

Number	WCEF-PO-HRS-0010				
Reasons for Creating or Amending Document	New or Amended Statutory Regulations; Impact from Organisational Changes; Full Review of Document				
Actual Change Details	Updated to align with 2022 WHS legislation. Updated to apply more broadly to WesCEF Exploration work sites				
Version	3.0.0	Published	04/12/2024	Review Date	4/12/2026

Table of Contents

1.	Introduction.....	3
1.1	Purpose Statement.....	3
1.2	Scope.....	3
1.3	Roles and Responsibilities.....	3
2.	Legislation.....	5
3.	Management of Radiation at WesCEF Exploration Work Sites.....	5
3.1	Radiation Management Plan Template.....	5
3.1.1	Location.....	5
3.1.2	Activities.....	5
3.1.3	Management of radioactive waste.....	5
4.	Description of Workforce.....	5
5.	Radiation Management System.....	6
5.1	Principal of Justification.....	6
5.2	Optimisation of Protection.....	6
5.3	Dose Limits.....	7
6.	Risk Assessment.....	8
7.	Sources and Pathways for Exposure.....	9
7.1	Portable XRF Exposure Pathway.....	9
7.2	Ultraviolet Radiation (UV) Light.....	9
7.3	Exploration Drilling.....	9
7.3.1	Reverse Cycle (RC) Drilling.....	9
7.3.2	Diamond Drilling.....	9
7.3.3	Personal Protective Equipment (PPE).....	11
8.	Control Measures.....	11
8.1	Engineering Controls.....	11
8.1.1	Elimination.....	11
8.1.2	Isolation.....	11
8.1.3	Engineering.....	11
8.2	Administrative Controls.....	12
8.2.1	Classification of work areas.....	12

8.2.2	Classification of workers.....	12
8.2.3	Surface Contamination Management and Clearances.....	12
8.2.4	SOP and JHA's	12
8.2.5	Housekeeping and personal hygiene	13
8.2.6	Signage	13
8.2.7	Personal Protective Equipment (PPE).....	13
8.3	Waste Management and Transport of Material.....	14
8.4	Sealed Sources and Irradiation Apparatus	14
9.	Radiation Monitoring Program.....	14
10.	Dose Assessment.....	14
10.1	Designated Workers	14
10.2	Non-Designated Workers	15
11.	Education and Training	15
11.1	Inductions	15
11.2	Training of Competent Persons	15
12.	Reporting and Record Keeping	15
12.1	Document control and confidentiality	15
12.2	Quarterly and annual reporting	16
12.3	Dose Records	16
12.4	Exceedance of Dose Limits	16
13.	Incidents and Emergency Management.....	16
13.1	Radiation Incidents	16
13.2	Emergency Response and Management.....	17
14.	Implementation of Radiation Management Plan	17
14.1	Commencement of Plan	17
14.2	Radiation Personnel	17
14.3	Monitoring Equipment.....	17
15.	Quality Assurance	17
16.	Review and Assessment	18
16.1	Work Area Inspections.....	18
16.2	Audit and Review.....	18
17.	Definitions	19
18.	References	20

1. Introduction

1.1 Purpose Statement

This Radiation Management Plan (RMP) has been prepared by WesCEF Exploration in order to identify and appropriately manage all radiological risks associated with regional exploration at WesCEF Minerals Exploration sites.

1.2 Scope

This RMP applies to the management of radioactive material for the protection of workers, the public and the environment at WesCEF Minerals Exploration sites. The RMP only applies if radiation is encountered or is expected to be encountered at a WesCEF Minerals Exploration site.

1.3 Roles and Responsibilities

Exploration Manager

- Employ an appropriately qualified Senior Radiation Advisor
- Construct and operate the site in accordance with the radiation management plan.
- Provide adequate resources and equipment to allow the workplace to be monitored for radiological contaminants and radiation exposures to be calculated and recorded.
- Keep the Senior Radiation Advisor informed of the various procedures in the operation and of any changes occurring, so that appropriate advice can be provided to minimise exposure of workers and the environment to radioactive material at all stages of development and operation of the mine and whenever abnormal conditions may arise.
- Obtain approvals from the regulatory authority for:
 - the radiation protection program for their site;
 - any part of the mine, processing plant or waste management facility prior to:
 - construction
 - operation; or
 - decommissioning
- any significant changes to any part of the operation to which the radiation protection program applies;
- removal from or introduction of any radioactive material (as defined by the National Directory (ARPANSA, 2011) to their site;
- If radioactive gauges are used at the site, hold the appropriate license for these sources.
- Report any unauthorised effluent discharges to stakeholders.
- Notify the stakeholders of any changes to operating conditions that may increase radiation exposures

Managers, Superintendents & Supervisors

- Identify, assess and manage all radiation hazards.
- Ensure that workers on site are competent to perform their duties.
- Ensure all workplace infrastructure or equipment, installed for the purposes of controlling radiation exposures or risk to the environment, are functioning correctly.
- Ensure all workers are properly instructed on the radiological risks in their work areas and in the use of equipment for the purposes of radiation protection.
- Investigate any failures to radiation protection controls and implement appropriate actions promptly.

All Employees

- Workers who may be exposed to radioactive material or perform duties which may affect the radiation exposure of others, must to the extent to which they are capable, comply with

all reasonable measures to control and assess exposure to radioactive material, or to manage radioactive waste.

- All workers must:
 - follow radiation protection and waste management practices specified in approvals or authorisations, and other regulatory requirements;
 - comply with the legitimate instructions of the employer, or his agents;
 - participate in training programs required under The Code, and make proper use of such training;
 - make proper use of plant and equipment supplied for radiation protection, or for the monitoring or assessment of radiation exposures;
 - not engage in any careless or reckless action which might result in unnecessary radiation exposure to themselves or others, or compromise the management of radioactive wastes;
 - report to the employer any defects of which they become aware, in plant equipment or procedures, which may compromise radiation protection or the management of radioactive wastes;
 - report all incidents or accidents to the employer;
 - advise the employer of previous employment involving occupational exposure to radiation and cooperate in obtaining records of such previous exposure.
 - Female workers are encouraged to notify their supervisor if they become pregnant.

Senior Radiation Advisor with the assistance of Radiation Technicians

- Implement the radiation management plan.
- Provide advice on all aspects of radiation protection.
- Provide radiation protection training to workers.
- Conduct the statutory radiation monitoring program.
- Conduct investigation monitoring to determine the efficiency of the hierarchy of controls in keeping radiation doses as low as practicable.
- Implement an appropriate quality assurance program for all radiation instruments and monitoring.
- Report on the radiation protection program to stakeholders.
- Determine radiation doses to designated workers, non-designated workers and members of public.
- Maintain a record of personal doses and radiation history.
- Implement a respiratory protection program in accordance with recommended standards.
- Assist in design and/or alteration to facilities that may influence radiological exposure to workers or members of the public.
- Provide advice and direction on actions to be taken in the event of planned special exposures, and emergency and accidental exposures.
- Determine whether a radiation incident requires a report to any statutory authority and to prepare such reports.
- Activity
- Maintain files of all applicable licences and registrations and ensure that renewals are processed when required.
- Supervise and assist in disposal of radioactive waste.
- Supervise and provide advice for clean-up and decontamination of radioactive material spills.
- Maintain a register of all radioactive sources and irradiating apparatus on site.
- Advise management on compliance with all State and Commonwealth laws and regulations relevant to radiation protection.
- Be aware of current international standards and publications.
- Promote awareness of radiation protection issues.
- Monitor and review the effectiveness of this RMP.

2. Legislation

The TMP meets the requirements of:

- The Code of Practice of Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (The Code);
- Work Health and Safety Regulations (Mines) 2022
- The Radiation Safety Act 1975

This document will assist WesCEF Exploration in both compliance with all relevant radiation legislation and to keep radiation doses As Low As Reasonably Achievable, economic and societal factors being taken into account (ALARA).

3. Management of Radiation at WesCEF Exploration Work Sites

WesCEF Exploration do not currently undertake drilling activities in areas of known or suspected radioactive lithologies. If radiation is expected or intersected, a site specific Radiation Management Plan (RMP) will be implemented. The RMP will be developed under the template set out in section 3.1 below to comply with WHS Regulations (Mines) 2022, Subdivision 3B.

3.1 Radiation Management Plan Template

3.1.1 Location

The project location will be described, including site conditions, access to site and exploration areas, and any temporary or permanent accommodation.

3.1.2 Activities

Planned activities at the project will be documented, including but not limited to;

- reverse-cycle drilling
- exploration drilling
- geological mapping
- soil sampling

3.1.3 Management of radioactive waste

Management and disposal of radioactive drill waste will be documented, including

- a plan for discharges of radioactive waste, including the authorised limit of waste to be discharged under the plan;
- the incidents about which the mine operator must notify the regulator

4. Description of Workforce

The WesCEF Minerals workforce, for the purposes of radiation protection, has been divided into two main categories:

- Designated workers
- Non-designated workers

Designated workers are defined as those that regularly work in controlled areas and have the potential to receive more than 5mSv per year. Non-designated workers are all other workers onsite. Unless unforeseen radioactive material is encountered in exploration, the only source of radiation

expected at WesCEF Minerals exploration sites is from geological or geophysical equipment, such as a portable XRF. Currently all workers at WesCEF Minerals sites are considered non-designated workers.

5. Radiation Management System

The system of radiation management at WesCEF Exploration operations is based on the justification, optimisation and limitation principles established by the International Commission on Radiological Protection (ICRP), standardised by the International Atomic Energy Agency (IAEA) and adopted in a joint Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and National Occupational Health and Safety Commission (NOHSC) document.

The three ICRP principals and how they apply to WesCEF Minerals Exploration projects are described in more detail in the following sections.

5.1 Principal of Justification

The principal of justification is stated by ICRP to be “Any decision that alters the radiation exposure situation should do more good than harm.”

This means that by introducing a new radiation source one should achieve sufficient individual or societal benefit to offset the potential detriment it may cause.

WesCEF Exploration does not set out to explore or benefit from the extraction of Radioactive minerals thus, the reasoning for this document is to ensure that its employees and the associated Stakeholders of WesCEF Minerals projects are not unduly exposed to radiation from natural or manmade sources.

5.2 Optimisation of Protection

The Principle of Optimisation of Protection is stated by the ICRP to be that the likelihood of incurring exposure, the number of people exposed, and the magnitude of their individual doses should all be kept as low as reasonably achievable, taking into account economic and societal factors (ALARA).

The process of optimisation of radiation protection involves achieving the best level of protection under the prevailing circumstances. It is an on-going iterative process that over time will see exposures optimised to ALARA.

Dose constraints are used in conjunction with the optimisation of protection to restrict individual doses. The ICRP defines a dose constraint as a restriction on the individual dose which serves as an upper bound on the predicted dose. It is level of dose above which it is unlikely that protection is optimised, and for which, therefore, action must almost always be taken. Dose constraints represent a basic level of protection and will always be lower than the pertinent dose limit.

Setting of appropriate dose constraints and keeping doses below this constraint is one step in demonstrating that doses at the exploration project are optimised.

The application of this process at WesCEF Minerals Exploration projects will involve the following steps:

1. Undertaking a radiological risk assessment to determine all sources, pathways and potential exposures in all workplaces to all individuals.
2. Setting of specific dose constraints and trigger action response levels to form upper bound for the optimisation process.
3. Identifying all the controls for reducing exposures.
4. Selecting the best set of controls for the operation using the hierarchy of controls (refer below) and also by considering the net exposure reduction versus the economic and societal factors.
5. Implementing the selected options

6. Regular monitoring and review of the system.

As part of the application of optimisation, WesCEF Exploration has elected to follow the standard safety and risk management methodology termed “the hierarchy of controls”. This has been adapted to a radiation protection situation as follows:

- Elimination
 - Not exposing individuals to radiological risks so far as is practicable;
- Isolation
 - Isolating sources of radiation, so far as practicable, through shielding, containment and remote handling techniques;
- Engineering
 - Providing engineering controls to reduce radiation exposures and radioactive contamination levels in workplaces;
- Administrative
 - Adopting safe work practices; and
- Personal Protective Equipment (PPE)
 - Providing personal protective equipment if other means of controlling exposure are not practicable or, where appropriate, to supplement these other measures.

5.3 Dose Limits

The principal of application of dose limits is stated by the ICRP as the total dose to any individual from regulated sources in planned exposure situations, other than medical exposure of patients should not exceed the appropriate limits specified by the commission.

The dose limits recommended by the ICRP (ICRP,2007) and adopted by the ARPANSA and NOHSC (ARPANSA and NOHSC, 2002) are applied to WesCEF Exploration projects; these are provided in Table 1. These take into account the latest recommendations from ARPANSA concerning the equivalent dose to the lens of the eye (RHC, 2011).

These recommended dose limits are set at a level such that any continued exposure just above the dose limit would result in additional risks that could reasonably be described as unacceptable in normal circumstances. For radiation exposures near or just below the limit risks are considered as tolerable. The dose level received by an individual, for which the risk could be considered acceptable, is that the level at which a practice has firstly been justified, and then all possible optimisation has been effectively carried out, including the utilisation of best practicable technology and the implementation of the ALARA principles.

Table 1: Occupational and Public Dose Limits. mSv = millisievert

Application	Occupational Dose Limits ¹	Public Dose Limits ¹
Effective Dose	20mSv per year, averaged over a period of 5 consecutive calendar years ²	1mSv in a year ³
Annual equivalent dose		
The lens of the eye	20mSv in a year, averaged over defined periods of 5 years, with no single year exceeding 50mSv	15mSv
The skin ⁴	500mSv	50mSv
The hands and feet	500mSv	-

6. Risk Assessment

Risk assessments at WesCEF Exploration projects are all conducted according to the job hazard analysis procedure and described in detail in the WesCEF Exploration risk register.

There are currently no known naturally occurring radioactive sources at the Mount Holland Project, or in the wider Forrestania Greenstone belt (see Appendix A). A risk assessment will be conducted before using a Portable XRF at WesCEF Exploration projects, or if naturally occurring radioactive material is intersected or expected to be intersected.

In the event of a risk assessment being required, a set of radiation specific consequence descriptors are outlined in Table 3.

Table 2: Radiation Specific Consequence Classification

Consequence	Radiation Exposure Descriptor
MINOR	Slight increase in radiation dose with outcomes remaining below dose constraints.
MEDIUM	Increase in radiation dose above the dose constraints but still below international limits.
SERIOUS	Increase in radiation dose to above international limits.
MAJOR	Radiation doses above 100 mSv to an individual and likely to significantly increase the risk of cancer to that individual.
CATASTROPHIC	Radiation doses to multiple individuals above 100 mSv or acute radiation syndrome to an individual.

7. Sources and Pathways for Exposure

Possible sources of exposure to radiation which may be encountered at Mount Holland are outlined below.

7.1 Portable XRF Exposure Pathway

X-ray fluorescence (XRF) units are used to test the elemental composition of geological samples. The unit subjects the material being tested to a short-wavelength X-ray or gamma ray, which in turn causes the material to emit radiation.

Due to the emission of radiation caused by the use of this tool, the operators of XRF units are required to be trained and licensed under the Western Australian Radiation Safety Act of 1975.

7.2 Ultraviolet Radiation (UV) Light

Ultraviolet Lights are used to identify fluorescing minerals in rocks. The unit emits an intense level of hazardous radiation capable of burning unprotected eyes and skin of the operator and those nearby. PPE requirements when operating or observing the use of the UV light are UV protective glasses, gloves, long sleeved shirts and long pants.

7.3 Exploration Drilling

Although no naturally occurring radioactive material is currently known to exist at the Mt Holland Project, the incomplete datasets characteristic of a mineral exploration environment can result in unexpected material in exploration drilling.

7.3.1 Reverse Cycle (RC) Drilling

RC drilling generates a large volume of dust. If drilling through radioactive material, this can cause high levels of exposure to workers around drilling rigs, as well as the environment. This can be mitigated through the use of dust suppression and wet drilling.

Rock chip samples containing radioactive minerals also pose a radiation hazard at a drill site. If radioactive material is identified during RC drilling, rock chip bags are to be placed well away from the working area.

7.3.2 Diamond Drilling

Drill core containing radioactive minerals may also pose a radiation hazard at a drill site. If radioactive material is identified during diamond drilling, core trays are to be placed well away from the working area.

As a precautionary measure, the same PPE requirements will be enforced for diamond drilling and RC drilling if drilling through radioactive material at WesCEF Minerals Exploration projects.

Possible exposure to radiation through exploration drilling is outlined in Table 4.

Table 3: Result from the decay of Radon (²²²Rn). LLAA = Long Lived Alpha Activity, which can be inhaled in airborne dusts

Activity	Workgroup	Job/Task	Sources	Pathways
Exploration Drilling	Drillers	Drilling into radioactive material	Dust generated during activity	Inhalation of LLAA
			Release of radon from intersected groundwater	Inhalation of RDP
			Contaminated surfaces	Ingestion
			Radon emanating from drill core or rock chips	Inhalation of RDP
			Gamma radiation from core or rock chips	Gamma exposure
	Offsiders	Handling and working around radioactive drill core or rock chips	Dust generated during activity	Inhalation of LLAA
			Gamma radiation from core	Gamma exposure
			Contaminated surfaces	Ingestion
			Contaminated surfaces	Ingestion of radiation
			Dust generated during activity	Inhalation of LLAA

7.3.3 Personal Protective Equipment (PPE)

Standard and additional Personal Protective Equipment (PPE) will be worn at all times by all personnel on drilling rigs if operating in an area of suspected radioactive material. This includes;

- Hard Hat
 - Safety Glasses
 - Gloves
 - P2 Respirator
 - Gumboots
 - Tyvek Suit
- } *Recommended*

Good housekeeping and hygiene practices are also essential, including washing before eating, laundering clothing in specified zones away from living areas, and using a 'clean-in/clean-out' procedure for drilling areas.

8. Control Measures

The following section outlines the control measures that will be used if radioactive material is encountered at WesCEF Minerals projects.

8.1 Engineering Controls

The most effective way of controlling radiological exposure to workers, the public and the environment is through the use of the first three levels of the hierarchy of controls, collectively known as Engineering Controls.

8.1.1 Elimination

An application of this is restricting the number of people who could be exposed to radioactive material. If this material is intersected in drilling, this could involve;

- limiting the number of people at the drill rig or drill site
- limiting the number of people processing drill core or rock chip samples

8.1.2 Isolation

An application of this is preventing people from becoming exposed to radioactive material. While it is difficult to do this in an exploration drilling context, some options are;

- Storing radioactive material in a designated area away from normal working and living areas
- If performing rehabilitation on a drilling pad with radioactive material, using a well-sealed cabin with filtered air-conditioning systems on equipment to isolate workers from dusty atmospheres.

8.1.3 Engineering

Engineering controls will be implemented wherever practicable if drilling through radioactive material. This may include;

- Wet drilling and dust suppression on reverse cycle (RC) rigs, and when collaring diamond drill holes
- Watering down drill pads if required

8.2 Administrative Controls

Administrative controls are used to further prevent exposure. These will only be implemented in the event of intersection of radioactive material and are summarised below.

8.2.1 Classification of work areas

Relevant work areas will be separated into controlled areas and supervised areas, as designated by ARPANSA in The Code (2005);

A controlled area is an area to which access is subject to control and in which workers are required to follow specific procedures aimed at controlling exposure to radiation.

A supervised area means an area in which working conditions are kept under review but in which special procedures to control exposure to radiation are not normally necessary.

8.2.2 Classification of workers

Workers will be classified as either;

1. "Designated" radiation workers – those who have the potential to receive an annual effective dose greater than 5 mSv (or pro-rata of this amount for short term contractors)
 - a. In almost all cases, designated workers are those who work in controlled areas.
 - b. Designated workers will be required to undertake good housekeeping and hygiene practices including washing before eating, laundering clothing in specified zones away from living areas, and using a 'clean-in/clean-out' procedure for drilling areas.
 - c. PPE worn by designated workers must not leave site
2. "Non-designated" workers are those who **do not** have the potential to receive an annual effective dose greater than 5 mSv, or an equivalent pro-rate amount for short term contractors

8.2.3 Surface Contamination Management and Clearances

In order to limit radioactive contamination to within controlled areas and prevent contaminated material from leaving site, a controlled area procedure will be implemented if radioactive material is intersected. This will involve the following:

- All radioactive material will be contained within controlled areas
- Any fixed or mobile plant or equipment that has entered a radiation-controlled area or otherwise come in contact with radioactive material will not leave site without being tested and cleared for surface contamination
- Any item, piece of clothing, equipment or vehicle that has been in a controlled area must be cleaned prior to moving to a supervised area
- Workers who enter controlled areas will be required to adhere to hygiene requirements

8.2.4 SOP and JHA's

All routine tasks performed at WesCEF Minerals Exploration projects have written procedures in order to inform workers of task processes and hazards involved with completing tasks. All non-routine tasks have written Job Hazard Analyses completed before commencement of the task in order to

identify and control associated hazards. If relevant, radiological hazards will be included in these documents.

8.2.5 Housekeeping and personal hygiene

Good housekeeping and personal hygiene is a strong basic control against ingestion of harmful foreign material, including radiological material. The following lists include general requirements for the WesCEF Minerals exploration projects, as well as specific requirements if radioactive material is encountered.

General housekeeping requirements at WesCEF Minerals Exploration projects are;

- Regular cleaning of work areas, crib rooms, offices and change rooms
- Use of boot washes before leaving a controlled area – this can be improved by wearing rubber boots such as gumboots in controlled areas
- Monitoring of surface contamination if radioactive material is intersected
- Restriction of the movement of items out of controlled areas

General hygiene requirements at WesCEF Minerals Exploration projects are;

- Workers showering and changing at the end of each shift
- No eating, drinking or smoking in controlled areas, unless it is identified that not drinking may cause heat stroke or dehydration. If this is the case a procedure will be put in place that will minimise the potential for radioactive contamination
- Use of gloves, disposable overalls and other PPE if working with radioactive materials
- Washing of hands and face thoroughly before eating, drinking and smoking
- Eating and drinking in assigned clean areas

8.2.6 Signage

All areas of potential or known radioactive material or elevated radiation levels will be clearly marked with safety signs that conform to the Australian Standard *AS 1319-1994 Safety Signs for the occupational environment*. As a minimum, these signs will be installed at;

- Entry points into radiation-controlled areas, and
- All radioactive material storage locations

8.2.7 Personal Protective Equipment (PPE)

General required PPE to safeguard against radiological exposure includes;

- Gloves
- P2 Respirators
- Rubber gum boots
- Disposable overalls

Required PPE may be dependent on the tasks that are being undertaken and will be designated accordingly if radioactive material is encountered.

8.3 Waste Management and Transport of Material

The management of any radioactive waste generated at WesCEF Minerals Exploration projects will be conducted in accordance the ARPANSA Code of Practice (2005). If exploration activities result in the production of radioactive waste, management of this waste will be included as part of relevant documentation such as procedures, work instructions and inspection forms.

Any radioactive material that is generated from exploration activities will be transported according to the Code of Practice for Transport of Radioactive Materials (ARPANSA, 2005).

8.4 Sealed Sources and Irradiation Apparatus

Small but highly radioactive sources may be used at the WesCEF Minerals Exploration projects, such as a portable X-ray Fluorescence (XRF) unit. If used this equipment will be managed according to the Radiation Safety Act (1975) in order to minimise the risk to workers.

9. Radiation Monitoring Program

A broad monitoring program has been undertaken at the Mount Holland Project in order to analyse the background level of Radon decay at several locations. This did not identify any significant background radiation. In the event of radioactive material becoming encountered in the future, a monitoring program will be developed in accordance with the relevant Radiation Protection Series guidelines. Radiation monitoring will also be undertaken at all future WesCEF Minerals Exploration sites.

10. Dose Assessment

10.1 Designated Workers

If radioactive material is encountered at WesCEF Minerals Exploration projects, the total effective dose to designated workers (defined in section 3.3) will be measured as the sum of the dose from three exposure pathways;

- External gamma radiation – can be measured with a personal monitoring device such as TLD badges
- Inhalation of radon decay products (RDP) – the average RPD concentration of the environment can be determined by taking samples of radioactive material, and effective dose then calculated as;

$$E_{RDP} = \sum_{\text{Radiation Areas}} h_{RDP} \cdot [RDP] \cdot IT$$

Where:

E_{RDP} - the effective dose due to inhalation of RDP (mSv)

h_{RDP} - dose conversion factor for RDP (mSv / $\mu\text{J h/m}^3$) (to be determined from radioactive material)

[RDP] - Average RDP concentration ($\mu\text{J/m}^3$)

IT - inhalation time (h)

This will be calculated for workers at WesCEF Minerals Exploration projects as part of Radon monitoring programs.

- Inhalation of long lived alpha activity (LLAA) in dust – measured for each designated workgroup using the personal air sampling program, and determined by;

$$E_{LLAA} = \sum_{DW} h_{LLAA} \cdot [LLAA] \cdot BR \cdot IT$$

Where:

E_{LLAA} - effective dose due to inhalation of LLAA (mSv).

h_{LLAA} - dose conversion factor for relevant LLAA (mSv/Bq α) (to be determined from radioactive material)

[LLAA] - average concentration of LLAA in air (Bq α /m³) for workgroup.

BR - breathing rate for light activity (assumed to be 1.2 m³/h) 5.

IT - inhalation time (h), or time working in workgroup

10.2 Non-Designated Workers

The radiation dose to non-designated workers will be calculated as a hypothetical maximum dose from each of the three exposure pathways outlined in Section 9.1.

11. Education and Training

11.1 Inductions

As part of the general induction for new workers, personnel will be required to read the Radiation Management Plan (this document) within 30 days of commencement of work. This must be refreshed annually, or whenever changes are made to the document.

It is also recommended that radiation in mineral exploration is discussed at Safety Toolbox meetings.

11.2 Training of Competent Persons

If radioactive material is encountered at any WesCEF Minerals Exploration projects, a Senior Radiation Advisor and Radiation Technicians will be appointed. These individuals should be suitably qualified according to the latest government requirements.

12. Reporting and Record Keeping

12.1 Document control and confidentiality

All of WesCEF Exploration's radiation related records and documents will be managed in the same manner as other major occupational health and safety documentation.

Radiation dose records will be classified the same as health records as shall be completely confidential. Confidentiality agreements will be signed by all personnel with access to the radiation dose records.

All radiation related records will be managed according to the requirements of the NOHSC National Standard for limiting occupational exposure to ionizing radiation (ARPANSA and NOHSC, 2002). Records will be kept during the life of working employees and afterwards for at least 30 years after the last dose assessment. All records of radiation doses will be passed to the DMP after completion of operations.

12.2 Quarterly and annual reporting

If radiation monitoring commences at any WesCEF Minerals Exploration project all results will be summarised periodically and included in reports to stakeholders.

12.3 Dose Records

If radiation monitoring commences at WesCEF Minerals Exploration projects, the following will be undertaken:

1. A personal dose record will be kept for all designated workers. This will contain the following information:
 - a. Full name, gender and date of birth
 - b. Date of commencement of work (and date of completion if applicable)
 - c. Dates working as a 'designated worker'
 - d. Details of any previous exposure records
 - e. Annual effective dose; total dose and dose from each pathway (see section 9.1)
2. The annual dose for each designated worker will be reported to that worker at the following times;
 - a. Annually
 - b. At any other time when requested by the worker
3. Individual dose records will be calculated on a quarterly basis and uploaded into the Australian National Radiation Dose Register (ANRDR). Workers may request their personal records

12.4 Exceedance of Dose Limits

If radiation monitoring shows a worker to have received a radiation dose in excess of the dose limit outlined in Section 4.3, the following will be completed:

1. The Senior Radiation Advisor (SRA) will immediately inform the General Manager (GM) or equivalent of the site in question
2. The SRA will confidentially inform the worker involved of the exceedance and provide necessary details of possible health consequences and work continuation
3. The SRA will conduct an investigation into the reasons for the exceedance and make recommendations to management about future actions based on this

13. Incidents and Emergency Management

13.1 Radiation Incidents

Any incidents involving radiation that occur at WesCEF Minerals Exploration projects are required to be reported to the Radiological Council of Western Australia within 7 days of occurrence. These will be classified as either;

1. Radioactive Substance Incidents – this includes intersection of radioactive material in exploration drilling, and de-containment of radioactive waste
2. Irradiating Apparatus and Electronic Product Incidents – this includes exposure to radiation from a portable XRF or similar equipment

Incident forms for these can be downloaded from the Radiological Council of Western Australia website.

13.2 Emergency Response and Management

Any radiation incident that occurs at WesCEF Minerals Exploration projects will be responded to as outlined in the WesCEF Exploration '*Emergency Management Plan*' and '*Incident Reporting and Investigation Procedure*'. The Senior Radiation Advisor or their delegate will provide advice to the Emergency Controller in order to minimise radiological exposures to workers and members of the public.

14. Implementation of Radiation Management Plan

14.1 Commencement of Plan

The site supervisor and/or Exploration Manager will determine when it is necessary to implement the radiation management plan. This may be decided due to;

- Intersection of a radioactive mineral in exploration drilling
- Use of equipment that releases radiation, such as a Handheld XRF

The following sections (13.2-13.3) outline WesCEF Exploration's course of action if the RMP is implemented.

14.2 Radiation Personnel

WesCEF Exploration will;

- ensure adequate numbers of staff, contractors and consultants are employed to guarantee proper implementation of the RMP
- ensure that senior management has access to appropriate radiation advice to ensure all requirements of the ARPANSA Code (2005) are met
- ensure radiation protection staff are suitably qualified and experienced as per up to date government requirements
- ensure radiation protection staff have access to continued training and professional development to ensure they remain up to date with the latest developments and regulations

14.3 Monitoring Equipment

WesCEF Minerals will;

- Purchase or hire radiation monitoring equipment in sufficient numbers to ensure monitoring is completed .
- Ensure radiation monitoring equipment meets all requirements for the task
- Maintain and calibrate monitoring equipment at regular intervals to ensure compliance with monitoring requirements

15. Quality Assurance

Good quality assurance and quality control will be necessary to have confidence in the results of radiation monitoring. Quality management principles will include;

- Regular calibration of monitoring equipment
- Regular background measurements (when relevant)

- Qualified persons undertaking monitoring activities
- Clear labelling and chain of custody for collected samples
- Prompt recording of results in a secure form
- Backing up of documentation

The quality management system that will be used in this instance is outlined below and is consistent with the Australian Standard for quality management systems (Australian/New Zealand Standard, 2008).

All radiation monitoring equipment will be calibrated to a known standard either annually or at the frequency recommended by the manufacturer, whichever is more frequent. Calibration will be conducted by an external provider. In addition to these checks, equipment will be tested weekly against any radioactive material in order to demonstrate consistency from week to week.

Background Alpha/Beta monitoring equipment will be checked weekly in order to determine if the instrument has become contaminated or is beginning to fail. If portable equipment is used, this will be checked at the location that monitoring is being conducted, not in an office or laboratory.

Personal air samplers used to measure LLAA in dust will be tested by measuring the flow rate through the filter prior to and immediately after monitoring. Calculations will then use the average flow rate from these measurements.

Each type of sampling will have an associated monitoring log to maintain a record of the sample identification number, equipment identification number and operator completing the monitoring. Sample identification numbers will be clearly marked on all samples. Any radioactive sample sent for external analysis will be accompanied by a chain of custody form.

16. Review and Assessment

Once the RMP is implemented, a program of inspections, audits and reviews will be conducted to ensure continuous improvement.

16.1 Work Area Inspections

Documented workplace inspections will be carried out on work areas regularly, with a primary focus on controlled areas. The objective of these inspections is to identify any potential issues with the RMP in a timely fashion. Any improvements identified will be reported to the site supervisor or their designated representative immediately.

16.2 Audit and Review

An internal audit of the RMP and associated plans and procedures will be completed annually, and an external audit is recommended every three years.

The RMP will also be updated following any changes to relevant legislation and re-submitted to regulatory authorities for approval.

17. Definitions

ALARA	As Low As Reasonably Achievable, economic and societal factors being taken into account
ANRDR	Australian National Radiation Dose Register
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
BR	Breathing rate
BRT	Business Resilience Team
The Code	The code of practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA, 2005)
DMP	Department of Mines and Petroleum, Western Australia
ICRP	International Commission on Radiological Protection
IT	Inhalation time
JHA	Job Hazard Analysis
LLAA	Long Live Alpha Activity
NOHSC	National Occupational Health and Safety Commission
PPE	Personal Protective Equipment
RDP	Radon Decay Products
RMP	Radiation Management Plan
SRA	Senior Radiation Advisor
TLD	Thermo luminescent dosimeter
U ₃ O ₈	Uranium oxide

18. References

GOVERNMENT OF WESTERN AUSTRALIA 2022 Work Health and Safety (Mines) Regulations 2022

GOVERNMENT OF WESTERN AUSTRALIA 1975. Radiation Safety Act 1975 (and amendments).

Radiological Council of Western Australia

ARPANSA 2004. Code of Practice and Safety Guide on Portable Density/Moisture Gauges Containing Radioactive Sources. *Radiation Protection Series No. 5*. Australian Government.

ARPANSA 2005. Code of Practice on Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing. Australian Radiation Protection and Nuclear Safety Agency.

ARPANSA 2007. Code of Practice on the Security of Radioactive Sources. *Radiation Protection Series No. 11*. Victoria: Australian Government.

ARPANSA 2008. Code of Practice on the Safe Transport of Radioactive Material. Australian Government.

ARPANSA 2011. National Directory for Radiation Protection, Republished July 2011, amendments 1-5. Victoria: Commonwealth of Australia.

ARPANSA AND NOHSC 2002. 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. Commonwealth of Australia.

AUSTRALIAN/NEW ZEALAND STANDARD 2001. AS/NZS 4801 Occupational health and safety management systems - specifications with guidance for use. Standards Australia.

AUSTRALIAN/NEW ZEALAND STANDARD 2004. ISO 14001:2004 Environmental Management Systems-Requirements with guidance for use. Standards Australia.

AUSTRALIAN/NEW ZEALAND STANDARD 2008. AS/NZS ISO 9001:2008 Quality management systems - Requirements. *Incorporating Amendment No. 1*. Standards Australia.

ICRP 2007. The 2007 recommendations of the International Commission on Radiological Protection. ICRP Publication No. 103. *Annals of the ICRP*, 37.

NHMRC 1989a. Code of practice for the safe use of industrial radiography equipment. *Radiation Health Series No. 31*. Australian Government.

NHMRC 1989b. Code of Practice for the safe use of sealed radioactive sources in borehole logging. *Radiation Health Series No. 28*. Australian Government.

RHC 2011. Statement on Changes to Occupational Dose Limit for Lens of the Eye. *In: AUSTRALIAN GOVERNMENT RADIATION HEALTH COMMITTEE (ed.)*. ARPANSA.

UNSCEAR 2010. Sources and Effects of Ionizing Radiation. *UNSCEAR 2008 Report to the General Assembly with Scientific Annexes*. United Nations Scientific Committee on the Effects of Atomic Radiation.

ERA 2013. Radiation Management Plan, Ranger 3 Deeps Exploration Decline. *61800 ERA Major Projects*. Energy Resources of Australia Ltd.