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Australian Submarine Agency

ASA

PART 5:
RADIOACTIVE WASTE MANAGEMENT

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Contents

List of Acronyms

ALARA	as low as reasonably achievable
ANSTO	Australian Nuclear Science and Technology Organisation
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
ASA	Australian Submarine Agency
AUKUS	Australia / United Kingdom / United States
CIF	controlled industrial facility
CONOP	concept of operation
HEPA	high efficiency particulate air
HMAS	His Majesty's Australian Ship
HLW	high-level radioactive waste
HPS	health physics surveyor
IAEA	International Atomic Energy Agency
ILW	Intermediate-level radioactive waste
IMS	Information Management System
LLW	Low-level radioactive waste
NNPPI	Naval Nuclear Propulsion Protected Information
NPS	nuclear-powered submarine
QR code	Quick Response barcode
PFR	Potential Free Release
PPE	personal protective equipment
RFID tag	radiofrequency identification tag
RWMP	Radioactive Waste Management Plan
RLW	radiological liquid waste
SAR	Safety Analysis Report
SMP	Safety Management Plan
SRF-West	Submarine Rotational Force-West
WHS	Work Health and Safety
WAC	waste acceptance criteria
WOSR	Waste Operations Service Request
WMS	waste management services
GBq/tonne	Giga Becquerels per tonne

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Chapter 1: Submarine Rotational Force – West Radioactive Waste Management

Section 1 – Introduction

1.1 In 2021 Australia, the United Kingdom (UK) and the United States (US) announced AUKUS, a trilateral security partnership committed to supporting a stable, secure and prosperous Indo-Pacific region. The first major initiative of the AUKUS partnership is the delivery of a conventionally armed, nuclear-powered submarine capability for Australia. From 2027, Phase 1 of Australia's pathway to acquire a nuclear-powered submarine capability will see a rotational presence of one UK Astute class submarine and up to four US Virginia class submarines at the HMAS *Stirling* naval base, Western Australia (WA), under Submarine Rotational Force-West (SRF-West).

1.2 New and upgraded facilities and infrastructure are required at *Stirling* to achieve an initial level of capability for SRF-West from 2027, and to establish comprehensive nuclear stewardship by the early 2030s that will ensure the nuclear safety requirements are met as a priority. One of a suite of new buildings that will be constructed to support SRF-West is the proposed controlled industrial facility (CIF).

1.3 The CIF building will have three core functions:

- Waste collection and management of solid and liquid low-level radioactive waste arising from nuclear-powered submarine maintenance and operations;
- Repair and/or servicing of components, tooling and equipment from nuclear-powered submarines that may contain contamination or activated components; and
- Working accommodation for CIF operations personnel.

1.4 The purpose of this Radioactive Waste Management Plan (RWMP) is to outline the effective radiological waste management arrangements that will be in place within the Australian Submarine Agency (ASA), to assure that activities conducted for the purpose of a site preparation phase for the controlled industrial facility at *Stirling* are carried out safely and in compliance with regulatory requirements, in preparation for SRF-West. This Radioactive Waste Management Plan is in early stages of development, and will evolve to assist the ASA in meeting its' regulatory obligations by outlining plans and arrangements.

1.5 Based on assumptions and calculations around estimated activity and volumes, the ASA assumes the controlled industrial facility will be a 'prescribed radiation facility' as defined in the s 13(1)(d)(i) of the *Australian Radiation Protection and Nuclear Safety Act 1998*. The controlled industrial facility is not a nuclear installation. Most importantly, the design and all of the developed policies and procedures of the controlled industrial facility will meet the requirements of AS/NZS 2243.4 Safety in laboratories, Part 4: Ionizing radiations (2018).

1.6 This plan is to be read in conjunction with the other ASA nuclear and radiation protection plans and arrangements, including the Safety Analysis Report, the Safety

Management Plan, the Radiation Protection Plan, the Emergency Response Plan and the Environmental Protection Plan.

1.7 The ASA is preparing an operational low-level radioactive waste Concept of Operation that will support planning for and licencing of the controlled industrial facility at *Stirling,* which will store, characterise, and decontaminate solid waste arising from the operation of nuclear-powered submarines as well as store and filter the liquid waste from those submarines. This document sits alongside the suite of nuclear policy plans and arrangements and their supporting documentation, and references them as appropriate.

1.8 Radioactive waste is material that no longer has any foreseeable use and contains radioactive materials with activities or activity concentrations at levels that require ongoing management to ensure its safety. The Australian classification scheme for disposal of radioactive waste is based on the international scheme issued by the International Atomic Energy Agency (IAEA) in their Disposal of Radioactive Waste, SSR-5 (Supplementary Information 1). This considers the safety of disposal pathways, taking into account the radioactivity level of the waste and the time it will take for the radioactivity to decay (half-life). Australia's radioactive waste classification system and the intended pathway for storage and disposal of Commonwealth government waste is consistent with international best practice.[1]

1.9 This document adopts the broad definitions of radioactive waste described by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)[2].

1.10 The IAEA's waste management hierarchy (see Figure 1), is a key element in the implementation of sustainable management, sets the priority for managing waste, and underpins Australia's approach and practice[3]. The waste management hierarchy ranks strategies in order of preference from avoiding the creation of waste as the most desired outcome, and disposal as the least desired outcome. Australia will take this hierarchy into account for the site preparation and construction of the controlled industrial facility, its operations and eventual decommissioning to ensure the creation of waste is prevented and minimised.

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[1] Department of Industry, Science and Resources, *Australian Radioactive Waste Management Framework*. (see Supplementary Information 2)
[2] Australian Radiation Protection and Nuclear Safety Agency, Radioactive Waste: Classification & Management, web page as at 18 December 2023 reproduced at Supplementary Information 3.
[3] IAEA, Management of radioactive waste from decommissioning. (Supplementary Information 4)

Figure 1 IAEA Waste Hierarchy

1.11 The ASA will operate a waste diversion program where waste that:

a. may not need to be stored under regulatory control is treated as 'Potential Free Release' (PFR) waste and is assessed as to whether the waste can be released from regulatory control and disposed of at local landfill facilities.

b. Is currently radioactive but contains short-lived radionuclides is treated as 'Delay and Decay' waste and is assessed as to whether the waste can be released from regulatory control after a period of interim storage and disposed of at local landfill facilities.

Section 2 – Scope and assumptions

There will be no radioactive waste arising from the site preparation stage of the Submarine Rotational Force – West (SRF-West) CIF.

2.1 The ASA is accountable for the management and oversight of the introduction of a conventionally armed, nuclear-powered submarine capability to Australia, including the acquisition, delivery, construction, technical governance, sustainment and appropriate disposal. As effective stewards of naval nuclear propulsion technology, the ASA is committed to protecting our people, the public, and the environment from the harmful effects of radiation.

2.2 s33(a)(ii) [redacted]

2.3 The controlled industrial facility (CIF) is one of the core support facilities for nuclear-powered submarines and delivers:

a. *Waste management function:* the acceptance, categorisation, treatment, packaging, storage and disposal of low-level waste from submarine operations. This waste will originate from US and UK submarines operating under SRF-West arrangements, and then Australian-flagged vessels once sovereign nuclear-powered submarines are acquired.

b. *Radiological repair function:* the management of the acceptance, clearance, calibration, repair and return of submarine components.

c. *Facility upkeep function:* the repair, maintenance, storage and disposal or facility equipment.

d. *Facility operations function:* storage of equipment, workforce office space.

2.4 s33(a)(ii) and (iii) [redacted]

a. Personnel Protective Equipment (PPE) - all personnel handling radioactive materials are wearing appropriate PPE such as gloves, long sleeved cloths, overshoes etc. - in line with the relevant area requirements.

b. Dosimetry – All personnel handling radioactive materials are also wearing appropriate dosimetry, including both electronic (e.g. Electronic Personal Dosimeters (EPDs)) and/or passive dosimetry (e.g. Thermoluminescent dosimetry (TLDs) et al) - in line with the relevant area requirements.

c. Contamination checks on leaving areas – All personnel leaving radiologically controlled areas undertake personal contamination checks before leaving an area - in line with the relevant area requirements.

d. All personnel will be suitably qualified and experienced personnel to undertake the relevant task.

e. The duration and time between some tasks will vary, with some tasks occurring immediately after the preceding tasks and others taking place months, if not years after.

f. s33(a)(ii) and (iii) [redacted]

g. [redacted]

h. Procedures, instructions, and forms and/or other controlled documents will be created as a part of an integrated management system that will detail the systematic processes for undertaking the activities discussed throughout these documents.

i. Instructions will be provided for the operator to safely manage the relevant risks. These controls will have been identified and assessed through a formal risk assessment process.

j. Radiologically controlled areas will have appropriate PPE available for personnel entering, appropriate equipment available for personnel and items leaving (fixed walk-through monitors etc.) and appropriate equipment for detecting contamination on items/people present in the locations.

k. The CIF will be located on the *Stirling* site so that there is no requirement for waste to be transported on public roads, until cleared for disposal, and there is no need to have the transport/movement packages approved by the Regulator.

l. s33(a)(ii) and (iii) [redacted]

m. The CIF Characterisation Laboratory will require a liquid nitrogen supply for the gamma spectrometry equipment contained within.

n. Contamination checks will involve the taking of 'swabs' and counting of the swabs in fixed contamination counters wherever appropriate.

o. s33(a)(i), (ii) and (iii) [redacted]

2.5 Non-ionising radiation sources are not expected to be part of this facility, and therefore such matters are not addressed in this document.

Section 3 – Management of radioactive waste

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

3.1 This Radiological Waste Management Plan provides information relating to the:

a. management of solid and liquid low-level waste (LLW) during the routine operations of nuclear-powered submarines for waste that will be offloaded as a part of SRF-West operations at HMAS *Stirling*,

b. movement of waste from ship to shore,

c. assessment of waste compliance against the CIF Waste Acceptance Criteria and regulatory approvals to import radioactive material into Australia,

d. interim storage of this waste at the CIF,

e. decontamination of hard waste,

f. filtration/treatment of liquid waste,

g. characterisation of waste,

h. assessment and potential free release of exempt waste, and

i. detail responsible / accountable parties at each stage of the waste management activity.

3.2 This Radiological Waste Management Plan will <u>not</u> consider:

a. the management of waste relating to the end of life of a nuclear-powered submarine (i.e., high-level radioactive waste (HLW), spent fuel and/or reactor pressure vessels (RPV)),

s33(a)(i), (ii) and (iii)

b. [redacted]

c. [redacted]

d. [redacted]

3.3 The overarching goals of the ASA's radioactive waste management activities are to:

a. ensure radiation exposure to personnel, members of the public and the environment is as low as reasonably achievable (ALARA) once social and economic factors are taken into account.

b. ensure all activities are undertaken in accordance with the relevant regulatory requirements and international best practice, particularly practices of the US and UK partners.

c. implement the Waste Hierarchy (refer Figure 1).

d. ensure radioactive waste is characterised, documented, packaged, stored and recorded appropriately for disposal (so as to not become legacy waste).

e. minimise the amount of radioactive waste created while balancing the need to provide protection to personnel through the appropriate use of PPE.

f. ensure accurate, accessible and complete records of all waste activities are maintained for the lifetime of the AUKUS program.

3.4 ss33(a)(ii) and 47C [redacted]

3.5 s47C [redacted]

a. [redacted]

b. [redacted]

c. [redacted]

3.6 [redacted]

3.7 [redacted]

3.8 The ASA has recently undertaken a review to inform the decision-making process to identify locations in the current or future Defence Estate suitable for the storage and disposal of intermediate and high-level radioactive waste, including spent fuel, from Australia's nuclear-powered submarines. s47C [redacted]

3.9 The ASA gives an undertaking to provide further description of the above aspects for construction stage.

Properties of the waste

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

3.10 This document adopts the broad definitions of radioactive waste described by ARPANSA in Supplementary Information 3 – Radioactive Waste: classification and management.

3.11 Low-level waste will include short-lived radionuclides with high activity and limited amounts of long-lived radionuclides at relatively low activities. Low-level waste emits radiation at levels which generally require minimal shielding during handling, transport, and storage. This LLW will be suitable for engineered near surface disposal at the appropriate time. Low-level waste has a short lived (half-life less than 31 years) radioactivity concentrations less than 4GBq/tonne (alpha activity), 12 GBq/tonne (beta/gamma activity) and low levels of long lived isotopes (half-life greater than

31 years). s33(a)(ii) and (iii) [redacted]

s33(a)(ii) and (iii) [redacted]

s33(a)(iii) [redacted]

s33(a)(ii) [redacted]

3.16 The ASA gives an undertaking to provide the detailed description of the waste in its documentation for the construction stage of the CIF.

Minimisation arrangements

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

s33(a)(ii) and (iii) [redacted]

3.18 As waste activities on-board nuclear-powered submarines are outside the scope of this licence, no further comment on generation can be made.

3.19 Waste minimisation is a goal of the Radiological Waste Management Plan.

3.20 The regular tracking of activities against and review of estimates and other goals and objectives is very much part of the development of a nuclear mindset. Waste generation will be minimised, while balancing the need to provide protection to personnel through the appropriate use of PPE. It is more important to protect the health of personnel, the public and the environment and/or ensure equipment is operating properly than pursuing waste minimisation as the only goal. Understanding unintended consequences of goals and objectives prior to them becoming issues is preferred however being able to adjust goals and objectives that have not been set correctly is also important. More important however is having personnel who truly understand the importance of safety over other objectives is most important priority.

Collection

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

3.21 The scheduling of submarines rotating though *Stirling* for SRF-West is yet to be announced s33(a)(iii) [redacted]

3.22 The collection of waste from a nuclear-powered submarine and moved to the CIF at *Stirling* is similar in principle to the collection of waste at existing Australian radioactive waste producers that ASA has observed. Because there are strong similarities, a system, similar to the Waste Operations Service Request form and SAP record management system is planned to be implemented by the ASA to manage the collection of waste from the submarine to the CIF. The functional requirements of the system are still to be determined and agreed by stakeholders.

3.23 s33(a)(i) [redacted] High level vignettes of the waste collection processes for solid /mixed hazardous waste and small volume liquid waste and bulk liquid waste are being developed (contained within the Operational Low-Level Waste CONOP – under draft development).

3.24 Regular waste campaigns will be determined by the arrival of submarines. s33(a)(ii) [redacted]

3.25 s33(a)(ii) and (iii) [redacted]

a. [redacted]

b. The data from this form will be imported into the Radioactive Waste Database.

c. This information will be used to complete the ARPANSA/Customs Radioactive Material Import documentation/process[4]. ASNO clearance is not expected to be required as the waste will not contain nuclear material. In undertaking the import permit process the following is noted:

   i. s33(a)(iii)

   ii. The ASA will engage with ARPANSA to consider whether an annual permit for importation can be granted, given the well-defined and consistent nature of the LLW, with routine reporting occurring quarterly.

d. s33(a)(i), (ii) and (iii)

e.

f.

[4] Under the Customs (Prohibited Imports) Regulations 1956, a permit from ARPANSA is required for the import of radioactive substances.

s33(a)(i), (ii) and (iii)

g. [redacted]

h. [redacted]

i. [redacted]

3.26 Additional information relating to the proposed waste collection processes is as follows:

a. To assist with waste segregation, different coloured containers could be utilised for different waste streams/fingerprints/waste types such as soft vs hard waste, PFR waste and delay and decay waste vs more probable LLW.

b. s33(a)(ii) [redacted]

c. Electronic process to create labels/stickers with barcodes/Radio Frequency Identification (RFID) tag and data needed for operational safety. s33(a)(ii) and (iii) [redacted]

d. s33(a)(ii) [redacted]

e. [redacted]

f. [redacted]

g. Due to the waste arising from outside of Australia, the ARPANSA Radioactive Material Import Permit process will be employed to enable customs clearance of radioactive materials and for an item to be transferred to an Australian licence. This process is normally used for the planned import of radioactive sources and/or nuclear medicines with shipments planned far enough in advance to allow for the minimum five day ARPANSA processing period.

h. s33(a)(ii) and (iii)

i. s33(a)(i), (ii) and (iii)

j. s33(a)(ii) and (iii)

k. s33(a)(ii)

i.

l.

m.

n. s33(a)(ii) and (iii)

o. s33(a)(ii) [redacted]

p. [redacted]

q. [redacted]

r. [redacted]

s. [redacted]

Segregation, characterisation, treatment and conditioning

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

3.27 Initial characterisation of the waste will occur on-board the nuclear-powered submarines as a part of the radiological clearances by Health Physics Surveyors and operational measurements by technicians to inform their handling of the items. This will be reinforced by detailed analysis of treated samples by personnel onshore.

s33(a)(ii) [redacted]

s33(a)(ii) and (iii) [redacted]

3.29 This will enable the CIF to characterise the radiological, chemical properties/makeup of items that will be exposed to neutrons, including any impurities present.

3.30 s33(a)(ii) [redacted]

a.

b.

c.

d.

3.31 Further processing to reduce volume will be required, noting that a balance between volume reduction and operator safety s33(a)(ii) [redacted] Filled drums are packed onto pallets and stored in racking.

3.32 s47C [redacted]

3.33 Small quantities of mixed (hazardous) LLW will be stored in the facility, pending disposal. Mixed (hazardous) LLW is expected to be less than 5% of the total solid waste volume.

3.34 s33(a)(ii) [redacted]

3.35

3.36

3.37

3.38

[6] Nominal volume 205 litre Type-A round, open head, steel drums, removable lid with head gasket and clamp ring.

s33(a)(ii)

3.39 s33(a)(ii) and (iii)

3.40 The ASA gives an undertaking to provide further description of the above processes in its documentation for the construction stage of the CIF.

Storage and disposal

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

3.41 There will be no onsite disposal of LLW at *Stirling*.

3.42 s47C

3.43 Areas within the CIF that have been identified for the short-term temporary storage of items that are about to undergo a process such as characterisation or decontamination are referred to as buffer stores. These are likely to be areas within the CIF that have been delineated with markings on the ground and that are accessible via forklift and potentially via a building crane.

3.44 These buffer stores will be large enough to store an appropriate amount of waste that is about to be processed in the nearby plant. Given the small amount of waste that is likely to be present in the CIF it is likely that space for two pallets of waste will be sufficient for most, if not all, of these buffer areas.

3.45 s33(a)(ii)

3.46 The longer-term storage areas within the CIF for delay and decay waste, LLW storage and potentially for conditioned LLW storage, will involve racking similar to that utilised in Australian Nuclear Science and Technology Organisation's s33(a)(i) Given the small amount of waste that will be handled it is not likely that an automated or even a semi-automated racking system will be needed and that forklift access for the movement of palletised waste drums is all that will be required.

3.47 Waste segregated in the delay and decay area of the CIF will be stored with other waste that is likely to 'decay' to potentially free release levels at the same time which may not necessarily be waste that was created at the same time.

3.48 s33(a)(ii)

a. s33(a)(ii) [redacted]

b.

c.

d. The configuration of the stored waste will allow for routine auditing, inspection, testing and maintenance of the packages.

Safe handling of waste

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

3.49 s33(a)(ii) and (iii) [redacted]

3.50 Within the CIF there will be a suite of manual handling equipment available to include: forklift jacks, forklifts and a gantry crane for heavy / bulk items. This will also facilitate remote handling for items that may pose a contact dose hazard for operators. In such cases remote tools such as Cee Vee Reachers will also be part of the equipment inventory at the CIF.

3.51 Detailed operating procedures, equipment, instructions and associate training requirements are to be developed to support all waste management operations.

Assessment of waste control measures

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

3.52 The Safety Analysis Report for the CIF and associate hazard identification assessments are currently being conducted. The outcomes of these assessments will inform the further development of robust waste control measures. These measures will be informed by the ASA's Safety Management Plan and industry best practice, existing Defence policy as well as Commonwealth legislation and regulation. At this stage further analysis and policy development by the ASA is required in order to adequately address the waste control measures that will be employed and whether they are fault tolerant.

Fissile material

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

3.53 Fissile material will not be transferred from the nuclear-powered submarine to the CIF.

Compliance with statutory authorities and local regulations

There will be no radioactive waste arising from the site preparation stage of the SRF-W CIF.

3.54 At this preliminary stage, further analysis by the ASA is required in order to identify and assess nuclear-powered submarine program compliance.

3.55 We acknowledge the Commonwealth regulatory framework that guides the conduct of waste management operations may be impacted by the following:

a. *Australian Radiation Protection and Nuclear Safety Act 1998* (ARPANS Act)

b. *Australian Radiation Protection and Nuclear Safety Regulations 2018* (ARPANS Regulations)

c. *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (the EPBC Act)

d. *Work Health and Safety Act 2011* (WHS Act)

e. *Nuclear Non-Proliferation (Safeguards) Act* 1987

f. *National Radioactive Waste Management Act 2012* (the NRWM Act)

g. *Australian Naval Nuclear Power and Safety Bill 2023*.

3.56 It is unclear at this stage the extent, if any, that State and Local Government regulations will apply to the CIF. It may be that Defence voluntarily complies with appropriate State and Local regulations. s47C [redacted]

Section 4 – Limiting ionising radiation exposure

Exposure pathways

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

4.1 The Safety Analysis Report for the CIF and associate hazard identification assessments are currently being conducted. The outcomes of these assessments will inform the identification of credible exposure pathways for all radioactive waste.

4.2 The ASA gives an undertaking to provide further description of the above aspects in its documentation for the construction stage of the CIF.

Limiting of exposure

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

4.3 Non-ionising radiation sources are not expected to be part of this facility. Existing Defence non-ionising radiation policy will apply for non-ionising radiation sources in use through the site preparation phase of the CIF (Appendix B).

4.4 Refer to Part 4 – ASA Radiation Protection, Chapter 1: Submarine Rotational Force – West.

Monitoring and assessing discharges

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

4.5 During the site preparation phase there are no routes of discharge of radioactive material into the environment. During the site preparation phase of the CIF there are no exposure pathways to wildlife in their natural habitats.

4.6 Refer to Part 4 – ASA Radiation Protection, Chapter 1: Submarine Rotational Force – West.

Discharge compliance

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

4.7 During the site preparation phase there are no routes of discharge of radioactive material into the environment. During the site preparation phase of the CIF there are no exposure pathways to wildlife in their natural habitats.

4.8 Refer to Part 4 – ASA Radiation Protection, Chapter 1: Submarine Rotational Force – West.

Section 5 – Packaging and containment of radioactive waste

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

Controlled Industrial Facility

5.1 Areas within the controlled industrial facility (CIF) that have been identified for the short-term temporary storage of items that are about to undergo a process such as characterisation or decontamination are referred to as buffer stores. These are likely to be areas within the CIF that have been delineated with markings on the ground and that are accessible via forklift and potentially via a building crane.

5.2 These buffer stores will be large enough to store an appropriate amount of waste that is about to be processed in the nearby plant. Given the small amount of waste that is likely to be present in the CIF it is likely that space for two pallets of waste will be sufficient for most, if not all, of these buffer areas.

5.3 s33(a)(ii)

5.4 The longer-term storage areas within the CIF for delay and decay waste, LLW storage and potentially for conditioned LLW storage, will involve racking similar to that utilised in Australian Nuclear Science and Technology Organisation's s33(a)(i) Given the small amount of waste that will be handled it is not likely that an automated or even a semi-automated racking system will be needed and that forklift access for the movement of palletised waste drums is all that will be required.

5.5 Waste stored in the delay and decay facility will be stored with other waste that is likely to 'decay' to potentially free release levels at the same time which may not necessarily be waste that was created at the same time.

5.6 s33(a)(ii)

a.

b.

c.

Packages

5.7 A 'package' is made up of the container (i.e., an industry standard bag, bottle, Type A drum, etc.) and the contents. For the purposes of this document however, a reference to a 'package' should be interpreted as a reference to just a container, excluding its contents.

5.8 s33(a)(ii)

5.9

5.10 A regular inspection and maintenance program will be implemented. The ASA gives an undertaking to provide further description of this in its documentation for the construction stage of the CIF.

5.11 The labelling of waste containers, including their relabelling with updated information, is a key component of long-term waste management. The use of labels with QR codes, barcodes or RFID tags will be considered and is discussed further below.

5.12 The processes/systems/procedures the ASA uses to determine what containers to utilise for their waste will need to be developed in further detail. Consideration will be given to the creation of a "packaging approval" officer although this work could potentially be outsourced as well.

Labelling

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

5.13 The labelling of waste containers whether for storage or movement, while relatively straightforward, is easy to underestimate in its importance. Labels provide a manner for personnel, at a glance, to understand what they are working with, any related risks, and what types and levels of precautions/controls are needed to handle the material.

5.14 If a container is going to be utilised for the transport of waste on public roads/ waterways/in the air then the labels will meet the requirements of ARPANSA's Code for the Safe Transport of Radioactive Material (Supplementary Information 7).

5.15 If the container is not going to be used for transport, then the requirements in the Transport Code will be referenced as a solid starting point for determining what information should be included in the labels.

5.16 As with the choice of container, several issues will be considered in both the choice of label type and the type of information contained on the label. These include: whether the container will be utilised for transport or not, how long the label may need to be in place for, agreed units of measurement for volume, radiation etc. i.e., SI units, kilograms, litres, becquerels, counts per second, micro Sieverts per hour etc. whether RFID tags, barcodes, QR codes/2D barcodes will be included in the label, access to label printers, the need for labels to be radiation resistant and also hard wearing, where labels are to be placed on a container and if multiple labels will be used i.e. on a side and the top of a container etc.

5.17 The use of label printers is preferred as this will ensure standardised label formats and content is included on all labels. Having access to alternative labelling equipment, such as a permanent marker and standardised templates in case a label printer is not operational, is also recommended.

5.18 The creation of label templates will be managed in a consistent manner with templates to be pre-approved in accordance with a relevant procedure. Due to the relatively small number of waste types that will be produced from nuclear-powered submarine, it is intended that a software package be utilised with pre-approved choices from drop down menus available to the operators preparing the labels and that the system is connected to the radioactive waste database for ease of use.

5.19 The ASA gives an undertaking to provide further description of the above aspects in its documentation for the construction stage of the CIF.

Recording dose rate measurements

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

5.20 Refer to Part 4 – ASA Radiation Protection, Chapter 1: Submarine Rotational Force – West.

5.21 Individual doses and combination of doses received as part of operations of the CIF will be limited to the doses described in the IAEA's Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (Supplementary Information 8), the International Commission on Radiation Protection's 2007 Recommendations of the International Commission on Radiological Protection (Supplementary Information 9), and the ARPANS Regulations.

5.22 Appropriate dose constraints for activities and tasking's will be developed by radiological controls engineers for radiological work prior to the operating stage of the CIF. These dose constraints will be based on an ALARA assessment of the work required, the options for radiation protection and their reasonableness, economic and societal aspects taken into consideration. Doses will be monitored against the dose constraints to improve the system of radiation protection.

5.23 The ASA gives an undertaking to provide further description of the above aspects in its documentation for the construction stage of the CIF.

Containment systems

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

5.24 The ASA will design and implement containment systems and spill response plans for liquid waste processing and will address air quality control and ventilation systems to mitigate airborne contamination risks. This will include the development of procedures for environmental monitoring and reporting, especially in sensitive marine environments. The ASA gives an undertaking to provide further description of this its documentation for the construction stage of the CIF.

5.25 Containers holding a liquid are to be marked as such and must be kept in a bund. Protection of the environment in regards to spills will require design features that allow for the collection of contaminated liquids and their management through pumps and decay tanks. This will be a core design requirement for the CIF.

5.26 Noting the above, the likelihood of groundwater contamination at *Stirling* from activities relating to the CIF is likely to be low. The facility will be designed in such a way as to minimise, if not mitigate entirely, the risk of spills reaching the groundwater.

5.27 The location of fire control systems – especially sprinklers is to be considered. There is a need to install bunding of areas where sprinklers may operate.

5.28 Most waste brought onshore will be in a solid form. Bulk liquid waste will require careful management with bunding arrangements – special care will need to be taken when offloading liquid waste from a submarine to the shore.

Section 6 – Storage of radioactive waste

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

6.1 The interim storage of waste onshore at the controlled industrial facility (CIF) is likely to be undertaken in a racking system using palletised containers for ease of movement/storage. It is intended that appropriate 205L Type-A metallic drums, are used at the CIF for the storage of waste from the nuclear-powered submarine. The ASA will be able to make use of the existing procurement arrangements that Defence already have in place. The use of these drums is in line with industry standards and will support the utilisation of already available characterisation and conditioning techniques such as a SGS Gamma Spectrometer and super compactor, similar to those in use at Lucas Heights.

Shielding and Ventilation

6.2 Due to the radiological hazards presented by radioactive wastes, some engineering controls will be necessary at the CIF to protect our people, the public and the environment. Additionally, active particulate monitoring will be included. This will enable CIF personnel to identify if there has been a release or breach of a container.

6.3 s33(a)(ii) [redacted]

6.4 [redacted]

6.5 [redacted]

6.6 [redacted]

6.7 Active ventilation systems, including high efficiency particulate air (HEPA) filters, charcoal filters, and negative pressure areas etc. are not likely to be required across the waste storage areas of the CIF, however this will require further analysis to confirmed the requirement.

6.8 Active ventilation systems, including HEPA filters, charcoal filters, and negative pressure areas etc. are likely to be required in the decontamination areas of the CIF with the extent of the measures to be determined via risk assessment and further analysis.

Inspection, maintenance and monitoring

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

6.9 The ASA will plan for the CIF's Integrated Management System (IMS) to be certifiable against standards including, but not necessarily limited to, ISO-9001 (Quality Management), ISO-14001 (Environment Management) and ISO-45001 (Safety Management).

6.10 The maintenance of the plant and equipment at the CIF will need to be planned and managed in a structured manner by suitably qualified and experienced personnel with the outcomes of maintenance activities recorded in an appropriate system. The ASA will implement an information management system, and will assess the SAP maintenance system that Australian Nuclear Science and Technology Organisation (ANSTO) currently operate and leverage off existing Defence maintenance systems.

6.11 The ASA will maintain records as a part of the routine inspection program and will allocate sufficient monetary and human resources for this work across the life of the program.

6.12 The regular (annual) calibration of radiation monitoring instruments will occur. It is unlikely that the ASA will be able to undertake these calibrations at the CIF and that the instruments will therefore need to be removed from service and sent to an external facility, such as the one operated by ANSTO for internal and external customers at Lucas Heights, for calibration. Due to the time required for calibration and transport of the instruments to and from the calibration facility, the ASA will either need to maintain spares of the relevant instruments or shutdown certain parts of the CIF while instruments are removed.

6.13 The ASA will stagger the calibration of instruments through the year so that not all instruments are unavailable at the same point in time.

6.14 Certain items of plant and equipment within the facility, such as cranes, may be identified as being safety critical during the safety assessments required for the licencing of the facility. The maintenance of these items will be of critical importance to the ongoing safety and licencing of the facility.

6.15 The priority will be to maintain plant and equipment under a planned maintenance regime, items of plant may require 'breakdown' maintenance due to unforeseen events.

6.16 The ASA gives an undertaking to provide further description of the above aspects in its documentation for the construction stage of the CIF.

Monitoring

6.17 Waste within the CIF will need to be both visually and radiologically monitored.

6.18 Visual inspections will occur on a regular basis, with care taken to inspect drums on the back of pallets as well as those on the front. The bottom of drums will also need to be inspected which will require the temporary removal of drums from their pallets. The frequency of this work needs to be balanced against the radiation dose received by personnel undertaking the work. It is likely that no more than an annual visual inspection will be required.

6.19 Remote visual monitoring will also be available. This is especially useful if there has been an (unlikely) event such as an earthquake/storm which has resulted in damage to the building and potentially to the waste storage containers.

6.20 Radiological monitoring in the form of personal dosimetry worn by operators and area dose rate meters will be utilised. Due to it being unlikely that airborne contamination will be present in the stores it is not likely that contamination monitoring will be required however this will be verified via risk assessment and further analysis.

6.21 In addition to dose rate monitoring, airborne contamination monitoring will be utilised in the decontamination facility within the CIF as there is a higher risk of contamination within this part of the facility. The decontamination facility will also require personnel and equipment contamination monitoring for personnel and equipment leaving that area.

6.22 The ASA gives an undertaking to provide further description of the above aspects in its documentation for the construction stage of the CIF.

Internal Transfer within the CIF

6.23 s33(a)(ii) [redacted]

a. [redacted]

b. [redacted]

c. [redacted]

d. [redacted]

e. [redacted]

6.24 The ASA gives an undertaking to provide further description of the above aspects in its documentation for the construction stage of the CIF.

Fissile material criticality safety

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

6.25 No fissile material will be stored at the CIF.

Section 7 – Documentation of radioactive waste

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

7.1 The Waste Operations Service Request (WOSR) that is to be developed by the ASA will be used to:

a. Provide nuclear-powered submarine personnel with information they need to ensure waste is presented to the CIF in compliance with the CIF waste acceptance criteria. Including verifying that no nuclear material is to be transferred to the CIF (for non-proliferation considerations) s33(a)(iii)

b. s33(a)(ii) and (iii)

c.

d.

e. Ensure processes relating to the movement of material from a radiologically controlled area to somewhere else are implemented.

f. Provide information to personnel at the CIF for the operational management of the waste, including any internal ASA reporting requirements.

g. Provide information to the ASA that will be utilised to determine the long-term management of the waste, including its disposal pathway.

h. Provide information for the ASA to support radioactive material import permit applications.

i. Provide information for the ASA to support routine reporting to regulators on waste production.

7.2 The types of data that is proposed to be included in the WOSR will include the following:

s33(a)(ii) and (iii)

s33(a)(ii) and (iii)

[redacted]

7.3 ASA gives an undertaking to provide further description of the above aspects in its documentation for the construction stage of the CIF.

Records handling

7.4 The management of records relating to radioactive waste is important for several reasons. This includes practical reasons such as being able to provide information on waste items inside sealed containers without needing to open the container and/or expose personnel to radiation hazards, assessment of compliance of a waste item against CIF waste acceptance criteria and against future criteria for offsite storage or disposal facilities, regulatory requirements, and potential requirements from the National Archives Act.

7.5 The ASA will be able to build on the examples provided by ANSTO through its use of the SAP software system to manage records relating to radioactive waste.

7.6 It is intended that the records system used by the ASA for radioactive waste will involve both digital (soft) and paper (hard) copy records.

7.7 Consideration will be given to what file format is used to store the digital records as well as where the data is stored and backed up to. Due to the need to manage radioactive waste over extended periods (potentially hundreds of years) it is important that the formats used for digital records are non-proprietary and accessible via commonly used software applications such as PDF files. This may require information stored in a database to also be 'transferred' regularly into more commonly used file formats.

7.8 The use of hard copies of records will also be considered. When stored properly, paper is a very resilient records storage medium. Consideration will need to be given to adequate storage capacity in appropriately environmentally controlled and vermin proof records storage areas – i.e., compactus in an airtight, air-conditioned room at the CIF.

7.9 The creation and update to records in a proposed radioactive waste database has been identified as a functional requirement by the ASA. The ASA will develop processes to control who can create new entries in, access, update, delete, or otherwise change the information in the database and will consider access control measures such as passwords and biometric identification etc.

7.10 The ASA gives an undertaking to provide further description of the above aspects in its documentation for the construction stage of the CIF.

Documentation compliance for any local government, State or Territory approvals

7.11 It is unclear at this stage the extent, if any, that State and Local Government regulations will apply to the CIF. It may be that Defence voluntarily complies with appropriate State and Local regulations.

7.12 Refer to Part 4 – ASA Radiation Protection, Chapter 1: Submarine Rotational Force – West.

7.13 Refer to Part 7 – ASA Emergency Management, Chapter 1: Submarine Rotational Force – West.

7.14 Refer to Part 8 – ASA Environment Protection, Chapter 1: Submarine Rotational Force – West.

Section 8 – Routine discharge of radioactive waste to the sewer

There will be no radioactive waste arising from the site preparation stage of the SRF-West CIF.

8.1 Refer to Part 4 – ASA Radiation Protection, Chapter 1: Submarine Rotational Force – West.

8.2 s33(a)(ii) and (iii)

8.3 Treated liquid may be s33(a)(ii) and (iii) or disposed of if no longer required. This might be via evaporation or discharge via a storm water/sewerage/trade waste connection.

8.4 Discharges will be measured and managed within agreed regulatory limits.

8.5 A first-step will be to consult with Environmental Protection Agency (EPA) Western Australia to determine their requirements.

Section 9 – Routine discharge of radioactive waste to the atmosphere

9.1 The ASA will be required to monitor radioactive discharges to the air in, around and above the CIF. This includes:

a. Stack monitoring – this will include both live measurements and weekly records of relevant radionuclides s33(a)(ii) and (iii)

b. Monitoring inside of the CIF - this will include both live measurements and weekly records of relevant radionuclides s33(a)(ii) and (iii).

c. Monitoring outside of the CIF - this will include both live measurements and weekly records of relevant radionuclides s33(a)(ii) and (iii)

9.2 The ASA will build processes based on existing ANSTO procedures for stack monitoring and site environmental monitoring for gaseous and liquid discharges.

9.3 The ASA gives an undertaking to provide further description of the above aspects in its documentation for the construction stage of the CIF.

Section 10 – Ultimate disposal or transfer of radioactive waste

Expected Life of Facility

10.1 Operations at HMAS Stirling are expected to continue for the life of the AUKUS program. The initial infrastructure to support this program is expected to have an operational lifetime of approximately 40 to 50 years. Prior to decommissioning the CIF replacement facilities will be established, licenced and enter into routine operations.

10.2 As individual pieces of plant and equipment will not have a 50-year lifetime the CIF will be designed in such a way as to allow for the easy maintenance and/or replacement of these items during operations and decommissioning activities. This will include systems such as the electrical power supply, communications and ventilation etc.

10.3 The ASA will develop a Decommissioning Plan, so that decommissioning does not become an unfunded liability for future generations.

10.4 The CIF will be operated in such a way as to minimise the production of secondary waste as much as is practicable however there will be secondary wastes produced from the decontamination facilities and ventilation systems.

10.5 This estimated lifetime is based on the design life of similar planned facilities, such as preliminary plans for Australian Radioactive Waste Agency's National Radioactive Waste Management Facility (NRWMF), however the ASA will take into account local climatic issues such as high salt content in the air causing corrosion etc.

10.6 It is anticipated that both active and passive institutional controls, such as security access restrictions, inspections and maintenance provisions, and environmental monitoring activities, would continue for a period of time post closure.

10.7 Any further activates will be determined by a post-closure safety case and performance assessment that will be prepared and kept updated.

10.8 Prior to an application to the nuclear safety regulator for releasing the facility of regulatory control, the facility operator will demonstrate that radiological and other hazards and risks to people and the environment are reduced, consistent with the requirements of the ARPANS Act.

Contamination Prevention

10.9 A combination of active and passive control arrangements will be used following the decommissioning to ensure limits are maintained within acceptable regulatory levels.

10.10 To assist with ease of decommissioning and related decontamination activities, several items are to be implemented:

a. Ground surfaces are to be coated with epoxy paints to enable decontamination if required.

b. Ventilation filters are to be easy to access for maintenance/replacement.

c. Ventilation fans are to be easy to access for maintenance/replacement.

d. The location of fire control systems – especially sprinklers is to be considered. There is a need to consider bundling of areas where sprinklers may operate.

e. Contamination can only be spread if it is present in the first place. To reduce the likelihood of spreading contamination items may be covered in plastic. This includes items that may be contaminated and supporting work areas/plant and equipment

Disposal Pathway

10.11 The ASA will develop a Decommissioning Plan as a part of the licencing of the facility. This will include a plan to dispose of contaminated equipment and infrastructure – noting that the CIF will be operated in such a way as to minimise contamination of infrastructure.

10.12 The decontamination facility and liquid waste tanks are the most likely items of plant to be contaminated. The waste storage facilities are highly unlikely to be contaminated.

Records

10.13 A robust records management system will support the decommissioning of the CIF in due course.

10.14 This will include the recording of any radiological events at the CIF, especially those involving contamination of plant, equipment, and infrastructure.

10.15 The management of records is important for several reasons. This includes practical reasons such as being able to provide information on waste items inside sealed containers without needing to open the container and/or expose personnel to radiation hazards, assessment of compliance of a waste item against a future waste acceptance criteria for a storage or disposal facility, regulatory requirements, and potential requirements from the National Archives Act as well.

10.16 Digital copies of records will be required, and consideration will need to be given to what file format is used to store the data as well as where the data is stored and backed up to.

10.17 Hard copies of records will also be considered. Paper is a very resilient records storage medium, when stored properly. Consideration will need to be given to adequate storage capacity in appropriately environmentally controlled and vermin proof records storage areas – i.e., compactus.

Section 11 – Appendices

A. Draft Operational Low-Level Waste Management Concept of Operations (SRF-West) (Obj Ref: s22)

B. Department of Defence, Defence Radiation Safety Manual. (Obj Ref:s22)

Section 12 – Supplementary Information

1. International Atomic Energy Agency, Disposal of Radioactive Waste, Specific Safety Standards Series No. SSR-5.
(Obj Ref: s22)

2. Department of Industry, Science and Resources, *Australian Radioactive Waste Management Framework*, April 2018.
(Obj Ref: s22)

3. Australian Radiation Protection and Nuclear Safety Agency, Radioactive waste: classification and management in Australia, reproduced from web page accessed 18 December 2023.
(Obj Ref: s22)

4. International Atomic Energy Agency, Management of radioactive waste from decommissioning.
(Obj Ref: s22)

5. Waste Facility Footprint Calculations
(Obj Ref: s22), copy of Obj Ref: s22

6. draft CIF Waste calculations
(Obj Ref: s22), copy of Obj Ref: s22

7. Australian Radiation Protection and Nuclear Safety Agency, Code for the Safe Transport of Radioactive Material, Radiation Protection Series C-2.
(Obj Ref: s22)

8. International Atomic Energy Agency, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirements (GSR) Part 3.
(Obj Ref: s22)

9. International Commission on Radiation Protection, *The 2007 Recommendations of the International Commission on Radiological Protection*, ICRP Publication 103.
(Obj Ref: s22)

Section 13 – References consulted

International Atomic Energy Agency, *Predisposal Management of Radioactive Waste*, Vienna, Austria, 2009.
(*Obj Ref:* s22)

International Atomic Energy Agency, *Safety Standards Disposal of Radioactive Waste*, Vienna, 2011.
(*Obj Ref:* s22)

International Atomic Energy Agency, *Leadership, Management and Culture for Safety in Radioactive Waste Management,* Vienna, 2022.
(*Obj Ref:* s22

International Commission on Radiation Protection, *Occupational Intakes of Radionuclides: Part 1*, Stockholm, Sweden, 2016.
(*Obj Ref:* s22)

International Atomic Energy Agency, *Management of radioactive waste from decommissioning*, Vienna.
(*Obj Ref:* s22)

Australian Government
Australian Submarine Agency

ASA

PART 8:
ENVIRONMENT PROTECTION

Version 1.0

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Document Control

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0.3	13 Mar 24	s22	Technical Review completed and edits made	s22 s22	Dr Kath Smith s22	
1.0	15 Mar 24	s22	First version released			

Contents

List of Acronyms

ADF	Australian Defence Force
ALARA	as low as reasonably achievable
ANP	Australian Naval Publication
ANSTO	Australian Nuclear Science and Technology Organisation
APS	Australian Public Service
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
ASA	Australian Submarine Agency
AUKUS	Australia / United Kingdom / United States
CIF	controlled industrial facility
CN	Chief of Navy
CR	concentration ratio
CSMC	Cockburn Sound Management Council
DCC	dose conversion coefficient
DCCEEW	Department of Climate Change, Energy, the Environment and Water
EMP	Environmental Management Plan
EMS	Environmental Management System
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPR	Emergency Preparedness and Response
EQC	environmental quality criteria
EQG	environmental quality guidelines
EQS	environmental quality standards
ERL	environmental reference level
FBW	Fleet Base West
DCRL	derived consideration reference level

HMAS	His Majesty's Australian Ship
HNE	Head Navy Engineering
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
LLW	low-level waste
NLP	Navy Lessons Program
NPS	nuclear-powered submarine
NSS	Nuclear Safety Suite
NSSSC/NS3C	Nuclear Safety, Security and Safeguards Committee
PPE	personal protective equipment
RAN	Royal Australian Navy
RAPs	reference animals and plants
SAR	Safety Analysis Report
SEG	Security and Estate Group (Defence)
SMS	Safety Management System
SRF-West	Submarine Rotational Force-West
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
VLLW	very low-level waste
WA	Western Australia
WMP	Waste Management Plan

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Chapter 1: Submarine Rotational Force – West Environment Protection

Section 1 – Introduction

1.1 In 2021 Australia, the United Kingdom (UK) and the United States (US) announced AUKUS, a trilateral security partnership committed to supporting a stable, secure and prosperous Indo-Pacific region. The first major initiative of the AUKUS partnership is the delivery of a conventionally armed, nuclear-powered submarine capability for Australia. From 2027, Phase 1 of Australia's pathway to acquire a nuclear-powered submarine capability will see a rotational presence of one UK Astute class submarine and up to four US Virginia class submarines at the HMAS *Stirling* naval base, Western Australia (WA), under Submarine Rotational Force-West (SRF-West).

1.2 New and upgraded facilities and infrastructure are required at *Stirling* to achieve an initial level of capability for SRF-West from 2027, and to establish comprehensive nuclear stewardship by the early 2030s that will ensure the nuclear safety requirements are met as a priority. One of a suite of new buildings that will be constructed to support SRF-West is the proposed controlled industrial facility (CIF).

1.3 The CIF building will have three core functions:

- Waste collection and management of solid and liquid low-level radioactive waste arising from nuclear-powered submarine maintenance and operations;
- Repair and/or servicing of components, tooling and equipment from nuclear-powered submarines that may contain contamination or activated components; and
- Working accommodation for CIF operations personnel.

1.4 This document sets out details of how the Australian Submarine Agency (ASA), as or in alignment with the designated licence holder, will manage the safety and security of facilities and radiological sources with specific regard to the protection of the environment. As per the *Fundamentals for Protection Against Ionising Radiation* (RPS F-1; ARPANSA, 2014), environmental exposures and the need for their management are described as "…*the exposure of wildlife to all additional radiation sources resulting from human activities. Wildlife may require protection in order to maintain biological diversity, conservation of species, or the health and status of natural habitats, communities or ecosystems, or anything that may be otherwise required from a conservation point of view in accordance with relevant legislation.*"

1.5 This Environment Protection Plan has been prepared to support the planning for and licencing of the CIF, and to assist the ASA in adhering to best practice for the management of radioactive materials as required to protect the environment, in alignment with complementary arrangements to protect personnel and the public.

1.6 The Concept of Operations (Appendix A) premise is that the CIF will facilitate the management of radioactive waste. Broader matters associated with environmental management, such as energy use, water conservation, non-radioactive waste management and similar for the CIF are managed as a component of the over-arching environmental management policies and procedures for *Stirling*, which are explained in Section 4.

1.7 As per the *Australian Radiation Protection and Nuclear Safety Act 1998* (the ARPANS Act) and *Australian Radiation Protection and Nuclear Safety Regulations 2018* (the ARPANS Regulations), the ASA will develop and follow its own plans and arrangements, as approved by the applicable regulators, to manage protection of the environment. This requirement is consistent with Principle 1 of the International Atomic Energy Agency's (IAEA) Fundamental Safety Principles SF-1 (IAEA 2006) which states that "the prime responsibility for safety is with the person or organisation responsible for facilities and activities that give rise to radiation risks".

1.8 The ASA has drawn on best practice to prepare this Environment Protection Plan, which is based on sections 46 & 47 of the ARPANS Regulations (ARPANSA, 2018).

1.9 This Environment Protection Plan will be updated to reflect details of radioactive waste types and quantities, and associated waste management, collection and processing arrangements are as they are finalised. s33(a)(ii) [redacted] As this baseline information becomes available, the Environment Protection Plan will be further developed, refined and matured in an iterative process with its partner plans, ensuring environmental protection factors are appropriately taken into account in the development of procedures and controls for the CIF.

1.10 This Environment Protection Plan is to be read in conjunction with the other ASA nuclear and radiation protection plans and arrangements, including their supporting documents, specifically, the Safety Analysis Report in Appendix A of Part 1 – ASA Nuclear Facilities, Part 3 – ASA Safety Management, Part 4 – ASA Radiation Protection, and Part 7 – ASA Emergency Management.

Section 2 – Scope and assumptions

2.1 This Environment Protection Plan (in its current developmental form) details analysis of potential exposure pathways, their possible consequences and subsequent management controls as necessary for the protection of the environment. These pathways may arise from the receipt, processing and interim storage of the specified radioactive waste materials from nuclear-powered submarines in HMAS *Stirling*. This spans the following:

- The offload and collection of solid radioactive wastes (very low-level wastes and low-level wastes) and liquid low-level radioactive wastes arising from the routine maintenance of nuclear-powered submarines as a part of Submarine Rotational Force-West (SRF-West) operations;
- The interim storage of this waste in the controlled industrial facility (CIF);
- The decontamination of hard waste in the CIF;
- The filtration/treatment of liquid waste in the CIF;
- The assessment and potential free release of exempt waste from the CIF; and
- s33(a)(ii) and (iii)

2.2 This Environment Protection Plan does <u>not</u> consider the management of waste relating to the end-of-life of a nuclear-powered submarine (i.e. high-level waste, spent fuel and/or reactor vessels) s33(a)(ii)

2.3 This Environment Protection Plan has been prepared under the assumption that very low-level waste and low-level waste from UK and US nuclear-powered submarines will be managed at the CIF in *Stirling* earlier than waste from Australian nuclear-powered submarines.

2.4 The experience to be gained from handling waste from the SRF-West UK and US boats will be used to implement and refine these practices in preparation for Australian nuclear-powered submarines in the longer term.

2.5 There are a number of number of assumptions that underpin this plan, including:

- The CIF will be a new freestanding building and will present no nuclear or radiological safety or management implications until it becomes operational (subject to subsequent licensing). Therefore, environmental management during site preparation and development will be limited to conventional environmental management hazards, controls and regulations involved in construction. Statements of intent have been included where work has begun on incorporation and development of nuclear safety and radiological protection principles with respect to the environment, within already existing systems; and

- This plan applies to all activities associated with the site preparation phase of the CIF. This plan does not describe in detail the environmental management procedures for the subsequent construction and future operation of the CIF, but nevertheless outlines the ASA's intended objectives for environmental management and the forecast means of realising them, subject to further formulation, approval and implementation.

Section 3 – Protection of wildlife

3.1 The ASA will adhere to three parallel objectives for the management of radiological exposures, namely the protection of people (workers), the public and the environment. The ASA will protect all three groups and limit their exposure to below regulatory limits, and keep risk as low as reasonably achievable (ALARA).

3.2 Measures to protect people and the public are detailed in the Radiation Protection Plan, the Emergency Response Plan and the Safety Management Plan. This Environment Protection Plan will work in conjunction with those other plans for protection of the environment.

3.3 The development and strict application of the techniques, processes, procedures, controls and oversight necessary to protect people will also have parallel benefit in limiting exposure to wildlife and the environment. Measures for the protection of the environment will be further tailored to ensure that chronic, low-level releases and cumulative exposures and their pathways, which may not otherwise occasion harm to the people and public, but which may otherwise be harmful to the environment, will be recognised and effectively managed.

3.4 The ASA will ensure the maintenance of robust wildlife populations. To do this, the ASA will ensure that there are no activities of regulatory concern at the controlled industrial facility (CIF) and associated areas arising from radiation exposures in relation to:

- Maintenance of biological diversity;
- Conservation of species; and
- Health of natural ecosystems.

3.5 Four endpoints (which sometimes overlap) are generally considered to capture the ways in which a population of biota may be affected by radiation. These are:

- Mortality (leading to changes in age distribution, death rate and population density);
- Morbidity (reducing 'fitness' of individuals, making it more difficult for them to survive and reproduce);
- Reproduction (by either reduced fertility or fecundity); and/or
- Cytogenetic alteration (by the induction of chromosomal damage).

3.6 It is recognised that some biota have been specifically identified in legislation and other instruments aimed at protecting species that are considered vulnerable, valuable or otherwise important. As the CIF will be a Commonwealth activity on Commonwealth land, the primary reference for such in relation to protected biota is the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

3.7 One particular species afforded protection by the EPBC Act, present at Garden Island is the little penguin (*Eudyptula minor*). This bird, which is both charismatic and iconic, in parallel with being a 'listed marine species' under the auspices of the EPBC Act, inhabits areas close to the CIF. Protection of little penguins, as well as other terrestrial and marine life around Garden Island, is inherent to this Environment Protection Plan.

3.8 It is recognised that wildlife populations may fluctuate considerably for natural reasons, such as drought, availability of food/nutrients, presence of predators and parasites, and disease; often in a cyclic fashion. While the impact of radiation from the CIF and associated activities, if any, may be a very minor contributor to such population changes, it is plausible that any such effects derived from radiation exposures may aggravate population effects due to other factors if the population is already under stress due to these other influences.

3.9 While protection of the environment will be a key focus, it is not suggested that there will be zero radiation dose to flora and fauna. It is the objective to achieve an effective level of protection in the circumstances of planned exposure situations and emergency exposure situations, such as in the event of fire or flooding of the CIF.

3.10 The ASA approach to radiation protection of the environment is conservative by design, based upon a tiered exposure modelling assessment. For planned exposure situations, the ASA will work to achieve radiation exposures to wildlife that do not exceed relevant environmental reference levels (ERLs). This precautionary approach reflects the scarcity of data regarding the transfer of radionuclides to wildlife and the associated biological effects caused by exposure to radiation.

3.11 Exposures above ERLs will not necessarily imply significant effects on the environment, or that the exposure is of regulatory concern. Any such finding of exposure above ERLs will trigger the need for further work to refine the assessment of exposure, dose and/or impact. It can be expected in many cases that, simply by using realistic scenarios and input modelling assumptions and parameter values, a refined assessment will be able to demonstrate that the environment is being satisfactorily protected.

3.12 If a refined assessment identifies incremental dose rates above the ERLs, then the ASA, in consultation with ARPANSA and any other applicable regulator, will determine whether additional considerations (e.g. an assessment of the probability, magnitude and distribution of radiation exposures and possible deleterious effects) or practical mitigation measures (such as improved control of the source) might be required. An optimisation process would be undertaken, cognisant that ERLs are reference points guiding optimisation, not limits.

3.13 For the purpose of environmental impact assessment, the relative risks of radiation exposure and other pollutants or disturbances (including those arising from earthmoving, land clearing, diversion of surface runoff, chemicals usage, light spill, etc.) have been or will be characterised and compared. The ASA will observe all Commonwealth environment protection obligations, including matters relating to the build and operation of the CIF in accordance with the EPBC Act.

3.14 Consistent with accepted international best practice, the ASA will observe the principle of ‘optimisation’ for protection of the environment (IAEA 2006), this being one of the tenets of radiation protection. In this paradigm, the likelihood of incurring radiation exposures, the number of organisms exposed and the magnitude of individual doses should be kept as low as reasonably achievable (ALARA).

3.15 The ALARA principle is founded on data that shows that potential adverse effects from radiation exposure follow a linear no-threshold model (LNT). In the LNT model the risk of exposure is linearly proportional to the dose, implying that every increment of radiation dose, no matter how small, constitutes an increased risk. The cost of providing radiological protections increases as doses are driven to zero. The ALARA objective seeks to achieve a balance, where doses are minimised to a point such that any further protections would be unreasonable or prohibitive from a societal or economic perspective (i.e. the costs of further protection would outweigh the benefit). Societal and economic costs can include factors such as time, financial cost, non-radiological safety, impact on submarine capability availability, and similar. The ALARA objective will be orders of magnitude lower than any environmental dose limits which may be set by regulatory authorities.

3.16 A foundational principle of this Environment Protection Plan is the consideration of whether or not an environmental radiological assessment is needed for a particular radiation practice or source, in order to ensure that effort and resources are optimally expended. As per ARPANSA (2015) guidance, an environmental radiological assessment should be undertaken when there is a real or potential risk of environmental exposures of concern due to the nature of the intended practice, and if there is uncertainty about the magnitude and extent of possible exposure, or otherwise as required by legal instruments.

3.17 Further, and as per ARPANSA (2015) guidance, it is recognised that for the purpose of demonstrating a suitable level of protection, it is generally not feasible to assess actual organisms inhabiting the environment under consideration, due to limited relevant data availability. This is particularly the case for Australia in general, and more specifically for the unique wildlife assemblage inhabiting Garden Island.

Screening and Reference Levels

3.18 As per established international practice, the ASA will adopt a dual-tier approach to assessing potential radiological exposures to the environment and their controls, based upon 'screening' and 'reference' levels. An initial screening approach, anchored in conservative assumptions, will be used to test if a general dose rate of not more than 10 μGy/h would be exceeded. Note that the 10 μGy/h screening level is a conservative, generic parameter considered to represent the dose rate at which 95% of the species in the ecosystem are expected to be protected, with an additional safety factor incorporated to account for limitations in initial data (ARPANSA 2015).

3.19 If not exceeded, then it may be acceptable to assume an appropriate level of protection for the environment has been demonstrated. If the screening level threshold is exceeded, then a more complex assessment, based upon site-specific data in concert with more focused, realistic assumptions and dose scenarios, is required.

3.20 Once exposures are calculated, assessed dose rates need to be compared with derived ERLs, which relate to observed biological effects from ionising radiation on nominated representative organisms[1] (see paragraph 3.24 below). The use of screening levels thus provide a reliable way to determine situations of exposures which are not of concern and where no further analysis or justification is required.

3.21 ERLs are dose rates to wildlife, in addition to those incurred normally from 'background' radiation, at which a more considered evaluation of the situation and the

[1] A 'representative organism' is a living organism that is considered to be typical of its class of organisms as present in an environment of interest and thus of use as a generic surrogate for all such similar organisms.

potential for detriment to wildlife might be a reasonable supposition, and which should be considered in the over-all optimisation process. ERLs applied to any particular situation and its assessment should be derived from knowledge of biological effects in wildlife, and their relationship to dose rate. They are neither dose limits nor ‘substitute’ values for them, and do not imply that higher dose rates are environmentally damaging, or that lower dose rates are in some way ‘safe’ or non-damaging. Rather, ERLs can be considered as:

- A dose rate increment to wildlife above the natural and normal background level, which might result in detrimental health effects in the environment; or
- A point of reference guiding ‘optimisation’, with optimisation being the holistically most effective level of effort expended on environmental protection, dependent on the overall management objectives and exposure situation.

3.22 In practice, the production of ERLs that are tailored to the wildlife present in the Garden Island area are not practically feasible, considering the immense diversity of wildlife and the attendant research and data requirements. Simplifications can, however, be made that facilitate assessment and demonstration of protection, where a straightforward approach to estimating the level of radiation impact and to guide decision-making is to use screening values of dose rate (which, like ERLs, are in addition to dose rates incurred from ‘background’ radiation) in the assessments. Such screening values will be selected so that if an assessment results in a measured or estimated dose rate below this value, the likelihood of any harmful effects on the actual wildlife intended to be protected would be small or negligible, and further regulatory or control actions would not be necessary.

3.23 Protection of ecologically significant tranches of wildlife populations and ecosystems are the focus of environmental protection measures, rather than individual organisms, be they animals or plants. Furthermore, assessed exposures exceeding a screening level represent neither an excursion above regulatory limits nor an indication of harm to the environment, but rather a level above which further investigations are warranted. In this context, it is recognised by the ASA that screening levels are not regulatory limits but rather levels above which further investigations and the application of species-specific ERLs are warranted. The relative relationship between ERLs and screening levels and their hierarchical relationship is depicted in Figure 1.

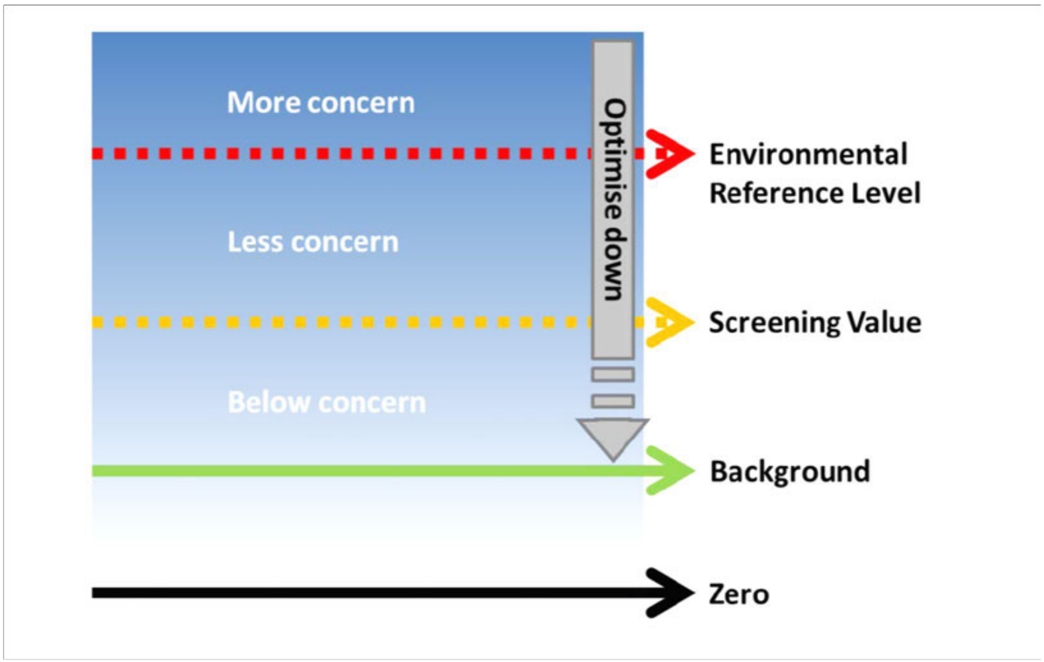


Figure 1: Application of ERLs and screening levels of dose rate for protection of the environment and associated trigger thresholds (ARPANSA)

Establishing environmental reference levels and selecting screening values for the CIF and associated activities

Establishing environmental reference levels

3.24 Environmental reference levels (ERLs) are the fundamental indicators of dose rates of biota where some level of detrimental effect can be expected among wildlife, and where at least some consideration on whether protection is adequate would be warranted. As this Environment Protection Plan matures the ASA will propose relevant ERLs which will be evidence-based and principally derived from a tiered dose assessment approach, review and analysis of the radiation effects literature and other relevant and available data. Review and analysis of the radiation effects literature will consider the likely exposure pathway and scenario and its relevance in an environmental context applicable to the CIF and its location. This will include focus on identifying the most radiosensitive organism group(s) in a specific environment (terrestrial, marine, etc), and assessment of whether potential biological effects are likely to impact only an exposed individual or small group of individuals, or whether it is likely to manifest as a population level effect within the potentially impacted environment.

3.25 Factors that will be considered by the ASA when establishing environmental reference levelss for the CIF and associated activities will encompass:

- Observed biological effects reported in the radiation effects literature, as may arise from acute or chronic exposures depending on the particular experiment or study reported. Chronic low-level exposures of organisms are those that are most likely to occur, particularly in anticipated CIF exposure situations, and thus would be most relevant in the regulatory context. Thus, it is intended to apply data from the radiation effects literature relevant to the type of exposures expected in the environmental situation relevant to the CIF.

- Not all organisms share common radiosensitivity. This means that some organisms, such as those that are long-lived or filter feeders are more prone to cumulative effects, will generally experience biological effects at lower dose rates compared with other shorter-lived organisms. Therefore, environmental exposure assessment values for the more sensitive organisms will be comparatively lower than those for other, less sensitive, organisms.
- Radiation effect data for most organism types are relatively sparse, especially for those biota of significance to Garden Island. Consequently, it is recognised that there will be inherent uncertainty in distinguishing the exact minimum dose rate at which biological effects in organisms of interest may actually occur. In order to account for this uncertainty, it is likely that the evaluations will seek to express environmental exposure assessment values in an aggregated fashion encompassing a reasonable range of organisms, rather than as a single (discrete) value.

3.26 As summarised by ARPANSA (2015), exposure levels below which there is not expected to be significant population level effects for a range of organism types have been formulated from review and analysis of the radiation effects literature. These derived values may be employed by the ASA in the selection of environmental reference values for use in relation to the CIF.

3.27 Table 1 below summarises a selection of information on effects on various representative organisms at different dose rates. These are as articulated by ARPANSA (2015) and represent an amalgam of work presented by the IAEA and the International Commission on Radiological Protection. These broad parameters are intended to guide the assessments and evaluations to be employed by the ASA when determining ERLs in relation to the CIF. Examples presented are for broad groups of wildlife in the terrestrial and aquatic environments, and derived consideration reference levels for ‘reference animals and plants’ (RAPs). The derived consideration reference levels identify a band of dose rates where the potential for deleterious effects of radiation in a particular species may need to be further analysed, while understanding that further considerations might be needed in order to take a fully informed decision. Where a generic reference organism[2] is sufficiently similar to one of the RAPs in the context of Garden Island, the corresponding derived consideration reference levels for that RAP may be used as the environmental reference value for the purposes of the CIF (as described in ARPANSA 2015). In other cases other values (such as those discussed by IAEA or UNSCEAR, see Table 1) may be nominated by the ASA as more appropriate. The rationale for the selection of ERLs will be clearly documented by the ASA in the associated assessment report.

[2] A ‘reference organism’ is a numerical approximation of the representative organism that provides a basis for the estimation of radiation dose rate. See further detail in Section 3.33.

Units in μGy/h

Organism	IAEA (1992)	UNSCEAR (1996, 2011)	ICRP (2008)
Terrestrial			
Plants	400	100**	
Reference pine tree*			4–40
Reference wild grass			40–400
Animals	40	40–100**	
Reference bee			400–4000
Reference earthworm			400–4000
Reference duck			4–40
Reference deer			4–40
Reference rat			4–40
Aquatic			
Freshwater organisms	400	400	
Reference frog			40–400
Reference trout			40–400
Marine organisms		400	
Reference crab			400–4000
Reference flatfish			40–400
Reference brown seaweed			40-400

*'Reference *organism type*' refers to the ICRP's Reference Animals and Plants (RAPs).
**Most highly exposed individuals.

Table 1: Summary of derived effects levels (μGy/h) below which population level effects are not expected to occur, with potential reference biota of relevance to the CIF detailed by red border

3.28 Note from Table 1 that different values have been derived for similar organisms due to the use of alternative data and/or application of differing levels of precaution. Note also that (except where otherwise indicated) IAEA (1992) and UNSCEAR (1996; 2001) values refer to population effects, whereas International Commission on Radiological Protection (2008) give dose rate bands where effects may occur to individuals of that type of RAP.

Selecting screening values

3.29 An 'as simple as possible but as complex as necessary' approach to demonstrating protection of the environment will be adopted by the ASA, albeit in a conservative manner. This assists in optimising resources to be spent on the assessment while allowing for a graded approach to protection. A tiered approach will be used to facilitate this, involving a first screening using simplified methodology and deliberately conservative, although not unrealistic, assumptions and parameter values against a screening value of dose rate. The screening values will be set to provide reasonable assurance that relevant ERLs are not exceeded provided the assessment results in exposures below the screening value.

3.30 ARPANSA (2015) posits that scientific data suggest that, if parameter values are reasonably conservative, including designation of transfer factor[3] and maximisation of the assessed impact of internal and external exposure, a screening value of 10 µGy/h is relevant. If the subsequent assessments indicate exposures below this value, the ASA will reasonably assume that the radiological exposure is below regulatory concern.

3.31 If the assessments indicate incremental dose rates to reference or representative biota groups above the level of 10 µGy/h, then a more complex assessment may be pursued if justified. This assessment would use location specific scenario-based assumptions or site-specific data obtained from literature, or the ASA's environmental measurement and monitoring programs, or targeted sampling if required. If such assessment is required, it would be likely that the ASA would compare the results of the assessment with relevant environmental reference levels rather than with the screening criterion, noting that the relevant ERLs may be either higher or lower than 10 µGy/h for the particular scenario under consideration. The calculated dose rates would be compared against relevant references levels to ensure environmental protection.

3.32 If any subsequent, more detailed and rigorous assessment of the specific situation still identifies incremental dose rates to wildlife above the ERLs, then the ASA would consult with ARPANSA and other applicable regulatory bodies to determine if and what additional assessments or mitigations may be required. For example, these may include an assessment of the probability, magnitude and distribution, spatially and temporally, of radiation exposures and possible adverse effects so arising. An optimisation process would likely be undertaken, observing that ERLs are reference points, not limits.

Reference and Representative Organisms of Relevance to the CIF and Associated Activities

3.33 As an approximation, and to facilitate assessments and decision-making with a reasonable degree of confidence, the assessment and decision-making is to be founded upon selected reference organisms. These are depicted as hypothetical representations of wildlife using a simplified (ellipsoid) geometry, and broadly representative of a group of wildlife (e.g. terrestrial mammals; marine invertebrates), for which data on dosimetry and biology and ecology, including morphology, habitat, life cycle, sensitivity to radiation, etc., is available and can be pooled (see Figures 2 and 3). Reference organisms are thus not real organisms, but simplified and generalised conceptual and numerical models intended to represent the selected wildlife of interest.

[3] In broad terms, 'transfer factor' is an element of exposure modelling which seeks to identify a value for the movement of radionuclides of interest from the environment to an organism of interest.

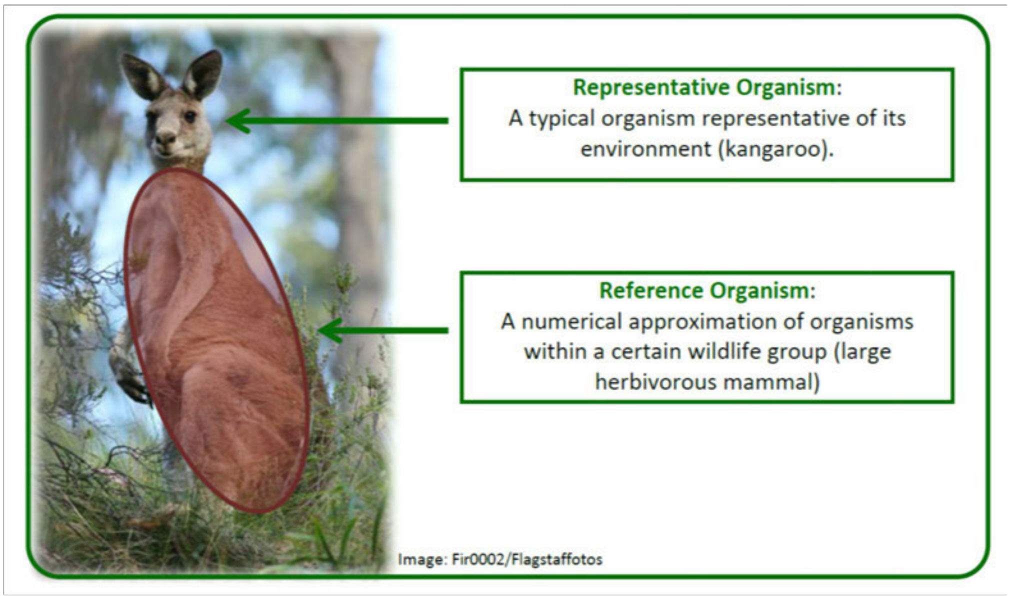


Figure 2: Relationship between a kangaroo as representative organism and a reference organism, as may apply for a tammar at Garden Island (ARPANSA).

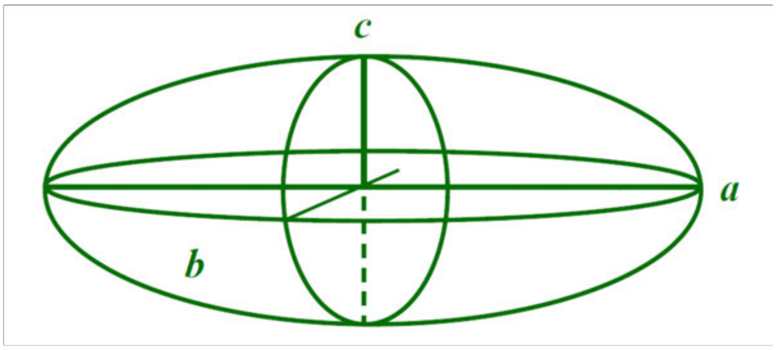


Figure 3: An ellipsoid, outlining the axes (a, b and c) that can be varied to accommodate for the different shapes of reference organisms (ARPANSA)

3.34 In selecting representative wildlife in relation to the CIF, the ASA has been mindful to select an amalgam of protected and/or otherwise iconic and charismatic species, as well as those organisms which may act as indicator or 'sentinel' species, by being reflective of wider processes or cumulative exposures. Given the location of the CIF and accompanying activities, both terrestrial and marine reference species are proposed, including assessment of the availability of sufficiently robust data. These provisionally nominated species (all subject to confirmation) are as detailed below.

Terrestrial

3.35 List of representative terrestrial organisms for Garden Island is as follows:

- Tammar (*Macropus eugenii*), as a long-lived herbivorous mammal, and one of particular conservation significance to Garden Island;
- An appropriate earthworm (annelid), representing an organism which resides in and ingests soil, and hence acting as an indication of status of soils as a sink for radiological releases to the environment;

- Rottnest Island pine (*Callitris preissii*), representing a slow growing, long-lived plant; and
- Arum lily (*Zantedeschia aethiopica*), representing a fast growing plant, although a weed, and is readily prevalent around Garden Island.

Marine

3.36 List of representative marine organisms, as significant to Careening Bay (where the CIF will be located) and Cockburn Sound, is as follows:

- Blue mussels (*Mytilus galloprovincialis*), representing a filter feeding, and hence bioaccumulative, organism;
- A bottom dwelling and bottom feeding fish, such as a flathead (such as *Inegocia japonica* or *Onigocia* cf. *spinosa*), representing an organism which ingests organisms feeding off sedimentary detritus, hence acting as an indicative bioaccumulative organism;
- A sediment dwelling worm (TBD), representing an organism which resides in and may ingest sediments, hence acting as an indication of status of marine sediments as a sink for radiological releases to the environment;
- *Ulva* sp. (TBD), representing a rapid growing algae grazed upon by other organisms, hence forming a base of the local trophic structure; and
- Seagrass (*Posidonia australis*), as a long-lived, iconic and locally significant element of the Cockburn Sound marine ecosystem.

3.37 Note that little penguins are not nominated as representative organisms. Rather, the intent is to demonstrate appropriate protection of this species via ensuring protection of the environment in general, as evidenced by employment of the nominated and indicative representative species which are selected on the basis of likely being more amenable to and more meaningful of exposure dose assessments.

3.38 One of the key practical purposes of the reference organisms to be nominated by the ASA is to provide a means for the bioaccumulation factors and subsequent estimation of dose rates using an ellipsoid model (see Figures 2 and 3 above). This is on the basis that radiation damage arises from the ionisation that follows the path that radiation takes as it passes through tissues. Hence the dimensions of an organism have relevance for the degree of radiation damage that may occur for a given exposure. These estimates provide a basis for subsequent assessment of the likelihood and degree of radiation effects using available effects information.

3.39 It is possible that once the ASA has completed exposure/dose assessments for nominated reference organisms there may be a need to examine in greater detail the impact on actual species inhabiting specific environments (i.e. representative organisms), for which suitable site specific reference data may not exist. This would not be a straightforward undertaking, hence the environment protection framework would be constructed to ensure that reference organisms provide a fit-for-purpose and conservative foundation for assessment of potential environmental exposures and their management.

3.40 In summary, the ASA recognises the simplifications assumed when employing reference organisms to include:

- Representation of different forms of wildlife by simple shapes (e.g. ellipsoids);
- Homogeneous radionuclide distribution in the tissues of the organism (internal dosimetry) and in environmental media (external dosimetry);
- Generic 'biology' in terms of habitat, occupancy, feeding, life cycle, reproduction and other factors; and
- Generic distributions for representative organism and homogenised diet/bioaccumulation factors.

3.41 Should the nominated screening value be exceeded, a more refined assessment would be triggered, including potential consideration of representative organisms. Assessment against a screening value will thus be employed as the first step in a tiered approach to assessment. This will enable the identification, characterisation and elimination of any potential exposures that would be of concern and require further attention, simultaneous with identifying those that would be considered to be acceptable. The tiered assessment approach to be followed by the ASA will support a graded approach to protection.

Western Australian Regulatory Requirements

3.42 Although the CIF will represent a Commonwealth activity and be located on Commonwealth land, the ASA is conscious of its obligation to consider WA Government regulations. This is pertinent for the waters and sediments of Careening Bay, within which is the wharf from which the nuclear-powered submarines will operate. The ASA, in consultation with the appropriate Western Australia (WA) regulatory agencies, will seek to act in a manner consistent with applicable WA regulations and procedures.

3.43 Regulations and procedures for the waters and sediments of Cockburn Sound are as detailed in the State Environmental (Cockburn Sound) Policy 2015 (WA EPA 2015) provided as Appendix B, and the associated Environmental Quality Criteria Reference Document for Cockburn Sound (WA EPA 2017) provided in Appendix C. Management oversight of Cockburn Sound, including assessment of its environmental quality against criteria promulgated in the State Environment Policy, is undertaken by the WA Government appointed Cockburn Sound Management Council. Defence is an appointed member of the Cockburn Sound Management Council.

3.44 The State Environmental (Cockburn Sound) Policy 2015 articulates the environmental management objectives and assessment criteria for Cockburn Sound, with guidance on the measurements and assessment of these criteria detailed in the Environmental Quality Criteria Reference Document (WA EPA 2017). The suite of environmental quality criteria established for Cockburn Sound includes parameters for radionuclides, namely gross alpha and beta activity. The Cockburn Sound environmental management and assessment criteria adopt a hierarchical tiered approach which resonates with the screening and environmental reference level tiers required by ARPANSA. Namely, the Cockburn Sound construct of Environmental Quality Criteria (EQC) is based upon a system of Environmental Quality Guidelines (EQG) and Environmental Quality Standards (EQS), founded upon the Australian and New Zealand Guidelines for Fresh and Marine Waters (ANZECC & ARMCANZ 2000). So far as may be practicable achievable and meaningful, the ASA will seek to align its approach to environmental protection with that pertaining elsewhere in the Cockburn Sound area, although it is understood that these Environmental Quality Criteria are more related to the protection of human health than to protection of the environment.

3.45 Environmental Quality Guidelines (EQGs) are threshold numerical values or narrative statements which if met indicate there is a high degree of certainty that the associated environmental quality objective has been achieved. If the guideline is not met then there exists some uncertainty as to whether the associated environmental quality objective has been achieved and a more detailed assessment against an Environmental Quality Standard (EQSs) is triggered. This subsequent assessment is risk-based and investigative in nature, and has the intent of determining, empirically as applicable, if the designated EQS may have been breached.

3.46 EQSs are threshold numerical values or narrative statements that indicate a level beyond which there is a significant risk that the associated environmental quality objective has not been achieved and a management response is triggered. Thus, the relationship between EQGs and EQSs for Cockburn Sound may be considered as generally analogous to the screening level and ERL threshold criteria adopted by ARPANSA (2015) (see Figure 4).

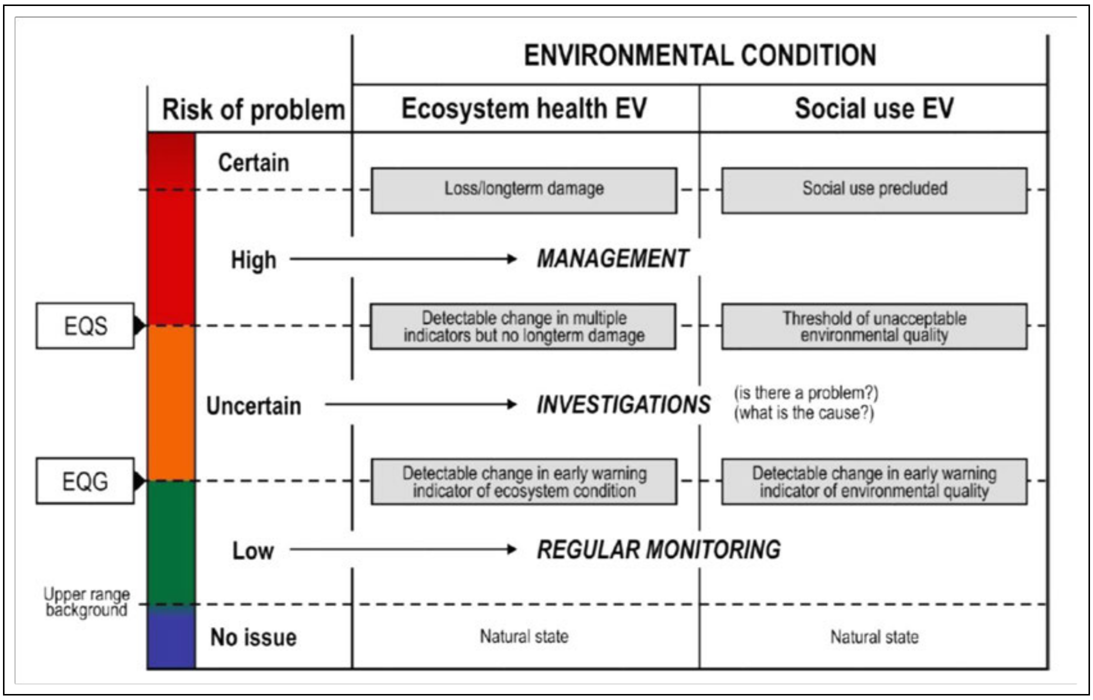


Figure 4: Conceptual diagram showing the relationship between the two types of EQC for Cockburn Sound on the left hand side with the associated environmental condition on the right hand side

3.47 With specific regard to measurement and assessment of radionuclides and gross alpha and beta activity, the Manual for Standard operating Procedures for Environmental Monitoring against the Cockburn Sound Environmental Quality Criteria (Supplementary Information 1) details the methods of measurement and assessment for Cockburn Sound (WA EPA 2005). This manual also states that the WA Department of Health is the responsible agency for assessing results. The manual directs that all radionuclide sampling results are to be provided to the Radiation Branch of the WA Department of Health for assessment and advice.

Exposure Scenarios to be considered

3.48 The assessments to be conducted will be based upon the contexts and potential or likely exposure scenarios to be developed, related to CIF operations and associated activities. This will involve the development of a conceptual model, common across other radiological management disciplines related to human health and safety, and undertaken in order to understand the entities and relationships that need to be assessed. The scenarios to be developed and assessed will encompass:

- Radiation practices and sources;
- Exposure situations (i.e. planned and emergency);
- Physico-chemical properties of the released radioactive material and the means of dispersion;
- Impacted environment, including actual or likely contamination levels;
- Characteristics and behavioural patterns of wildlife populations of concern or interest, including their interaction with the impacted environment;
- Reference organisms selected for the assessment and the rationale for their selection;
- Transfer and exposure pathways;
- Features, events and processes that could influence the release of radionuclides from the source into the wider environment;
- Spatial and temporal scales of potential exposure; and
- Aggravative and ameliorative properties which influence uptake into organism.

3.49 The general aspects to be considered for establishing pertinent environmental exposure scenarios include:

- Natural background;
- Source;
- Environmental transfer;
- Organisms and pathways;
- Timescales; and
- Biological endpoints & risk.

3.50 The overall effect of radiation exposure in the context of other contaminants will also be taken into account. It is recognised, however, that the lack of available and relevant data may preclude a fully informed evaluation and decision, underpinning the need to take a suitably conservative approach.

3.51 Further elucidation of the environmental exposure scenarios to be considered by the ASA are detailed below.

Natural Background

3.52 A baseline value for natural background will be established. A program has been developed to collect and analyse environmental baseline data at HMAS *Stirling*, including consideration of radiological baseline of this area. This program, at least in its initial phases, encompasses marine mussels and seagrasses, as well as marine waters and marine sediments and terrestrial soils (ASA 2023).

3.53 AECOM, an infrastructure consulting firm, have been contracted to undertake an Environmental Baseline Contamination Assessment including gathering information on measured environmental radiation at *Stirling*. AECOM current scope includes collection of samples from terrestrial soil and sediment, marine waters and sediment, marine invertebrates and seagrasses sampling, and periodic radiation monitoring over a 12-month period in accordance with the Program Plan.

3.54 Terrestrial soil and sediment samples will be collected from five locations in current undeveloped areas and above the low tide line across the portion of the Site subject to the future licensed site area over one sampling period.

3.55 Marine flora (seagrass) and fauna (invertebrates – mussels) will be sampled biannually (end of summer and winter) at six locations in the vicinity of Garden Island and Cockburn Sound (total 12 samples of each biota annually). Samples will be concurrently collected for both radionuclide and chemical analysis.

3.56 Periodic radiation monitoring for neutron and gamma radiation will be conducted using thermos-luminescent dosimeters (TLDs) or optically stimulated luminescence (OSL) dosimeters at 18 locations on and around Garden Island. TLDs will be collected for measurement post three months following installation and will be conducted over four quarterly events over a 12-month period.

3.57 Marine waters and sediments will be sampled over four quarterly events. Sampling of marine sediments will occur at 22 locations (total 88 annually), and marine waters at nine locations (36 annually). Locations to be sampled in vicinity of the site targeting the Stirling area include the future licensed facility, the northern Explosives Ordnance Area pier, Garden Island west coast and Cockburn Sound area.

3.58 Queensland Health has been engaged by AECOM to complete all radiological analytical testing requirements for the Project.

3.59 AECOM is not anticipating any radiological contamination above baseline levels as a result of previous activities.

3.60 Based on the current AECOM program the final issue of the Contamination Analysis and Assessment Report is due by the second quarter of 2025. The report will include a summary of baseline environmental conditions and recommendations to inform ongoing monitoring of the Site.

Figure 5: Area for terrestrial soil and sediment sampling (yellow)

Source

s33(a)(ii)

[redacted]

s33(a)(iii)

[redacted]

s33(a)(iii)

3.63 Notwithstanding the absence of specific detail available at the time of preparation of this Environment Protection Plan, it is anticipated that evaluation of potential exposure pathways and their characteristics, in terms of potential hazards to the environment, will consider the information as outlined below in relation to liquid and solid radioactive waste emanating from submarines alongside in *Stirling*. These factors are expected to span the following as detailed in 3.57, 3.58 and 3.59.

3.64 Expected types, sources and volumes of very low-level solid waste and the associated:

- Collection pathways from submarines/wharf to the CIF
- Packaging and handling practices
- Frequency and quantity each time of collection from submarines/wharf to the CIF
- Collection/movement practices
- Fate once received in CIF
- Resultant exposures for environment / reference biota from normal operations
- Reference accident/abnormal event for loss/release of very low-level waste
- Resultant exposures for environment (e.g. soils) / reference biota from such accident/abnormal event
- Intended controls / contingency responses in event of accident/abnormal event

3.65 Expected types, sources and volumes of solid low-level waste and the associated:

- Collection pathways from submarines/wharf to the CIF
- Packaging and handling practices
- Frequency and quantity each time of collection from submarines/wharf to the CIF
- Collection / movement practices
- Fate once received in CIF
- Resultant exposures for environment (e.g. soils) / reference biota from normal operations
- Reference accident/abnormal event for loss/release of solid low-level waste
- Resultant exposures for environment / reference biota from such accident/abnormal event
- Intended controls / contingency responses in event of accident/abnormal event

3.66 Expected types, sources and volumes of liquid radioactive waste and the associated:

- Collection pathways from submarines/wharf to the CIF
- Containment and handling practices
- Spill / leakage prevention and containment measures

- Collection / movement practices
- Frequency and quantity each time of collection from submarines/wharf to the CIF
- Processing once received in CIF:
- released vapours and their fates
- concentrated residues and catalysts and their fates
- Resultant exposures for environment (e.g. soil) / reference biota from normal operations
- Reference accident/abnormal event for loss/release of liquid radioactive waste and its derivatives
- Resultant exposures for environment / reference biota from such accident/abnormal event
- Intended controls / contingency responses in event of accident/abnormal event

Environmental Transport

3.67 Mechanisms by which radionuclides emanating from the CIF and associated activities may physically move through the environment will be identified. These will include migration or dispersion pathways through soil, air, water and other biota consumed successively via the various trophic level interchanges. The spatial and temporal scales of radionuclide transfer will also be taken into account. An appropriate dispersion model is likely to be used to estimate the transfer of the source material to the environment.

Organisms and Pathways

3.68 It is expected that an initial, or screening, assessment will be undertaken using generic reference organisms, as outlined in Table 1. If this assessment indicates that there is no significant risk then the process will be terminated, as per ARPANSA (2015) guidance and no further specific information or evaluation pertaining to organisms applicable to the CIF will be necessary. For example, if the most radiosensitive biota group is suitably protected, there would be no need to undertake additional work to determine if less sensitive species are also protected. Note that this will apply equally for rare, protected, culturally sensitive or keystone species, given the inherently conservative approach taken in a screening assessment, as a precautionary approach (Jordan & O'Riordan 2004).

3.69 If a more complex assessment is required, representative organisms would be assessed. Those of relevance to the CIF (to be provided as soon as this information is available) are subject to further assessment and confirmation of their amenability—by way of sufficient and suitable ancillary information—for further exposure assessment. Relevant pathways of exposure from external and internal sources associated with defined scenarios for exposure to radionuclides would be considered for the selected representative organisms. The specific habits of the nominated local wildlife or assumptions associated with these would be incorporated into the defined scenarios.

Timescales

3.70 The duration of source releases and resultant exposure times will be embodied in any assessments to be conducted. This will likely include the assumption of steady-state conditions for routine operations of the CIF, as well as short-term exposures as may be indicated for accepted emergency scenarios. Assessed exposure times will likely be related to the habits and behaviours of the selected reference organisms. It is noted that short-term assessments of the order of days and months following a modelled release might require specialised dynamic models (UNSCEAR 2014).

3.71 The nature of the source materials will also be taken into account. For example, where long half-life radionuclides are included in the source term, a long-term assessment of radionuclide transfer will be considered. To a reasonable extent, this will seek to take into account timescales in which engineered controls might be expected to fail, potentially leading to the release of radionuclides to the environment with the subsequent fate of any such released materials to be assessed. This would include aspects such as likely radionuclides which may be released, their quantities and half-lives.

Biological Endpoints and Risk

3.72 Exposure to high levels of radiation can cause biological changes. The size of the risk (or estimations of probability) that exposure to radiation will bring about deleterious effects on a population or ecosystem is discussed in the context of ERLs. If feasible, the discussion would be extended to consider how significant this effect may be. This would encompass analysis of the transfer, uptake and effects of exposure to ionising radiation, including the derivation of dose-effect relationships for various biological endpoints in exposed organisms (Oughton et al., 2004). Consideration would also be given to the redundancy of the exposed habitat in relation to the broader regional context and the ability of biota to recruit back into the affected habitats from refugia.

Conduct of the Exposure Assessments

3.73 Once the applicable exposure scenarios have been developed, appropriate facets of the staged process for undertaking the subsequent environmental assessments for the CIF and associated activities will be addressed according to ARPANSA guidelines using:

- Appropriate assessment tools;
- A tiered/graded approach;
- Screening & reference levels; and
- Protection at population levels.

Appropriate Assessment Tool

3.74 The ASA is aware that a range of assessment tools and exposure models are available for radiological environmental assessments. These typically use differing methodologies of calculation, and are based upon inherent assumptions. It is, therefore, critical that the appropriate tool is applied for any specific application. It is considered likely that of the available tools, that which will be employed by the ASA will be Environmental Risks from Ionising Contaminants: Assessment and management (ERICA) software which is advised to be generally preferable for Australian applications (ARPANSA 2015; Doering 2010).

3.75 It is noted that ERICA is based upon the concentration ratio methodology (further information will be provided when available). The ASA is conscious that selection of appropriate concentration ratio data is important, as this variable is likely to have the greatest influence on the assessment outcomes. ARPANSA (2015) opines that default values can be applied for screening level assessments of minor operations, but for most assessments a literature search would be appropriate. Whether the CIF activities may be considered as a 'minor operation' will be determined in due course. Where a literature search may need to be conducted, data for similar representative organisms and climate types will be sought and used. ARPANSA (2015) states that for the highest risk operations should a monitoring programme for determining concentration ratios be considered.

Tiered/Graded approach

3.76 It is anticipated that the assessment tool to be used for the assessment of the CIF and associated activities will be one that incorporates a tiered or graded approach, as intended to be applied by the ASA. This should assist to ensure that the assessment is 'as simple as possible but as complex as necessary', and is undertaken to the satisfaction of the responsible regulators.

3.77 A pictorial representation of the tiered approach expected to be followed by the ASA is shown in Figure 7.

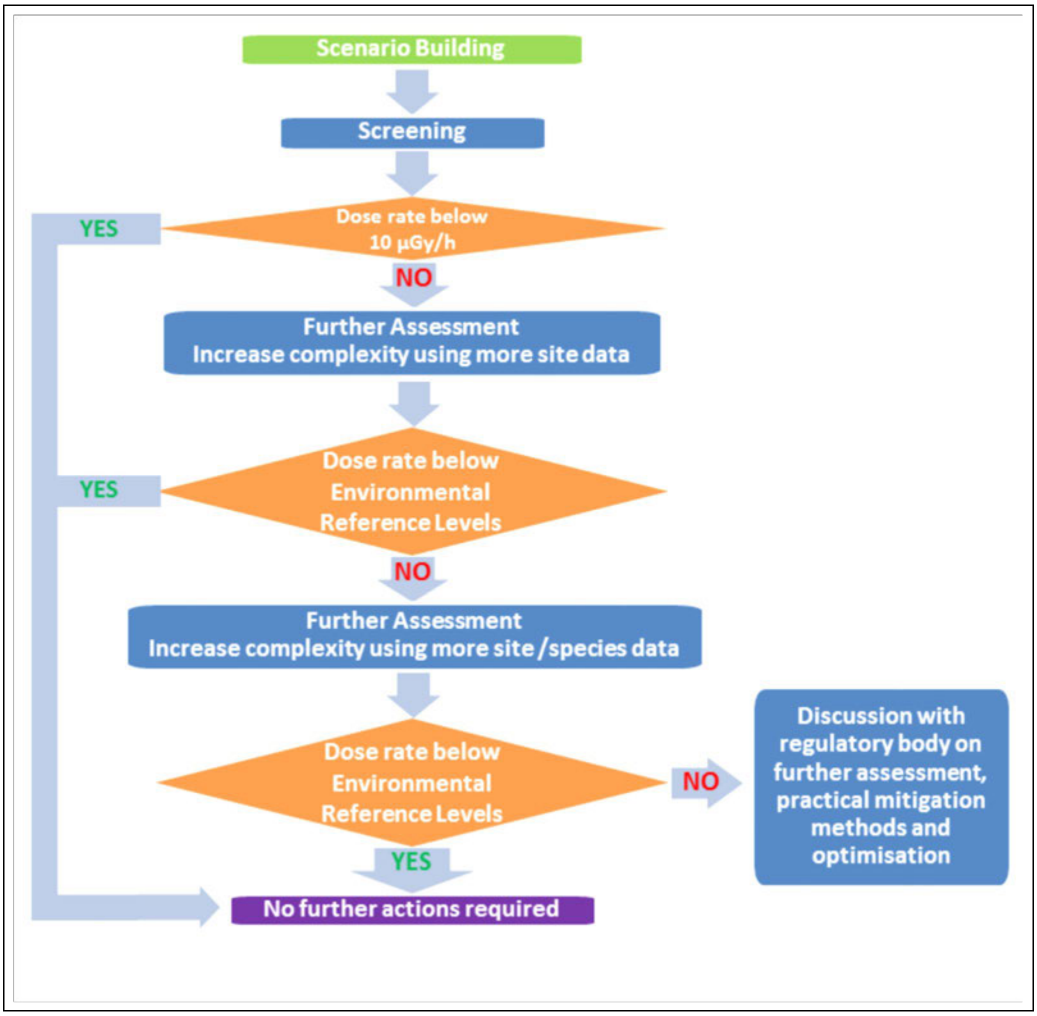


Figure 6: Outline of the application of a tiered/graded approach to radiological assessment

3.78 In this approach the exposures which are indicated as below the threshold of concern can be identified at the screening stage. Further assessment at a more complex level, as may be required, would then be instigated and justified by comparison with ERLs based on applicable and appropriate species-specific biological effects data relevant to the site preparation of the CIF.

Estimating Exposures

3.79 The ASA is aware that exposures of wildlife can be measured, but to do so can be resource-intensive, if at all feasible, and typically not cost-effective. Any wildlife sampling and analysis program would also need to properly consider and take account of regulatory requirements, which can be onerous and restrictive if not properly developed and focused, as well as matters of ethics. Furthermore, in the case of a proposed future facility such as the CIF, there are no exposures that can be measured until such time as it commences operations. Until the facility is constructed chemical analogues can be used as substitute for their radioactive counterparts to determine site specific media/biota concentration ratios for use in estimating potential exposures scenarios, and consistent with the intended context of the required assessment. Further consideration of the practicalities for the ASA of estimating wildlife exposures, both external and internal, and any subsequent potential impacts upon the environment is presented below.

External Exposures

3.80 Concentrations of radionuclides in environmental media, such as soil, water and sediments, can often be measured in the case of ongoing activities and operational facilities, as well as in the case of existing and emergency exposure situations or through measurement of a radionuclides isotopically stable counterpart. Thus, the exposure of wildlife could be directly assessed once the CIF was in operation. Given that possible radionuclide concentrations cannot be known before the CIF is in operation, it is necessary for the ASA to estimate radionuclide concentrations of environmental media and subsequent concentration ratios into biota.

3.81 It is expected that the ASA will employ an appropriate mathematical model to estimate radionuclide concentrations in air, soil, water and sediments. These models may take into account relevant environmental transport processes, such as advection and diffusion, sediment scavenging, resuspension or migration. The behaviour of radionuclides, including radioactive half-lives and possible daughter ingrowth will also be taken into account to the greatest practicable extent, consistent with the availability and reliability of data and the degree of precision, on a conservative basis, required for the modelling and assessments. It is yet to be determined which may be selected, but existing databases and models for estimating equilibrium radionuclide concentrations in environmental media when activity concentrations are not known and which may be used by the ASA include:

- IAEA Safety Reports Series No. 19 (IAEA, 2001) – Generic models for estimating concentrations in air and water due to discharges to the environment;
- PC Cream (ukhsa-protectionservices.org.uk) – Includes modules for estimation of radionuclide concentration in air, oceans and rivers;
- RESRAD (https://resrad.evs.anl.gov) – Include dispersion modelling, biota via all media; and
- PDC-ARGOS (pdc-argos.com) – Radiological and nuclear dispersion modelling for dose assessment.

Internal Exposures – Transfer Parameters

3.82 Estimations of the internal exposures of wildlife can only be conducted when either measured activity concentration data or appropriate organism-to-media concentration ratios (CR) and distribution coefficients (Kd) are known for the relevant organism-media combinations. These values are normally assumed to reflect an equilibrium situation between the exposed wildlife and the environmental media which they inhabit.

3.83 Being mainly derived for equilibrium conditions, these transfer parameter values are particularly appropriate for assessments of constant long-term exposures, but have less applicability in dynamic situations where environmental concentrations are changing rapidly with time, such as in abnormal or emergency events. It is understood that this sort of approach tends to overestimate internal activity concentrations in any initial phase when the activity concentration in media is increasing, but may more likely underestimate internal activity concentrations if the environmental media concentrations have declined at the time of sampling but are within the biological half-life of the radionuclide in question.

3.84 Different approaches to determining concentration ratios for various environmental circumstances and different forms of wildlife may be used. Examples of approaches which may be employed by the ASA for evaluation and periodic review of the CIF are outlined below.

Whole-Organism Concentration Ratio

3.85 The whole-organism to media concentration ratio ($CR_{WO\text{-}media}$) is a value used to quantify the equilibrium activity concentration between an environmental medium and the whole organism. It generally does not include parts of the organism, such as the gut or pelt, which might be contaminated by environmental media like soil or silt. Definitions of $CR_{WO\text{-}media}$ for terrestrial and aquatic organisms are as follows:

a. Terrestrial organisms:

(1) CR = Activity concentration in biota whole-body (Bq/kg fresh weight) / Activity concentration in soil (Bq/kg dry weight)

(2) Exceptions for terrestrial biota exist for chronic atmospheric releases of s33(a)(ii) and (iii) [redacted] where:

i. CR = Activity concentration in biota whole-body (Bq/kg fresh weight) / Activity concentration in air (Bq/m^3)

b. Aquatic organisms:

(1) CR = Activity concentration in biota whole-body (Bq/kg fresh weight) / Activity concentration in filtered water (Bq/l)

Tissue-Media Concentration Ratio

3.86 The tissue-media concentration ratio ($CR_{tissue\text{-}media}$) is a value used to quantify the equilibrium activity concentration between an environmental medium and a specific tissue such as muscle, bone, or similar. Some values applicable to wildlife may be available as a result of efforts to assess doses to people via the consumption of particular foods, such as meat or milk.

3.87 ARPANSA (2015) advises that tissue-to-media CRs should not be used in dose assessments for wildlife in lieu of organism-to-media data. This is because radionuclide activity concentrations (and thereby the CR) for a specific tissue may be substantially less than, or greater than, that for the whole body due to preferential uptake of certain radionuclides by certain tissues. However, for some tissues, conversion factors have been published, with further details of those which may be applicable to the CIF provided by ARPANSA (2015).

Distribution Coefficient (Kd)

3.88 For application in aquatic ecosystems, the distribution (or partition) coefficient (Kd) describes the relative activity concentrations of radionuclides in sediment and water, where:

a. Kd (l/kg) = Activity concentration in sediment (Bq/kg dry weight) / Activity concentration in filtered water (Bq/l)

3.89 The distribution coefficient can be used to predict the radionuclide activity concentration in sediment from that in water, or vice versa, if data for either are lacking. It is preferential, however, to use site-specific water and sediment data. The use of model default Kd values can result in elevated uncertainty ranges as literature values often do not match site-specific conditions.

Estimation of Dose Rates

3.90 The ASA will refer to available and endorsed databases that allow for estimating the dose rate from both external and internal exposures, based on activity concentrations in wildlife and environmental media. These will likely include look-up tables for dose conversion coefficients which have been integrated into software tools. Examples of databases which may be used by the ASA for conversion of external and internal radionuclide concentrations to absorbed dose rates in wildlife include:

- ICRP Publication 108 (ICRP, 2008) – Includes tabulated data for dose calculation;
- RESRAD (https://web.evs.anl.gov/resrad) – A family of codes for evaluation of radioactively contaminated sites. This also includes tools for estimating concentrations;
- ERICA Tool (http://www.erica-tool.com) – A software system for assessing radiological risk to terrestrial, freshwater and marine biota. Includes tools for estimating concentrations; and
- Environment Agency R&D Publication 128, Impact Assessment of Ionising Radiation on wildlife (withdrawn 3 April 2023) (reproduced at Supplementary Information 2) – Documented spreadsheet model for coastal, freshwater and terrestrial ecosystems by the Environment Agency of England and Wales.

Section 4: Environmental management systems, tools and procedures

Overview of Over-Arching Defence and Navy Environmental Management Systems and Tools

4.1 The ASA, in collaboration with Defence will establish and implement an Environmental Management System (EMS) for the oversight and control of the broader span of environmental management obligations and risks associated with the operation of the controlled industrial facility (CIF) and SRF-West. Given that the CIF, and SRF-West itself, will exist within the established, existing, multi-faceted ship and submarine basing and support activities at HMAS *Stirling*, it is intended that the SRF-West Environment Management System will form a component of the wider HMAS *Stirling* Environment Management System construct as administered by Defence.

4.2 The SRF-West Environment Management System will directly address those elements of the support of nuclear-powered submarines which are unique to those submarines and support activities which are not otherwise addressed, or not fully and suitably addressed, by the existing HMAS *Stirling* Environment Management System and its associated services and processes.

s33(a)(iii) [redacted]

4.4 In the establishment of SRF-West the ASA will conduct due diligence evaluations in collaboration with wider-Defence to ensure that those common elements of the *Stirling* Environment Management System are 'fit for purpose' in terms of suitability of being used for submarines assigned to SRF-West.

4.5 The ASA will be implementing a structured approach to environmental management in order to achieve a consistently high standard of environmental performance. Importantly, as outlined in this plan, the ASA will integrate into already mature and robust systems implemented within the Defence landscape, i.e. the Defence Environmental Strategy 2016-2036 (Appendix D) and the Defence Environment and Heritage Manual (Appendix E).

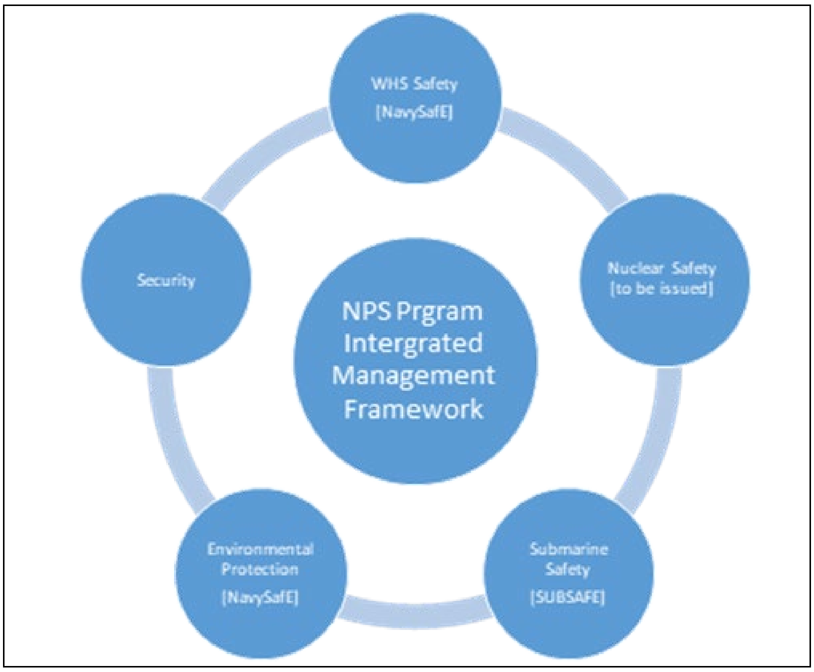
4.6 The ASA will also integrate CIF environment protection measures with the Navy Safety (NavySafE) and Navy Environment Management Systems. s47C [redacted]

4.7 The Royal Australian Navy (RAN) instruction, ANP 2201 – Navy Environment Management System (refer Appendix F), provides high-level policy direction and framework for the implementation and maintenance of the Navy Environment Management System (NEMS), which forms the basis for the provision of environmental management applicable to all Navy activities, supplemented by Defence's Security and Estate Group Environment Management System which encompasses shore support and sustainment activities undertaken in Australia's naval shore establishments.

4.8 The NEMS applies to all 'Navy personnel', which includes uniformed Australian Defence Force (ADF) members, Australian Public Service (APS) employees, contractors and all other persons when in Navy workplaces or undertaking Navy activities. All subsequent requirements and/or amplifications over and above that already held with the Navy EMS for nuclear safety will be integrated within the Australian Navy Publication (ANP) system.

4.9 Defence (including Navy and the ASA) is committed to ensuring the health, safety and welfare of personnel, the public and the environment from the harmful effects of radiation. Central to this commitment is a proactive Work Health and Safety Management System, and Environment Management System. Together with Head Navy Engineering and leveraging off an already strong, well-documented and compliant Safety and Environment Management System, the ASA is building a supplementary suite of artefacts to meet the needs required to safely operate the nuclear-powered submarine capability.

4.10 Figure 8 displays the Nuclear-Powered Submarine Program Integrated Management Framework, which considers conventional safety, nuclear safety, submarine safety, environmental protection and security. The integrated framework supports the achievement of the fundamental safety objective of protecting 'our people', the public and the environment from harmful effects of radiation, and takes into account the interfaces between safety and security. Some elements of the framework are more mature, and others will grow in maturity (both in the depth and breadth) as the Program evolves.



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[redacted]

4.12 In addition, the Navy Safety Policy Statement (Appendix G) outlines the Chief of Navy's expectation that all Navy people be committed to a safe working environment. Navy is to maintain a safety culture that enhances Navy capability and reputation and meets the expectations of the Australian Government and the Nation. As of 1 July 2023, the Navy Safety Policy Statement also includes reference to the nuclear mindset, as *'a different view on quality, errors and personal responsibilities. It demands a different approach to safety culture with a low tolerance for actions that fall short of perfection'*.

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[redacted]

4.14 Within the N Library Program, the N2 suite is the primary repository for Navy-wide policy, processes and procedures for the Navy SMS and the Navy EMS. ANP2201 documents the Navy EMS through a series of Level 2, 3 and 4 documents, which work together as a system to guide Navy's proactive environmental management, including leadership, governance, hazard and risk management, communication and consultation, emergency response and an assurance and performance management cycle. The Navy EMS policy suite consists of the publications located in the N2 Sub-Library as outlined in Figure 9 (note that not all Level 4 publications are relevant to the CIF).

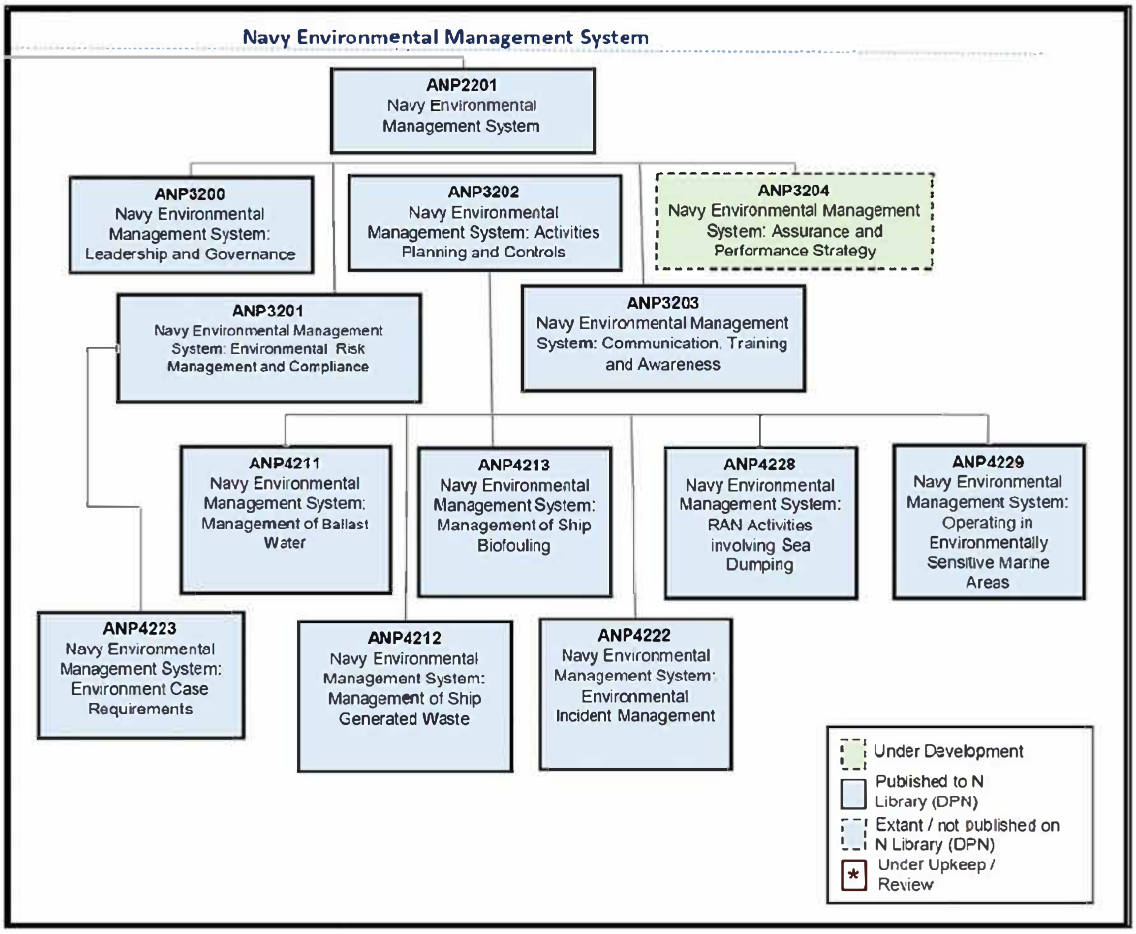

Figure 8: Outline of N4 publications forming the Navy Environment Management System

4.15 As additional nuclear safety and environmental management artefacts are identified and developed, including policies, procedures and guidance, these will be incorporated within the N Library.

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Goals and Objectives

4.18 The overarching goals of ASA radioactive environmental management are:

- Ensure radiation exposure to the environment, as well as personnel and members of the public is as low as reasonably achievable (ALARA) once social and economic factors are taken into account;
- Ensure all activities are undertaken in accordance with the relevant regulatory requirements;
- Implement the principles of the Waste Hierarchy, namely: avoid or reduce, reuse, recycle, treat, dispose;
- Ensure radioactive waste is characterised, documented, packaged, stored and recorded in such a way as to not become legacy waste;
- Minimise the amount of radioactive waste created while balancing the need to provide protection to personnel through the appropriate use of personal protective equipment (PPE); and
- Ensure accurate, accessible and complete records of all waste activities are maintained for the lifetime of the AUKUS program.

Minimisation of Risk to the Environment and Human Health

4.19 The ASA intends to implement the ALARA principle and ensure radiation doses to personnel are monitored, controlled and kept as low as reasonably achievable. By extension, limiting, monitoring and controlling radiation exposure to personnel and the public will have the parallel effect of limiting, monitoring and controlling exposure to the environment.

4.20 Procedures to be implemented by the ASA to minimise risk to human health and the environment will consider both radiological risks and risks posed by other hazards such as those presented by chemical substances and other hazardous materials. There will sometimes be conflicting risks that need to be balanced such as the need to consider chemical/physical properties of PPE – biodegradable items, which may normally provide a benefit to the environment if recycled, but which may not be suitable for disposal due, for example, to gases being released during material decay or reprocessing.

4.21 In terms of potential risks to the environment and their control, other pertinent factors to consider are as follows:

- As the CIF is an onsite interim waste storage/management facility and not a disposal facility, there is a large amount of flexibility in regards to site selection criteria. This is because radioactive material on the site will always be actively managed and will never be passively managed as in an institutional control period for a waste disposal facility; and
- Groundwater pathways from the CIF are unlikely to present a significant vector, noting that there is no intention for radioactive material from the CIF to enter the groundwater and that any contamination of the soil/ground would be as the result of an abnormal or

emergency incident, ameliorated by passive design controls, and the intent for any loss to be contained and cleaned up prior to entering groundwater.

4.22 It is noteworthy that the ASA's intended controls for ensuring the protection of workers from radiation hazards will simultaneously ensure that members of the public and the environment will also be protected, augmented as necessary by complementary, additional controls.

Emergency Management

4.23 The ASA's Emergency Preparedness and Response (EPR) Program will ensure that appropriate resources and infrastructure are in place prior to operations at the CIF commencing. This will include arrangements with external service providers and the provision of contingent resources and infrastructure at *Stirling*.

4.24 *Stirling* emergency operations personnel will be provided with training as planned under the ASA training program to address specific hazards and emergency scenarios potentially arising from waste management activities.

4.25 More detail is provided in the Emergency Management Plan.

Environmental Protection Measures

4.26 Non-radiological aspects of environmental protection relating to CIF activities will be addressed by the ASA in collaboration with Defence. These aspects include matters such as noise, light, dust, fuel use, non-radioactive wastes, non-radioactive hazardous wastes, protected flora, fauna and ecological communities, and similar. As noted previously, the existing HMAS *Stirling* EMS and associated processes will be used as the vehicle for the control of these matters of orthodox environmental management.

4.27 As previously noted, a program has been developed to collect and analyse relevant environmental baseline data in *Stirling*, including consideration of ambient radiological and background radiation matters. This program encompasses selected marine biota, marine waters and marine sediments, and terrestrial soils (ASA 2023).

4.28 The ASA will assess the potential impacts from CIF activities on the environment, spanning the build, operations and decommissioning phases. These potential impacts on the environment will be considered in accordance with the obligations imposed by the EPBC Act, as regulated by the Department of Climate Change, Energy, the Environment and Water (DoE 2013; DSEWPaC 2013). Subject to further evaluation, it is considered unlikely that CIF construction and operational activities will have a greater impact on the environment than existing activities in *Stirling*. The design and construction of the CIF was subject to a process of environmental reviews and assessments, as per the requirements of the EPBC Act, at the time of preparation of this (interim) Environment Protection Plan.

4.29 Based upon existing Australian and international best practice, it is considered that processing and interim storage of radioactive wastes in the CIF is unlikely to have significant radioactive exposure risks to the environment. s33

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4.30 The design and operation of the CIF will incorporate passive and active measures for the purposes of limiting the likelihood of uncontrolled or unintentional escape or release of radioactive materials in the first instance, and the extent and consequence of any such instance in the event of occurrence. These measures are likely to include:

- Security fencing and other physical barriers and access and monitoring controls, excluding both unauthorised people and wildlife;
- Strict separation of radioactive materials and their handling and storage areas from non-radioactive materials;
- Waste cataloguing and tracking controls, through all stages of acceptance, collection, processing, packaging and interim storage;
- Site and waste monitoring procedures and controls;
- Vermin exclusion controls, to prevent ‘leakage’ of radioactive material via biological uptake;
- Impermeable liners and floor sealers;
- Spill and leak containment barriers;
- Runoff controls;
- Leak detection systems;
- Filtered and monitored atmospheric emissions systems; and
- Contingency and emergency response plans, procedures and equipment.

4.31 An Environmental Management Plan will be developed for the CIF and associated activities which includes the specific control procedures required by the CIF EMS. A key element of the CIF Environment Management Plan will be the Waste Management Plan. When developed, in advance of commissioning of the CIF, it is envisaged that the Waste Management Plan will be based upon established and proven Australian and international best practice procedures, as exemplified by the analogous ANSTO Waste Management Plan (ANSTO 2021).

Section 5 – Appendices

A. Controlled Industrial Facility Concept of Operations
(Obj Ref: s22)

B. State Environmental (Cockburn Sound) Policy 2015
(Obj Ref: s22)

C. Environmental Quality Criteria Reference document for Cockburn Sound
(Obj Ref: s22)

D. Defence Environment Strategy 2016-2036
(Obj Ref: s22)

E. Defence Environment and Heritage Manual
(Obj Ref: s22)

F. ANP 2201 – Navy Environment Management System
(Obj Ref: s22)

G. 2023 Chief of Navy Safety Policy Statement
(Obj Ref: s22)

Section 6 – Supplementary Information

1. WA EPA (2005). *Manual of Standard Operating Procedures for Environmental Monitoring Against the Cockburn Sound Environmental Quality Criteria (2003 - 2004)*. WA Environmental Protection Authority, Perth.
(Obj Ref: s22)

2. Impact Assessment of Ionising Radiation on Wildlife. Environment Agency R&D Publication 128 (withdrawn 3 April 2023)
(Obj Ref: s22)

3. Secretary and CDF Joint Directive 16/2023: Accountabilities between Defence and the Australian Submarine Agency
(Obj Ref: s22)

Section 7 – References

1. ANSTO (2021). WMS Plans and Arrangements for Managing Safety: G-5416. Australian Nuclear Science and Technology Organisation, Lucas Heights. (Obj Ref: s22)

2. ANZECC & ARMCANZ (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water* Quality. National Water Quality Management Strategy Paper No 4, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra. (Obj Ref: s22)

3. ARPANSA (2014). Fundamentals for Protection Against Ionising Radiation: Radiation Protection Series F-1. Australian Radiation Protection and Nuclear Safety Agency, Melbourne. (Obj Ref: s22)

4. ARPANSA (2015). Guide: Radiation Protection of the Environment - Radiation Protection Series G-1. Australian Radiation Protection and Nuclear Safety Agency, Melbourne. (Obj Ref: s22)

5. ASA (2023). *Statement of Services: Environmental Baseline Contamination Assessment – SRF-W HMAS Stirling*. Australian Submarine Agency, Canberra. (Obj Ref: s22)

6. DoE (2013). Matters of National Environmental Significance: Significant Impact Guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999. Department of the Environment, Canberra. (Obj Ref: s22)

7. Doering, C. (2010). Environmental protection: Development of an Australian approach for assessing effects of ionizing radiation on non-human species. ARPANSA Technical Report Series No. 154, Australian Radiation Protection and Nuclear Safety Agency, Melbourne. (Obj Ref: s22)

8. DSEWPaC (2013). Actions On, or Impacting Upon, Commonwealth Land, and Actions by Commonwealth Agencies: Significant Impact Guidelines 1.2, Environment Protection and Biodiversity Conservation Act 1999. Department of Sustainability, Environment, Water, Population and Communities, Canberra. (Obj Ref: s22)

9. IAEA (1992). Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards. Technical Report Series No. 332. IAEA, Vienna. (Obj Ref: s22)

10. IAEA (2006). Fundamental Safety Principals: Safety Fundamentals No. SF-1. International Atomic Energy Agency, Vienna.
(Obj Ref: s22)

11. IAEA (2018). Radiation Protection of the Public and the Environment: General Safety Guide No. GSG-8. International Atomic Energy Agency, Vienna.
(Obj Ref: s22)

12. ICRP (2008). Environmental Protection: The Concept and Use of Reference Animals and Plants. ICRP Publication 108. Ann. ICRP 38(4-6).
(Obj Ref: s22)

13. Jordan, A. & O'Riordan, T. (2004). The precautionary principle: a legal and policy history, Chapter 3 in The Precautionary Principle: Protecting Public Health, the Environment and the Future of Our Children. Edited by: Marco Martuzzi and Joel A. Tickner. World Health Organization.
(Obj Ref: s22)

14. UNSCEAR (1996). Sources and Effects of Ionizing Radiation. UNSCEAR 1996 Report to the General Assembly, with Scientific Annexes. United Nations, New York.
(Obj Ref: s22)

15. UNSCEAR (2011). Sources and effects of ionizing radiation. UNSCEAR 2008 Report Volume II to the General Assembly with Scientific Annexes. Annex E, Effects of Ionizing Radiation on Non-Human Biota. United Nations, New York.
(Obj Ref: s22)

16. UNSCEAR (2014). Sources and Effects of Ionizing Radiation. UNSCEAR 2013 Report Volume I to the General Assembly with Scientific Annexes. Annex A, Levels and Effects of Radiation Exposure Due to the Nuclear Accident After the 2011 Great East-Japan Earthquake and Tsunami. United Nations, New York.
(Obj Ref: s22)

17. WA EPA (2005). Manual of Standard Operating Procedures for Environmental Monitoring Against the Cockburn Sound Environmental Quality Criteria (2003 - 2004). WA Environmental Protection Authority, Perth
(Obj Ref: s22)

18. WA EPA (2015). State Environmental (Cockburn Sound) Policy 2015. WA Environmental Protection Authority, Perth
(Obj Ref: s22)

19. WA EPA (2017). Environmental Quality Criteria Reference Document for Cockburn Sound. WA Environmental Protection Authority, Perth
(Obj Ref: s22)

Australian Government
Australian Submarine Agency

PART 9:
DECOMMISSIONING

Version 1.0

8 March 2024

Document Control

Version No.	Date	Objective Reference	Description of Amendment(s)	Prepared by	Reviewed by	Approved by
0.1	6 Feb 24	s22	First Draft	s22		
0.2	29 Feb 24	s22	Technical Review and edits made	s22	s22 Dr Kath Smith	
1.0	8 Mar 24	s22	First version released			

Contents

List of Acronyms

ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
ASA	Australian Submarine Agency
AUKUS	Australia / United Kingdom / United States
CDF	Chief of Defence Force
CIF	controlled industrial facility
HMAS	His Majesty's Australian Ship
IAEA	International Atomic Energy Agency
SRF-West	Submarine Rotational Force – West

List of Figures

Chapter 1: Submarine Rotational Force – West Decommissioning

Section 1 – Introduction

1.1 In 2021 Australia, the United Kingdom (UK) and the United States (US) announced AUKUS, a trilateral security partnership committed to supporting a stable, secure and prosperous Indo-Pacific region. The first major initiative of the AUKUS partnership is the delivery of a conventionally armed, nuclear-powered submarine capability for Australia. From 2027, Phase 1 of Australia's pathway to acquire a nuclear-powered submarine capability will see a rotational presence of one UK Astute class submarine and up to four US Virginia class submarines at the HMAS *Stirling* naval base, Western Australia (WA), under Submarine Rotational Force-West (SRF-West).

1.2 New and upgraded facilities and infrastructure are required at *Stirling* to achieve an initial level of capability for SRF-West from 2027, and to establish comprehensive nuclear stewardship by the early 2030s that will ensure the nuclear safety requirements are met as a priority. One of a suite of new buildings that will be constructed to support SRF-West is the proposed controlled industrial facility (CIF).

1.3 The CIF building will have three core functions:

- Waste collection and management of solid and liquid low-level radioactive waste arising from nuclear-powered submarine maintenance and operations;
- Repair and/or servicing of components, tooling and equipment from nuclear-powered submarines that may contain contamination or activated components; and
- Working accommodation for CIF operations personnel.

1.4 The aim of this Decommissioning Plan is to outline the processes and procedures that the Australian Submarine Agency (ASA) will undertake to safely decommission the CIF as a prescribed radiation facility at the end of its useful life, or at the end of life of type for the nuclear-powered submarine capability.

1.5 The CIF will be decommissioned as part of a wider Defence program of work authorised by the Government on request from Defence. The decommissioning of the CIF will be a deliberate decision by the Defence executive in consultation with Government and the licence holder. The basis for decommissioning is a standard Defence approach to capability management and will be driven by consideration as to the ongoing requirement for the facility and whether it remains capable of meeting its original design requirement.

1.6 The decommissioning plan is not a standalone plan and is to be read in conjunction with the other ASA nuclear and radiation protection plans and arrangements, including their supporting documents, such as the Radiological Protection Plan, Safety Management Plan, and Waste Management Plan.

1.7 The key reference documents used in the drafting of this plan are:

- ARPANSA Regulatory Guide – Decommissioning of Controlled Facilities (ARPANSA-GDE-1731) (Reference 1)
- IAEA, Decommissioning of Facilities, General Safety Requirements Part 6 (Reference 2)

Section 2 – Scope and assumptions

2.1 The scope of this Decommissioning Plan is limited to the decommissioning of the CIF at HMAS *Stirling* that supports the nuclear-powered submarine capability. It specifically excludes any other facility.

2.2 When operating the CIF, ASA will adhere to the IAEA Waste Hierarchy model, especially Level One Waste Prevention, to which describes considerations for the reduction of waste during operation. This will assist the ASA to minimise the cost and complexity of decommissioning activities that need to be undertaken.

2.3 The following assumptions have been made in the development of this decommissioning plan:

- Only authorised activities that are consistent with the licenses, permits and approvals granted for the controlled industrial facility at *Stirling* will be conducted at the CIF;
- The CIF is for waste management only and not for long-term storage of waste. s47C [redacted]

s33(a)(i) [redacted]

- This plan has been developed based on current legislation, policies and practices. It is assumed that similar legislation, policies and practices will be in place at the time of decommissioning.

Section 3 – Facility description

Site Location and Description

3.1 The CIF is located on Garden Island, Western Australia and is part of the HMAS *Stirling* Naval Base. Figure 1 below shows the location of HMAS *Stirling* on Garden Island. Figure 2 shows the location of the controlled industrial facility within *Stirling*.

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[redacted]

s33(a)(i)

[redacted]

s33(a)(i)
3.2 [redacted]

Building, Systems and Equipment Description

Building

3.3 The proposed facility is a structure consisting of, but not limited to, the following main areas:

s33(a)(i)
[redacted]

3.4 The purpose of these compartmentalised areas is to reduce the overall size of contaminated areas, and to facilitate clean up during decommissioning. During design and construction of the CIF consideration will be given to the choice of materials to ensure sufficient resistance to degradation from chemicals, radiation and weather so as to simplify decommissioning.

Systems

3.5 The building contains the following main systems:

- Ventilation;
- Electrical, which provides Australian standard mains power to the normal operating systems of the building and an independent back power supply;
- Radiation monitoring;
- Potable water;
- Sewage; and
- Storm water, provides for the capture, classification, treatment and discharge of stormwater on the site.

3.6 These systems will be designed and constructed with eventual decommissioning in mind.

Baseline Survey

3.7 A baseline radiological survey for *Stirling* is currently underway and scheduled for completion in late 2024, as part of the establishment of the CIF. Additional pre-decommissioning surveys will be undertaken as a component of the initial phase of decommissioning.

Section 4 – Decommissioning Strategy

4.1 After decommissioning of the CIF, the site will be restored to its original baseline so that it may be utilised for other Defence purposes. Any persistent radiological sources will be safely treated and removed.

4.2 A detailed decommissioning strategy will be developed over the life of the facility with consideration given during design, construction and operation to decommissioning in order to safely facilitate the process in the future.

Section 5 – Decommissioning Management

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5.2 Decommissioning of the CIF is not anticipated before 2080. It is expected that Australia will have all of the resources required to carry out decommissioning at that time, including the workforce.

Management System

5.3 The management system for decommissioning will be similar to the control arrangements used for the operation of the facility. The key stakeholders for decommissioning area as follows:

- Australian Naval Nuclear Power Safety Regulator (ANNPSR);
- Australian Radioactive Waste Management Authority (ARWA); and
- The Department of Defence:
    - Office of the CDF and Secretary
    - Royal Australian Navy
    - Security and Estate Group
    - HMAS *Stirling*

5.4 The stakeholders will form an Integrated Project Management Team to undertake the project as per major projects procedures. The Integrated Project Management Team will be accountable to the Director General ASA for all actions related to decommissioning including the following:

- All planning for decommissioning;
- Submission of all required decommissioning documentation such as licence application and public works committee submission;
- Conduct of the approved decommissioning activities; and
- Transfer of the site back to Defence at the end of decommissioning.

Safety Management

5.5 Safety Management for decommissioning will follow the licensee safety management system and Defence's extant safety management systems and policies as applicable.

5.6 A safety management committee will form a subset of the decommissioning management committee. The safety committee will be the primary entity responsible for the management of all safety critical activities during decommissioning. They will undertake the decommissioning hazard identification analysis and the development of mitigation strategies and risk controls.

Organizational and administrative controls

5.7 The organisational structure for decommissioning will be similar to the effective control arrangements described in Part 2 – ASA Effective Control Arrangements, Chapter 1 (SRF-West).

5.8 Detailed control arrangements have not been determined at this time, as the process will not commence for approximately 70 years.

Staffing, Qualifications and Training

5.9 A decommissioning workforce performance-needs analysis based on the Systems Approach to Defence Learning has not yet been conducted for the decommissioning phase for the CIF. Prior to the completion of this detailed analysis, the decommissioning Integrated Project Management Team will nominate a project management office to execute the decommissioning plan.

5.10 Defence will establish specific training intervention to close any skills or knowledge gaps identified by the performance-needs analysis. This may be a combination of formal training, self-paced training or on the job training. This will be managed by the Integrated Project Management Team and delivered by the Project Management Office.

Project Management

5.11 Decommissioning of the CIF will adhere to standard Defence project management processes including the following:

- Decommissioning Scoping Analysis – refined decommissioning plan;
- Decommissioning Requirement Analysis – Work Breakdown Structure (WBS) Dictionary;
- Decommissioning Schedule Analysis – Project Schedule derived from WBS Dictionary;
- Decommissioning Risk Analysis – decommissioning risk management matrix and risk control plan; and
- Decommissioning Cost Analysis – decommissioning budget

Cost Estimate

5.12 Defence will undertake cost analysis at the lowest level of the WBS. This is done via a basis of estimate for each Work Breakdown Structure element. The cost estimate will include the account for:

- Workforce;
- Project Management;
- Waste Management and Categorisation;
- Decontamination and demolition; and
- Site remediation.

Quality Management

5.13 The ASA is in the process of establishing a quality management system. It is expected that the system will be ISO 9001 compliant.

Documentation and Recordkeeping

5.14 The ASA adheres to the requirements of the *Archives Act 1983*, as the basis for all record keeping. The current tool for recordkeeping within the ASA is Objective, which provides full electronic document management and record keeping functionality, including fully auditable tracking of documents created in the Defence system.

5.15 The radiological source inventory system has not yet been selected for the ASA. The selected system will meet the requirements of the *Archive Act 1983*, Defence and ARPANSA.

Contractor involvement

5.16 It is anticipated that the ASA will use specialist contractors for some of the tasks associated with decommissioning. This will be determined during the detailed requirement analysis for decommissioning. Standard government contracting methodology that adheres to the requirements of the *Public Governance, Performance & Accountability Act 2013* will be used. All contractors will be required to verify their specific skill sets as part of the induction process. As standard practice, they will adhere to all ASA and Defence normal safety and security requirements.

Decommissioning Schedule

5.17 Decommissioning of the facility is not anticipated before 2080; no further details on the decommissioning schedule are known at this time.

Section 6 – Conduct of decommissioning

6.1 As decommissioning of the facility is not anticipated before 2080, details on the conduct of decommissioning are not known at this time. Consideration will be given to the following aspects during decommissioning:

- Contaminated structures, systems and equipment that may be within the CIF;
- Surface and subsurface soil and sediment that may be impacted by the CIF;
- Ground and surface water that may be impacted by the CIF;
- Techniques and technologies that may be utilised to decontaminate and dismantle the CIF;
- Criteria for finalising the decommissioning of the CIF; and
- Ongoing surveillance and maintenance requirements for the site of the decommissioned CIF.

Section 7 – Waste management program

7.1 Radioactive waste management will be undertaken in accordance with ASA radioactive waste management policies. See Part 5 – ASA Radioactive Waste Management, Chapter 1 (SRF-West) for more details.

Section 8 – Radiation protection

8.1 Radiation protection will be undertaken in accordance with ASA radiation protection and control policies. See Part 4 – ASA Radiation Protection, Chapter 1 (SRF-West) for more details.

Section 9 – Safety assessment

9.1 The current Safety Analysis Report and hazard identification report are contained in Appendix B of Part 1 – ASA Nuclear Facilities, Chapter 1 (SRF-West). Updated safety assessment documentation will be developed in conjunction with updating this Decommissioning Plan.

Section 10 – Environmental impact assessment

10.1 An environmental impact assessment for decommissioning will be undertaken, once the ASA has identified that the CIF has reached the end of its useful life and is to be decommissioned, in accordance with the *Environmental Protection and Biodiversity Conservation Act 1999*. An Environmental Impact Statement is currently in progress, for the construction of the CIF, and this will be included as an appendix to this plan once completed.

Section 11 – Emergency planning

11.1 No changes to the licensee and Defence emergency plan are anticipated during decommissioning. The current emergency plan is contained at Part 7 – ASA Emergency Management, Chapter 1 (SRF-West).

Section 12 – Physical protection and safeguards

12.1 The extant physical protection methodologies in place during the operation of the CIF will be utilised during the decommissioning phase. s33(a)(i) [redacted]

12.2 A security risk analysis will be conducted as part of the detailed decommissioning planning process. This analysis will determined the sequence of establishment of temporary physical security systems in order for the closure and removal of the permanent systems. If the analysis determines that the systems will provide value for the future use of the decommissioned facility then they will be maintained for the duration of the decommissioning process and then transferred to Defence on site handover. s33(a)(i) [redacted]

12.3 As part of maintaining Australian safeguards no nuclear material will be accepted by the facility s33(a)(iii) [redacted] A range of technical and administrative measures may also be implemented in order to verify the absence of safeguarded material.

Section 13 – Final radiological survey

13.1 A final radiological survey will be planned to be conducted to finalise the decommissioning process. This survey will be undertaken over the site and will seek to mirror the initial radiological baseline survey. Specific methodology, instruments and procedures will be determined prior to commencing decommissioning but will be similar to the initial radiological baseline survey.

13.2 The purpose of this final survey is to demonstrate compliance with a commitment to return the site to its initial state and to demonstrate there is no ongoing radiological risk associated with the decommissioned site. All source information and site survey information will be recorded and maintained within both the ASA and Defence electronic document management systems.

Section 14 – References

1. Australian Radiation Protection and Nuclear Safety Agency, Regulatory Guide – Decommissioning of Controlled Facilities (ARPANSA-GDE-1731).
   (Obj Ref: s22)

2. International Atomic Energy Agency, Decommissioning of Facilities, General Safety Requirements Part 6, No. GSR Part 6.
   (Obj Ref: s22)