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NUCLEAR MEDICINE MANUFACTURING PROGRAM

NMMF Decommissioning Plan

For Siting Licence

File Number: NMMP-0410-PM-0007

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Records					
Document Location	[redacted]				
Revision History					
Revision	Date	Summary of Change	Author	Review	Approved
A0	22/07/2024	Original Issue	[redacted]	[redacted]	[redacted]
A1	30/10/2024	Response to SRA feedback. A1	[redacted]	[redacted]	[redacted]

1. Purpose

The purpose of this Decommissioning Plan is to describe the organisational arrangements for decommissioning management under the siting and development phase for a new Nuclear Medicine Manufacturing Facility (NMMF) at the ANSTO Lucas Heights campus.

The plan outlines the processes used in selection of the proposed site and to ensure compliance with the relevant legislation, including the Australian Radiation Protection and Nuclear Safety (ARPANS) Act [Ref: (1)] and Regulations [Ref: (2)]. This plan is an integral element of the ARPANSA Siting Licence Application.

ANSTO is committed to maintaining and enhancing the high standards of identifying the steps required for the characterisation and eventual decommissioning recommended by the International Atomic Energy Agency (IAEA) and required by ARPANSA [Ref: (3)]. The plan is consistent with IAEA standards and guidelines, specifically IAEA Safety Standard Series No. GSG Part 6 [Ref: (4)].

This plan should be read in conjunction with the NMMF Safety Analysis Report (SAR) [Ref: (5)] and Plans and Arrangements supporting the Siting Licence Application.

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Please note for clarity, NMMF refers to the Nuclear Medicine Manufacturing Facility, i.e., the physical structure. NMMP is the Nuclear Medicine Manufacturing Program which includes the NMMF, and the Program of works required to deliver the NMMF.

2. Scope

The scope of this document covers ANSTO's arrangements for decommissioning and typically includes:

- Planning for characterisation
- Planning for decommissioning
- Regulatory approval to conduct decommissioning actions
- Post Operative Clean-Out (POCO)
- Conducting Decontamination and Dismantlement (D&D) activities
- Final release of the facility from regulatory control.

3. Introduction

Decommissioning is the last major period in the lifecycle of a licenced facility.

The actions involve decontamination, dismantling, and removal of radioactive materials, waste, components, and structures. They are carried out in order to achieve a progressive and systematic reduction in radiological hazards and are taken on the basis of planning and assessment to ensure safety during decommissioning operations.

The IAEA Decommissioning of Facilities General Safety Requirements Part 6 [Ref: (4)] identifies three strategies for decommissioning a facility as detailed in Table 1.

Decommissioning Type	Description
Immediate Dismantling	Immediate dismantling is the strategy by which the equipment, structures and parts of a facility containing radioactive contaminants are removed or decontaminated to a level that permits the facility to be released for unrestricted use, or with restrictions imposed by the regulatory body. In this case, decommissioning implementation activities begin shortly after the permanent cessation of operations. This strategy implies prompt completion of the decommissioning project and involves the removal of all radioactive material from the facility to another new or existing licensed facility and its processing for either long term storage or disposal. The timescale for immediate dismantling, as defined by the IAEA, is within 10 years.
Deferred Dismantling (also called Safe Storage, Safe Store, or Safe Enclosure)	Deferred dismantling is the strategy in which parts of a facility containing radioactive contaminants are either processed or placed in such a condition that they can be safely stored and maintained until they can subsequently be decontaminated and/or dismantled to levels that permit the facility to be released for unrestricted use or with restrictions imposed by the regulatory body.
Entombment	Entombment is the strategy by which radioactive contaminants are encased in a structurally long-lived material until radioactivity decays to a level permitting the unrestricted release of the facility, or release with restrictions imposed by the regulatory body.

Table 1: IAEA's Decommissioning Strategies

The strategy chosen for the NMMF is immediate dismantling. The justifications for immediate dismantling are:

- Ceasing of the operational licence costs.
- Removes the maintenance overhead and removes future radiological liabilities.
- Allows for re-use of the existing site.
- Takes advantage of the short radionuclide half-lives produced during operations.
- Allows for knowledge capture and use of operational staff experience.

However, there may be a period of transition, known as the Possess or Control or Care and Maintenance i.e., the time between permanent shutdown and the granting of authorisation to begin decommissioning actions. During this time, the delay and decay principle will be used to ensure that the risks associated with decommissioning the facility are minimised.

Throughout the lifecycle of the NMMF, the operational history, including the use of diverse materials and radiological inventory, will be tracked to ensure a detailed dismantling and decommissioning methodology can be developed at a later stage.

4. Facility Funding

A preliminary estimated cost of decommissioning the facility will be developed at a later stage. This also includes an analysis of appropriate financing mechanisms to enable decommissioning.

5. Decisions Affecting Characterisation and Decommissioning

Many of the activities required during the early stages of characterisation and decommissioning will be dependent on the:

- Timeline to cease operations in the NMMF.
- Funding availability for characterisation and eventual decommissioning.
- Priority of project.
- Definition of the facility end-state and decommissioning boundary.
- Availability of information and records such as health physics records, facility drawings, plant and equipment details, and incident records.
- Availability of experienced operators for the planning of characterisation and decommissioning.
- Post Operative Clean-Out (POCO) including the completion of AF-7030 Preparing to Vacate a Building or Designated Hazardous Area [Ref: (6)].
- Development of strategies for specific radioactive material disposition including the disposal of mixed liquid waste, dismantlement of hot cells and removal of resulting waste, and the possibility of hazardous material including radiological and non-radiological contamination sources.

Other decisions that may affect the characterisation and decommissioning of the NMMF include, but are not limited to:

- Frequent and early communication between the regulator, licensee, and other stakeholders.
- Appointing a responsible person and organisational structure or team for the characterisation and decommissioning planning, management, and execution.
- Establishing the necessary staffing and financial resources.
- Preparing a Waste Management Plan.
- Preparing a final Decommissioning Plan.

5.1. Facility Design

Safe design means the consideration of hazards and incorporation of control measures early in the design process to reduce risks to health and safety throughout the lifecycle of the facility to As Low As Reasonably Practicable (ALARP). The lifecycle of an asset incorporates design, manufacture, transport, installation, construction, commissioning, use, inspection, maintenance, cleaning and repair, decommissioning, demolition, and disposal of the plant or structure. Safe design begins at concept development and continues through all design stages to design maturity considering all stages of the facility lifecycle.

As per the safety in design principles detailed in the Design Guide - Safety in Design Strategy NMMP-0710-PM-0001 [Ref: (7)] the plant should be designed to facilitate safe build, commissioning, and D&D.

As such, the design will ensure that:

- Build, commissioning, decommissioning and dismantle can be conducted safely in accordance with approved procedures and relevant legislation.
- The choice of materials and construction will minimise eventual quantities of radioactive waste.
- Undesired accumulations of chemical or radioactive materials are avoided and processes that minimise and reduce the volumes of waste are utilised.
- Any important access facilities required for commissioning and decommissioning are provided.
- Access to process equipment, structures, systems, and large components are facilitated through designs such as dedicated exclusion zones.
- The choice of materials is likely to be compatible with future waste treatment, storage, and disposal routes.
- Account is taken of the need to make the facility passively safe at the end of its operational life before it enters care and maintenance prior to dismantling and decommissioning.

Additionally, the NMMF will hold equipment and infrastructure such as hot cells, HVAC systems, and waste storage tanks which will require specific planning to execute dismantling and decommissioning.

5.2. Radiological Monitoring of the Site

Prior to the facility's construction and operation, the environmental baseline levels of radiation will be established. This baseline radiological survey will determine the levels of radiation for use in assessing the future impact of the facility. A characterisation process will be conducted prior to undertaking dismantling and decommissioning activities to inform the strategy at a future stage.

5.3. Knowledge Management

Throughout the operation of the facility, adequate measures will be taken to ensure skills and knowledge of the facility are preserved. Ensuring the safe and efficient transfer of critical information and expertise from experienced personnel to new teams over the NMMF's operating lifecycle will help to maintain continuity and prevent the loss of essential knowledge. Prioritising knowledge management in radioactive facility decommissioning enhances safety, minimises risks, and promotes responsible stewardship of nuclear assets.

The IAEA has recognised the importance of, and challenges associated with nuclear knowledge management and has developed various programs and publications to approach knowledge management. One example is *A Taxonomy for the Decommissioning of Nuclear Facilities* [Ref: (8)] which proposes core and enabling concepts, detailed in Figure 1, based on the knowledge and expertise of international decommissioning experts.

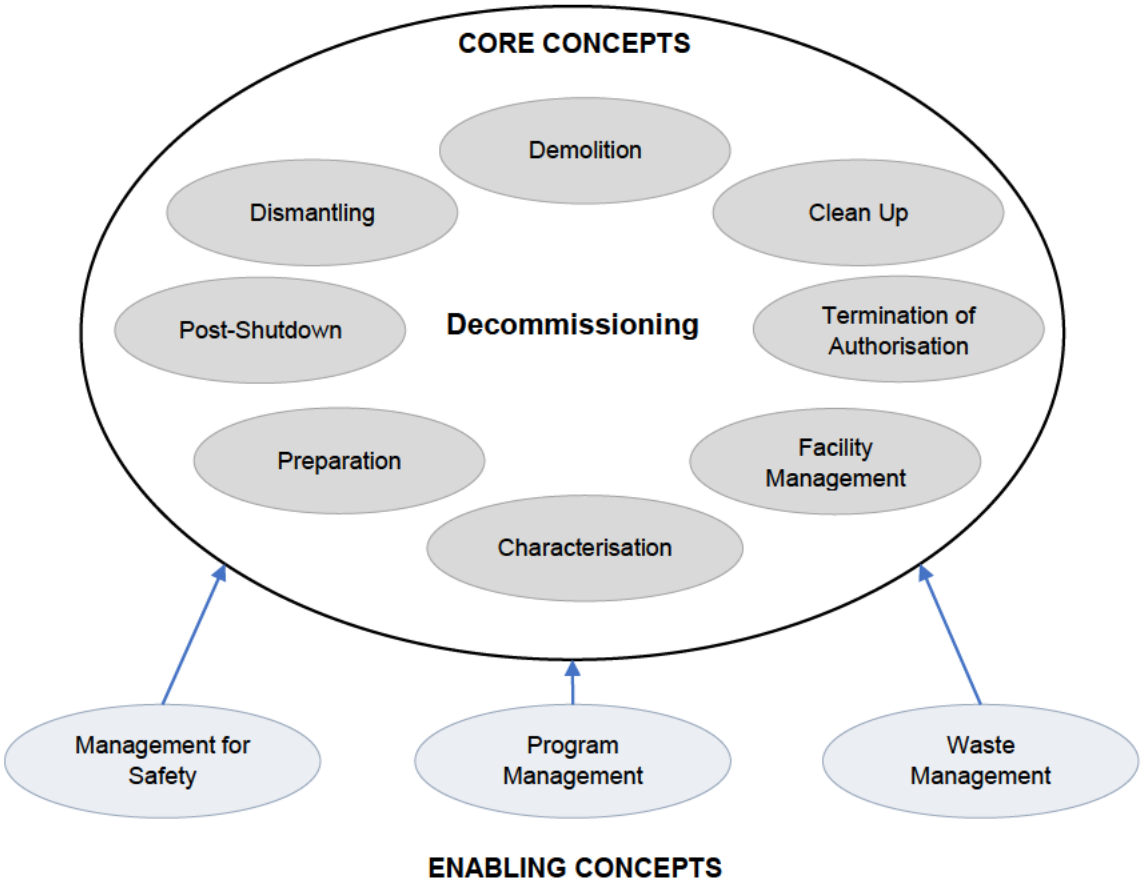

Figure 1: Representation of Core and Enabling Concepts for Decommissioning

A1 6. Preliminary Facility / Site Investigation

There are multiple stages to the characterisation and decommissioning planning of a complex facility such as presented by the NMMF. The first stage to be completed is the initial site investigation consisting of the following stages:

- Historical Site Assessment
- Initial Site Scoping Survey/s
- Radiological Baseline Survey.

6.1. Historical Site Assessment

The Historical Site Assessment (HSA) is a collection of information on the area bounding the NMMF site. The purpose of the HSA is to provide a comprehensive record of the site prior to and for use during a planned decommissioning of the facility. The HSA includes historical land uses, history of any major incidents, an inventory of active and non-active equipment used on the site, past present and expected radiological state, indications of non-radiological hazardous material contaminants, details of any previous surveys completed, and a summary of details garnered from ANSTO hazard databases.

The NMMF HSA will ensure data on the site is captured and records are maintained throughout the construction and operational phases of the asset lifecycle.

6.2. Initial Scoping Survey/s

An initial Site Radiological Scoping Survey [Ref: (9)] has been performed to determine the extent of any surface radiological activity.

The Site Radiological Scoping Survey considers:

- Radiological activity measurements
- Any initial sampling -if required
- Radiological calculations – if required
- Radiological activity mapping
- Dose-rate measurements.

The survey report will form part of the Historical Site Assessment.

6.3. Radiological Baseline Survey

A Radiological Baseline Survey will be performed during or near completion of the facility bulk excavations to determine and document the radiological state of the site prior to building construction works.

The Radiological Baseline Survey will add to and form part of the Historical Site Assessment.

7. Detailed Facility/ Site Investigation

After the HSA and initial site investigations have been concluded, the NMMF will undergo a more detailed characterisation.

7.1. Facility / Site Characterisation Including Waste Characterisation for Disposal

A more detailed determination of the radionuclide inventory in the facility to be decommissioned as well as in the surrounding environment will be conducted through radionuclide modelling, direct measurements, sampling, and radiochemical analysis.

This investigative stage would also include determination of non-radionuclide contaminants such as hazardous materials. The analysis of any intrusive sampling of materials may be used for waste characterisation purposes. Characterisation of non-radiological facilities should provide data for the Final Site Survey (FSS).

7.2. Hazardous Material Surveys and Analyses

Intrusive characterisation surveys and analysis for chemical, heavy metal, and asbestos materials is to be carried out for the non-radioactive and conventional parts of a facility / site. Generally, to complete this work, the building will have to be fully isolated from site services such as electrical, IT network, water, and air.

7.3. Environment Protection and Biodiversity Conservation Act (EPBC) Referral

ANSTO has submitted a referral to construct and operate a new Nuclear Medicine Manufacture Facility at Lucas Heights, NSW. The referral was for a proposed action under Section 68 of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

The delegate for the Minister for the Environment and Water has confirmed that the proposed action is not a controlled action, provided it is taken in the manner described in decision document EPBC Notification of Referral Decision - (EPBC 2023/09748) [Ref: (10)].

Formal comments on the referral were received from:

- National Indigenous Australians Agency (NIAA)
- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)
- Department of Industry, Science and Resources (DISR).

Geoscience Australia concurred with ANSTO that construction of the NMMF is not likely to have a significant impact to the environment and should not be considered a controlled action.

A1 8. Facility Decommissioning Plan or Site Remediation Plan

Following a thorough site investigation, the next phase of decommissioning includes:

- Development of a licence application or regulatory approval for characterisation or decommissioning.
- Plans for the final decommissioning / remediation of the facility.
- A detailed decommissioning risk analysis.
- Safety and security planning.
- A plan for the environmental management.
- Waste management plan.
- Radiological characterisation for waste classification/ clearance.

8.1. License Applications and Regulatory Approval

The necessary regulatory assessment, licence applications, licence documentation, preparation, and revision of technical and operating specifications will be put forward to the regulator for their approval. Questions that are considered in the development of the licence application should be:

- Will the site be redeveloped / re-purposed?
- Will the public have access?
- What site services will be impacted and require relocation or re-instatement?
- Are there impacts to other facility operations?
- What site infrastructure requires relocation such as gardens and roads?

8.2. Decommissioning / Remediation Planning

Decommissioning planning includes the evaluation of decommissioning options, consideration of cost, time and personnel capacity, the review of the HSA, any/all radiological and non-radiological survey documentation, and an inventory of the active and non-active equipment to be dismantled. This should also include a brief estimate of occupational dose and identify possible scheduling of activities as well as the site requirements (such as fencing and traffic management).

8.3. Detailed Decommissioning Risk Analysis

Detailed Decommissioning Risk Analysis methodically identifies the risks involved with decommissioning and produces a comprehensive risk assessment report. A detailed decommissioning risk analysis will be undertaken at a later stage including elements related to radiological and conventional industrial risks such as exposure, contamination to workers, public, and the environment, accidents, fire, and building collapse.

8.4. Safety and Security Planning

Safety and security plans involve the development of contingency planning for emergencies, the assessment of physical protection needs as well as traffic, pedestrian, public, and/or contractor safety. A safety management plan, NMMF Safety Management Plan NMMP-0410-PM-0002 [Ref: (11)], and a security plan, NMMF Security Plan NMMP-0410-PM-0008 [Ref: (12)], have been developed for the siting phase for the NMMF. As the facility approaches the decommissioning stage, these will be updated to reflect the current status of the NMMF.

8.5. Environmental Management Plan (EMP)

An environmental protection plan, NMMF Environment Protection Plan NMMP-0410-PM-0006 [Ref: (13)], has been developed for the NMMF as part of the Siting Licence Application. When the NMMF is approaching the end of its lifecycle, this plan will be leveraged to develop a decommissioning-related EMP.

8.6. Waste Management Plan (WMP)

The development of a WMP establishes the waste management criteria for decontamination, disposal, clearance/ release, and recycling. It also looks at the impacts on decontamination and dismantling methods, mainly the creation of secondary wastes from decontamination and dismantling methods.

The WMP identifies the system to be used for final waste management, identifies the release criteria, and establishes possible waste packaging (including waste conditioning). Existing waste management systems and processes will be leveraged to manage waste from future decommissioning.

A waste management plan, NMMF Waste Management Plan NMMP-0410-PM-0004 [Ref: (14)], has been developed for the NMMF as part of the Siting Licence Application. When the NMMF is approaching the end of its lifecycle, this plan will be leveraged to develop the WMP which will include decommissioning and dismantling related implications as required.

8.7. Radiological Characterisation for Waste Classification

Any material that is being disposed of or recycled must be characterised and managed in alignment with their activity levels as detailed by ARPANSA and the NSW Environmental Protection Agency (EPA). Materials generated from decommissioning activities may be designated as cleared and can be removed from regulatory control and managed through conventional municipal, restricted, and hazardous disposal pathways. Classification (Class 1, 2, or 3) is preliminarily determined by the HSA and then confirmed by the PSI and subsequent detailed characterisation. For Class 1, 2 and 3 radiological facilities, this characterisation may take place during detailed characterisation when intrusive samples are collected.

Waste classification of non-radiological facilities can occur during demolition, with bulk representative samples collected for analysis.

9. Final Site Handover – Post Decommissioning

The final steps in the decommissioning of NMMF will involve final surveys, determination of any ongoing monitoring requirements, and the issuance of a Clearance Certificate to the ANSTO Landlord.

9.1. Final Site Surveys (FSS) – Radiological and Non-Radiological

Final survey of site, including the planning for final survey and sampling, gathering all survey documentation, and any administrative and/or physical controls to isolate the surveyed areas, including plans preventing recontamination once the survey has been completed.

9.2. Ongoing Monitoring Requirements

If the project is unable to clear all hazardous material, further consideration is required to determine if there are any ongoing monitoring requirements for the site.

9.3. Clearance Certification

ANSTO will require a certificate from Radiation Protection Services (RPS) that the site is clear (radiologically) for unrestricted use. This may need approval from ARPANSA.

A second clearance certificate will be required, generally from the organisation that completed the initial hazardous-material surveys and analyses, to state there are no non-radiological contaminants (such as asbestos and heavy metals) remaining after site remediation.

10. Definitions

The following abbreviations / definitions have been used in this document:

Term	Definition
ALARP	As Low As Reasonably Practicable
ANSTO	Australian Nuclear Science and Technology Organisation
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
D&D	Decontamination and Dismantlement
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
EPBC	Environment Protection and Biodiversity Conservation
FSS	Final Site Survey
HSA	Historical Site Assessment
NMMF	Nuclear Medicine Manufacturing Facility
NMMP	Nuclear Medicine Manufacturing Project
POCO	Post Operative Clean-Out
PSI	Preliminary Site Investigation
RPS	Radiation Protection Services
WMP	Waste Management Plan

11. References

The following items are referred to in this document or were used in its creation.

1. Australian Radiation Protection and Nuclear Safety (ARPANS) Act. Cth, 1998.
2. Australian Radiation Protection and Nuclear Safety (ARPANS) Regulations. Cth, 2018.
3. ARPANSA-GDE-1731 ARPANSA Regulatory Guide: Decommissioning of Controlled Facilities. 2020.
4. IAEA Safety Standards, GSR Part 6, Decommissioning of Facilities. Vienna : International Atomic Energy Agency, 2014. GSR Part 6.
5. Safety Analysis Report. NMMP-0410-RT-0004.
6. AF-7030 Preparing to Vacate a Building or Designated Hazardous Area.
7. NMMP-0710-PM-0001 Design Guide - Safety in Design Strategy.
8. IAEA-TECDOC-2029 A Taxonomy for the Decommissionng of Nuclear Facilities.
9. NMMP-1100-RT-0008 NMMF Site Radiological Scoping Survey.
10. EPBC Notification of Referral Decision. EPBC 2023/09748.
11. NMMP-0410-PM-0002 NMMF Safety Management Plan.
12. NMMP-0410-PM-0008 NMMF Security Plan.
13. NMMP-0410-PM-0006 NMMF Environmental Protection Plan.
14. NMMP-0410-PM-0004 NMMF Waste Management Plan.

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