HIFAR PLANS & ARRANGEMENTS

DECOMMISSIONING (PHASE A)

Public Consultation Version

Purpose and Scope

This document describes the Plans and Arrangements for managing safety and security of ANSTO's HIFAR facility during the first phase (Phase A) of decommissioning. The Australian Radiation Protection and Nuclear Safety Act 1998 and ARPANS Regulations 2018 and other relevant statutory requirements will be complied with at all times while the licence remains in force.

The purpose of the Plans and Arrangement is to safely manage the HIFAR facility through an established hierarchical manner and includes:

1. Arrangements for maintaining effective control of the facility.
2. Safety Management Plan
3. Radiation Protection Plan
4. Radioactive Waste Management Plan
5. Security Management Plan
6. Emergency Plan
7. Environmental Management Plan
8. Plans for the Safe Storage of Controlled Materials and Maintenance of the HIFAR Facility.

Background

The High Flux Australian Reactor (HIFAR) was a 10 MW heavy water moderated and cooled reactor, of the DIDO class. HIFAR went critical for the first time on 26 January 1958 and was permanently shut down at 10:25am on 30 January 2007, after 49 years of operation.

Characterisation of the HIFAR Facility took place over a period of approximately four years from November 2014 until August 2018. The first phase (Phase A) of the decommissioning of HIFAR is planned and this document will form part of the decommissioning licence application.

The HIFAR Decommissioning Project (Phase A) will be implemented in three segments as shown in Table 1. Each segment will be supported by a regulatory submission to ARPANSA, and approval sought for implementation of the works.

Table 1: HIFAR Decommissioning Phase A plan

REGULATORY MILESTONE	SCOPE OF APPROVAL
Submission A-I	Decommissioning and dismantlement of: • The control room • Unused platforms, redundant tools and equipment within the Reactor Containment Building • Neutron beam instruments (excluding the installed rigs), their platforms and shielding, and • The irradiation rigs support equipment • Flasks and other radioactive material-handling equipment
Submission A-II	Decommissioning and dismantlement of the cooling systems (circuits) and process plant and equipment
Submission A-III	Decommissioning and dismantlement of the No.1 Storage Block contents

Document History

This document replaces the HIFAR Plans and Arrangements for Managing Safety (AG-7302).

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1. Effective Control Plan

1.1. Purpose and Scope

The purpose of the *Effective Control Plan* is to outline the management arrangements that are in place within ANSTO for the purpose of safely managing the decommissioning activities for the HIFAR facility. The scope includes accountability, organisational and management issues in accordance with ARPANS Act 1998 and ARPANS Regulations 2018 and the ANSTO arrangements covering the issues referred to in the ARPANSA Regulatory Guide - Plans and arrangements for managing safety.

1.2. Accountability of Applicant

The Chief Executive Officer (CEO) of ANSTO is the applicant to ARPANSA for all ARPANSA Licences including the HIFAR Decommissioning licence. The responsibility for maintaining effective control of HIFAR and for ensuring compliance with the ARPANS legislation has been delegated to the Licence Nominee, who for HIFAR is ANSTO's Chief Engineer, ANSTO Maintenance & Engineering (AME). This delegation is described in AS-1682 ANSTO Delegations Manual and permits the Licence Nominee to make changes to the licensing basis in line with the ARPANS Regulations. The Nominee has assigned responsibility for the day-to-day implementation of these Plans and Arrangements and management of the HIFAR Facility to the HIFAR Facility Officer.

The staff and monetary resources necessary to safely manage the sources and facilities and meet the ARPANSA requirements are approved by senior management under the ANSTO budgetary processes.

ANSTO management remain informed and aware of the safety of the facility through a combination of normal line management reporting, toolbox talks, meetings, incident reporting processes, and workplace health and safety committee meetings. The incident response system, described in Chapter 2: *Safety Management Plan*, rapidly informs management of safety incidents and accidents.

ANSTO follows the requirements for reporting to ARPANSA as described in the licence conditions and the requirement for immediate reporting in the event of a significant incident as described in the ARPANS Legislation.

1.3. Organisational Arrangements

ANSTO, and its predecessor the AAEC, operated HIFAR safely for almost 50 years until its permanent shutdown in January 2007. Consequently, ANSTO has many years of experience in research reactor operations.

The ANSTO Operational Framework provides a blueprint for all staff, particularly new starters, about how ANSTO works as an organisation to coordinate resources to achieve its strategic objectives, which are outlined in the ANSTO Corporate Plan (an external facing, strategic document), supporting key projects and initiatives, which are set out in the ANSTO Business Plan (an internal-facing business tool), and meet the requirements of the ANSTO Act. Read in conjunction with the ANSTO Code of Conduct, and the ANSTO values, the Operational Framework provides a handbook for all ANSTO staff about how we work together, safely and efficiently, to achieve the organisation's strategic objectives.

The CEO is responsible for the Work Health and Safety Management System (WHSMS) and safety support including radiation protection services. The Office of the CEO is central to the safety arrangements for ANSTO. The work group structure is on the ANSTO intranet.

The Radiation Protection Services (RPS) group has specialist Health Physicists (HP) who provide input into the WHS Management system. This group also provides the Health Physics Surveyors (HPS) who conduct radiological assurance surveys to ensure the ongoing effectiveness of radiological control measures and the management of risks to optimal or As Low As Reasonably Achievable (ALARA). The dosimetry services are also within this group.

The WHS section provides specialist WHS advice and support across site. The ANSTO Health Centre forms part of the ANSTO WHS section and are responsible for coordinating health assessment processes and provides injury treatment, workers compensation and rehabilitation services. General training, including safety training is managed by the Learning and Development section.

The ANSTO Maintenance and Engineering (AME) group provides maintenance support, engineering design, manufacturing and project management input into facilities. They provide decommissioning experience and expertise. The Systems Safety and Reliability group within AME have safety specialists who conduct detailed safety and risk assessments for project and operational activities. This group plays an integral role at ANSTO in the development of safety assessments and their corresponding limits and conditions.

Safety significant activities are evaluated through the Safety and Reliability Assurance process, overseen by the WHSE Executive sub-committee, using a graded approach. The evaluation process includes safety subject matter experts, operators, process and engineering experts to ensure all hazards are appropriately controlled and risks are reduced so far as is reasonably practicable prior to operation. Line management has responsibility for acceptance of the safety risks associated with the activity. All new or changed safety significant activities licensable with ARPANSA or Comcare are subject to independent challenge and then endorsement by the Chief Nuclear Officer or High Reliability General Manager respectively prior to submission. Ongoing liaison with the regulators, including ARPANSA is maintained by the Regulatory Affairs Manager who reports to the Chief Operating Officer.

ANSTO's national and international obligations, for the safeguard of nuclear material and associated items, are maintained and implemented through the ANSTO Safeguards Office. The ANSTO Safeguards Office maintains close control, in relation to accurate recording and the safe protection and storage of all ANSTO's nuclear material that is subject to safeguards.

These organisational arrangements are reviewed periodically.

Each building has an appointed Building Manager who is a delegate of the relevant Group Executive and are authorised to address any health, safety and environment concerns relating to personnel, equipment and processes in their appointed building. They provide an oversight and assurance function as to the safety within the building or nominated area. The role is described in AG-3212 Role of the Building Manager.

Area Supervisors and Deputy Area Supervisors are appointed for all designated hazardous areas. They are a local delegate of management who is authorised to address any health, safety and environment concerns in their designated hazardous area. Their role is described in AG-2952 Role of the Area Supervisor.

HIFAR assets are managed according to G-7543 HIFAR Asset Management Plan. Contractors will report through their supervisor/ manager to a Contractor Supervisor as per ANSTO's WHS Management System.

Training and authorisation of staff is described in the ANSTO WHSMS. HIFAR has additional specific training requirements, and this process is managed by the HIFAR Facility Officer. All staff have defined job roles set out in their position description, AG-2362 WHS Accountabilities, Responsibilities and Actions and their performance is monitored against objectives through the ANSTO Performance and Effectiveness Appraisal process.

Special organisational arrangements operate in response to a serious incident and these are described in AG-5945 ANSTO Emergency Management Plan.

The HIFAR Facility Officer performs management functions associated with the control of the facility. These are primarily maintenance and oversight of the facility and that decommissioning activities are executed safely and in accordance with approved plans. The Facility Officer provides advice to staff and management on regulatory requirements appropriate to the HIFAR facility and provides information required for regulatory reporting and submissions. The Facility Officer will also act as the point of contact for conduct of inspections

The Licence Nominee has also appointed a Licencing Officer for HIFAR who will provide advice to the Facility Officer and management on reporting requirements. The Licencing Officer is responsible for the preparation of ARPANSA reports and assist in the preparation of regulatory submissions. The Licencing Officer will be the point of contact for coordinating ARPANSA inspections and follow-up on actions arising from inspections. Periodic review of the Plans and Arrangements and updates to the HIFAR Safety Analysis Report will be coordinated by the Licencing Officer.

AME have provided a project team to manage the HIFAR Decommissioning Project (Phase A). This team will undertake work as described in the approved decommissioning plans as well as be responsible for safety and compliance within the facility and manage ARPANSA licencing issues. The HIFAR Decommissioning Project Manager will ensure that all project personnel undertake work as described in the licence application. The Project Responsible Officer will maintain controlled material in an appropriate secure way, and ensure they are properly logged in a suitable register and manage sources in accordance with AG-2471 Safe Management of ARPANSA Controlled Material.

1.4. Management Systems

HIFAR falls under the ANSTO Maintenance and Engineering's (AME) Decommissioning group, which on a regular bases, review process for safety, security, operations, finance, resourcing and business requirements.

ANSTO has policies in place relating to all aspects of its operations and these ensure the safe and effective management of the decommissioning of the HIFAR Facility. AB-0102 Work Health & Safety Policy states ANSTO's commitment to occupational health and safety. In a similar manner, AE-7100 Environment Policy states ANSTO's commitment to the environment and sustainability. Both policies outline ANSTO's actions to meet those commitments. Other policies, including those for security, quality, human resources and business provide a comprehensive framework. All policies are periodically reviewed.

There are several measures in place to ensure these policies are available and understood. They are provided at induction and available on the ANSTO intranet which is accessible to all staff. There are regular staff forums held by the CEO and within the business units at which safety is discussed and emphasised and this reinforces the intent of the policies. Safety training programs further expand and explain the intent of the policies.

Supporting the WHS Policy are the radiation safety standards. The AE-2310 Radiation Safety Standard commits to the ALARA principle to optimise radiation protection and safety and outlines the ANSTO dose constraint framework. The AE-2307 Nuclear Safety Standard outlines the nuclear safety practices which are employed to ensure the safe and secure use of nuclear materials and nuclear facilities.

ANSTO also has an environment monitoring program which is discussed in more detail in Chapter 7 Environmental Management Plan.

Procedures and instruction documentation is developed in accordance with the ISO 9001 certification and in conformance to the ANSTO project governance framework described in document CPMO Governance. Documents supporting WHSMS and other policies are managed in accordance with ANSTO's ISO 9001 certified quality management systems, ISO 14001 certified environmental management system and/ or the ISO 45001 certified work health and safety management system and this ensures there are procedures for document control and records management.

The effectiveness of these management systems is monitored and maintained by the audit programs required by the ISO certifications. These include both internal audits by ANSTO staff and external audits by the certifying organisation. Audit records are maintained, and non-conformances and corrective actions are managed through these processes.

HIFAR has implemented a systematic and integrated approach to ensure effective control of all activities undertaken by personnel at HIFAR. A HIFAR Business Management System (BMS) has been developed to provide the framework necessary to:

- Implement organisational arrangements focusing on safety, environmental and quality objectives.
- Ensure personnel have the necessary skills, knowledge and attributes to safely maintain the facility and undertake the planned activities.
- Foster recognition by the personnel of the need for their actions to support performance of safety functions.
- Promote a responsible approach to an effective safety culture.

The HIFAR BMS follows the P-7542 HIFAR Records Management to facilitate the creation, control and management of its documents and records.

ANSTO has a Service Level Agreement that outlines the delivery of:

- Airborne effluent monitoring, provided by the ANSTO Environmental Monitoring group, for compliance with the Discharge Authorisation.
- Radiation protection services, provided by ANSTO RPS.
- Liquid effluent sampling and waste handling provided by WMS.
- Engineering support and maintenance provided by AME.

HIFAR is certified to ISO 9001. The certificate states that BMS covers the '*Management of the de-fuelled HIFAR facility including maintenance, monitoring, surveillance and final closure activities, arrange preliminary dismantling of the facility for safe enclosure under the Possess and Control Licence.'*

Regular checks and reviews of the management system are facilitated through audits and management reviews. The internal and external audits and inspections assess the proficiency and effectiveness of the system as well as its capabilities to meet the statutory and regulatory requirements. Outputs resulting from the management review provide opportunities for corrective/preventive actions and continual improvement of safe practices and business operations.

1.5. Resources

The ANSTO processes for identifying the safety resource requirements are at several levels. For each potentially hazardous process or activity, a hazard identification and risk assessment following AE-2301 WHS Risk Management Standard is performed which identifies the required equipment, including Personal Protective Equipment (PPE). For all activities a Safe Work Method and Environmental Statement (SWMES) or similar risk assessment is prepared prior to work commencing. Risks associated with decommissioning activities have been assessed in a safety assessment.

Risk assessments and plans are reviewed internally through the ANSTO Safety and Reliability Assurance (SRA) process where applicable.

The details relating to the employment of all safety related resources are developed during the detailed work planning. This includes the preparation of the SWMES which will identify any further resources needed. This detailed planning will ensure there are sufficient workers assigned to each task.

The ANSTO project management and approval processes for projects ensure there is sufficient funding available for the necessary equipment and people resources. AG-8192 ANSTO Capital Committee Charter describes the capital works and funding process. The funding is allocated by the Capital Committee comprising senior management and the projects are monitored throughout their lifecycle by the Project Review Committee (PRC).

On approval, the funds are made available to the project manager and staff. All external purchases of items and services, including additional training, are through the ANSTO Procurement section and follow the requirements of the Government Procurement Guidelines. ANSTO has received sufficient funding from the federal government to execute Phase A Decommissioning of HIFAR.

1.6. Records

Records are maintained using the HIFAR BMS and ANSTO's AR-1477 ANSTO Records Management Process to facilitate the creation, control and management of its documents and records. Recordkeeping in respect of HIFAR includes records of:

- Planning, operation, maintenance, test results, periodic inspections of the facility, its systems, structures, components and equipment
- The inventory of controlled materials (such as controlled sources), including their physical, chemical and radiological characteristics
- The disposition and transfer of controlled materials
- Personnel radiation exposures

- Abnormal occurrences, incidents and accidents
- Accidental or planned releases of radioactive materials from the facility
- Modifications to equipment and procedures
- Training
- Audits

1.7. Process Implementation and Change Management

Changes to activities, processes or operations which are evaluated as having safety implications will be subjected to the SRA process and regulatory approval.

Project activities will be controlled by Project Responsible Officers under the supervision of the HIFAR Decommissioning Project Manager. All decommissioning activities will be conducted in accordance with the Decommissioning Execution Plans (DEP's) and these Plans and Arrangements.

The following control steps are included in the process for implementation or change management:

- Change request to be initiated via an AF-3186 Request for Change and presented to the PRC
- Evaluation of the impacts of the new or changed process
- Safety Reliability and Assurance (SRA) review, as required
- Approval from regulators, including ARPANSA, as required
- Approval to implement the new or changed process
- Review of implementation effectiveness once the process is complete

2. Safety Management

2.1. Purpose and Scope

The purpose of this Safety Management Plan is to outline the safety management system, including responsibilities, policies and procedures that are in place within ANSTO, to assure that all activities conducted at the HIFAR Facility are carried out safely and in compliance with regulatory requirements.

The scope of this plan includes all safety and licensing issues in accordance with the ARPANS Act 1998 and ARPANS Regulations 2018 and the ANSTO safety arrangements covering the issues referred to in the ARPANSA Regulatory guide: Plans and Arrangements for Managing Safety. This plan should be read in conjunction with the other HIFAR plans and arrangements.

2.2. Safety Culture

The ANSTO strategic directions emphasise the goal of ensuring that ANSTO facilities and activities are safe. ANSTO is responsible for the health and safety of its all workers, visitors and the public as outlined in the Work, Health, Safety, Community and Environment Policy. The policy is supported by AE-2300 Work Health and Safety Management Overview. All activities at ANSTO are undertaken in accordance with the ANSTO WHSMS which is a system of procedures and guides that assist ANSTO in meeting its strategic plans and legislative obligations. The safety policy and safety arrangements are communicated to all via ANSTO new starter inductions and are readily available to staff on the ANSTO intranet. The Safety policy and safety arrangements are subject to regular consultation and review.

Clear, unambiguous lines of responsibility in safety are paramount. Safety delegations are defined in the ANSTO Delegations Manual. Safety performance is monitored through management review of incidents and key performance indicators for safety.

An aspect important to safety culture is that people have a questioning attitude and adopt a rigorous and prudent approach to work incorporating conservative decision making. Appropriate training and awareness instilled by staff forums, divisional forums, divisional management meetings, safety briefings, toolbox talks, safety inspections, safety training and use of the STAR (Stop, Think, Act, Review) principle all help to build the safety culture of ANSTO.

Financial resourcing and the safety approval processes are clearly separated to ensure commercial pressures do not influence the decision making of management regarding safety. The SRA process ensures all risks to the health and safety of ANSTO staff and the community are reduced so far as is reasonably practicable. Safety and Reliability Assurance Procedure (AP-1094) describes this process.

The ANSTO WHSMS has several layers of protection for workers, the community and the environment. AE-2310 Radiation Safety Standard outlines the defence in depth strategy. Some general examples of this approach are discussed below.

All activities undertaken in HIFAR have comprehensive risk assessments undertaken prior to commencement of works in accordance with AG-2390 WHS Hazard Identification and Risk Assessment Guide and the associated AG-2395 Risk Analysis Matrix.

Maintenance and decommissioning work is managed by ANSTO workers. Contractors working in HIFAR must be supervised by ANSTO Contractor Supervisors. Contractors are selected in accordance with the tender process and compliance assessed on the Contractor Management System. This is described in AP-2303 Safe Management of Contractors.

The procurement guidelines are outlined in AG-3295 Procurement Guidelines and Thresholds which includes health, safety and security considerations as an evaluation criterion in the assessment of goods and services.

Good communication and consultation are central to providing a good safety culture. At the ANSTO organisational level, the CEO holds bi-annual ANSTO forums open for all workers to attend, High reliability publish and promote the monthly safety focus. Work groups hold regular forums at which safety is the initial topic of discussion. There is the provision for consultation with workers including staff and contractors in aspects of safety, including the Central Safety Consultative Forum (CSCF), Work Group Health and Safety Committees (HSC) and Health and Safety Representatives (HSRs). The CSCF and HSCs have terms of reference set out in the ANSTO WHSMS.

Every month a new safety focus is promoted to all groups at ANSTO to ensure staff are kept up to date and aware of the latest safety initiatives. The focus is supported by resources on the intranet.

The BMS provides a framework for controlled documentation across all of ANSTO. The BMS may include procedures relating to safety performance and guidance.

All safety-related incidents including near hits, hazards and observations are reported, independently assessed for potential severity and investigated using a graded approach following AP-2372 Event Response Process in the ANSTO incident management system, GRC. This process also captures actions for continuous improvements. Staff members are actively encouraged to report safety concerns, anomalies, deviations, and incidents to promote corrective or preventative actions.

Safety inspections are carried out as a proactive measure to identify potential safety hazards. Toolbox talks are used to identify, discuss and control any potential safety hazards.

Safety issues and lessons learnt are discussed and communicated in meetings at all levels from the Board meeting through to Executive meetings, Business Unit Management meetings down to Toolbox talks (at the unit or team level).

At the organisational level, ANSTO conducts periodic surveys on safety culture.

2.3. Administrative Arrangements

The safety regime supports the strategic directions and the WHS policy is expanded principally in the WHSMS. These are supplemented where needed by divisional and site-specific arrangements where required.

Contractors are managed in line with ANSTO contractor safety practices. The work performed is assessed against SWMES (prepared by the contractor and reviewed by ANSTO contractor supervisors, Relevant SME's) and relevant legislative requirements that identify the safety hazards and controls including the safe work permit process AP-2408 Safe Working Permit (SWP). The SWP must be signed by all parties before work commences.

Contractors involved in construction or maintenance work must hold all relevant licences, qualifications and have undertaken all ANSTO specific training required for site access prior to work commencing. Qualifications, tickets and licences of contractors conducting work are vetted via Smartek to ensure compliance, during the SWMES development phase.

Safety requirements are disseminated to workers, principally through the training arrangements. This includes safety induction training and the HIFAR local area induction in P-7298 HIFAR Training Procedure. Radiation safety training for radiation workers is performed as required.

The arrangements for radiation protection and radiation safety are given in AE-2310 Radiation Safety and supporting practices which together form a comprehensive suite of documents consistent with international best practice.

HIFAR has energised systems, and for any maintenance activity which works on these the energised system must be isolated and tagged out as per AP-2409 Isolations and Lockout Tag-out procedure. Isolations will be identified on the SWP, and personal danger tags / locks will be used by all people working on the energised system.

Working alone in the HIFAR facility must be approved by the Facility Officer on a case-by-case basis.

2.4. Safe Premises, Building and Equipment

HIFAR was built to the safety and construction standards at that time. When refurbishments occur in the building they are completed in compliance to the current standards.

All new or changed activities that clearly identify higher than low level hazards must be screened using AF-2322 SRA Screening Form to determine if processes/equipment/facilities require further evaluation of safety hazard controls to ensure the safety of workers, public and the environment. Depending on the outcome of the screening an AF-2321 Safety Control Evaluation Checklist developed in conjunction with subject matter experts may be required. Detailed SWMES will be prepared for associated activities not governed by existing detailed procedures.

All activities to be undertaken during decommissioning in HIFAR will have comprehensive hazard identification and risk assessment (Safety Assessment) performed as a supporting document to the Safety Analysis Report. Hazards identified for areas are detailed on the Hazard Identification Notice Board outside the area, as per AG-2414 Safety Hazard Notice Board Process.

ANSTO develops service level agreements with most supporting groups which will facilitate the safe conduct of the planned activities within the HIFAR facility.

All electrical equipment is tested and tagged following AG-2458 Electrical Safety – Inspection and Testing and all electrical work is conducted in accordance with Australian Standard AS/NZS 3000:2018.

Asset ownership and supporting asset management plans which define the examination, maintenance, inspection and testing of assets and components are in SAP. These are prioritized for items important to safety.

ANSTO has undertaken to comply with relevant Australian Standards. Such standards include pressure vessel standards, fire safety, chemical safety and the safety of lifting equipment. Supporting the Australian Standards are ANSTO specific requirements for electrical safety (AG-2304 Electrical Safety Guide), chemicals (AP-2302 Risk Management of Hazardous Chemicals), and entry to, and work in, confined spaces (AP-2401 Confined Space Risk Assessment and Entry Process). Specific approvals are required for pressure equipment (AG-2501 Pressure Equipment Process) and lifting equipment (AG-2497 Lifting Equipment Process).

Security provisions, including safe entry and exit from premises, buildings and sites, are discussed in Chapter 5: Security Management Plan and responses required in the event of an emergency are discussed in Chapter 6: Emergency Plan.

2.5. Competency, Training and Supervision

ANSTO has comprehensive processes which collectively ensure that potentially hazardous work is performed by and supervised by properly trained, authorised and qualified workers. This process is initiated by the recruitment process for employees and non-employees where the selection is based on the approved selection criteria for the role. The criteria include the qualifications, knowledge and experience appropriate for the work to be performed. For certain tasks (e.g., Confined Space entries) there may also be the requirement to undertake a fitness test to demonstrate that the person can do the task.

Radiation Protection Services workers play an important safety role in radiation areas and controlled facilities providing radiation monitoring and advice during all phases of the project. RPS workers must be demonstrably Suitably Qualified and Experienced to fulfil their respective roles. RPAs are recruited with the necessary knowledge, skills and experience required to undertake the role of RPA or are trained, deemed competent and authorised to act in this capacity within the ANSTO training framework. HPS are given comprehensive theoretical and practical training and must be deemed competent for all HPS training modules before they are authorised to undertake HPS functions at ANSTO.

WHS team provide information, advice, assessments and training as well as developing, managing and maintaining the ANSTO WHSMS. Learning and Development coordinate and manage training onsite, while inductions are managed at the local level.

Workers employed as Contractor Supervisors who supervise high risk works as defined in AP-2303 Safe Management of Contractors must have been formally nominated by their General Manager. In order to act in this capacity, the Contractor Supervisor must have completed the ANSTO Contractor Supervisor (C1 – High Risk) course and successfully completed the assessment of competence and any other course relevant to the work being undertaken by their contractors. This is to ensure a level of competence in critically reviewing risk assessments, management plans and work being undertaken.

Within HIFAR there are specialised tasks that require specific training. This process is managed by the HIFAR Facility Officer for facility related tasks and the Project Responsible Officer for decommissioning related tasks. Task-specific training and specific inductions are provided (if training has not previously been completed). Training uses a combination of theory and practical methods. High-risk work licences and SafeWork NSW tickets must be on the worker at all times and recorded in the site training matrix and in the ANSTO Learning Management System (LMS). All activities associated with HIFAR are documented in the HIFAR BMS, or by way of SWMES. Once approved, changes to HIFAR BMS documents are communicated to personnel and, where necessary, supported by appropriate training.

Building Managers AP-3212 and Area Supervisors AP-2592 additionally have responsibilities relating to authorizing and/ or stopping work within their designated areas and ensuring that workers undertaking tasks in their areas are trained and with appropriate risk assessments. Contacts for the facilities are in detailed in the Building Managers list and Area Supervisors list.

Contractors involved in construction or maintenance work must hold all relevant licences, qualifications and have undertaken all ANSTO specific training required for site access prior to work commencing. Contractor qualifications are assessed through an independent external party (Smartek- Barrington's) prior to contractors being allowed to undertake activities on the ANSTO site. All task-specific training identified as part of planning, as detailed in the work-specific risk assessment (SWMES) or as part of the contract company training matrix must be sighted, current, recorded and on site at all times.

2.6. Visitors, Contractors and Other Persons

ANSTO has a duty of care for the safety of all workers including contractors and visitors. Under the *WHS Act 2011*, contractors are identified as workers and are therefore subject to the same Duty of Care as ANSTO workers. Building 42 Room 1007 is used as a contractor check point which has information that introduces the contractor to the area, points out the hazards and highlights the safety rules prior to the contractor commencing work.

ANSTO restricts worker access to HIFAR by use of secure access systems. The issuing of ANSTO ID cards is controlled by ANSTO Security following a security assessment after submission of a clearance pack and formal request of line managers and/ or contractor supervisors. Only workers who are required to work in HIFAR and with the appropriate safety training including a local site-specific induction and supervision will be given access unless they are supervised by an inducted person. All of the general PPE required will be provided at a suitable location near the entry to the area where that PPE is required. Within the work areas there is signage specifying the PPE needed for each area.

The radiation safety requirements are described in the *Radiation Protection Plan*. There must be at least one EPD worn by a group of visitors to HIFAR.

There are comprehensive safety training requirements in place for contractors and these are included in AG-2058 Work Health and Safety Training Handbook. Completion of the online ANSTO Basic Radiation Safety course is required for enrolment on the ANSTO Dosimetry Service for work in radiation classified areas. Prior to doing the work, contractors demonstrate their knowledge of the hazards and safety controls by their involvement in the preparation of the SWMES and SWP.

Arrangements are in place to ensure that all visitors to the HIFAR facility are informed of hazards and are under the supervision and escort of a HIFAR pass-holder at all times.

There is a designated first aid officer for HIFAR who can be contacted through DFAO List. There are first aid kits within HIFAR.

2.7. Control of Hazards

Phase A decommissioning activities are detailed in Decommissioning Execution Plans (DEP's), which provide step by step dismantlement sequences for each the SSC's to be decommissioned. HIFAR can be undertaken safely without posing any undue risks to the worker, public and the environment. The DEP's were used as input to the Safety Analysis Report demonstrates that risks associated with the planned decommissioning activities for HIFAR, do not extend beyond the facility. The analyses also showed that the risks are sufficiently low and able to be managed without any significant impact on people or the environment.

Any project will be managed according to both ANSTO and local HIFAR procedures and implemented following evaluation according to the SRA process and submissions to ARPANSA (where applicable).

ANSTO processes for the identification, assessment and control of hazards are described in the ANSTO WHSMS. These include the SRA process, which used the DEP's to reviews the overall project safety approach, through to the SWMES which identifies hazards and controls for individual tasks. Identified risks are eliminated or mitigated through the use of the hierarchy of controls.

The SWMES ensures that workers understand the radiation and other hazards and controls associated with the work. The SWP process ensures that contractors are aware of the controls for, general and specific hazards in the area, and ensures that relevant stakeholders are aware of proposed works in the nominated area. This will be reinforced by the daily toolbox safety talks with the work groups. Radiation assessments are also used.

All of the working level arrangements for the control of hazards are assessed and depending on the level of risk, supplemented by the SRA process, which ensures that the ANSTO WHS requirements have been followed including AG-2407 Hierarchy of Risk Control. The process is described in AG-1094 Safety and Reliability Assurance.

Most hazardous chemicals and materials were removed from HIFAR during the operational period. There remain small amounts of cleaning chemicals which may be flammable or corrosive. These are controlled and stored in designated areas. Vehicles may be driven into HIFAR by the Vehicle Air Lock. They shall not be left running any longer than is necessary and shall be removed as soon as possible. The use of hazardous materials within HIFAR will be risk assessed on an individual case by case basis through the use of standard ANSTO risk management techniques and the preparation of a SWMES.

As the reactor has been de-fuelled and the heavy water has been drained from the reactor, nuclear (criticality) safety is no longer relevant to the facility. Therefore, the hazards present will be predominantly of a conventional industrial and occupational nature, rather than of a nuclear nature. Radiological hazards remain, such as airborne tritiated water vapour, contamination of surfaces and high dose rates in specific areas of the facility. Specific controls for radiation protection are in accordance with the HIFAR Radiation Protection Plan.

Other hazards and their mitigations will be considered and addressed specifically in each decommissioning plans for the components to be removed during Phase A activities.

2.8. Deviations, Anomalies, Incidents and Accidents

There are several arrangements in place to deal with deviations, incidents and accidents. These range from the reporting of potentially unsafe work conditions to emergency response and follow-up for significant accidents or incidents.

The risks in HIFAR are outlined in the Safety Assessment or other risk assessments for specific tasks. These identify foreseeable incidents and the controls for coping with these incidents. Potentially unsafe conditions identified during decommissioning activities are reported and managed by the HIFAR Decommissioning Project Manager.

The ANSTO incident management system is described in AP-2372 Safety Incident Response & Notification and this captures near hits, incidents and accidents. The process involves an investigation by a suitable person and review by the line manager. The incident is signed off by the division General Manager if the incident is triaged as Moderate or above. Outstanding incident reports are monitored by key performance indicators prepared by the High Reliability and reviewed regularly in the Nuclear Operations and Nuclear Medicine safety management meeting.

The Emergency Response Team (ERT) will be supported by external emergency services if required.

AG-5445 Guide on ARPANSA Requirements specifies the requirements for reporting incidents to ARPANSA and includes the requirement to report any radiological accidents involving a significant failure in the safety provisions within 24 hours and a written investigation report within 14 days. Additionally, the document AP-2372 Safety Incident Response & Notification outlines the requirements for notification of incidents to ARPANSA, Comcare and other regulatory bodies within required timeframes.

2.9. Audits and Review

There is a comprehensive audit schedule in place to plan the audit and review of the ANSTO WHSMS. The safety requirements, including those for radiation safety are in the ANSTO WHSMS.WHS audits take place regularly or at key milestones in projects.

ANSTO maintains ISO 9001 and ISO 45001 certification and conducts regular management system audits and reviews of work group systems compliance, management reviews and the WHS system and procedures (which includes RPS and WHS).

Audits of operations, maintenance etc. are undertaken through the BMS system.

2.10. Workplace Safety and Housekeeping Inspections

Workplace safety inspections are a planned systematic approach for the identification of hazards and control of risks in the work area. ANSTO uses Workplace Safety Inspections and Housekeeping Inspections as part of the system to pro-actively identify and address hazards so they can be controlled to prevent an incident occurring. Inspections are also a tool to monitor previous control measures and local procedures.

These inspections are intended to be a positive and engaging experience for workers. The workplace inspections are documented and reviewed by the HIFAR Facility Officer or delegate who monitors that the corrective actions have been identified and completed. Inspections are conducted in accordance with AG-2432 Workplace Safety and Housekeeping Inspections.

2.11. Project Meetings and Toolbox Talks

Project meetings and toolbox sessions will be held regularly with the Decommissioning Project team. Corrective/preventative actions are discussed and areas for improvement are identified.

The tools that maybe used for these sessions are:

- The AF-3706 WHS Management System Implementation Self-Assessment Tool may be used by the Decommissioning Project team to self-assess the effectiveness of the implementation of the WHSMS as it applies to the scope of their work.
- The AF-3915 Construction Site Audit checklist to assist in auditing site safety
- The AF-2438 Toolbox Talk to record toolbox talk sessions

2.12. Records and Reporting

HIFAR information and documentation is stored on ANSTO computer servers and paper records are kept in the B42 records room. Relevant workers have appropriate access to this information.

The ANSTO WHSMS is within the ANSTO's certified ISO 45001 system to ensure appropriate reporting and storage of records. General requirements for records are given in AR-1477 ANSTO Records Management Process which details the applicable legislation, storage locations, and responsibilities. The safety assessments, all associated risk assessments including the SRA process documents are stored in the central SRA files and in project records.

Organisational training records are maintained against a worker's learning profile in the ANSTO LMS. Incident reports and records are maintained in GRC. These records contain information related to the incident and any follow-up investigation reports and summary information on any injuries. Summary information on each incident is entered into a WHS database to facilitate retrieval of details, follow-up and closure. Incidents may be rated in accordance with the International Nuclear Event Scale (INES) depending on the type of incident.

GRC has provisions for recording the incidents, analysing the root cause, recommending corrective/preventive actions and reporting to ARPANSA and/ or Comcare based on the severity of the of the incident. The level of investigation is based on the potential severity of the incident.

The process emphasises and facilitates learning from errors and requires that incidents are investigated, corrective actions implemented, and that lessons are learned from the incident.

Medical records associated with any injuries are maintained confidentially by the ANSTO Health Centre. AP-6074 ANSTO's Workplace Early Intervention and Rehabilitation Procedure describe the requirements for record keeping including reporting to the WHS regulator, Comcare.

3. Radiation Protection

3.1. Purpose and Scope

The purpose of this Radiation Protection Plan is to describe the organisational arrangements and procedures that will be implemented for the purpose of controlling exposure to ionising radiation during all activities at the HIFAR facility.

The plan outlines the systems and processes that ensure compliance with standards and regulatory requirements on radiation protection and the application of optimisation of protection, which contribute to the development of a safety culture at HIFAR.

This Radiation Protection Plan is compliant with current Australian National Standards and Codes including Fundamentals for Protection Against Ionising Radiation (2014) (Radiation Protection Series F-1), Code for Radiation Protection in Planned Exposure Situations (2020) (Radiation Protection Series C-1 (Rev. 1)) and the ARPANS Act and Regulations. The plan is consistent with international best practice and is in accordance with the International Atomic Energy Agency (IAEA) standards and guidelines on protection against the effects of ionising radiation, including Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards | IAEA, Occupational Radiation Protection | IAEA and P103 The 2007 Recommendations of the International Commission on Radiological Protection (sagepub.com).

This plan should be read in conjunction with other Plans and Arrangements for HIFAR, specifically those relating to effective control, emergency arrangements and waste management.

3.2. Responsibilities

The CEO of ANSTO is the applicant to ARPANSA for the decommissioning licence. The CEO of ANSTO has delegated responsibility for the safe management of HIFAR decommissioning project to the Licence Nominee. The organisational arrangements are described in detail in Chapter 1 *Effective Control Plan*. Organisational arrangements specific to radiation protection is provided in this chapter.

3.2.1. Organisational Responsibilities

All individuals have responsibility to apply the ANSTO WHSMS and follow the related procedures and instructions. This will ensure that radiation protection measures are considered optimised for the prevailing circumstances and worker exposures remain ALARA and are within the applicable limits and constraints. All workers involved directly or indirectly with the handling of radioactive materials or apparatus have a responsibility to:

- Read and comply with radiation safety practices as described in this Radiation Protection Plan
- Comply with all relevant safety instructions
- Inform management immediately of any incidents or accidents which they believe may contribute to a radiation hazard
- Refrain from careless or reckless practices or actions likely to result in an unexpected radiation hazard to themselves or to any other person.

3.2.2. Radiation Protection Services

ANSTO's RPS section is led by the appointed ANSTO Radiation Safety Officer (RSO) and provides resources, namely Radiation Protection Advisors (RPA), Health Physics Surveyors (HPS) and related services, to support this radiation protection plan for HIFAR.

The RSO is an experienced, recognised radiation protection specialist who is responsible for ensuring that ANSTO's radiation protection advice reflects current relevant Australian radiation protection legislation and international radiation protection best practice. The RSO ensures that the ANSTO radiation protection guides and arrangements are appropriate to meet current Australian National Standards and Codes, the ARPANS Act and Regulations and International Best Practice. The RSO also ensures that RPS staff are adequately trained and experienced to fulfil their duties.

The HP is an experienced professional trained in radiation protection who advises the Nominee, manager, workers, visitors and contractors of HIFAR on radiation protection issues, safe working practices, relevant standards and the optimisation of operational radiation protection measures. The HP assists workers with improvements in radiation safety at a practical operational level through the review of working practices and input into working procedures. The HP advises on the procedures, instructions and written work systems for all activities where radiological safety assessment is required. Monitoring programs and their implementation are advised upon and reviewed by the HP. Advice on handling, storage and management of radioactive waste and the transport of radioactive material is also available from the HP.

The HP is supported, at an operational level, by HPS from RPS. The HPS performs radiation assurance monitoring surveys within HIFAR to an agreed schedule. The results of these surveys will be reported for review to the HP and to the Licence Nominee or their nominated delegate.

All workers working in radiologically classified areas attend radiation safety training provided by RPS. Further training in specific hazards where radioactive materials are used, the use of radiological instrumentation and applicable monitoring techniques are provided by the local management with support from RPS personnel.

The HP and the HPS have the authority to suspend work if the radiological conditions have significantly deviated from the expected operational levels and it is believed that these conditions present an intolerable risk to either workers or to members of the public.

3.3. Radiation Protection Principles

ANSTO is committed to maintaining and enhancing standards of radiation safety recommended by the International Commission of Radiological Protection (ICRP), and the International Atomic Energy Agency (IAEA), and required by ARPANSA, and Safe Work Australia through the application of its radiation safety management systems.

ANSTO is committed to keeping the likelihood of incurring exposures, the number of people exposed, and the magnitude of their individual doses ALARA, taking into account economic and societal factors (Recommendations of the International Commission on Radiological Protection (2007)). This means that the level of protection should be the best under the prevailing circumstances and should provide for adequate margin of benefit over harm.

The AE-2310 ANSTO Radiation Safety Standard is applicable to work that either introduces a radiological hazard (potential or otherwise) or is performed in operational areas where existing radiological materials have the potential to become an operational hazard (i.e. within radiological classified areas).

The Standard describes in detail the principles applied to all controllable radiation exposures including:

- Justification
- Optimisation of Protection
- Dose Limitation
- Defence in Depth
- Safety Culture

These are strengthened through the development and maintenance of a strong safety culture within ANSTO; and managing exposures using a graded approach to appropriately consider both radiological and non-radiological aspects of the prevailing circumstances, whilst applying defence-in-depth to protective measures. The principle of justification and the principle of optimisation of protection apply equally to all controllable exposure situations, and the principle of dose limitation applies to public and occupational exposures in planned situations.

The Standard is implemented through the application of the guides as described throughout this document and in the ANSTO BMS.

3.3.1. Justification

Radiological exposures are anticipated to be received by workers during decommissioning and transport of HIFAR components. Considerable institutional knowledge of the operation, maintenance, repairs, modifications and history of HIFAR has assisted the development of Safety Assessments and the decommissioning strategy to decrease or avoid undue exposures. Coupled with ANSTO's stringent safety and management systems and waste management capabilities, the Decommissioning Project will provide a progressive and systematic reduction in radiological hazards.

3.3.2. Optimisation of Radiation Protection

For those activities that have been assessed and are deemed to be justified, their protection should be optimised so it represents the best level of protection that can be achieved under the prevailing circumstances. As such ANSTO is committed to reducing the likelihood of incurring exposures, the number of people exposed, and the magnitude of their individual doses ALARA, taking into account economic and societal factors. A detailed description of the principle of optimisation, the process followed, and the decision-making tools used for optimisation of protection is provided in AE-2310 ANSTO Radiation Safety Standard.

3.3.3. Dose Constraints

Dose Constraints (or Dose Review Levels) for occupationally exposed workers at the facility are used to identify a boundary which individual exposures from planned work should not exceed and below which optimisation of protection should take place.

The HIFAR dose constraint and any specific work constraints or reference levels within the facility are determined and set by the RPA in consultation with appropriate personnel within HIFAR. The dose review level process follows G-1372 Effective Local Dose Constraints Guide.

Analysis of planned exposures during 2018, 2019 and 2020 shows that the maximum annual individual doses for HIFAR were 0.16 mSv, 0.12 mSv, and 0.21 mSv, respectively. It is anticipated that future work in the facility will be similar to this previous period. Therefore, an appropriate facility individual effective dose constraint of 1 $mSva^{-1}$ has been determined.

Appropriate dose review levels across shorter time periods and for specific tasks are defined by the HP in consultation with the Facility Officer and the HIFAR Decommissioning Project Manager. If a dose review level is exceeded, the specific task and likely completion time/exposure is considered in the context of the current exposure level and the overall radiation dose review level for the planned tasks to ensure that these remain at a reasonable level prior to continuing.

The Facility is committed to ensure that, for all activities at the facility, effective radiation doses (including committed effective radiation doses) to members of the public do not exceed any dose constraints for the Facility. The annual dose constraint for a member of the public shall be in accordance with AE-2310 ANSTO Radiation Safety Standard.

3.3.4. Radiation Dose Limits

Individual doses due to the combination of exposures from all regulated ANSTO activities must not exceed the specified effective dose limits and equivalent dose limits for planned exposure situations as stated in the ARPANS Regulations. These limits are repeated in AE-2310 ANSTO Radiation Safety Standard.

3.3.5. Defence in Depth

The defence in depth principle will be incorporated into procedures to compensate for potential failures in protection or safety measures. In-depth defensive measures are incorporated into the decommissioning program of work and associated operating procedures. This includes the use of multiple barriers to contain radiation and radioactive material, and redundancy and diversity in safety control and monitoring systems where necessary and as appropriate to the hazard.

3.3.6. Safety Culture

ANSTO promotes and maintains a strong safety culture that guides the attitudes and behaviour of all individuals in the realisation of radiation protection. The objectives are outlined in AE-2310 ANSTO Radiation Safety Standard.

3.4. Radiological Hazards and Controls

Specific radiation hazards and their controls are analysed in the HIFAR Safety Analysis Report and associated risk assessments. Activation of components of HIFAR over its lifetime may pose a radiation hazard for the decommissioning or dismantling work to be undertaken. Radiation characterisation and safety assessments were conducted to identify the levels of activation prior to dismantling components.

In relation to external radiation hazards, the main principles of protection are

- Time: limiting the duration of exposure
- Distance: keeping away from the radiation source so that the dose rate is lower
- Shielding: using appropriate materials to attenuate the relevant radiation types

HIFAR has additional engineered provisions, for example, containment, active ventilation and controls to prevent access to areas where dose rates are higher (core and storage block).

3.5. Radiological Classification of Areas

The Classification of Contamination and Radiation areas is undertaken according to the process described in AG-2509 Classification of Radiation and Contamination Areas and in compliance to the AE-2310 ANSTO Radiation Safety Standard. These define the system of radiological classification of areas employed to control, prevent, limit and review occupational exposure (actual or potential) to ionising radiation. This system of radiological classification helps ensure that occupational dose limits are not exceeded and is part of the process of ensuring that doses to individuals are kept ALARA in line with dose constraints.

3.5.1. Initial Classification of Areas

The initial area classification for HIFAR working areas is determined by the Area Supervisor in consultation with the HP. These classifications are based on calculated results as well as operational experience obtained from similar activities. Where relevant, the planned occupancy times of staff in those areas during normal operation will be considered.

3.5.2. Reclassification of Areas

Area classifications may be changed if appropriate in consultation with the HP.

This will be done by reviewing radiological data obtained from installed and portable monitoring equipment and the final occupancy factors and may result in changes in area classification to either higher or lower categories.

Areas may be temporarily reclassified to reflect temporary changes in radiological conditions, with the changes in classifications and application of controls being commensurate with the temporarily changed conditions. Certain operations in radiological classified areas may raise or lower the hazard and potential radiation exposure for workers.

Changes in area classification (with any associated changes in work practices required) are notified to workers and appropriate signage installed.

3.6. Safety Hazard Notification

Any potential safety hazards (including radiological) present in ANSTO premises are identified and illustrated graphically on safety hazard notice boards in areas. The safety hazard notice boards are prominently posted at the entrance to any radiologically classified area and display the radiation and contamination classification of the area, potential hazards by colour code, contamination and radiation hazard pictograms, along with contact details for the responsible officers. All radiation areas classified blue or red are subject to area and personnel monitoring programs.

3.6.1. Personal Protective Equipment

Personal Protective Equipment (PPE) for working in radiological classified areas shall be supplied and worn according to AG-2511 Radiation Protection Requirements in Radiological Classified Areas.

The PPE required is determined against the nature of the hazard and the work that is being undertaken however the minimum requirement for work in a contamination classified area is:

- Laboratory coat
- Enclosed shoes with overshoes
- Gloves
- Safety eyewear (as appropriate)

This PPE shall be supplied at the barrier to any radiological classified area and following use shall be monitored, laundered and re-used or, for disposable PPE, passed to waste. Entry and exit to these areas shall be done according to AG-2511 Radiation Protection Requirements in Radiological Classified Areas.

3.7. Radiation Monitoring Programs

Monitoring is the collection of information about radiological conditions in the workplace and the evaluation of this information (workplace and area monitoring). This, together with information on exposures to workers (dosimetry results), assists in confirming that safe working practices and engineering standards have been successfully implemented and that the radiological hazards are under effective control.

The monitoring programs that demonstrate adequate protection and optimisation of those protection measures are described in two parts. The first is based on measurements (radiological surveys) taken in the workplace. The second is based on measuring individual exposure to radiation using personal dosimetry.

3.7.1. Workplace and Area Monitoring

Task based radiological monitoring is performed by operators (non-RPS workers) as confirmation of expected radiological conditions within the work areas during routine operations. Training in the use of the radiological instrumentation is provided by local management with support from RPS staff and appropriate records maintained (i.e., training records or induction records). Routine area assurance radiological monitoring may also be performed by HPS staff for the purposes of:

- Confirmation that dose rates and contamination levels within and around radiological classified areas are within agreed parameters
- Confirmation of the area classifications

As described in Section 3.10 of this plan, any abnormal results found in these assurance surveys are reviewed by the Facility Officer/ Area Supervisor and by the HP.

The monitoring programme is based on an assessment of the radiological hazards within the facility with the frequency of survey being based upon the magnitude of the hazard, the potential for exposure of an operator or a member of the public and the potential for the conditions to change.

3.7.2. Monitoring of Individuals

Occupationally exposed workers are monitored in accordance with AG-2521 Personal Dosimetry as part of the routine dosimetry program. This will include the supply of dosimetry, analysis of internal dosimetry (whole body monitoring, bioassay and air sampling) and a dose record keeping service provided by RPS.

Routine external monitoring using Thermoluminescent Dosimeters (TLDs) for the measurement of effective dose (β/γ exposure to the whole body) and to the extremities (β/γ) is carried out. Individual monitoring using electronic dosimetry (for occupational dose control) is also carried out. TLD issue/assessment period for each occupationally exposed individual will be defined based on their potential exposure and is anticipated to be quarterly (for routinely exposed staff).

Task and special external individual monitoring may be warranted for ALARA assessment purposes, for incident/ event assessment or for assessment of non-uniform exposures. Such monitoring programs would be developed by the HP in conjunction with the HIFAR Decommissioning Project Manager and workers and may include urine analysis for tritium monitoring.

Workers exiting radiologically classified areas are required to perform self-monitoring for contamination. Training as per AG2511 Radiation Protection Requirements in Radiologically Classified Areas is provided to workers required to perform self-monitoring by RPS during initial Basic Radiation Safety training. Monitoring instrumentation is provided at the relevant change areas. This monitoring is used to identify personal contamination events (of the workers exposed skin, personal clothing or of the discarded PPE).

3.7.3. Radiation Monitoring Instrumentation

Radiological monitoring equipment is selected based on the radiological conditions in the area. The radiation monitoring equipment used in HIFAR consists of a combination of fixed and portable instrumentation designed to monitor the radiological conditions, stack discharges and personnel.

HIFAR radiation monitoring equipment include:

- Real-time B15 area radiation monitoring – connected to SCADA and ASOC
- Real-time B15 Tritium monitoring – connected to SCADA and ASOC
- Real-time airborne particulate monitoring – connected to SCADA and ASOC
- Real-time active and normal extract ventilation filters monitoring – connected to SCADA and ASOC
- Portable radiation monitors, including portable Tritium detector
- Stacks 15A and 15M continuous air flow measurement in conjunction with the bubbler sampling program (ANSTO's Environmental Monitoring program AG-1304).

Radiation monitors are installed to measure and display gamma radiation levels in the HIFAR Facility. They incorporate visual and audible alarms, including a connection to the personal airlock (PAL) and vehicle airlock (VAL) warning lights as well as the B15 evacuation alarm. The refurbished SCADA system has monitor screens in the HIFAR Auxiliary Plant Room B40 and the B42 PAL foyer.

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These radiation monitors have local displays and trigger visual and audible alarms if dose rates are higher than pre-determined values that have been set by consultation with RPS and the HIFAR Facility Officer.

Portable monitors are typically used to complement and validate the information provided by fixed detectors and to survey specific operations or procedures and surface and airborne contamination levels.

Wherever a contamination risk is present, to reduce the possibility of contamination spread, measurement of potential external contamination of personnel is routinely performed as close as possible to the contamination source by means of portable equipment.

Portable instruments are also used to measure items leaving areas where contamination may be expected, as well as to release material to users outside contamination-controlled areas.

Potentially contaminated surfaces are surveyed using portable monitoring instruments or applying smear sampling techniques and remote assessment.

All fixed and installed radiation monitoring instrumentation are subject to a maintenance program that includes calibration by ANSTO's Instrument Calibration Facility (ICF).

The maintenance programs for components are outlined in the maintenance manuals for specialist pieces of equipment. Commercial or off-the-shelf equipment is maintained as recommended by the manufacturer.

3.7.4. Monitoring of the Environment

The radiological discharges to the environment from HIFAR will be subject to notification levels as specified for the site. Radioactive discharges from the stacks are monitored by the Environmental Monitoring group within the Nuclear Science and Technology division. The building extraction ventilation system incorporates carbon and HEPA particulate filtration systems. The final discharge to atmosphere is continuously recorded with the stack monitoring system. These are consolidated into the site environmental emissions report provided to ARPANSA quarterly and annually.

Water that falls on the shell of HIFAR is collected in a moat and directed into the site trade waste lines. Wastewater generated within the radiological classified area will be collected in waste storage tanks and will be discharged to ANSTO Waste Operations.

3.8. Training

Basic training in Radiation Safety is carried out in accordance with ANSTO WHSMS. All staff working on active components in HIFAR must undertake the Basic Radiation Safety course and the Radiation Protection Workshop. Additional training is provided by HPS to workers on how to operate the portable tritium monitor.

All HPS at ANSTO undergo theoretical and practical training through the Health Physics Surveyor Accreditation Portfolio. This is concluded with an assessment to determine if the individual is competent to perform the duties of a HPS. HPS are trained in the operations, instrumentation and radiological requirements of areas where radiation sources are located.

3.9. Transport and Movement of Radioactive Materials

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3.10. Review and Audit of the Radiation Protection Plan

3.10.1. Occupational Exposure

Investigation levels for occupationally exposed workers are defined AE-2310 ANSTO Radiation Safety Standard. Dose results are reviewed at appropriate periods (taking into account the issue period for dosimetry) and will be compared to facility dose constraints and to these investigation levels.

Investigation Levels have been defined to ensure that, where pro-rata doses suggest a dose constraint may be challenged, a formal investigation is performed by the local line management in conjunction with the HP. The results of such investigations and associated recommendations for future management of exposure are discussed with the Facility Officer/ Project Responsible Officer where ANSTO radiation sources are used.

3.10.2. Monitoring Results

RPS staff will review the radiological conditions within HIFAR, as measured during routine assurance or special surveys and, where the conditions suggest that either:

- The radiation classification of the area is incorrect
- There is a trend towards increasing radiation or contamination levels in an area
- There is a specific radiological concern.

The HP will make recommendations for any rectifications required.

3.10.3. Event / Incident Reports

Events that are assessed as incidents against AP-2372 Safety Incident Response and Notification are investigated by an appointed investigator with additional expertise made available from ANSTO. The frequency and magnitude of radiological events will be considered an indicator of the effectiveness of the Radiation Protection Plan (and its implementation). Performance indicators used to measure the Radiation Protection Plan's effectiveness may include but are not limited to occupational exposure to individuals and monitoring results from routine radiological surveys.

4. Radioactive Waste Management

4.1. Purpose and Scope

The purpose of this Radioactive Waste Management Plan is to describe the organisational arrangements and responsibilities for the control, storage and transfer of the radioactive waste generated from the HIFAR Decommissioning Project (Phase A). It details how solid and liquid radioactive waste generated by HIFAR during that period will be transferred to ANSTO's Waste Management Services. The systems and processes outlined in this document address current best practice, including waste minimisation principles, and are in line with IAEA guidelines for the safe management of radioactive waste.

4.2. Radioactive Waste Management Arrangements

Radioactive waste management at ANSTO is implemented through AG-2517 Safe Management of Radioactive Waste. Waste Management Services (WMS) accept, treat and condition waste as required. Radioactive wastes are managed in accordance with WMS systems which are in line with current best practices and in compliance with applicable Commonwealth and NSW legislation, regulations and codes of practice.

Radioactive waste generated by decommissioning activities remains under the effective control of the HIFAR Responsible Officer until the waste is removed from the Facility. The Responsible Officer must ensure that wastes are safely stored and shielded to minimise dose to ANSTO workers, in accordance with the ALARA principles. Areas where wastes are stored must be regularly monitored for radiation levels.

4.2.1. Waste Minimisation – Design Systems and Processes

In line with ANSTO Radioactive Waste Management Policy and AG-2517 Safe Management of Radioactive Waste (Guide), HIFAR minimises waste generation through segregation of waste, delay and decay and ongoing education and training of personnel on waste minimisation and radiation safety.

ANSTO employs a number of measures to ensure that decommissioning actions do not result in large volumes of primary or secondary wastes including;

- Size reduction of bulky components to enable optimal packaging
- Segregation of wastes into radioactive and non-radioactive waste categories
- Reuse of operational equipment such as lifting and material handling equipment by decontaminating for re-use where practicable
- Training of personnel to be aware of decontamination and size reduction and contamination control best practices
- Using suitable treatment, decontamination and conditioning methodologies
- The release of materials and equipment to landfill which meet regulatory requirements
- Release of materials for recycling that meet regulatory requirements
- Packaging of wastes into containers which are compatible with ANSTO's super-compactor facility

Inactive wastes are recycled or disposed of directly through the municipal waste management system. Exempt level wastes are processed through the existing ANSTO exempt level waste clearance system. Where practicable, exempt waste is routed through recycling schemes.

ANSTO's certified Environmental Management System (EMS) provides the commitment to minimise ANSTO's environmental footprint. The EMS is compliant with ISO 14001 and provides a structured approach to the identification of environmental aspects and the controls that limit the environmental impacts of ANSTO's activities. Within the EMS, there are defined objectives and targets that focus on effective management of airborne, liquid and solid wastes. This includes stack sampling for tritium and active particulates.

4.2.1.1. Solid Waste

A large portion of the material and equipment that will be removed from HIFAR will be non-radioactive or exempt level waste.

Radioactive solid waste is classified in accordance with the ANSTO classification system and is managed in accordance with existing procedures. All solid radioactive waste generated directly or indirectly from ANSTO activities and projects are stored at the LHSTC. Only wastes that meet the exempt level waste criteria defined by the regulatory limits are disposed to authorised landfills (solid waste). The ultimate disposal of ANSTO's radioactive waste to the proposed National Radioactive Waste Management Facility (NRWMF) will strictly follow all statutory and regulatory requirements.

Material which is removed from the HIFAR Facility and is found to exhibit dose rates less than 2 mSv/hr at contact will be handled in accordance with the P-6567 Contact Handled Solid Waste Procedure. Most of the radioactive waste that will be generated as part of Phase A of the HIFAR decommissioning is anticipated to fall into this category. Dismantling, decontamination and packaging activities involving contact handled solid waste will not require shielding or specialised handling equipment or procedures.

Material that has a dose rate greater than 2 mSv/hr at contact will be handled in accordance with P-6496 Remote Handled Waste Procedure and I-3306 Management, Transport and Storage of Intermediate Solid Waste.

WMS staff utilise physical and chemical decontamination methods to remove radioactive contamination from the surface of materials or segregate radioactive sections of equipment from non-radioactive sections. Contaminated objects may be cut up to improve ergonomics for the application of subsequent decontamination methods. This will allow easier and more efficient packaging if decontamination efforts are unsuccessful. Equipment or items known to be activated will be cut and segregated into parts where significant changes in radioactivity are measured.

4.2.1.2. Liquid Waste

Liquid waste will be discharged to the B-line or C-line subject to the limits specified in ANSTO WH&S Guide AG-2517 Safe Management of Radioactive Waste. Liquids containing higher levels of activity or those materials not permitted to be disposed of through the discharge lines will be stored separately until it is collected by WMS for treatment and conditioning.

Any discharge to the sewer will be in accordance with the current Trade Waste Agreement with Sydney Water.

4.2.1.3. Airborne Emissions

Airborne emissions are reported to ARPANSA. In addition to the routine reporting, any inadvertent release is reported if it exceeds the notification levels in the HIFAR Limits and Conditions. The Environmental Monitoring program AG-1304 Environment Monitoring Program for ANSTO is carried out by the Environmental Monitoring group. Details of airborne emissions are described in the SAR.

Airborne emissions may be derived from evaporating tritiated heavy water remnants in parts of the primary circuit; from emissions of tritium (present as tritiated heavy water) de-adsorbing from the graphite space and from any dusts generated in sample gathering for waste characterisation.

Dusts arising from specific activities will be controlled using appropriate local containment methods when undertaking any work that might generate dusts. Dusts that escape this local containment will be removed from the airstream by HEPA filtration in the HIFAR active and normal ventilation systems.

The HIFAR active ventilation system is designed to extract air and gases from the Reactor Containment Building (RCB). The extracted air and gases are passed through filters before being discharged to the atmosphere through the stack. The filters trap 99.9% of particulate matter larger than 0.5 micron. The

portable hood trunking is exhausted by a booster fan to the active extract ducting. Two groups of three gamma radiation sensors mounted between the active extract filter housings are used to monitor radiation levels within the active ventilation system. Alarms will trigger upon exceedance of pre-programmed levels.

The likely potential pathways of exposure to personnel from airborne waste are:

- Inhalation of airborne radioactive materials present in the workplace.
- Ingestion of radioactive materials in particulate form in the workplace.

Tritium monitoring is performed, and particulates are monitored by air samplers, as deemed necessary through risk assessments.

4.2.2. Limiting Exposure to Radioactive Waste

The AE-2310 Radiation Safety Standard is implemented through the application of the guides and practices provided in the ANSTO WHSMS. It provides guides on radiation protection and control measures to minimise the risks of radiological hazards associated with the radioactive waste sources. The arrangements for minimising exposures to ionising radiation arising from radioactive waste sources are addressed as part of the Radiation Protection Plan. The following general approaches will be employed to limit exposure of workers and optimise protection during decommissioning activities and implementation of waste management practices:

- Effective work planning by using HIFAR characterisation data to conduct dose assessments, taking into consideration all exposure pathways, to help minimise the duration and level of exposure to the radioactive waste
- Isolation of the radioactive waste items by utilising distance when possible
- Shielding of radioactive waste items during dismantling activities and waste handling movements by using shielded containers, lead bricks, concrete blocks and shielded flasks
- Utilisation of PPE such as breathing apparatus, respiratory protection, gloves, overshoes and overcoats
- Utilisation of radiation detection and monitoring instrument during both decommissioning and waste handling activities
- Utilisation of forced ventilation systems to frequently change air and reduce exposure to radioactive and non-radioactive hazardous airborne contaminants.
- Application of engineering controls to mitigate exposure pathways to liquid and airborne secondary wastes, e.g., bunds, tanks, active ventilation, and drainage transfer systems.

The ALARA principle is applied where applicable to minimise the routine radiation exposure from the waste sources to ANSTO staff, members of public and the environment.

4.2.3. Packaging and Containment of Waste

Designated packaging areas will be setup with appropriate shielding and contamination control provisions if deemed to be necessary after having completed a AF-2354 Radiological Risk Assessment using HPS and Radiation Protection Advisors.

AG-1266 Packaging Waste from Classified Areas Guide specifies the local requirements of waste packaging prior to collection by WMS. Waste is segregated and placed in the appropriate bin or container according to its waste type. The identification and characteristics of waste are recorded on the AF-2358 Waste Service Request Form together with the dose rate and contamination level measured by a qualified HPS. This information is then recorded in an electronic database (SAP) for tracking of all radioactive waste packages.

Containers and packages will be labelled with sufficient information in relation to the contents and the intent of the package, i.e., whether the contents need to be further conditioned or decontaminated or if the package is ready for interim storage.

4.2.4. Transport of Waste

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4.2.5. Record Keeping

The ANSTO SAP system maintains records of the radioactive waste received by WMS and provides tracking control of radioactive and exempt wastes regarding:

- Identification
- Type (low or intermediate level, liquid or solid)
- Characteristics (weight, volume, dose rate)
- Container type/package
- Chain of custody (details of acceptance, location including movement, processing steps storage, discharge or disposal)

Separate spread sheet inventories are maintained for low volume/frequency wastes as well as legacy wastes. The waste inventories are regularly updated, and a summary is reported to ARPANSA in the quarterly reports.

5. Security Management

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6. Emergency Plan

6.1. Purpose and Scope

The purpose of this Emergency Plan is to outline the emergency arrangements that are in place within ANSTO for HIFAR. The scope of this plan are the emergency issues in accordance with the ARPANS Act 1998 and ARPANS Regulations 2018 and the ANSTO safety arrangements covering the issues referred to in the ARPANSA Regulatory Guide: Plans and Arrangements for Managing Safety. Emergency Plans

6.2. Emergency Plans

As described in the AG-5945 ANSTO Emergency Management Plan there are five main components to ANSTO's emergency planning arrangements, which mimic the Australasian Interservice Incident Management System:

1. Roles and Responsibilities
2. Prevention
3. Preparedness
4. Response
5. Recovery

Hazards and risks are identified in the HIFAR SAR, risk assessments or hazard notice board. Hazards associated with the typical activities carried out are identified and risks assessed prior to commencement, and this drives the level of response required for various incidents in accordance with the ANSTO WHSMS.

B15 HIFAR emergency planning categorisation

The Radiological hazards and the potential consequences of an emergency have been assessed for the HIFAR facility and are detailed in Radiation Protection Services Technical Note ANSTO/RPS/TN/2022-03. The assessed hazard from a safety and security perspective results in the B15 facility being classed as Emergency Preparedness Category III.

6.3. Emergency Procedures

The purpose of this plan is to ensure an appropriate, timely response to all possible emergencies to minimise the risk to staff, the public and the environment.

The Area Supervisor is responsible for ensuring that local emergency arrangements are in place and all relevant workers are trained in their roles as described in AG-2952 Role of Area Supervisor.

The Building Warden is responsible for marshalling evacuees and securing the affected building as described in AG-2465 Building Wardens. There are trained deputies for this role.

HP and HPS have roles in radiation incidents as part of the ANSTO general emergency arrangements.

If an incident or accident occurs which requires a greater response, the ANSTO emergency response arrangements will be invoked. Central to these arrangements is the ASOC which is manned 24/7 and is the focal point for communications in an emergency. In addition to the security alarms, all safety alarms are monitored and all calls to the ANSTO emergency number are directed to this Centre.

This next level of emergency response is managed by the on-call Incident Controller or the Emergency Operations Manager. These arrangements are described in AG-5945 ANSTO Emergency Management Plan.

Incident Controllers (IC) are appointed senior ANSTO staff rostered 24/7 to respond to incidents or emergencies and can be contacted through the ANSTO radio communications network or through the ASOC (via duty mobile phone, radio or pager). The IC has the necessary authority to take control of the emergency and command further ANSTO resources if required. The IC ensures that the local response is satisfactory and, where necessary, escalates the incident to the Emergency Operations Manager (EOM).

The EOM is responsible for the overall operational response for all ANSTO related emergencies. Should an incident or emergency situation escalate, the EOM may assume control as ANSTO Incident Commander (AIC) in the field until such time as the Emergency Operations Centre is activated. At which point the EOM will manage the emergency from the EOC.

The response to an incident or emergency situation may be escalated to the IC and the EOM in two ways. The officers in the ASOC have defined responses for each alarm and for some alarm situations. The automatic response is to inform the IC and the EOM. The IC and the EOM will also be contacted by the ASOC when there is a call to the centre requesting further emergency assistance.

ANSTO RPS section maintains 24/7 health physics support for radiation incidents. This service is described in AG-5945 ANSTO Emergency Management Plan. An experienced on-call HPS is contactable by phone 24/7 and can respond in a vehicle containing the necessary radiation detection and decontamination equipment.

If necessary, the EOM can seek senior management advice and support through the arrangements described in AG-5945 ANSTO Emergency Management Plan.

External communications to the media and other organisations is through ANSTO Communications and the Combat Agency for the emergency.

6.4. Emergency Preparedness

The emergency arrangements described in the previous sections include back up contingencies for all emergency roles. The ASOC, which is the emergency communications point, is manned 24/7 and there are always back-up officers at the site. The, EOM, IC and the on-call HPS and HP roles are rostered 24/7 and any absences are covered by alternates.

All staff with a role in emergency response are trained and the emergency arrangements are exercised. Emergency drills are used to test the plans. The higher-level response arrangements involving the EOM and the IC are exercised regularly and some of these exercises involve the external emergency services. There is ongoing review of the emergency arrangements, including updating of the contact lists and safety alarm responses, particularly after exercises. The EOM will take lessons learnt from other exercises to update the emergency arrangements.

Emergency evacuation exercises are conducted at regular intervals as per AP-2361 Planning Emergency Exercises. The Building Manager and Building Wardens are responsible for organising an emergency evacuation exercise prior to commencing operations, to ensure HIFAR personnel are familiar with the evacuation process. Building Wardens will have the responsibility of ongoing emergency exercises for the facility during decommissioning activities. Up to date staffing lists are to be kept at each dedicated muster point and be readily available to account for workers working within the facility. Muster points are identified and sign posted. Facility maps are displayed throughout the facility showing the external and internal muster points, and safety equipment locations in the facility including fire extinguishers, spill kits and first aid kits.

Maintenance and testing of all emergency equipment and alarms is managed through relevant service agreements with engineering contractors, HIFAR staff, or ANSTO Support Services e.g., Information Technology, Facilities Maintenance.

The ANSTO medical centre is located on the Lucas Heights campus is available for HIFAR staff.

6.5. HIFAR Facility-Specific Emergency Procedures

HIFAR will be evacuated in the event of any of the following alarms activating:

- Fire
- B15 Evacuation
- Ventilation system
- Radiation, including tritium and airborne contamination

All personnel are to evacuate the buildings and assemble in the designated muster areas. The last person out of B15 is to close both airlock doors. All personnel are to follow the instructions of the Building Warden and/or emergency response personnel. The HIFAR Building Warden is to obtain the Record of Personnel Entering and Leaving B15 (NH60) from the B42 personal airlock foyer. All personnel are to remain mustered until directed otherwise by the PA system or emergency response personnel. And all evacuations are raised as an event in GRC and investigated.

Following an alarm ERT will reset the alarms in accordance with I-7293 Resetting B15 SCADA Alarms.

In the event of a fire where an alarm has not sounded where safe to do so, take any actions that may ameliorate the situation, such as extinguishing a small fire or removing flammable items from the vicinity of the fire. ASOC is called to manage the event and an event raised in GRC on conclusion of the event.

In the event of a D2O spill, and the tritium alarm does not sound where safe to do so, take any actions that may ameliorate the situation, such as place active extract trunking over spill area and clean up the spill. ASOC is called to manage the incident and a notification raised in GRC on conclusion of the incident.

When airborne contamination or high background radiation is detected, and alarms are not sounded personnel should immediately evacuate the building and ASOC called to manage the incident.

If a worker leaving the facility is found to be personally contaminated by the entry/exit contamination monitor ASOC must be immediately called to provide advice on how to proceed. Generally contaminated clothing is placed in plastic bags and emergency showers located near the personal air lock are for use if required to remove contamination. The effected worker should attend whole body monitor as soon as possible.

If the airlocks of the truck bay and personal airlock fail to operate, there is an instruction that describes how to manually open the doors.

7. Environmental Management Plan

7.1. Purpose and Scope

The purpose of this plan is to describe how the ANSTO Environmental Management System (EMS), and the associated ANSTO EMS Strategy FY18-19 make provision for the environmental aspects and potential impacts of the HIFAR. This plan summarises specific elements of relevant EMPs, with explanatory comments specific to HIFAR.

7.2. Objectives and Targets

Specific environmental objectives targets have been set to assist ANSTO attain its overall environmental objectives. For each environmental objective, one or more targets are defined to achieve the specified objective. The environmental objectives and targets relevant to HIFAR and ANSTO more broadly are summarised in the ANSTO EMS Strategy FY18-19. A key objective of the strategy includes reduction of waste and emissions to minimise ANSTO's environmental footprint. Pre-conditioning of waste in preparation for disposal to the NRWMF will be managed by WMS.

7.3. Environmental Aspects and Impacts

HIFAR uses the AME Local Environmental Coordinator. Their role is to monitor the potential environmental aspects and impacts. HIFAR's potential environmental impact is considered to be very small and primarily relates to some ongoing airborne discharges of tritium, small quantities of liquid effluent discharges, transport of materials between HIFAR and WMS, and non-radiological aspects of dismantling external structures.

In accordance with Environmental Aspects Identification and Evaluation (AP2068), the Environmental Aspects and Compliance Obligations Register is used to register ANSTO's environmental risks. Currently there is one environmental aspect identified as directly relating to HIFAR, however none of these are identified as significant environmental aspects (environmental aspect with a residual risk rating of medium or above). There are five ANSTO-wide significant environmental aspects indirectly related to HIFAR. These are shown in Table 2.

Table 2: ANSTO Environmental Aspects relevant to HIFAR

Ref	Activity Description	Significant Aspect	Division Area	Location
4	Non-radioactive landfill waste	Yes	ANSTO	LH Site
11	Use of Electricity	Yes	ANSTO	LH Site
12	Use of Water	Yes	ANSTO	LH Site
108	Offsite effluent pipeline breakage	Yes	WMS	Buffer Zone
149	Emission of tritium to the environment from HIFAR characterisation and decommissioning activities (air discharge through HIFAR ventilation system and liquid discharge to trade waste system)	No	HIFAR	B15
331	Drainage systems for buildings. Includes sewer, industrial trade waste (C-line), radioactive trade waste (B-line) and stormwater for all buildings on site	Yes	ANSTO	Whole of site

7.3.1. Airborne Emissions

The primary radioactive airborne emissions generated during decommissioning activities include tritium, tritiated water vapour and radioactive particulate. The HIFAR Reactor Containment Building's active ventilation system was designed to provide approximately one air change per hour. Air is circulated through HEPA air filters to remove airborne particulate matter before being discharged to the atmosphere via the stack. Airborne discharges from the HIFAR facility are monitored offline for radioactive gases, water vapour (tritium/triated vapour) and airborne particulate.

During decommissioning activities, it is expected that dust will be generated from cutting, decontamination and dismantling activities. The dusts and emissions that arise from decommissioning activities will be monitored by the Environmental Monitoring team who manage ANSTO's Stack Monitoring Program.

7.3.2. Solid Wastes

Decommissioning activities will predominantly produce solid waste. To reduce ANSTO's environmental footprint, non-radioactive solid waste will be re-used or recycled where possible. Radioactive solid waste materials which exceed the exempt levels will be stored on-site at ANSTO until the proposed NRWMF is available.

7.3.3. Liquid Effluent

During decommissioning activities, maintenance, chemical cleaning and other miscellaneous activities will generate liquid waste. Small quantities of liquid discharges may be generated during preliminary dismantling activities (e.g., from decontamination work). Such wastes may be active or inactive, aqueous or non-aqueous and may require further chemical or physical treatment prior to discharge or storage. Aqueous liquid wastes are discharged to the HIFAR North or HIFAR South pit tanks or collected by WMS if discharge to the effluent drains is inappropriate, such as for non-aqueous wastes.

Any discharge to the sewer will be in accordance with the current Trade Waste Agreement with Sydney Water. Further detail is given in the Waste Management Plan.

7.4. ANSTO Environmental Monitoring Program

The environmental monitoring program for the ANSTO site is undertaken by the Environmental Monitoring (EM) Group in accordance with AG-1304 Environmental monitoring program. The EM group routinely collect and analyse samples according to the Environmental Monitoring Sampling Schedule (G-3900). The Environmental Monitoring Program provides detail of the environmental sampling and measurement activities performed, the frequency, analysis type employed and along with the purpose or motive for the continuous monitoring activity. The Environmental Monitoring Program is broad in its coverage with radioactivity measurements being applied to a range of local environmental media, including:

- Nearby river water and groundwater,
- Surface water comprising of storm water runoff,
- Near-surface groundwater leaving the Lucas Heights Science and Technology Centre,
- Air,
- Sediments; and
- In the marine biota located near the ocean outlet of the Cronulla Waste Treatment Plant (WTP).

Cumulative annual effective dose from external radiation is monitored at the site perimeter fence, at the Cronulla water treatment plant and nearby residences using environmental TLDs.

7.5. Protection of Wildlife

International best practice has recognised protection of wildlife (non-human) biota as requiring separate consideration to protection of people, as laid out by the International Commission on Radiological Protection (ICRP), the International Atomic Energy Agency (IAEA), and, recently in Australia, by the ARPANSA Guide: Radiation Protection of the Environment .

As discharges from the HIFAR facility during Phase A decommissioning will be within existing agreements and limits, the exposure of wildlife has been evaluated using ANSTO's current entire discharge rates to air and water. Liquid wastes containing low levels of activity are managed as described in Section 7.3. These discharges are continuously monitored and must meet quality conditions set in the discharge authorisation. The results of sampling conducted by ANSTO's Environmental Monitoring Program (see section 7.4) indicate relatively low activity concentrations in environmental media, suggesting negligible potential effects on wildlife .

In 2008, ANSTO completed an evaluation titled Radioecological Risk Analysis of ANSTO's Monthly Effluent Releases 2006-07 (ANSTO-E-764). The study estimated biota doses of 8E-5 to 1.0E-2 µGy/hr for existing conditions (e.g. using measured dilution for ANSTO's liquid effluent entering the Cronulla Waste Treatment Plant, and measured discharge activity concentrations for a set of key radionuclides. ANSTO has evaluated the dose rates to a range of marine biota in the receiving environment at Potter Point, near Cronulla, NSW. These evaluations indicate ERICA Screening Risk Quotients of 0.2 or less below the 1.0 level - 1.0 or higher which requires further investigation. Dose rates were calculated using conservative (protective) parameters and were in all cases below the most conservative screening benchmark (10 µGy/hr), and thus far lower than the Environmental Reference Level of 400 µGy/hr level that would suggest impacts to populations (Table 1, ARPANSA RPS G-1).

Another study published by ANSTO titled 'Dose assessment for marine biota and humans from discharge of I-131 to the marine environment and uptake by algae in Sydney' was completed in 2011 (Veliscek Carolan, 2011) on radioactive iodine discharges. This report found that dose rates to biota near the Cronulla discharge location were well below the 10 µGy/hr benchmark. It was found that the portion of this dose derived from ANSTO discharges was less than 2% (most came from medical facility discharges).

A more recent screening evaluation was completed in 2017 by ANSTO titled, Screening Assessment of Dose Rates to Wildlife Related to the Nuclear Medicine Mo-99 Facility'(ANSTO-E-785). This study was based on projected conditions (e.g. using increased projected discharge activity concentrations (x1.5), and an expanded set of radionuclides. Dose rates were estimated using the ERICA Assessment Tool for sea anemones, mollusc, crustacean, polychaete worm, phytoplankton, macroalgae, and pelagic fish, and ranged from 9.2E-3 to 2.2E+0 µGy/hr.

These screening dose rates for projected conditions were higher than those for existing conditions due to the use of more conservative (protective) assumptions (e.g. using the most conservative (lowest) dilution allowed under a trade waste agreement within the sewage system, using a factor of x1.5 projected increased discharge activity concentrations, as well as assuming continuous presence of transitory species near (within 50m) the outfall at Potter Point, assuming no metal/radionuclide removal by the Cronulla sewage treatment plant, when, in fact, this tertiary treatment effectively removes many of the radionuclides.

However, as part of ongoing best practice, ANSTO has performed a screening evaluation of dose rates to wildlife via the air pathway, including exposure to noble gas isotopes. This evaluation indicated dose rates of less than 3E-04 µGy/hr when considering exposure to grasses, trees, annelids, arthropods, reptiles and mammals (ANSTO-E-785). The largest dose contributor was from xenon isotopes, followed by tritium. The evaluation used standard biota assessment tools ERICA assessment software system. Conservative assumptions were used such as employing maximum air concentrations from a one-year period and using the wind vector with the highest activity concentrations.

In summary, the screening evaluations of dose to wildlife considered the stack emission and liquid discharge pathways, used conservative (protective) assumptions, and indicate potential dose rates that are well below the lowest benchmark for potential effects. For the liquid discharge pathway, additional evaluations published in 2008 and 2011, also concluded that dose rates to exposed biota were well below benchmarks. It is expected that due to the low levels of stack emissions and liquid waste to be generated during Decommissioning activities that these will not contribute to overall levels.

Although dose rates are low, the presence of radionuclides in air and water discharges are routinely monitored by ANSTO through a well-managed environmental program which is periodically reviewed and evaluated for improvement. The results of sampling indicate relatively low activity concentrations in environmental media, suggesting negligible potential effects on wildlife.

8. References

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