. confined spaces, working at heights, hot works etc:
• Apply First Aid (at least for one person on site)</td><td>PPE required:</td><td>☒Gloves</td><td>☒Eye protection</td><td>☐Sunscreen</td></tr>
<tr><td>☒Overalls</td><td>☐Hard hat/helmet</td><td>☐Hi visibility vest</td><td>☐Lab coat</td></tr>
<tr><td colspan="2">Has a risk assessment been completed for any work involving confined spaces, electrical work or diving work Yes☐ No☐ N/A☐</td><td>☒Safety footwear
(enclosed or steel cap)</td><td>☐Hearing protection</td><td colspan="2">☒Other (please list)
• Face shield
• SCBA (where an inhalation risk exists)</td></tr>
</table>

Approval (Officer, Manager, Supervisor i.e. person responsible for ensuring compliance with Safe work methods & procedures)

Name:	**Signature:**	**Date:**

I have read and understand this Safe Work Method Statement

Name	Signature	Date

Name	Signature	Date

Radiation Services

Radiation Management Plan
W B Clarke Geoscience Centre
Londonderry NSW

July 2014

REPORT DETAILS

Title: Radiation Management Plan W B Clarke Geoscience Centre Londonderry NSW

Author(s): Jordan Saratsopoulos

Client: NSW Trade & Investment, Mineral Resources

Client Contact: Kevin Capnerhurst, Steven Hall

Reference: ESTM JS347

REVISION / CHECKING HISTORY

REVISION NUMBER	DATE	REVIEWED BY	APPROVED FOR ISSUE	DISTRIBUTION – NUMBER OF COPIES		
				Client	ANSTO File	Comments
v0.1	07.07.2014	Jordan Sara	n	-	1(e)	Development
v0.2	14.08.2014	Andrew Popp	n	-	1(e)	Initial review
v1.0	25.08.2014	Andrew Popp	y	1(e)	1(e)	Client review
v1.1	23.09.2014	Robert Blackley	y	1(e)	1(e)	Client review
V2.1	29.12.2014	Robert Blackley	y	1(e)	1(e)	Client review

Table Notes: *(e) – electronic copy*
(h) – hard copy

Contents

1. Introduction

The W B Clarke Geoscience Centre in Londonderry NSW is a major drill core sample archiving and reference facility run by NSW Trade & Investment, Mineral Resources to support the mineral exploration industry in New South Wales. Drill core samples that may contain naturally occurring radioactive material (NORM), such as Thorium (Th) or Uranium (U), will be stored at the core library facility. These core samples could potentially be classed as radioactive material.

1.1. Purpose

The purpose of this Radiation Management Plan (RMP) is to "control the exposure of employees and members of the public to radiation at or from the practice by the inclusion of measures that are relevant to the degree of risk"[1].

The RMP will ensure all activities at the W B Clarke Geoscience Centre involving radioactive material are conducted in a safe manner and are in compliance with the NSW Radiation Control Act 1990, NSW Radiation Control Amendment Act 2010, and the NSW Radiation Control Regulation 2013.

1.2. Limitations

This Radiation Management Plan (RMP) is limited to operations at the W B Clarke Geoscience Centre. It does not cover other facilities owned or operated by NSW Trade & Investment.

The RMP does not outline any processes or procedures for the management of radioactive waste. The management of radioactive waste should be covered by a Radioactive Waste Management Plan (RWMP).

1.3. Structure

The RMP is structured in sections as per the table below

Section	Topic
2	Responsibilities
3 - 5	Radiation source, exposure pathways and exposure controls
6	Radiation monitoring program
7	Dose assessment
8 – 9	Training and record keeping
10	Emergency information

1.4. Periodic review and update of the Radiation Management Plan

The RMP shall be reviewed and updated at intervals not exceeding 12 months, or as required by the W B Clarke Geoscience Centre or the Regulatory Authority, the NSW

[1] ARPANSA Safety Guide, Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005)

Environmental Protection Authority (NSW EPA). Review and update shall also be carried out following:

1. changes in operating procedures;
2. possession of radioactive sources other than core samples;
3. modification of storage areas;
4. in the event of an emergency, accident or incident;
5. changes to the personnel who could have access to the radioactive material or who could be exposed to ionising radiation hazards; and
6. indications of any reduction in compliance with safety procedures.

2. Responsibilities

Employers, Employees, Radiation Safety Officers (RSO) and Regulators involved with practices that involve the use of prescribed quantities of radioactive material which may lead to exposure of ionising radiation all have responsibilities to ensure proper radiation safety is applied.

2.1. Employer

In addition to general care of duty, Employers have a responsibility to ensure that operations under their control adhere to the recommendations of this RMP. This includes any or all of the following:

- Obtaining all necessary approval and authorisations.
- Appointing Radiation Safety Officers as necessary.
- Providing appropriate training for employees who may be exposed to ionising radiation in their work, including training on the safe handling of radioactive material.
- Ensuring a plan for the control of exposure to radiation is developed and followed at all times.
- Ensuring that workplace procedures are designed and implemented to keep exposure to ionising radiation As Low As Reasonably Achievable (ALARA) taking into account social and economic factors.
- Provision of appropriate personal protective equipment (PPE) if required
- Develop a contingency plan to deal with incidents, accidents and emergencies involving exposure to radiation.
- Ensure that any radiation monitors (if applicable) are subject to annual maintenance and calibration.

2.2. Radiation Safety Officer

The role of the Radiation Safety Officer is to obtain and maintain knowledge of the principles and practices of radiation protection and of the potential radiation hazards associated within the W B Clark Geoscience facility, sufficient to undertake the measurements, investigations and assessments and other duties required by the RSO or the relevant code of practice.

These duties include:

- Being familiar with any applicable requirements as detailed in the N*SW Radiation Control Amendment Act (2010)* and *Radiation Control Regulation (2013).*

- Being familiar with the relevant National Codes of Practice and Safety Guides as detailed by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), *Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005), RPS9*
- Carrying out radiation and contamination surveys, of a scope and frequency acceptable to the regulatory authority, to ensure that safe practices are being followed.
- Preparation and delivery of "Radiation Safety" training for the staff working with Radioactive Material
- Induction training for Visitors and Contractors working with or around Radioactive Material.
- Development of documentation and procedures where appropriate.

2.3. Employees

All employees either directly or indirectly involved with the handling of radioactive material:

- Have a responsibility to read and comply with radiation safety practices as set out in this Radiation Management Plan.
- Have a responsibility to comply with any other relevant safety instructions.
- Have a responsibility to use any provided equipment including PPE appropriately
- Must inform Management immediately of any incidents or accidents in which they believe may contribute to or present a radiation hazard.
- Must refrain from any careless or reckless practice or action likely to result in an unexpected radiation hazard to themselves or any other personnel.

2.4. Regulatory Authority

The Regulatory Authority, NSW Environmental Protection Authority (NSW EPA) is responsible for ensuring that the radiation protection strategies adopted for the safe handling and storage of radioactive material are appropriate and in accordance with the relevant codes and recommendations.

3. Source of Exposure

The main Radiation Exposure Source at the W B Clarke Geoscience Centre is that of drill core samples containing Naturally Occurring Radioactive Materials (NORM) such as Th and U. There are three naturally occurring radioactive decay chains, each with a very long-lived parent nuclide:

- Thorium-232 (half-life 14 billion years), specific activity 4,040 Bq/g thorium.
- Uranium-235 (half-life 704 million years), specific activity 564 Bq/g uranium
- Uranium-238 (half-life 4.5 billion years), specific activity 12,300 Bq/g uranium

Table 1 shows the radionuclides of concern from the thorium-232, uranium-235, and uranium-238 decay chains.

Table 1 - Flow chart of NORM decay series'

U-238 Decay Chain	Th-232 Decay Chain	U-235 Decay Chain
Uranium 238	Thorium 232	Uranium 235
Thorium 234	Radium 228	Thorium 231
Protactinium 234	Actinium 228	Protactinium 231
Uranium 234	Thorium 228	Actinium 227
Thorium 230	Radium 224	Thorium 227
Radium 226	Radon 220 (Thoron) (gas)	Radium 223
Radon 222 (gas)	Polonium 216	Radon 219 (Actinon) (gas)
Polonium 218	Lead 212	Polonium 215
Lead 214	Bismuth 212	Lead 211
Bismuth 214	Polonium 212 (64%)	Bismuth 211
Polonium 214	Thallium 208 (36%)	Thallium 207
Lead 210		
Bismuth 210		

4. Exposure Pathways

There are two main activities and or areas where personnel working or visiting the W B Clarke Geoscience Centre may be exposed to a radiation in the form of radioactive material. The two activities and or areas are listed below.

4.1. Handling of radioactive drill core samples

There are five main exposure pathways that personnel working or visiting the W B Clarke Geoscience Centre can be exposed to when handling drill core samples containing NORM. The exposure pathways from radiation are:

- Exposure from external radiation from a source outside the body such as standing next to radioactive drill core samples (an external radiation hazard).
- Through the inhalation of airborne particulates into the lungs which may remain in the lungs or be absorbed into the bloodstream, depending upon its particular physical and chemical properties (an internal radiation hazard).
- Exposure from radon decay products (RDP) following the inhalation of radon, which may remain in the lungs (an internal radiation hazard).
- Through ingesting material via the mouth, where it will either be absorbed into the bloodstream and distributed around the body, or if insoluble pass through the gut and be excreted (an internal radiation hazard).
- Through entry of radionuclides into the bloodstream via cuts and abrasions in the skin (an internal radiation hazard).

Instructions on how to control the exposure of radiation from the handling of radioactive drill core samples can be found in accordance with procedure “Safe Handling of Radioactive Material”.

In general the cores should be handled using gloves, the handling area subject to good housekeeping procedures to minimise loose particulates and hands washed upon completion of handling the cores. Dust masks should be worn if a high level of suspended dust is generated through the handling of the cores.

4.2. Storage of radioactive drill core samples

There are two main exposure pathways that personnel working or visiting the W B Clarke Geoscience Centre can be exposed to when storing or retrieving drill core samples from the designated radioactive storage area, containing NORM. The exposure pathways to radiation are:

- Exposure from external radiation from a source outside the body such as standing next to a radioactive drill core samples (an external radiation hazard).
- Exposure from radon decay products (RDP) following the inhalation of radon, which may remain in the lungs (an internal radiation hazard).

Instructions on how to control the exposure of radiation from the storage of radioactive drill core samples can be found in accordance with procedure “Safe Handling of Radioactive Material”.

In general the cores with a higher radiological content should be stored in areas of lower personnel occupancy and at least initial radon monitoring conducted to determine typical radon concentrations in the area

5. Control of Exposure

Control of exposure to ionising radiation is generally achieved through a combination of engineering and administrative controls. Engineering controls create a physical barrier between personnel and the hazard, including storage, shielding, ventilation and locks. Administrative controls alter the way the work is done, including policies, procedures and work practices such as standards and safe handling procedures (including training, housekeeping, equipment maintenance, and personal work practices).

5.1. Designated handling area

The W B Clarke Geoscience Centre has a designated handling area within the facility for identified radioactive drill core samples. The designated handling area:

- Is in a designated location within the facility away from high personnel occupancy areas such as offices, tea rooms and display areas.
- Has portable floor signage clearly displayed with the words “Caution Radioactive Material” when handling radioactive core samples. These are to be removed on completion of studying radioactive core samples.
- Has contact details of the designated Radiation Safety Officer and Building Manager.
- Has a “Safety Hazard” notice board clearly displaying the potential hazards in the area.

- Has a copy of this Radiation Management Plan stored in the designated handling location.
- Has a copy of the procedure “Safe Handling of Radioactive Material” procedure stored in the designated handling location.
- Has a Radioactive Spill kit stored in the location.
- Has Personal Protective Equipment such as gloves, and P2 masks available (if work will generate dust).
- Has a designated waste bin for the disposal of potentially contaminated PPE such as gloves and P2 masks.

5.2. Designated storage area

The W B Clarke Geoscience Centre has a designated storage area within the facility for identified radioactive drill core samples. The designated storage area:

- Is in a designated location within the facility away from high occupancy areas such as offices, tea rooms and display areas.
- Has sufficient ventilation to reduce any potential build-up of radioactive radon gas from the drill core samples
- Has signage with the words “Caution Radioactive Material” clearly displayed within and around the designated area.
- Has contact details of the designated Radiation Safety Officer and Building Manager.
- Has a “Safety Hazard” notice board clearly displaying the potential hazards in the area.
- Has a copy of this Radiation Management Plan stored in the location.
- Has a copy of the procedure “Safe Handling of Radioactive Material” stored in the location.
- Has a Radioactive Spill kit stored in the location.

5.3. Cutting of drill core samples

The W B Clarke Geoscience Centre will not undertake cutting of any radioactive drill core. If a company requires that core shall be cut and sampled the radioactive core must be transported by the company off site to an approved facility.

Radioactive drill core to be cut becomes the responsibility of the company undertaking the task. It is the company’s responsibility to meet the requirements of all relevant legislation covering transport and handling of radioactive core.

6. Radiation Monitoring

A comprehensive radiological baseline survey has been completed to provide a set of radiological data against which potential future radiological impacts can be measured against. These future radiological impacts are likely to be from an increase in the storage of drill core samples containing naturally occurring radioactive material such as Th and U.

A radiological dose rate monitoring survey program is implemented and carried out quarterly by the designated RSO to ensure any significant increase in radiological hazards are captured and managed appropriately.

Once a number of cores containing higher levels of uranium and thorium are stored at the facility, radon monitoring using passive radon detectors should be implemented and carried out to determine initial radon concentrations in the area. If the radon-222 concentration is close to or greater than 1000 Bq/m^3 (based upon recommended actions levels in ARPANSA's RPS1 – Annex C), an ongoing policy of radon monitoring may be required to be implemented.

Additional radiological surveys are carried out:

- Following any movement or relocation of the designated radiological drill core storage area;
- If it is suspected any maintenance or damage to the designated storage area has affected the engineering or administrative controls in place to reduce radiation exposure;
- If there is a significant increase in the number of cores stored with higher radiological concentrations;
- After any accident or incident involving the handling of radioactive drill core samples;
- After any accident or incident involving the cutting of radioactive drill core samples

6.1. Drill core samples containing NORM

In NSW, under the Radiation Control Regulation (2013), for the purposes of the definition of *radioactive ore* the prescribed concentrations of uranium and thorium are:

a) In the case of an ore that contains uramiun but not thorium, 0.02% by weight of uranium, or
b) In the case of an ore that contains thorium but not uramiun, 0.05% by weight of thorium, or
c) In the case of an ore that contains both uranium and thorium, a percentage by weight of uranium and thorium such that the expression :

$$\frac{U}{0.02} + \frac{Th}{0.05}$$

is equal to, or greater than, one.

Where: U is the percentage by weight of uranium

Th is the percentage by weight of thorium

For practical purposes a simplified categorisation based upon dose rates has been devised to assist in the radiological segregation and handling of different cores.

All drill core samples received by the W B Clarke Geoscience Centre shall be surveyed for radioactivity using a radiation dose rate meter, with measurements in micro-Sieverts per hour (µSv/h) taken at 0.05 metres and 0.5 metres (5 cm and 50 cm) from the largest surface of the core tray.

The supplier of any new drill core samples shall declare before delivery any core known or believed to be containing NORM. Where possible, actual dose rate levels in micro-Sieverts

per hour (µSv/h) shall be supplied, measured at 0.05 metres and 0.5 metres (5 cm and 50 cm) from the largest surface of the core tray.

The survey meter shall be passed slowly down the centre (long axis) of the core tray at approximately 5 cm above the core tray. If the dose rate at any point 5 cm from the surface of the core tray exceeds 0.25 µSv/h above background the drill core sample shall be considered to be containing NORM.

6.1.1. Categorisation of drill core samples

If the drill core sample has been found to contain NORM then that core tray shall be categorised by measuring the dose rate at 50 cm from the largest surface of the core tray. This categorisation scheme provides a risk based ranking of drill core samples containing NORM. The categorisation system is based on a logical and transparent method that provides the flexibility for it to be applied in a wide range of circumstances. On the basis of this categorisation, risk informed decisions can be made using a graded approach to the control of radiation exposure to meet regulatory requirements, see Section 7.

The categories are as follows:

- Negligible: less than or equal to 2 µSv/h @ 50 cm.
- Low: more than 2 µSv/h, less than or equal to 25 µSv/h @ 50 cm.
- Medium: more than 25 µSv/h, less than or equal to 50 µSv/h @ 50 cm.
- High: more than 50 µSv/h, less than or equal to 75 µSv/h @ 50 cm.
- Denied: more than 75 µSv/h @ 50 cm.

Any drill core sample with a measured dose rate above 75 µSv/h at 50 cm from the largest surface of the core tray will not be accepted for storage at the W B Clarke Geoscience Centre.

The core shall also be determined to be ‘friable’ or ‘non-friable’. For the purposes of this document ‘friable’ shall include core that is prone to dusting. Friable core shall be flagged on the radioactive drill core sample inventory.

Cores should be stored in the designated storage area in accordance with their categorisation and the minimisation of dose rates to personnel.

7. Dose Assessment

The annual dose limit for members of the public working or visiting the W B Clarke Geoscience Centre is 1 mSv (1000 µSv) as set out by ARPANSA, Radiation Protection Series No. 1 (RPS 1), see Appendix A. Compliance with the annual dose limit requires either measurement or estimation of the doses that personnel will receive as a consequence of being exposed to ionising radiation.

To ensure no exposure from the handling or storing of radioactive drill core samples under normal operating conditions will approach the 1 mSv annual dose limit engineering and administrative controls are implemented, see section 5.

In preparation for the construction of the W B Clarke Geoscience Centre's designated storage area an estimation of doses received by the various individuals who will attend the facility must be made.

As personal doses will not be measured directly at the facility, an estimation of doses received by personnel at the facility is outlined below. This adopts a conservative approach with assumptions on external and internal exposures, and exposure time and occupancy factors for the three main activities/areas where personnel may be exposed to ionising radiation.

Using gamma dose rate measurement data from a previous study[2] conducted on single core boxes containing various Uranium grade core samples, the following formula has been used as an estimate for the gamma dose rate in micro Sieverts per hour (µSv/h) from a single core box at a distance of 1 metre from the midpoint of the box.

1% Uranium Grade Core Sample = 0.61 µSv/h at 1 metre

7.1. Estimated radiation exposure from handling of radioactive drill core samples

The following conservative assumptions have been made:

a) Personnel will be at a distance of 0.5 metres from the core sample.
b) Gloves will be worn during the examination / study of the radioactive drill core sample.
c) No food or water will be consumed during the examination or study.
d) Hands will be thoroughly washed on completion of handling the radioactive drill core sample.
e) The average time where personnel are exposed to radiation from the examination or study of a core sample is 15 minutes.
f) The frequency of the examination or study of a radioactive drill core sample by the same person is once per week.
g) The total exposure time for a person examining or handling a radioactive drill core sample is 750 minutes per year (15 minutes per examination / study x once per week x 50 weeks per year).
h) The average core sample handled will be of 10% Uranium grade.

[2] Saskatchewan Labour, Canada Radiation Protection Guidelines for Uranium Exploration, Page 3 http://www.lrws.gov.sk.ca/radiation-protection-guidelines-uranium-exploration

i) 10% Uranium grade core sample will have a gamma dose rate of 17 µSv/h at 0.5 metres (low category).

Annual external dose received by a person examining or studying radioactive core samples would be:

Annual Dose = Dose Rate x Time

= 17 µSv/h x 15 minutes per week x 50 weeks

= 213 µSv

= **0.21 mSv**

The annual external dose received by a person handling radioactive drill core samples based on the conservative assumptions listed above is 213 µSv or 0.21 milli Sieverts (mSv) which is equal to 21% of the annual dose limit (1mSv/yr) as set out by the regulations for members of the public.

7.2. Estimated radiation exposure from designated storage area

The following conservative assumptions have been made:

a) A forklift will be used to store and retrieve radioactive drill core samples.
b) The forklift driver will be an employee of the W B Clarke Geoscience facility.
c) The forklift driver will maintain a distance of 1 metre from the storage racks containing radioactive drill core samples.
d) The time taken to store a radioactive drill core sample into its designated storage rack is two minutes.
e) The time taken to retrieve a radioactive drill core sample from its designated storage rack is two minutes.
f) The frequency of storing or retrieving a radioactive drill core sample is ten movements per working week (2 movements per day x five working days = 10 movements).
g) The total exposure time for an employee storing or retrieving radioactive drill core samples is 1000 minutes per year (2 minutes per movement x 10 movements per week x 50 weeks per year).
h) The average core sample stored or retrieved from the designated area will be of 10% Uranium grade.
i) 10% Uranium grade core sample will have a gamma dose rate of 6.1 µSv/h at 1 metre (low category).

Annual external dose received from the designated storage area for an employee storing and retrieving core samples would be:

Annual Dose = Dose Rate x Time

= 6.1 µSv/h x 4 minutes x 5 days x 50 weeks

= 102 µSv

= **0.1 mSv**

The annual external dose received by an employee storing and retrieving radioactive drill core samples based on the conservative assumptions listed above is approximately 102 µSv or 0.1 milli Sieverts (mSv) which is equal to 10% of the annual dose limit (1mSv/yr) as set out by the regulations for members of the public.

7.3. Total radiation exposure

Assuming that the same person will complete both tasks as per sections 7.1 and 7.2, Table 2 outlines the estimated total radiation dose exposure for that person.

Table 2 – Estimated Annual Radiation Exposure

Source of Exposure	Exposure Pathway	Occupancy assumptions	Estimated Dose (mSv)	% of annual limit
Handling radioactive drill core samples	External radiation	15 minutes per examination / study x once per week x 50 weeks per year	0.21	21 %
Storing and retrieving radioactive drill core samples	External radiation	2 minutes per movement x 10 movements per week x 50 weeks per year	0.1	10 %
		Total Estimated Annual Dose	**0.31**	**31 %**

As core samples are received and measured exposure calculations will be updated with actual radiological measurements performed specific to the W B Clarke Geoscience Centre.

8. Training

Training and induction programs are documented and reviewed by the W B Clarke Geoscience Centre at a minimum of every two years. Employee participation in training programs, visitor and contractor inductions are recorded and retained by the W B Clarke Geoscience Centre as part of their Records Management System.

8.1. Radiation Safety Officer(s)

The Radiation Safety Officer (RSO) will have formal Radiation Safety training recognised by the Regulatory Authority. The RSO will revalidate Radiation Safety training requirements every two years.

The RSO will provide or organise training and inductions to all other employees, visitors and contractors working with or around Radioactive Material.

The RSO will ensure employee participation in training programs; visitor and contractor inductions are recorded and retained by the W B Clarke Geoscience Centre as part of their records.

8.2. Employees, Visitors and Contractors

Training is provided to all employees, visitors and contractors involved in the handing of Radioactive Material i.e. handling of radioactive drill core samples containing natural Th and U. The training should include, but not be limited to:

a) Basic understanding of radiation.

b) Safety when working with radioactive material.

c) Familiarisation with standard operating procedures.

d) Familiarisation with equipment capability.

e) Emergency procedures.

f) Accident reporting procedures.

g) Australian Codes of Practice.

9. Record Keeping

Records are kept available for inspection and retained for a suitable period as required by the Regulatory Authority.

Records include:

- If applicable, approvals, licenses and authorisations granted by the Regulatory Authority.
- An inventory covering all radioactive material present at the facility.
- The Radiation Management Plan.
- Details of training courses provided to and attended by employees.
- Any radiological survey reports for the facility.
- Reports of any incidents or accidents involving exposure to ionising radiation.

10. Emergency Information

In the event of an emergency that may occur or arise and emergency services are required, they need to know that existing HAZMAT procedures and PPE are adequate to control the radiological hazards and that the core sample material:

1. Is not explosive.
2. Will not burn.
3. Can be approached without danger for injury from external radiation.
4. Is a naturally occurring radioactive material of low specific activity.
5. Should not be inhaled, eaten or allowed to get into an open wound.

Responding emergency services shall take the following actions where safe and practicable to do so:

- **Rescue injured personnel and provide any emergency first aid/medical attention required.**
- Use respiratory protection to reduce the possibility of inhaling radioactive material.
- Control fires and other common consequences of transport accidents.
- Identify any other associated hazards (e.g. other dangerous goods such as fuel spills, electrical sources) and establish a controlled cordoned-off area.
- Control and prevent any additional spread of radioactive contamination.

10.1. Radiological accident or incident

In the event of a radiological accident or incident, a contingency plan document addresses potential accident scenarios and specifies appropriate action, see procedure “Safe Handling of Radioactive Material”.

When large core samples are spilled or released, personnel will stop work immediately. Proper recovery operations will be planned with the advice of Radiation Safety Officer to maintain exposure controls, prevent or mitigate further consequences, and regain control of the situation.

In the event of loss of containment the main exposure for personnel in attendance is likely to occur through inhaling suspended material (dust) from the radioactive core samples. The use of correct personal protective equipment (i.e. appropriate respiratory protective equipment and gloves) would reduce the risk of radiation exposure.

The affected area will be suitably controlled and segregated, and access will be restricted.

Qualified persons such as the facility Radiation Safety Officer will take control of the accident or incident and supervise the response operation.

The spilt material shall be cleaned up by suitably experienced W B Clarke Geoscience Centre personnel using dustpans, brushes and the spill kit, wearing appropriate personal protective equipment. Upon completion the area should be monitored by suitably experienced personnel. Corrective measures will be taken, as necessary, to prevent the spread of contamination and to prevent a recurrence, see procedure “Safe Handling of Radioactive Material”.

10.2. Notification

A radiological accident or incident has occurred if it is unplanned or unexpected and if:

a) one or more persons have or could have received an effective dose in excess of 5 millisieverts (occupationally exposed personnel) or 1 millsievert (all other persons)
b) the premises or the environment are contaminated above prescribed levels for the area

All such radiological accidents or incidents will be reported without delay to the NSW EPA (see Appendix B for contact details). The NSW EPA will be advised as soon as is practicable of the cause of the accident or incident, its consequences (including radiation doses arising) and the steps taken to remedy the situation and to prevent a recurrence.

In the event of an accident which causes or which may lead to significant doses of radiation or significant contamination of persons with radioactive materials, and following any immediate first aid and medical assistance provided, the NSW EPA be consulted without delay for advice on the management of those exposed. Appropriate counselling will be provided to the persons affected.

11. References and Other Supporting Documents

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA),

Radiation Protection Series No. 1 (RPS 1)

Recommendations for limiting exposure to ionizing radiation (1995) (Guidance note [NOHSC:3022(1995)]) and National standard for limiting occupational exposure to ionizing radiation [NOHSC:1013(1995)] (republished March 2002), at:

http://www.arpansa.gov.au/pubs/rps/rps1.pdf.

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA),

Radiation Protection Series No. 6 (RPS 6)

National Directory for Radiation Protection (NDRP) (2014), at:

http://www.arpansa.gov.au/pubs/rps/rps6_6.pdf

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA),

Radiation Protection Series No. 9 (RPS 9)

Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005), at:

http://www.arpansa.gov.au/pubs/rps/rps9.pdf

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA),

Radiation Protection Series No. 15 (RPS 15)

Safety Guide for the Management of Naturally Occurring Radioactive Material (2008), at: http://www.arpansa.gov.au/pubs/rps/rps15.pdf

NSW Radiation Control Amendment Act (2010), at:

http://www.legislation.nsw.gov.au/sessionalview/sessional/act/2010-91.pdf

NSW Radiation Control Regulation (2013) at:

http://www.legislation.nsw.gov.au/viewtop/inforce/subordleg+52+2013+cd+0+N

International Atomic Energy Agency (IAEA),

Safety Guide No. RS-G-1.1,

Occupational Radiation Protection, 1999 (under review), at:

http://www-pub.iaea.org/MTCD/publications/PDF/Pub1081_web.pdf.

Saskatchewan Labour, Canada Radiation Protection Guidelines for Uranium Exploration, at: http://www.lrws.gov.sk.ca/radiation-protection-guidelines-uranium-exploration

12. Appendix A – Radiation Protection and Limits

Radiation protection systems and procedures are developed to ensure that any occupational related exposures accrued, above natural background exposure, are justified and minimised as far as reasonably possible.

Radiation protection for exposure due to an operation is therefore based upon and subject to the three principles of justification, optimisation and limitation. Justification (benefits must outweigh the risks) is required for a practice to begin or continue if it exposes members of the public or radiation workers, Optimisation (keeping the doses as low as reasonably achievable) and limitation (placing an upper limit on the exposure allowed) of exposure to ionising radiation is exercised in all normal situations by application of controls at the source.

Dose limits are provided by both the NSW State Regulator and Commonwealth Regulator for 'Members of the Public' and 'Occupationally Exposed Workers'.

The dose limits for Occupationally Exposed Workers and Members of the Public, from all exposure pathways, are described in Table 3 below.

These dose limits do not include exposure from natural background radiation sources, nor do they include exposure from medical treatments.

Table 3 – Dose limits for occupationally exposed workers and members of the public

Application	**Dose Limit**	
	Occupational	**Public**
Effective Dose	20 mSv per year, averaged over a period of 5 consecutive calendar years, with further provision that the effective dose shall not exceed 50 mSv in any single year	1 mSv in a year

13. Appendix B - Relevant Regulatory Authorities

Where advice or assistance is required from the relevant radiation regulatory authority, it may be obtained by contacting one the following:

Regulator	Contact
New South Wales	Manager, Hazardous Materials, Chemicals and Radiation Environment Protection Authority PO Box A290 SYDNEY SOUTH NSW 1232 Email: radiation@epa.nsw.gov.au Tel: (02) 9995 5959 Fax: (02) 9995 6603 Web: www.epa.nsw.gov.au/radiation/index.ht
Commonwealth	Chief Executive Officer Australian Radiation Protection and Nuclear Safety Agency PO Box 655 MIRANDA NSW 1490 Email: info@arpansa.gov.au Tel: (02) 9541 8333 Fax: (02) 9541 8314 Web: www.arpansa.gov.au

Safe Handling of Naturally Occurring Radioactive Material

August 2014

Ansto Radiation Services

1. Introduction

The W B Clarke Geoscience Centre in Londonderry NSW is a major drill core sample archiving and reference facility run by NSW Trade & Investment, Mineral Resources to support the mineral exploration industry in New South Wales. Drill core samples that may contain naturally occurring radioactive material, such as Thorium (Th) or Uranium (U), will be stored at the core library facility. These core samples could potentially be classed as radioactive material.

2. Purpose

The purpose of this document is to provide information to employees and visitors to the W B Clarke Geoscience Centre on how to safely handle core samples that may contain naturally occurring radioactive material, such as Th and U.

3. Understanding Radiation

Everybody is exposed to ionising radiation on a daily basis, from a variety of natural radiation sources. These include cosmic radiation from outer space, potassium-40 inside our bodies, the presence of uranium, thorium and potassium-40 in the earth's crust and subsequent incorporation into food, water and building materials, and radon gas released during the decay of uranium and thorium.

4. Radiation Basics

The radioactivity (or activity) of a substance is expressed as the number of nuclear disintegrations per unit time. The international (SI) unit of radioactivity is the Becquerel (Bq), which is equivalent to one disintegration per second. The concentration of radioactivity in a substance is measured as activity per unit mass, usually Bq/g.

Radionuclides decay by emission of radiation which can cause damage to biological tissue. The three main modes of radioactive decay are:

- Emission of an alpha (α) particle, which is similar to a helium nucleus consisting of two protons and two neutrons. Alpha particles have only a short range in air and do not pose a significant external radiation hazard. However, they pose an internal radiation hazard via inhalation and/or ingestion.
- Emission of a beta (β) particle, which are high energy electrons emitted from the nucleus. The range and effects of beta radiation depend on its energy. Beta radiation can pose an external skin dose hazard and an internal hazard.
- Emission of gamma (γ) radiation, which consists of high energy photons emitted from the nucleus. Gamma radiation is highly penetrating and poses an external radiation hazard.

Alpha and beta emissions are often accompanied by emission of gamma radiation.

The alpha, beta and gamma radiation emitted by radionuclides are examples of "ionising radiation". When such radiation interacts with human tissue it has the potential to damage the cell structure and induce health effects such as cancer. The extent of damage depends on the type of radiation and its energy and is described by the "effective radiation dose". The

unit of effective radiation dose is the Sievert (Sv). Since the Sievert is a large unit, radiation doses are often expressed as milli-Sieverts (mSv) and dose rates as micro-Sieverts (μSv) per hour or mSv per year.

The glossary at the end of this procedure contains useful definitions of the more important radiological terms.

5. Naturally Occurring Radioactive Material (NORM)

For the drill core samples that may be stored at the W B Clarke Geoscience Centre, the most important naturally occurring radioactive materials are those that contain uranium, thorium and their radioactive progeny (sometimes referred to as “daughters”). There are three naturally occurring radioactive decay chains, each with a very long-lived parent:

- Thorium-232 (half-life 14 billion years), specific activity 4,040 Bq/g thorium.
- Uranium-235 (half-life 704 million years), specific activity 564 Bq/g uranium
- Uranium-238 (half-life 4.5 billion years), specific activity 12,300 Bq/g uranium

Table 1 shows the radionuclides of concern from the thorium-232, uranium-235, and uranium-238 decay chains. If left undisturbed for a very long time, as in most mineral deposits, the activity of each member of the chain will be identical and the radionuclides are described as being in “secular equilibrium”. Mineral deposits that have been weathered may not be in secular equilibrium due to the selective leaching of some radionuclides. If the chain is “broken” by processing, radionuclides will decay or in-grow to establish a new secular equilibrium at a rate determined by the half-lives of the various radionuclides. A useful “rule of thumb” is that secular equilibrium will be restored within five half-lives of the longest lived daughter.

Table 1 - Flow chart of NORM decay series’

U-238 Decay Chain	Th-232 Decay Chain	U-235 Decay Chain
Uranium 238	Thorium 232	Uranium 235
Thorium 234	Radium 228	Thorium 231
Protactinium 234	Actinium 228	Protactinium 231
Uranium 234	Thorium 228	Actinium 227
Thorium 230	Radium 224	Thorium 227
Radium 226	Radon 220 (Thoron) (gas)	Radium 223
Radon 222 (gas)	Polonium 216	Radon 219 (Actinon) (gas)
Polonium 218	Lead 212	Polonium 215
Lead 214	Bismuth 212	Lead 211
Bismuth 214	Polonium 212 (64%)	Bismuth 211
Polonium 214	Thallium 208 (36%)	Thallium 207
Lead 210		
Bismuth 210		
Polonium 210		

Naturally occurring radioactive materials are common in the environment and contribute to the natural radiation exposure. The median concentrations of uranium and thorium in soils are 3 ppm (0.035 Bq/g) and 7 ppm (0.030 Bq/g), respectively. Radon gas produced by the decay of uranium (Rn-222) and thorium (Rn-220, referred to as thoron), continually emanate from soils. Exposure to radon and thoron gas (from uranium and thorium decay) is unavoidable and is responsible for about 50% of the average radiation dose to individuals, worldwide. In some ores and minerals, much higher concentrations of uranium or thorium are encountered.

6. Radiation Exposure Pathways

Humans can be exposed to radiation through various pathways, resulting in either an external exposure or an internal exposure. The five main exposure pathways that human organs and tissue can be exposed to radiation are:

- Exposure from external radiation from a source outside the body such as an X-ray machine or standing next to a radioactive source or ore body (an external radiation hazard).
- Through the inhalation of airborne particulates into the lungs which may remain in the lungs or be absorbed into the bloodstream, depending upon its particular physical and chemical properties (an internal radiation hazard).
- Exposure from radon decay products (RDP) following the inhalation of radon, which may remain in the lungs (an internal radiation hazard).
- Through ingesting material via the mouth, where it will either be absorbed into the bloodstream and distributed around the body, or if insoluble pass through the gut and be excreted (an internal radiation hazard).
- Through entry of radionuclides into the bloodstream via cuts and abrasions in the skin or in some cases by absorption through the skin (an internal radiation hazard).

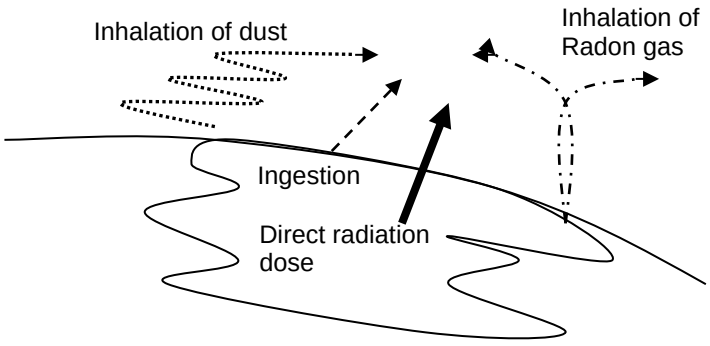


Figure 1 - Simple conceptual model of potential exposure pathways

Exposure via these pathways is highly dependent upon the chemical and physical properties, and forms of the radionuclides.

Regardless of whether the exposure is an internal or external dose, exposure from all pathways contributes to a person's dose, which is measured in mSv

7. Natural Background Radiation

Everybody is exposed to ionising radiation every day, from a variety of natural radiation sources. These include cosmic radiation from outer space, potassium-40 inside our bodies, the presence of uranium, thorium and potassium-40 in the earth's crust and subsequent incorporation into food, water and building materials, and radon gas released during the decay of uranium and thorium.

The global average total dose to an individual is approximately 2.4 mSv per year. However, this varies considerably depending upon factors such as local geology, altitude, the material that houses are built out of and the food consumed. Typical doses in Australia are somewhat lower; around 1.5 mSv per year.

Uranium, Thorium and isotopes from their associated decay chains are present in low concentrations in rocks and soils. Typically they average about 3 parts per million (ppm) Uranium and 10 ppm Thorium in ordinary soil, and up to 30 ppm or more in some granites. Uranium ores range from 0.03% (300 ppm) up to a few percent (> 10,000 ppm) in the richest international uranium ore deposits. A number of radionuclides in these natural decay chains emit gamma radiation, which can be an external radiation hazard to people. Radioactive potassium-40 also exists naturally alongside stable potassium isotopes and contributes to external radiation exposure. In addition, potassium-40 exists within our bodies and naturally is a source of internal exposure.

Some radionuclides from the Uranium and Thorium decay series may be incorporated into food and drinking water, which results in internal exposures to radiation.

Radon (^{222}Rn) gas and thoron (^{220}Rn) gas can be a significant source of exposure through inhalation, and may contribute to more than half of the exposure to individuals from natural sources. The exposure from radon and thoron will vary significantly, depending upon the ventilation of the dwelling, the local geology and the weather.

Activities such as the mining of resources containing naturally occurring radiological materials (NORM) or indeed mining the minerals themselves, can lead to additional exposure. Enhanced levels of NORM may also be present at a site as a result of processing this material.

8. Minimising Radiation Exposure

All persons using radioactive materials are required to ensure that exposure to radiation follows the ALARA principle: exposure is kept As Low As Reasonably Achievable. This philosophy should always be borne in mind when working with radiation and fundamentally involves the considerations of time, distance and shielding to control external radiation hazards; and contamination control for internal radiation hazards. The amount of control required will be dependent on measured dose rates from the core sample where you will be working, and how easily transferable (loose) the radioactive core sample material is.

9. Control of External Radiation Exposure

The external hazard is controlled by applying three basic principles: Time, Distance and Shielding.

9.1. Time

The less time you spend near a source of radiation, the less dose you will receive.

Before approaching a core sample containing radioactive material prepare equipment and relevant paperwork. Plan your activities to reasonably minimise time spent near the core sample. This will be dependent on dose rates from the sample where you will be working. While not actually physically inspecting a core sample, keep at a distance where dose rate is not measurably above background.

9.2. Distance

The further you are from a source of radiation, the less dose you will receive.

Ionising radiation spreads through space like light or heat, and the gamma dose rate from radioactive material is inversely proportional to the square of the distance from the source, i.e. the Inverse Square Law applies: twice the distance results in quarter the dose rate.

Work practices such as recording details of the core samples should be done at a reasonable distance from the radioactive core sample. Where possible, rather than recording information directly in front of a core sample use bench space at least one metre away. When handling the core sample use an extended arm, where possible, to keep the distance between your body and the radioactive material as large as possible.

9.3. Shielding

The more shielding material between you and a source of radiation, the less dose you will receive.

The dose rates around a core sample containing radioactive material should be low enough that for the time required to inspect the sample, no significant radiation will be received when following procedures. In some cases, shielding may be used to reduce exposure. Dose rates measurable around a core sample shall dictate the necessity for shielding. If large volumes of core samples are stored in high occupancy areas shielding may need to be considered to protect personnel from an increase in radiation exposure.

There are a variety of shielding materials that can be placed between people and a source of radiation to absorb most of the radiation that would otherwise reach them. The choice of shielding material depends on the type of radiation and what would be considered an acceptable dose rate.

9.4. Categorisation of drill core samples

All drill core samples received by the W B Clarke Geoscience Centre shall be surveyed for radioactivity using a radiation dose rate meter, with measurements in micro-Sieverts per hour (µSv/h) taken at 0.05 metres and 0.5 metres (5 cm and 50 cm) from the largest surface of the core tray.

The survey meter shall be passed slowly down the centre (long axis) of the core tray at approximately 5 cm above the core tray. If the dose rate at any point 5 cm from the surface of the core tray exceeds 0.25 µSv/h above background the drill core sample shall be considered to be containing NORM.

If the drill core sample has been found to contain NORM then that core tray shall be categorised by measuring the dose rate at 50 cm from the largest surface of the core tray.

The categories are as follows:

Category	Dose rate at 50 cm (µSv/h)
Negligible	Less than 2 µSv/h
Low	2 µSv/h – 25 µSv/h
Medium	25 µSv/h – 50 µSv/h
High	50 µSv/h – 75 µSv/h
Denied*	More than 75 µSv/h

* Any drill core sample with a measured dose rate above 75 µSv/h at 50 cm from the largest surface of the core tray will not be accepted for storage at the W B Clarke Geoscience Centre.

The core shall also be determined to be ‘friable’ or ‘non-friable’. For the purposes of this document ‘friable’ shall include core that is prone to dusting. Friable core shall be flagged on the radioactive drill core sample inventory.

10. Control of Radioactive Contamination

Radioactive contamination refers to loose radioactive material that may enter the body. People who handle radioactive material may take some of the radioactive material into their bodies via ingestion, inhalation, injection or absorption through intact or damaged skin. Radioactive contamination is generally not visible, so anything that has come into contact with a radioactive core sample must be assumed to be contaminated until a contamination clearance has been conducted, either by direct monitoring or analysing a wipe test. If radioactive contamination enters the body, the contamination then causes internal radiation exposure.

To prevent internal radiation exposure the following control measures apply to personnel handling a core sample containing radioactive material:

a) Special considerations should be given to protecting damaged skin. Personnel with open wounds or rashes must not conduct work with core samples unless suitably covered with waterproof dressing. As part of the risk management process consider postponing operations until skin has healed.

b) Disposable gloves are to be worn at all times when handling radioactive material.

c) The handling of radioactive material is to be carried out in a designated controlled area.

d) The designated controlled area must be clearly labelled with signs stating “CAUTION RADIATION AREA” with the radiation trefoil symbol.

e) When moving a core sample containing radioactive material around the facility it should be packaged in enclosed containers/trays.

f) No smoking, eating or drinking is permitted in areas where radioactive material is being handled.

g) Do not place pens or other tools such as rulers in mouth while handling radioactive material.

h) Do not lick core samples.

i) So as to reduce the risk of personal contamination remove gloves on completion of handling radioactive material by peeling off inside out from the wrist, and wash hands prior to commencing new tasks.

j) Anything that comes into contact with a core sample should be checked before leaving the controlled area with a contamination monitor capable of detecting alpha, beta and gamma radiation.

k) When handling core samples attempt to minimise dust, or wear a P2 dust mask to avoid breathing dust from the material.

l) Instructions as to the immediate actions that will be taken in the event of emergencies must at all times be carried by forklift drivers when moving radioactive material, and be displayed in the designated controlled area.

10.1. Control of Contaminated Clothing

1. Put on a clean pair of gloves to carefully remove all contaminated clothing in such a way as to prevent further contamination, especially to the skin. Remove clothing inside out to contain the contamination.

2. Seal the contaminated clothing in a plastic bag. Write the following information on the bag: Name of the owner, date bagged, telephone number of the owner of the clothing, and the radioisotopes involved.
3. After removal of contaminated clothing, carefully monitor all exposed skin areas. Monitor your hands. Follow the personal decontamination procedure if skin contamination is detected.
4. The clothing must be stored safely until it can be cleaned. If the clothing cannot be cleaned it must be analysed for contamination levels to determine the correct disposal path.

10.2. Personal Decontamination

Radioactive contamination should be removed from the skin as soon as possible to reduce radiation exposure. Contamination deposited directly on the skin can cause irradiation of the skin as well as substantially increasing the risk for intake into the body.

1. Use water, mild hand soap or other appropriate solution for use on the skin. It is highly likely that the contamination will be in the form of dirt or soil and therefore water or mild hand soap should be used first when attempting to remove contamination. Some decontamination solutions and cleansers contain harsh chemicals and are not intended for use on the skin.
2. Water used for skin decontamination should be lukewarm in temperature. Water that is too hot or too cold will increase the blood flow to the area and increase the absorption of the contamination.
3. Gently wash or scrub the affected skin areas for 2 to 3 minutes. Pay special attention to the fingernails if the hands are contaminated.
4. Rinse with clean water and gently pat dry. Re-monitor the area with a contamination monitor.
5. Repeat this procedure as necessary, RUB DO NOT SCRUB.

NOTE: Gloves should be worn to prevent the spread of radioactive contamination to the hands during decontamination operations.

6. Work from the centre of your body out (if your forearm is contaminated wash from the elbow towards the hand, hold your arm such that the water runs off your arm into the sink, not onto the floor or your body).
7. Monitor affected skin areas after every decontamination; attempt to determine effectiveness.
8. Stop cleaning immediately if contamination cannot be removed, or if the skin becomes irritated.
9. Rinse your eyes in an eyewash station for at least 15 minutes to flush foreign material out.
10. Rinse your mouth with water, but DO NOT swallow.
11. Blow your nose and keep the tissue, it will be analysed for radioactive contamination. The nose filters approximately 50% of particulate matter.
12. Have someone absorb surface liquids, and liquids in the outer ear, lean to the side which has the liquid in it. Do not stick anything in your ear.

10.3. Decontamination of Equipment and Surfaces

Tools, equipment, and work areas must be free of radioactive contamination whenever possible. All users are responsible for conducting surveys and promptly decontaminating all items and surfaces, if required.

1. Always wear protective clothing during decontamination operations. Minimum requirements include wearing a lab coat and two pairs of gloves.
2. Ensure that all radioactive waste generated during decontamination is properly collected and disposed of into designated and clearly labelled radioactive solid and liquid waste containers.
3. Conduct wipe tests to assess if there is any removable contamination.
4. Methods used in decontamination include washing, scrubbing, abrasion, and corrosive methods. Always start with washing before progressing to more difficult decontamination methods.

   Decontamination methods that may be applied:

   a. Tape strip method:

   i. Attempt to remove the contamination using a manageable strip of cloth backed sticky tape by placing over the contaminated area and carefully removing again.
   ii. Encapsulate the tape strip within a glove.
   iii. Monitor the tape (within the glove) away from the immediate area to determine effectiveness and dispose of appropriately.
   iv. Check / replace gloves as necessary.
   v. Re-survey the decontaminated area to determine if any contamination remains, if there has been a reduction, continue to decontaminate using the tape method (as above).

   b. Cloth and decontamination agent method:

   i. Moisten area with decontamination agent / detergent.
   ii. Using a cloth, decontaminate the area by wiping from the outer perimeter of contaminated area inwards.
   iii. Encapsulate the cloth within a glove.
   iv. Monitor the cloth (within the glove) away from the immediate area to determine effectiveness and dispose of appropriately.
   v. Check / replace gloves as necessary.
   vi. Re-survey the decontaminated area to determine if any contamination remains, if there has been a reduction, continue to decontaminate.

   c. Scourers and decontamination agent method:

   i. Moisten area with decontamination agent / detergent.
   ii. Using a scourer, decontaminate the area by rubbing in a circular motion from the outer perimeter of contaminated area inwards.
   iii. Encapsulate the scourer within a glove.

iv. Monitor the scourer (within the glove) away from the immediate area to determine effectiveness and dispose of appropriately.

v. Check / replace gloves as necessary.

vi. Re-survey the decontaminated area to determine if any contamination remains, if there has been a reduction, continue to decontaminate.

5. DO NOT use methods such as grinding, sanding, scraping or chipping contaminated surfaces without further consulting the Radiation Safety Officer.
6. Complex items should be disassembled as much as possible to allow sufficient cleaning of inner surfaces which may be contaminated. Do not disassemble if such action will jeopardize the operational integrity of the item or equipment.
7. Use disposable materials, such as paper towels.
8. Minimise the spread of contamination during decontamination operations. Avoid wiping a highly contaminated cleaning towel over a less contaminated surface. Generally, the best technique is to start at the edge of a contaminated area and work toward the area of highest contamination. The exception to this, however, would be to clean highly contaminated areas first if those areas were creating unacceptably high radiation exposure levels (dose rates).
9. Frequently monitor surfaces during decontamination with either portable survey instruments or wipe tests to determine the effectiveness of the procedures being used. Continue decontamination as necessary.
10. Items and surfaces which cannot be successfully decontaminated must be identified and controlled as radioactive material. Such areas may also require shielding.
11. Once decontamination procedures are complete, remove gloves and wash hands thoroughly. Monitor hands, body, lab coat, clothing, etc., for radioactive contamination.

11. Emergency Information

A contingency plan should address potential accident scenarios and specify appropriate action, since the risk of external and internal exposure may increase under accident conditions. When large core samples are spilled or released, personnel should stop work immediately. Proper recovery operations should be planned with the advice of radiation safety personnel to maintain exposure controls.

Instructions as to the immediate actions that will be taken in the event of emergencies must at all times be carried by forklift drivers when moving radioactive material, and be displayed in the designated controlled area, see Appendix A.

In summary, in the event of loss of containment the main exposure for personnel in attendance is likely to occur through inhaling suspended material (dust). The use of correct personal protective equipment (i.e. appropriate respiratory protective equipment and gloves) and restricting the time spent working around the spilt material would further reduce the risk of radiation exposure.

The affected area should be suitably controlled and segregated, and access should be restricted. Qualified persons such as the facility radiation safety officer would take control of the incident and supervise the response operation.

Suitably qualified and experienced W B Clarke Geoscience Centre personnel will respond with appropriate equipment for undertaking immediate monitoring of the area, and conducting any clean up actions.

11.1. Spill Kits

An incident response spill kit will be present in the designated storage area for radioactive material (stage 5) and in designated controlled areas. The kit has been designed to assist in safe and efficient containment in the initial stages of a spill. The kit would include, but not be limited to, the following items:

- Personnel Protective Equipment (PPE);
- Personal hygiene materials;
- Workplace first aid kit;
- Traffic management devices;
- Recovery equipment; and
- Emergency Information.

The spill kits are maintained by the Radiation Safety Officer. Procedural control will ensure that the contents of the kits are checked on a regular basis to ensure they are maintained and ready for use at any time during transport or inspection of core sample containing radioactive material.

11.2. Emergency Response Priorities

In the event of an accident or emergency that may occur or arise and emergency services are required, they need to know that existing HAZMAT procedures and PPE are adequate to control the hazard, and that the core sample material:

1. Should not be inhaled, eaten or allowed to get into an open wound.
2. Is not explosive.

3. Will not burn.
4. Is a naturally occurring radioactive material of low specific activity.
5. Can be approached without danger for injury from external radiation.

Responding emergency services shall take the following actions where safe and practicable to do so:

- Rescue injured personnel and provide any emergency first aid/medical attention required.
- Evacuate non-essential personnel and members of the community in the immediate area if required.
- Use respiratory protection to reduce the possibility of inhaling radioactive material.
- Control fires and other common consequences of transport accidents.
- Minimise the time spent nearby, and maximise the distance to, any spilt material.
- Identify any other associated hazards (e.g. other dangerous goods such as fuel spills, electrical sources) and establish a controlled cordoned-off area.
- Control and prevent any additional spread of radioactive contamination.

12. Glossary

Activity

The measure of the number of disintegrations or radioactive decays per second. The unit of activity is the Becquerel (Bq). This replaced the previous unit of Curie (Ci) which is equivalent to 3.7×10^{10} Bq.

ALARA

Acronym for the principle that radiation doses should be kept (As Low as Reasonably Achievable), economic and social factors taken into account.

Becquerel (Bq)

Unit of radioactivity defined as 1 disintegration per second.

Curie (Ci)

Former unit of radioactivity defined as 3.7×10^{10} disintegrations per second. 1 Ci = 37 GBq.

Daughter Product

The nuclide formed by the radioactive decay of (parent) nuclide (also known as progeny).

Designated Radiation Area

An area where the occupational exposure of personnel to radiation or radioactive material is under the supervision of a radiation safety officer.

Half life

The time taken for the activity of a radioactive substance to decay to half of its initial value.

IAEA

International Atomic Energy agency.

ICRP

International Commission on Radiological Protection.

Inverse square law

When a source of electromagnetic radiation is very small in physical size i.e. it can be considered a point source, the intensity of radiation is inversely proportional to the square of the distance from the source.

Ionizing Radiation

Penetrating radiation, either particulate or electromagnetic, which is able to ionise atoms with which it interacts (i.e. has enough energy to knock electrons off atomic shells).

Isotopes

Atoms of the same element which have the same atomic number but different mass numbers. The atoms have identical chemical properties but differ in their mass and physical properties. Some may be stable and some may be radioactive.

NORM

Naturally Occurring Radioactive Material

Radiation Safety Officer / Radiation Protection Adviser

A person appointed by the management / employer wherever radioactive materials are used in amounts that require licensing or wherever irradiating apparatus is used.

Radioactive Decay

Transformation of an unstable substance into a more stable form, usually accompanied by the emission of charged particles and gamma rays.

Radioactive Material

Any substance that consists of, or contains any radionuclide, provided that the specific activity is greater than 70 Bq per gram.

Sealed Source

A radioactive source bonded within metals or other solid substance or sealed in a capsule or other container and whose structure is such as to prevent, under normal conditions of use, any dispersion of the radioactive material into the environment.

TLD

Thermoluminescent dosimeter. A type of personal radiation monitoring device.

Unsealed Radioactive Source

Any radioactive source that is not a sealed radioactive source.

13. Appendix A – Emergency Information

The Emergency Information over page is applicable to core samples containing naturally occurring radioactive material with isotopes of the uranium-238, thorium-232 and uranium-235 decay chains.

EMERGENCY INFORMATION

In the event of an emergency contact the site radiation safety officer (RSO):

RSO's name Job title	Tel Mob Email	

MATERIAL INFORMATION

Your core sample: may contain naturally occurring radioactive material with isotopes of the uranium-238, thorium-232 and uranium-235 decay chains.

NATURE OF DANGER

This material:

1. Should not be inhaled, eaten or allowed to get into an open wound.
2. Is not explosive.
3. Will not burn.
4. Is a naturally occurring radioactive material of low specific activity.
5. Can be approached without danger for injury from external radiation.

EQUIPMENT FOR PERSONAL AND GENERAL PROTECTION

The following equipment shall be carried on board transport units, and stored in designated areas:

- dry powder fire extinguishers;
- two self-standing warning signs;
- eye rinsing liquid; and

for each member of the vehicle crew/personnel working in the designated area:

- a high visibility warning vest;
- P2 dust mask;
- disposable coveralls;
- overshoes;
- a pair of protective gloves; and
- eye protection (e.g. protective goggles).

GENERAL ACTIONS TO BE TAKEN BY PERSONNEL

In the event of an accident or emergency that may occur or arise during carriage or inspection, the members of the vehicle crew/personnel conducting work shall take the following actions where safe and practicable to do so:

- Where applicable, apply the braking system, stop the engine and isolate the battery by activating the master switch where available.
- Avoid sources of ignition, in particular, do not smoke or switch on any electrical equipment.
- Inform the facility radiation safety officer, giving as much information about the incident or accident and substances involved as possible: see contact details above.
- Put on the warning vest and place the self-standing warning signs as appropriate.
- Keep the transport documents readily available for responders on arrival.
- Advise other persons to avoid breathing any dust from the material.
- Advise other persons to move away from the vicinity of the accident or emergency and follow the advice of the emergency services. Extreme distance is not necessary.
- Obtain help from the emergency services if necessary to reroute traffic around the spill area.

ADDITIONAL AND/OR SPECIAL ACTIONS TO BE TAKEN BY PERSONNEL

SPILLAGE

Additional equipment for in case of minor spillage:

- a shovel; and
- a collecting container.

Additional information in case of spillage:

- Where appropriate and safe to do so, use stored equipment to contain spillages.
- Wear a P2 dust mask to avoid breathing dust from the material.
- When collecting the material, work the material in such a manner as not to stir up excessive dust.

FIRE

Additional information in case of fire involving the vehicle or in the immediate vicinity of the core sample:

- Where appropriate and safe to do so, use the fire extinguishers to put out small/initial fires, such as in tyres, brakes and engine compartments;
- Fires in load compartments shall not be tackled by members of the vehicle crew;
- The material you are hauling/inspecting will not burn.
- Do not spray water into open or leaking containers. There is no reaction with water but a heavy stream of water will spread the material and make clean up more difficult.

FIRST AID

In case of contact with the core sample containing radioactive material:

- If substance has got into the eyes - immediately wash out for several minutes.
- Remove any contaminated clothing and used contaminated protective equipment and dispose of it safely.
- Wash affected skin with plenty of water.
- Seek medical treatment when anyone has symptoms apparently due to inhalation, swallowing, contact with skin or eyes, or fumes produced in a fire.