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ANM Mo99 Project

Commissioning Plan of Safety Related Systems

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Revision Details

Print name, date and initial each box

Rev. Letter	Description of Revision	Prepared	Reviewed	Approved	Agreed
A	Initial Issue				
B	Update after SAC comments				

Notes:
1. Revision shall be verified in accordance with the Quality Plan for the project.
2. Revision to be agreed by the relevant Client.

Distribution List

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2	ANM Mo99 Project

1. Purpose

The purpose of this document is to outline the plan for the commissioning of the radiological safety related systems of the ANSTO Nuclear Medicine (ANM) Mo99 radiopharmaceuticals production facility (Building 88 at Lucas Heights Science and Technology Centre).

The commissioning plan should be read in conjunction with the other plans and supporting documents comprising the operating licence application.

2. Scope

The scope of work described in this commissioning plan is limited to the safety systems relating to the ARPANS legislation (1), (2). The commissioning plan is based on the safety systems categorised as 1 and 2, and outlined in the preliminary Safety Analysis Report (3)

This plan does not cover other commissioning activities required to complete the overall project. Other commissioning activities are documented in the ANM Mo-99 project commissioning plan (4) and Mo-99 production process commissioning plan (5).

3. Definitions, Abbreviations and Acronyms

Abbreviation	Definition
ALARA	As Low As Reasonable Achievable
ANM	ANSTO Nuclear Medicine
RPA	Radiation Protection Advisor
LLLW	Low Level Liquid Waste
LLSW	Low Level Solid Waste
ILLW	Intermediate Level Liquid Waste
ILSW	Intermediate Level Solid Waste

Table 1: Table of Definitions, Abbreviations and Acronyms

4. Roles and Responsibilities

Commissioning is a project activity and is part of the overall ANM project managed by ANSTO Engineering and Capital Programs.

Project staff and Watpac Constructions Pty Ltd, as Principal Contractor, plan and manage the commissioning activities and involve ANM staff, Radiation Protection Advisers (RPA) and specialist engineers.

The ANM Technical Manager has responsibility for overseeing the commissioning activities and reviewing the results of the commissioning tests.

5. Safety Related Items at ANM

Item	Description	Safety Function Requirement	ANM Mo99 Category
1	Hot Cell Shielding	Ensures that the dose rate from the hot cells during normal operations is reduced to ALARA levels.	1
2	Hot Cell Containment	Ensures that any spill or aerial release of radioactive material is physically impeded from transfer/migration into the Operator Environment.	2
3	PADIRAC Cask/Shielding	Ensures that the dose rate from the PADIRAC Cask during normal operations is reduced to ALARA levels.	1

Item	Description	Safety Function Requirement	ANM Mo99 Category
4	Process Vessels Containment (In Dissolver Cell)	Ensures that the radioactive material is prevented from contaminating the cell and presenting a challenge to the hot cell containment.	1-2
5	BU Container Interlock	Ensures that during the operation of the shield door/gate for BU container movement, the shielding/containment integrity is not compromised.	2
6	Flask Shielding	Ensures that the dose rate from the Flask normal operations meet the transport index requirement and is reduced to ALARA levels.	1-2
7	Rear of Cells Crane	Ensures that the crane is certified appropriately for dangerous good rating lifting purpose.	2
8	Active Ventilation System Containment	Ensures that any spill or aerial release of radioactive material is physically impeded from transfer/migration into the Operator Environment. Ensures that any gaseous or airborne particulate radioactive material is removed to the extract ventilation system. Maintains the ductwork at negative pressure which minimises the risk of escape of activity following a breach.	2
9	Container Handling and Despatch Shielding	Ensures that the dose rate at the despatch area during normal operations is reduced to ALARA levels.	2
10	QC Lab, Retention Samples, Other dose areas shielding	Ensures that the dose rate at the QC area during normal operations is reduced to ALARA levels. Note: QC Lab is not fitted out for the new ANM facility and will be commissioned at a later stage.	2
11	ILLW System Shielding	Ensures that the dose rate at the surface of the holding and decay tanks, ILLW tanks and holding tanks transfer line to Synroc and the Valve Room is reduced to ALARA levels.	1
12	ILLW System Containment	Ensures that any spill or aerial release of radioactive material is physically impeded from transfer/migration into the environment.	1
13	LLLW System Shielding	Ensures that the dose rate at the surface of the holding, decay tank and the Valve Room is reduced to ALARA levels.	1
14	LLLW System Containment	Ensures that any spill or aerial release of radioactive material is physically impeded from transfer/migration into the environment.	1
15	Carbon Column Shielding	Ensures that the dose rate at the surface of the lead shielding of the Carbon Column room is reduced to ALARA levels.	1-2
16	HEPA / SIAMs Shielding	Ensures that the dose rate at the surface of the lead shielding of the HEPA / SIAMs room is reduced to ALARA levels.	2

Item	Description	Safety Function Requirement	ANM Mo99 Category
17	Basement / Airlock Shielding	Ensures that the dose rate at the concrete walls, floor and roof of the basement is reduced to ALARA levels.	1
18	Area Radiation Monitors	Provides an alert of the presence of a high dose rate within the area.	2

6. Arrangements for Testing and Commissioning

In addition to the above items formally identified as safety systems within the preliminary SAR, the following systems within the facility will also be confirmed operational:

- Electrical Services (distribution boards, outlets, etc.)
- Hydraulic Services (water supply, trade waste, etc.)
- Pipe gases (manifolds, regulators, gas lines, compressed air system etc.)
- Fire Services
- Information Management Systems (BMS, EMS etc)
- Security Services

6.1. Factory Acceptance Testing and Site Acceptance Testing

Key equipment items are subject to Factory Acceptance Testing (FAT) prior to consignment to and installation at ANSTO. Factory Acceptance Testing is performed for the hot cell containment and interlock systems.

Major equipment and systems are also subject to Site Acceptance Testing (SAT) or Commissioning by the Vendors/Contractors. The completed records will be reviewed and signed off, prior to acceptance by ANSTO. Some of the Vendors/Contractors SAT or commissioning tests will provide the records for the cold and hot commissioning discussed below.

6.2. Cold Commissioning

The testing and commissioning prior to introducing the irradiated target to the facility / process is called ‘Cold Commissioning’ and is performed under the Construction Licence issued by ARPANSA.

The testing and commissioning using the irradiated target is called ‘Hot Commissioning’ and is anticipated to be performed under a restricted Operating Licence issued by ARPANSA. The outcome of the Cold and Hot Commissioning confirm the safety performance of the systems.

Item	Description	Commissioning Activities	Acceptance Criteria	Responsible
1	Hot Cell Shielding	Perform visual inspection of Hot Cell Structure Verify shielding thickness Verify material certificate Conduct short path testing (use sealed source)	Confirm no visually obvious damage Shielding thickness as per design specification Material certificate as per design specification Confirm no radiation short paths detected	RPA Project Engineer

Item	Description	Commissioning Activities	Acceptance Criteria	Responsible
2	Hot Cell Containment	Perform hot cell leak test Confirm that negative pressure is maintained with primary active ventilation is in operation	Leak rate conforms to: DCEL1: Class 2 ISO-10648 Other Cells: Class 3 ISO-10648 Hot cell pressure gauge maintained specified pressure document in Mo99_OGAS_MECH_PID_0130 DCEL1: -500 Pa HCELL: -400 Pa PCEL1: -400 Pa ECEL1: -350 Pa DSPC1: -300 Pa PKGC1: -350 Pa IPSC: -200 Pa ISWC: -200 Pa LSWC: -200 Pa	Vendor/Contractor Engineer HVAC Engineer
3	PADIRAC Cask/Shielding	Perform visual inspection of PADIRAC structure Verify shielding thickness Conduct short path testing (use sealed source)	Confirm no visually obvious damage Shielding thickness as per design specification Confirm no radiation short paths detected	RPA Project Engineer
4	Process Vessels Containment (In Dissolver Cell)	Verify pressure vessel leak test	Pressure and Vacumn Leak Test: pressure / vacuum hold for 5 min as a startup check.	Project Engineer ANM Operator
5	BU Container Interlock	Perform BU Container Interlock functional check including alarms	Interlock to prevent B(U) flask trolley table being lowered if the lid is not placed correctly on the B(U) Inner Container. Interlock to prevent the lowering of the B(U) IC trolley if the radiation level inside the packaging cell is above a safe threshold setting. Interlock to prevent opening the packaging hot cell shield door if the radiation level inside the packaging cell is above a safe threshold setting Interlock to prevent inter-pass doors between the dispensing cell and packaging cell from opening if the trolley is not engaged with the packaging cell. Detect the trolley position	Vendor/Contractor Engineer I&C Engineer

Item	Description	Commissioning Activities	Acceptance Criteria	Responsible
			and isolate the pneumatic air to the pneumatic air solenoid for the inter-pass door. Functional check of all alarms passed.	
6	Flask Shielding	Perform visual inspection of Flask structure Verify shielding thickness Conduct short path testing (use sealed source)	Confirm no visually obvious damage Shielding thickness as per design specification Confirm no radiation short paths detected	RPA Project Engineer
7	Rear of Cells Crane	Verify the crane is certified for Dangerous Goods rating	Crane is approved by Lifting Equipment Approval Officer Crane is registered and certified for Dangerous Goods application.	Project Engineer Technical Manager
8	Active Ventilation System Containment	Perform leak test on active ventilation ductwork Perform zone pressure control test (*)	Leak tests on active ventilation ductwork as per drawing Mo99_FACL_MECH_ED_2615 : ANM Mo-99 Facility Pressure Zoning for Air Directional Flow: Primary system to conform to Class 2 ISO 10648-2 Secondary system to conform to AS4254.2 2012	Vendor / Contractor Engineer HVAC Engineer
9	Container Handling and Despatch Shielding	Perform visual inspection of Container structure Verify shielding thickness Conduct short path testing (use sealed source)	Confirm no visually obvious damage Shielding thickness as per design specification Confirm no radiation short paths detected	RPA Project Engineer
10	QC Lab, Retention Samples, Other dose areas shielding Note: ANM QC Blue Lab will not be fitted out until a later date. Building 2 QC Blue Lab is to be used	Perform visual inspection of Flask structure Verify shielding thickness	Confirm no visually obvious damage Shielding thickness as per design specification Confirm no radiation short paths detected	RPA Project Engineer QC Leader

Item	Description	Commissioning Activities	Acceptance Criteria	Responsible
11	ILLW System Shielding	Perform visual inspection of Shielding structure Verify shielding thickness Conduct short path testing (use sealed source)	Confirm no visually obvious damage Shielding thickness as per design specification Confirm no radiation short paths detected	RPA Project Engineer
12	ILLW System Containment	Perform leak test for the system	Pressure test for leak of Decay tank / ILLW tank / Holding tank and transfer line	Vendor/Contract Engineer Project Engineer
13	LLLW System Shielding	Perform visual inspection of Flask structure Verify shielding thickness Conduct short path testing (use sealed source)	Confirm no visually obvious damage Shielding thickness as per design specification Confirm no radiation short paths detected	RPA Project Engineer
14	LLLW System Containment	Perform leak test for the system	Pressure test for leak of Decay tank / LLLW tank / holding tank and transfer line:	Project Engineer Technical Manager
15	Carbon Column Shielding	Verify shielding thickness Conduct short path testing (use sealed source)	Confirm no visually obvious damage Shielding thickness as per design specification Confirm no radiation short paths detected	RPA Project Engineer
16	HEPA / SIAMs Shielding	Verify shielding thickness Conduct short path testing (use sealed source)	Confirm no visually obvious damage Shielding thickness as per design specification Confirm no radiation short paths detected	RPA Project Engineer
17	Basement / Airlock Shielding	Verify shielding thickness Conduct short path testing (use sealed source)	Confirm no visually obvious damage Shielding thickness as per design specification Confirm no radiation short paths detected	RPA Project Engineer

Item	Description	Commissioning Activities	Acceptance Criteria	Responsible
18	Area Radiation Monitors	Review calibration records Generate audio-visual alarms using sealed source or equivalent signal injection (change setpoint as required for testing purpose) Confirm all radiation monitors are reset to the pre-determined setpoint at the conclusion of the testing	Instruments are in calibration Confirm functional requirement: alarm activates as expected Pre-determined setpoint setup as per RPA requirement	RPA I&C Engineer

(*) Leak testing is undertaken for the Blue and Red areas. This is achieved by extracting and measuring air from the zone at the design room pressure with the supply system sealed, thus measuring the building fabric leakage

6.3. Hot Commissioning

The operations of the Safety Related Systems are to be confirmed during cold commissioning (i.e. prior to the introduction of a significant radiological hazard into the Facility). The remaining test requires the introduction of the irradiated target to the hot cell and the subsequent processing of the Mo-99 manufacturing sequences. These tests may only proceed under an appropriate licence issued by ARPANSA.

The tests for the Hot Commissioning are given below:

Item	Description	Commissioning Activities	Acceptance Criteria	Responsible
1	Hot Cell Shielding	Perform radiological surveys outside the hot cell (with increase radiation activity)	Confirm that the shielding meets the requirements of the Dose Rate Design Limit in: Report TN 146748: Safety Review of the Concrete Hot Cell Shielding in the ANM Mo99 Facility: • Table 1: Dissolution Hot Cell • Table 3: Hydrogen Converter Hot Cell • Table 5: ILSW Hot Cell • Table 7: LLSW Hot Cell Report TN 146749: Safety Review of the Lead Hot Cell Shielding in the ANM Mo99 Facility:	RPA Technical Manager

Item	Description	Commissioning Activities	Acceptance Criteria	Responsible
			• Table 1: Purification Hot Cell • Table 3: EvaporationHot Cell • Table 5: Dispensing Hot Cell • Table 7: Packaging Hot Cell	
2	PADIRAC Cask Shielding Note: this test might not be able to be completed during Hot Commissioning as the SUF Cup is required to be decayed over a period before this can be transferred	Perform radiological surveys of the PADIRAC Cask Shielding during the transfer of the SUF Cup with increasing the number of Cups transfer	Confirm that the shielding meets the requirements of the Dose Rate Design Limit in Table 7 of the Dose Rate Design Limit in the report TN 146966: Safety Review of Flasks, Doors and other Shielding in the ANM Mo99 Facility	RPA Technical Manager
3	Flask Shielding Note: this test might not be able to be completed during Hot Commissioning as the SUF Cup is required to be decayed over a period before this can be transferred	Perform radiological surveys of the Waste Flask Shielding during the transfer of the SUF Cup with increasing the number of Cups transfer	Confirm that the shielding meets the dose rate limit of 2 miliSievert/Hour	RPA Technical Manager
4	Container Handling and Despatch Shielding	Perform radiological surveys of the BU Container Handling and Despatch Shielding during hot commissioning operation	Confirm that the shielding meets the dose rate limit of 10 microSievert/hr	RPA Technical Manager
5	QC Lab, Retention Samples areas shielding Note: ANM QC Blue Lab will not be fitted out until a later date. B2 QC Lab is to be used.	Perform radiological surveys of the QC Lab and Retention Samples areas shielding	Confirm that the shielding meets the dose rate limit of 10 microSievert/hr	RPA QC Leader

Item	Description	Commissioning Activities	Acceptance Criteria	Responsible
6	ILLW Holding Tank and Decay Tank Shielding	Perform radiological surveys of the Waste Tank area during operation for a period of time for the accumulated waste	Confirm that the shielding meets the requirements of the Dose Rate Design Calculation in section 5.2.16 of report TN 146966: Safety Review of Flasks, Doors and other Shielding in the ANM Mo99 Facility	RPA Technical Manager
7	LLLW Holding Tank and Decay Tank Shielding	Perform radiological surveys of the Waste Tank area during operation for a period of time for the accumulated waste	Confirm that the shielding meets the requirements of the Dose Rate Design Calculation in section 5.2.16 in report TN 146966: Safety Review of Flasks, Doors and other Shielding in the ANM Mo99 Facility	RPA Technical Manager
8	Carbon Column Shielding	Perform radiological surveys of the Carbon Column and gas decay tank area after 72 hours decay during hot commissioning and will be monitor further for accumulated activity during operation.	Confirm that the shielding meets the requirements of the Dose Rate Design Limit in Table 29 of in report TN 146966: Safety Review of Flasks, Doors and other Shielding in the ANM Mo99 Facility	RPA Technical Manager
9	Basement / Airlock Shielding	Perform radiological surveys of the basement area after 72 hours decay during hot commissioning	Confirm that the shielding meets the requirements of the Dose Rate Design Limit in Table 2 of in report TN 143679: Safety Review of Basement Shielding in the ANM Mo99 Facility	RPA Technical Manager

6.4. Commissioning Method

Each of the system tests above will be recorded in the Commissioning Test Form/Protocol as Appendix A. The detail of the test will be reviewed and issued before commissioning is commenced.

The acceptance of satisfactory test completion must be confirmed by the Responsible Officer; by witnessing that the test has been performed or by sighting the evidence of the test has been carried out in other commissioning activities. Approval requires demonstration that the acceptance criteria have been achieved.

Any system that fails commissioning shall be recorded in a Non-Conformance report and shall be reviewed by the ANM Project Manager, the ANM Client Office Manager and as appropriate, the RPA, Safety and Reliability Officer and the Vendor of the equipment. Corrective actions are to be completed and the test to be re-executed.

7. Reference Documents

1. *Australian Radiation Protection and Nuclear Safety (ARPANS) Act.* s.l. : Cth, 1998.
2. *Australian Radiation Protection and Nuclear Safety (ARPANS) Regulations.* 1999.
3. *ANM-Mo99-C-LA-C4d Construction Licence PSAR.*
4. *Mo99_FACL_OTHER_2216 ANSTO ANM Mo99 Project Commisioning Plan.*
5. *Mo99_COMM_PROC_CTP_1174 Commissioning Plan Mo-99 Production Process.*
6. *ANM-Mo99-C-LA-C4e Construction Licence Testing and Commissioning of Safety Related Items.*
7. *ANM Mo99 Facility Shielding Report.* Mo99_FAC_CELL_ER_2002.
8. *TN 143679: Safety Review of the Basement Shielding in the ANM Mo99 Facility.*
9. *TN 146855: Safety Review of the Ground Floor Shielding in the ANM Mo99 Facility.*
10. *TN 146966: Safety Review of Flasks, Doors and other Shielding in the ANM Mo99 Facility.*
11. *TN 146748: Safety Review of the Concrete Hot Cell Shielding in the ANM Mo99 Facility.*
12. *TN 146749: Safety Review of the Lead Hot Cell Shielding in the ANM Mo99 Facility.*

8. Appendix A: Commissioning Test Form/Protocol

GENERAL

System / Equipment:			
Dates:		**Tester:**	
Test equipment:	Item	Calibrated until	

TESTS

No	Test Description / Requirement	Acceptance Criteria	Pass/Fail	Verified / Checked by	Date	Comments
1						
2						
3						

RESULTS

Summary:				
Outstanding work (if any)				
Witnesses / Test Approval	**Personnel Involved:**	Vendor Project RPA Other	Who (print)	Sign & Date

Results/Status	☐ Accepted	☐ Corrective Action	☐ Rejected
Approved By	Name	Signature	Date