Australian Government
Australian Submarine Agency

ASA

Radiation Protection

Controlled Industrial Facility (HMAS *Stirling*)
ARPANSA Construction Licence
Technical Overview

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Contents

List of Acronyms

ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
ASA	Australian Submarine Agency
AUKUS	The trilateral security partnership between Australia, United Kingdom and the United States of America
CIF	Controlled Industrial Facility
HMAS	His Majesty's Australian Ship
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
µGy/h	microgray per hour
mSv/year	millisievert per year

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Radiation Protection

Section 1 – Introduction

1.1 This Technical Overview provides general information on radiation protection for construction of the Controlled Industrial Facility (CIF) at HMAS *Stirling*.

1.2 This Technical Overview addresses Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) requirements detailed in Section F of the ARPANSA – Form -1797 v11.1 dated November 2022.

1.3 This Technical Overview contains information submitted to ARPANSA developed using the Regulatory Guide - Plans and arrangements for managing safety (ARPANSA-GDE-1735) and the ASA's internal guidance set out in *Best Practice Guidance for Managing Nuclear Safety and Radiation Protection*.

1.4 This Technical Overview is not a standalone document and is to be read in conjunction with the other ASA technical overview documents, including for the *Safety Analysis Report*, *Safety Management*, *Radioactive Waste Management*, *Emergency Response* and *Environmental Protection*.

1.5 There will be no radioactive waste produced or stored at the CIF during construction. Information included in this Technical Overview is provided to demonstrate how the construction of the CIF will ensure protection of our people, the public and the environment during future CIF operations (pending regulatory approval for facility operations).

Section 2 – Radiological Protection Principles

2.1 The Australian nuclear-powered submarine program will apply both international best practice (as outlined in this Section) and bespoke radiation control principles (outlined in Section 3).

International System of Radiation Protection

2.2 The International Commission on Radiological Protection, *Recommendations on Radiological Protection*, is based on three key principles, these are the principles of:

a. Having a clear ***justification*** for dealing with and handling radioactive material, which applies in extant, planned, and emergency exposure scenarios and requires demonstration that the dealing does more good than harm

b. ***Optimisation*** of activities when dealing with and handling radioactive material to ensure any potential exposure is minimised, which also applies in extant, planned and emergency exposure scenarios

c. Applying ***dose limits*** to radiation workers, which applies only for doses expected to be incurred with certainty as a result of planned exposure scenarios.

2.3 These principles are described and contextualised for the NPS enterprise in the following paragraphs.

Justification

2.4 Radiological work and repair of submarines is a necessary activity in achieving nuclear stewardship, required for Australia to operate and sustain a sovereign nuclear-powered submarine capability. Hence the need for a waste management function in the CIF.

2.5 The facility has been designed to provide the highest level of protection and lowest level of exposure to our people, the public, and the environment.

Limitation

2.6 Individual and collective doses received will be limited to the regulatory dose limits specified in Part 6 Division 2 of the *Australian Radiation Protection and Nuclear Safety Regulations 2018*, based on the IAEA's International Basic Safety Standards and Table 1 of the International Commission on Radiological Protection, *Recommendations on Radiological Protection*.

2.7 The ARPANSA regulatory dose limits for the Australian nuclear-powered submarine program that apply are as follows:

Dose	**Worker** **(aged at least 18 years)**	**Worker** **(aged 16-17 years)**	**Public**
Regulatory Limits			
Effective dose limit	20 mSv/year averaged over 5 years and not more than 50 mSv in any one year	6 mSv/year	1 mSv/year
Equivalent dose lens of eye	20 mSv/year averaged over 5 years and not more than 50 mSv in any one year	20 mSv/year averaged over 5 years and not more than 50 mSv in any one year	15 mSv/year
Equivalent dose to the skin	500 mSv/year	150 mSv/year	50 mSv/year
Equivalent dose to the hands and feet	500 mSv/year	150 mSv/year	-

Table 1: ARPANSA Regulatory Dose Limits

2.8 The facility has been designed to ensure individual and collective doses to which our people, the public and the environment are exposed are well within the regulatory dose limits.

Optimisation

2.9 ASA is committed to ensuring doses are as low as reasonably achievable, taking into consideration societal and economic aspects. This will be achieved by undertaking a risk based approach to prospective dose assessment of planned activities and tasks[1]:

a. Defining the objective

b. Making a preliminary analysis of the type and level of exposure

c. Defining the radiation protection options

d. Quantifying, where possible, the impact of these options in terms of cost, dose, time, operational impact etc. (where necessary a qualitative assessment may be used)

e. Comparing the credible options

f. Conducting a sensitivity analysis

g. Selecting and implementing the optimised solution.

2.10 A hazard assessment will be undertaken to determine the dose constraint on which doses measured during the activity will be assessed. Predetermined dose constraint and measured doses will be compared post activity to confirm that doses are optimised. This will provide a negative feedback mechanism into future assessments to determine whether the doses are as low as reasonably achievable.

2.11 During the construction phase there will be no radiological components produced, used or stored on site. Therefore, no radiological material can be released into the environment. Additionally, the CIF is to be constructed in such a way that, once operational, unplanned releases of radiological material from the CIF is to be eliminated or mitigated by the design.

2.12 The CIF is being designed and constructed in ways that will protect workers and the public while ensuring that radiological doses that may be present to local wildlife are significantly lower than the recommended levels. Access controls and physical security of buildings will ensure that wildlife are unable to access controlled areas, even though these areas would not normally be considered their natural habitat.

2.13 Non-ionising radiation sources are not expected to be used in CIF operations. Existing Defence non-ionising radiation policy will apply for non-ionising radiation sources used through the construction phase of the CIF.

[1] See: Commission of the European Communities (1991) *ALARA: From theory to practice*, report EUR 13796.

Section 3 – Radiological Controls Principles and Levels

Radiological Controls Principles

3.1 The Australian nuclear powered submarine program will apply best practice principles of radiation protection. Further, the program will use bespoke principles of radiological protection, contextualised for the nuclear powered submarine program, to promote the operational culture for workers and define how workers are to operate in order to achieve appropriate radiation protection. Our eight guiding radiological control principles are:

a. Control and monitor the doses of our people

b. Keep doses as low as reasonably achievable

c. Prevent contamination of our people and the work environment

d. Prevent internal exposure of our workers

e. Control radioactive material from cradle to grave

f. Protect the public

g. Prevent adverse impacts to the environment

h. Ensuring our people have the training, supervision and resources necessary to execute their work to achieve the mission.

Control Levels

3.2 Control levels are an internationally agreed method for optimisation of protection in the system of radiation protection. Control levels are set below statutory limits and are a key input into radiation protection efforts. They will demonstrate that proposed activities involving radioactive material can be carried out without undue risk to the health and safety of people or the environment.

3.3 Control levels will be applied for the future operation of the CIF and will demonstrate ASA's commitment to best practice in the protection of our workers, the public, and the environment.

3.4 A tiered scheme of control levels will be established in order to ensure that doses are detected and analysed at levels well below the statutory limits.

Section 4 – Radiological Controls Workforce

4.1 A number of key roles in the CIF that support the radiological control function include the following:

a. Director of Radiological Controls: Radiological Control Technicians, Radiological Control Engineers and Health Physicists all report to the Director of Radiological Controls, who performs the function of a radiation safety officer for the site

b. The Radiological Controls Technicians perform the function of operational radiation safety officer. The Radiological Controls Technicians supervise radiological work and ensures that radiological controls requirements are followed

c. The Radiological Controls Engineers develop procedures and processes to be followed by radiation workers and radiological controls technicians for specific activities and tasks

d. Health Physicists are part of the local radiological controls team and provide scientific support to radiological controls (e.g. environmental monitoring, dosimetry, clearance of material, internal monitoring).

Workforce Training

4.2 Workforce training will be competency based and follow a learn, see, practice, prove, do, maintain procedural skills training and learning model.

4.3 The training programs will be structured according to a tiered approach, contingent on the level of expertise required for each role. Entry-level training will necessitate several days to weeks of training, while other training programs have been identified that can last up to 18 weeks. Some positions will require advanced levels of education and training including a formal tertiary qualification in a relevant discipline.

Section 5 – Radiation Safety Committee

5.1 The primary role of the radiation safety committee will be the revision of the system of radiation protection by the organisation and will include as a minimum:

a. Radiation protection plans

b. Objectives that keep doses as low as reasonably achievable

c. Dose records

d. Incidents review

e. Review of exercises

f. Lessons learnt

g. Recommendations for policy changes

h. Consultation with radiation workers, visitors and non-radiation workers

i. Perform outreach with relevant state and Commonwealth organisations.

Section 6 – Planning and design of the workplace

6.1 The technical overview for *Safety Analysis Report* outlines the radiological protection and safety considerations taken into account during the planning and design of the facility.

6.2 Workflow planning has been conducted during the facility design to ensure doses are as low as reasonably achievable.

6.3 The design demonstrates that doses can be managed to the dose constraints for radiation workers, members of the public and non-radiological workers. Adherence to limits will be confirmed by monitoring.

6.4 Engineering controls considered during the design process include shielding, active ventilation, liquid storage and an overhead crane to allow movement of radioactive items at a distance. Waste container and storage device inspection areas will be used to ensure packages do not degrade over time.

6.5 Mechanical ventilation systems will be monitored for surface contamination, airborne contamination, and releases to the environment where appropriate.

6.6 Where liquids are stored or collected there is a requirement to design-in lips, dams, or bunds to contain a potential liquid spill. To minimise both the potential for undetected contamination to occur outside the facility the eventual decommissioning of the facility, sumps, drains, and underground piping have been minimised where possible in the design. The facility will be required to be protected from the weather and is designed to limit the ingress of water and other environmental factors during rain and storm events.

6.7 Consideration was given to the requirement for floors with minimal penetrations and joins, surface finishes to floors, ceilings and walls that are simple to decontaminate, are impervious to liquids and can withstand foot and vehicular traffic. These requirements will also aid future decommissioning.

6.8 The operating principle of the fire suppression system is to prevent the outbreak of an uncontrolled fire whilst additionally preventing the potential spread of radioactive materials. Any coatings or finishes must take into account specific fire protection requirements. The facility is designed to allow easy access of fire suppression appliances.

6.9 Electronic access controls will be part of the design requirements that will limit access to radiological areas to authorised personnel only.

Section 7 – Classification of work areas

7.1 Radiological control areas will be defined in a tiered approach based on the hazard of the activities to be performed. Each type of control area will necessitate varying levels of design features, monitoring equipment and personal protective equipment. The Australian and New Zealand Standard AS/NSZ 2243.4 (2018) provides excellent guidance on these requirements.

Section 8 – Local rules and procedures

8.1 Local rules and procedures will be developed against the requirement of the Radiological Controls Manual. Personnel will be trained on these procedures as part of their occupational training. These procedures will not be required during the construction phase of the CIF.

Section 9 – Personal protective equipment

9.1 Practices based on the radiological principle of controlling radioactivity at the source will minimise the requirement for protective clothing. Most radiological work will be conducted inside engineered barriers or glove bags such that protective clothing provides a layer of protection in addition to the engineered barrier. Any protective clothing and gloves will take into account the chemical and radiological protection requirements as well as the requirements to manage environmental factors that could impact on human health (e.g. heat stress, and ergonomics).

9.2 It is not expected that respiratory protection requirements will be required for the activities planned in the CIF. If future requirements change, all respiratory protection will be required to be certified under appropriate Australian Standards such as AS/NZS 1716:2012 *Respiratory Protective Devices*.

Section 10 – Monitoring the workplace

10.1 The ASA has determined detailed equipment performance requirements for the various circumstances in which radiation monitoring is required. Equipment will be selected for the specific types of measurements envisaged.

10.2 The selection and use of equipment will contribute to ensuring that workers do not exceed regulatory dose limits.

Section 11 – Monitoring of individuals

11.1 Monitoring worker dose is the primary way to measure the efficacy of the system of radiation protection. It provides an important feedback mechanism to ensure that the process of keeping doses as low as reasonably achievable is used and ensures that there is information to inform processes to optimise doses. Dosimetry provides assurance to the worker that they are not receiving doses different to what is planned and that their doses are consistent with what is expected for an activity or tasking. It forms an important part of the occupational health record of the worker.

11.2 Visitors will be deemed as members of the public and will be escorted and managed appropriately.

11.3 All radiation workers will be part of a dosimetry program and radiation workers will not be able to enter designated radiation areas unless they are suitably trained and qualified, and are part of a dosimetry program.

Dosimetry

11.4 All radiation workers must wear appropriate personal dosimetry when in radiological controlled areas, with appropriate record keeping in accordance with relevant legislation or regulation.

Dose reconstruction

11.5 In the event of loss or failure of a dosimeter, or a suspected exposure, the prospect dose assessment and health physics assessment will be used to inform a dose reconstruction that will be clearly identified in the workers' dose record.

Frequency will be established based on recommended best practice

11.6 It is unlikely that high-risk radiation work will occur in the CIF. Dosimeters will be assessed immediately following any incident or accident exposure.

Section 12 – Monitoring of the environment

12.1 The radionuclide activity in processed liquid waste will be analysed prior to evaporation to ensure compliance with regulatory limits for atmospheric discharge. All discharges are expected to be below the limits in ARPANSA *Code for the Disposal of Radioactive Waste by the User* (2018) (RPS C6) and therefore no discharge limits will need to be set by the regulatory authorities.

12.2 Baseline environmental surveys will include the collection of data that will support pathway analysis for all potential exposure pathways. During the construction phase there will be no potential exposure of the environment to radioactive material.

12.3 The technical overview for *Environment Protection* outlines the ASA's process to protect the environment.