Document Number: RRRP-7265-EDEAN-001-REV0
Revision: REV0

ansto

Replacement Research Reactor Project

RADIATION PROTECTION PLAN

Prepared By

Australian Nuclear Science and Technology Organisation

9 September 2004

ANSTO		Document N°: **RRRP-7265-EDEAN-001-REV0** Revision: **REV0**		
Replacement Reactor Project		Document Title: Radiation Protection Plan		
REVISION SHEET		Ref No:		
		Print name, date and sign or initial		
Revision Letter	Description of Revision	Prepared	Checked/ Reviewed	Approved
0	Original issue to ARPANSA	AMP	KJH	GDW
Notes: 1. Revision must be verified in accordance with the Quality Plan for the job.				

TABLE OF CONTENTS

1 PURPOSE AND SCOPE OF THIS RADIATION PROTECTION PLAN

1.1 PURPOSE

The purpose of this Radiation Protection Plan is to describe the organisational arrangements for the control of exposures to ionising radiation during all activities involved with the operation of the Reactor Facility.

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

1.2 SCOPE

This plan applies to all activities associated with the normal operation of the Reactor Facility and the radiation protection of all personnel in the facility. This includes the reactor groups, those who utilise the reactor facilities, support services, and personnel within ANSTO and external to ANSTO, including the following activities: Reactor Operation and Maintenance, Radioisotope Irradiation, Neutron Activation Analysis (NAA), Neutron Beams Utilisation, management of radioactive waste, and the transport of radioactive materials within and to/from the facility.

Interfaces with ANSTO facilities and plans are described, in order to ensure a comprehensive, international best practice Radiation Protection Program for the Reactor Facility. Protective actions implemented in emergency exposure situations are described in the Reactor Facility Emergency Plan, a separate document describing actions taken when intervention levels may be exceeded.

2 REFERENCES

a) Regulatory Guideline on Review of Plans and Arrangements, ARPANSA, RB-STD-15-03, Version 0, August 2003

b) Recommendations for limiting exposure to ionizing radiation (1995) (Guidance note [NOHSC:3022(1995)]) and National standard for limiting occupational exposure to ionizing radiation [NOHSC:1013(1995)], ARPANSA, Radiation Protection Series Publication No. 1, Republished March 2002

c) International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, IAEA, Safety Series No. 115, 1996

d) IAEA Safety Standard Series: Occupational Radiation Protection, IAEA, Safety Guide No. RS-G-1.1, October 1999

e) IAEA Safety Standard Series: Assessment of Occupational Exposure Due to Intakes of Radionuclides, IAEA, Safety Guide No. RS-G-1.2, October 1999

f) IAEA Safety Standard Series: Assessment of Occupational Exposure Due to External Sources of Radiation, IAEA, Safety Guide No. RS-G-1.3, August 1999

g) Code of Practice for the Safe Transport of Radioactive Material, ARPANSA, Radiation Protection Series Publication No. 2, September 2001

h) APOL 2.1 Health Safety and Environment Policy

i) ANSTO Safety Directive 1.1: Safety Management System Overview

j) ANSTO Safety Directive 1.3: Safety Responsibilities of Area Supervisors

k) ANSTO Safety Directive 2.1: The Safety and Review Approvals System

l) ANSTO Safety Directive 4.1: The ANSTO Event Response System

m) ANSTO Safety Directive 5.1: Radiation Protection Principles

n) ANSTO Safety Directive 5.2: ANSTO's Policy on As Low As Reasonably Achievable

o) ANSTO Safety Directive 5.3: Annual Limits on Intake and Derived Air Concentrations of Some Common Radionuclides

p) ANSTO Safety Directive 5.4: Radiological Classification of Areas and Access Control to Radiological Areas

q) ANSTO Safety Directive 5.5: Personal Dosimetry

r) ANSTO Safety Directive 5.6: Safe Movement and Transport of Radioactive Materials.

s) ANSTO Safety Directive 5.7: ANSTO's Radioactive Waste Management System.

t) ANSTO Safety Directive 7.1: Statement of OH and Safety Policy.

u) ANSTO Safety Directive 7.3: Safety Training Policy

v) ANSTO Safety Directive 7.11: Safe Working Permits

w) ANSTO Safety Directive 7.14: Personal Protective Equipment

x) ANSTO Safety Directive 7.15: Safety Hazards Notice Boards

y) ANSTO Safety Directive 7.5: Medical Arrangements at LHSTC

3 DEFINITIONS

The following definitions have been used in this plan.

The reactor facility; or the Replacement Research Reactor	The reactor facility means the multipurpose research reactor that replaces HIFAR, and its associated buildings, physical plant, structures, components and systems including software and, where relevant, any management systems necessary to achieve the design, construction and operation of the facility.
The Lucas Heights Science and Technology Centre	An area of approximately 70 hectares, including a number of facilities immediately outside the perimeter security fence, such as the Lucas Heights Motel, canteen, Woods Centre, and other buildings in the ANSTO Technology Park

3.1 ACRONYMS

AEM	Air Effluent Monitoring
AHSEC	ANSTO Health Safety and Environment Committee
ALARA	As Low As Reasonably Achievable
ANSTO	Australian Nuclear Science and Technology Organisation
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
CNS	Cold Neutron Source
GTP	Gravity Transfer Pipes
HEPA	High Efficiency Particle Air Filters
HPS	Health Physics Surveyor
IAEA	International Atomic Energy Agency
IHCE	Inter Hot Cells Elevator

INVAP	Reactor Vendor
IPTS	Inter Building Pneumatic Transport System
LEM	Liquid Effluent Monitor
LHSTC	Lucas Heights Science and Technology Centre
LOCA	Loss of Coolant Accident
NSW	New South Wales
OHS	Occupational Health and Safety
PAM	Post Accident Monitor
PSAR	Preliminary Safety Analysis Report
QMS	Quality Management System
RAC	Reactor Assessment Committee
RCMS	Reactor Control and Monitoring System
RHS	Radioisotope handling system
RPA	Radiation Protection Adviser
RPO	Reactor Pool
RPP	Radiation Protection Plan
RPS	Reactor Protection System
RPSS	Radiation Protection Services Section
RRR	Replacement Research Reactor
RSC	Radiation Safety Committee
SAC	Safety Assessment Committee
S&RS	Safety and Radiation Science
SAMO	Secondary Water Activity Monitor
SAR	Safety Analysis Report
SD	Safety Directive
SPO	Service Pool
TM	Tritium Monitor
WASMO	Waste Stream Monitor

4 RADIATION SAFETY ORGANISATION, ROLES AND RESPONSIBILITIES

The roles and responsibilities associated with the implementation of this plan are as identified in this section. This includes all individuals involved in radiation safety, and specific roles of individuals and groups/committees and links between them and other relevant safety groups.

4.1 ORGANISATIONAL RESPONSIBILITIES FOR THE REACTOR FACILITY

The Facility Nominee, Radiation Protection Adviser, Reactor Facility RPSS staff, Radiation Safety and Reactor Assessment Committees and all facility workers form the Radiation Safety organisation, which implements radiation protection strategies as described in this plan and associated documents.

4.2 MANAGER, REACTOR OPERATIONS

The Manager, Reactor Operations is the Reactor Facility Nominee for the Reactor Facility and has overall responsibility for radiation safety in the Facility. This includes ensuring effective implementation of this plan and sufficient resources for its implementation in the Reactor Facility at all times.

4.3 REACTOR MANAGER

The Reactor Manager has responsibility for installing systems, procedures and technologies to ensure compliance with radiation safety standards and optimised radiation protection of staff members and the public, ensuring all exposures are ALARA.

He/she has responsibility for the oversight of any program to ensure the maintenance and control of radiation monitoring systems, and that all operations are conducted in accordance with the organisational safety systems (eg local rules, SOPs, SAC recommendations, SDs etc).

4.4 REACTOR FACILITY STAFF

The Reactor Manager, line managers, group leaders and area supervisors are appointed to carry out specific tasks and procedures related to the nominee and facility officer's radiation protection responsibility. These include representation on committees, preparation of reports on radiation safety matters to these and other committees, reports to ANSTO management and external organisations, and the review of relevant monitoring programs. All individuals have responsibility to apply the relevant Safety Directives, SAC recommendations, SOPs, procedures and instructions to ensure radiation exposures are as low as reasonably achievable and within limits and constraints (reference ANSTO Policy, APOL 2.1 & SD 5.1).

4.5 RADIATION SAFETY COMMITTEE (RSC)

An ongoing review of the radiation protection program and radiation safety aspects of the Reactor Facility will be performed through a committee, nominally the Radiation Safety Committee. This committee will run as a stand-alone committee, but may have its functions incorporated into one of the existing committees that oversees safety in the Reactor Facility. The Radiation Safety Committee is established to review and advise the Nominee, Reactor Facility and the Reactor Manager on the effectiveness of the operational radiation safety program. The functions and membership of the RSC are outlined in general terms below. The actual guidelines, functions and membership of the RSC will be recorded in the Reactor Facility QMS.

The functions of the Reactor Facility RSC include to review and advise on:

- overall performance of the operational radiation safety program for the Reactor Facility facility;
- performance of design features and operating procedures relevant to control of radiation exposure and contamination;
- airborne and liquid radioactive effluent monitoring, sampling and discharges, and potential doses to the public and the local environment;
- area monitoring programs, including the use of radiation monitoring equipment;
- individual monitoring programs, including reviews of personnel dosimetry results and activities to ensure and maintain ALARA;
- abnormal occurrences involving radioactive contamination or radiation exposure;
- the radiation safety training program; and

- summaries of radiation safety aspects of Reactor Facility (SAC submissions and approvals, Safety Analysis Report updates, and modifications to plant and operating procedures affecting radiation safety).

The membership of the Reactor Facility RSC may comprise of the following core (5 individuals):

- Reactor Manager (Chairperson);
- Radiation Protection Adviser for Reactor Facility (from Safety and Radiation Science; to perform role of RSC executive officer for agenda setting and direction);
- Representative of the Reactor Facility Health Physics Surveyors' team (from Safety and Radiation Science);
- Reactor Facility Area Supervisor(s) Representative; and
- H&S Representative from Reactor Facility Workplace Safety Committee.

Additional membership may be obtained as required, usually depending on the specific agenda, as follows:

- Reactor Facility Safety and Licensing Officer – for regulation and licensing matters;
- Representative from RAC – for nuclear safety matters
- Representative(s) from Reactor Facility Sections (Operations, Maintenance, Utilisation, Engineering, Analysis)
- Representative(s) from functional areas (eg Bragg Institute).

4.6 RADIATION PROTECTION ADVISER (RPA)

The RPA is a person trained in radiation protection who advises Reactor Facility management/leaders, supervisors and others on radiation protection issues, safe working practices, standards including operational radiation protection measures and on their optimisation. The RPA has professional experience in applied health physics and radiation protection. The RPA assists in supporting staff with improvements in radiation safety on a day to day basis. Monitoring programs and their implementation are advised and reviewed by the RPA.

The RPA advises on the effective implementation, maintenance and review of this plan. The RPA is leader of the group of Radiation Protection Services personnel from S&RS, including the Health Physics Surveyors in the Reactor Facility. Advice on licensed source handling and storage, radioactive waste and transport of radioactive material are also available from the RPA and HPS.

The RPA advises on the development, application and modification of Reactor Facility procedures, instructions and written work systems for all activities where radiological safety assessment is required. The RPA possesses tertiary qualifications in a relevant discipline such as Science or Engineering. The qualifications of the RPA are described in Chapter 13 of the SAR, and the duties are described in relevant documentation in the QMS for the Reactor Facility.

5 RADIOLOGICAL EVALUATION AND SAFETY ASSESSMENT

An initial pre-operational safety assessment of operational radiation safety has been undertaken, as described in chapter 12 of the PSAR and SAR for the Reactor Facility. Chapter 12 identifies all the potential radiation sources (SAR 12.2) and the RP Design Features to control the potential exposures (SAR 12.3, 12.4). Detailed design calculations of protection measures for interlocks, shielding, ventilation systems and monitoring and control systems (e.g.

classification of area listing from occupancy and potential dose rate values, RCMS system) together with assumptions and criteria are described. ANSTO policies and principles, and SD's have been applied to radiation safety.

The information contained in Chapter 12 of the SAR (in particular section 12.5 describing estimates of potential dose by task) shows that the potential calculated radiation doses produced by the operation of Reactor Facility to staff members, visitors and the public are below the regulatory limits and constraints, and the estimated average individual annual doses to workers are below the ALARA objective. The average estimated potential doses to occupationally exposed workers in maintenance, utilisation and operator groups ranges from 0.31 to 1.97 mSv per year, while for a member of the public located at the buffer zone boundary the estimated potential dose is less than 0.0001 mSv per year.

6 RADIATION PROTECTION PRINCIPLES AND POLICIES

6.1 SAFETY CRITERIA AND POLICIES

The Radiation Safety Criteria applying to the reactor facility are described in section 2.2.2 of the SAR. The Reactor Facility is designed and constructed to operate within the following radiation safety criteria:

6.1.1 Safety Criterion 1: Occupational Radiation Dose Limit

The effective dose to any occupationally exposed person from all activities associated with the operation, maintenance and utilisation of the Reactor Facility during normal operation and anticipated operational occurrences is not to exceed 20 mSv annually, averaged over five consecutive years. The effective dose in any one year is not to exceed 50 mSv (referenece: ARPANS Act).

As part of meeting this criterion, the effective dose from normal operation of the Reactor Facility to any occupationally exposed person is constrained by ANSTO policy to be less than 15 mSv per year (ref SD 5.1, 5.2). The estimated average annual dose for an occupationally exposed worker in the most exposed group is predicted to be less than 2 mSv per year (reference: SAR Chapter 12 Section 12.5).

6.1.2 Safety Criterion 2: Public Radiation Dose Constraint

The effective dose from normal operation of the Reactor Facility to any member of the public at the buffer zone boundary be constrained to be less than 0.1 mSv per year. This ensures that the effective dose to any member of the public from all activities associated with the operation, maintenance and utilisation of the Reactor Facility during normal operation and anticipated operational occurrences will not exceed the public dose limit of 1 mSv annually.

Discharges from the Reactor Facility will comply with levels given in the Discharge Authorisation set by the Regulator. Airborne discharges from the whole site will not lead to exposure of a member of the public greater than 0.01 mSv per year. (ref SD 5.1, 5.2).

6.1.3 Safety Criterion 3: Occupational and Public Radiation Dose Optimisation

The magnitude of individual doses, the number of people who are exposed, and the likelihood of incurring exposures to radiation, will be ALARA, taking into account economic and social factors.

ALARA assessments are performed according to ANSTO Safety Directive 5.2, which specifies criteria and procedures for ALARA assessments, including dose rate objectives below which ALARA assessments would not be required.

The safety management system at ANSTO includes the application of international and national standards for radiation safety through the Safety Directives 5.1 to 5.7. Together with training programs, safety approval and monitoring systems and an event response system, it can be demonstrated that there is a framework for commitment to good radiation protection.

The principles and criteria for radiation protection have been detailed in Chapter 12 of the SAR, which is the basis of a prior radiological evaluation for the Reactor Facility. Chapter 12 includes the identification of the sources of routine and potential exposures (SAR Chapter 12 section 12.2), and an estimate of relevant worker doses based on expected dose rates and frequency and times of exposure (section 12.5). An identification of the radiological protection measures required to meet the optimisation principle is also described in Chapter 12 of the SAR (engineering features, administrative controls and procedures, and protective equipment - sections 12.3, 12.1 and 12.4).

Elements of this safety analysis and protection methods are described in sections 6.2, 7, 8 and 9 of this plan.

6.2 RADIATION PROTECTION DESIGN TARGETS AND REFERENCE LEVELS

The Reactor Facility has been designed in such a way as to minimise potential radiological exposures to staff and the public. The Facility has been designed according to the following objectives:

- Exposure of individuals to radiation must not exceed the applicable established limits.
- Exposure of individuals must be reduced to the lowest value that can be reasonably reached, taking into account economical and social factors (ALARA criteria).
- Radiological protection achieved through the application of a radiation protection program designed to complement the radiation safety aspects of the Reactor Facility design.

The layout of the facility provides for the isolation of radioactive material from the facility personnel and from the general public. The layout includes zoning that classifies the facility areas according to their potential for radioactive contamination and/or radiation exposure (section 7 describes the classification and zoning in the Reactor Facility). The zoning objectives are:

- To minimise the transport of contamination to other areas.
- To reduce to the minimum, the annual dose received by personnel during normal operation of the plant.

In practical terms, this has been achieved through the layout design of the different components throughout the facility and engineered features that are designed specifically for dose reduction. The layout and engineered features include:

- Provision of transit ways for easy access to/from reactor building.
- Provision of shields and isolations that are possible to dismantle for maintenance and access.
- Provision of contamination control and monitoring points at several levels in the Reactor Facility, facilities for immediate decontamination of personnel and a designated item decontamination facility.
- The hot water layer designed to reduce the dose rates above the open pools.
- Decay tanks for the Primary Cooling System (PCS) and Reactor and Service Pools Cooling System (RSPCS) that allow for the decay of nitrogen-16 before coolant passes through the cooling system pumps and heat exchangers. The decay tanks are located within a specially

designated room to prevent access to staff while the reactor is in the Power state, thereby shielding staff from the radiation present in the room while the reactor is at power.

- Ion-exchange columns, pumps and heat exchangers in the –5 level are separated from each other to provide shielding and permit access and maintenance to components that are not operating.
- The heavy water room is segregated from other plant on the –5 and –7 levels, with dedicated ventilation and airlock access systems.
- Specially designed hot cells facilitate remote handling of radioactive materials to and from the Service Pool, pneumatic transfer facilities and shielded flasks.
- Storage areas are provided to permit storage of waste products, in low occupancy areas, with sufficient shielding to minimise exposures to staff (reference SAR Chapters 4 and 12).
- Circulation of air from areas of potentially lower concentration to areas of higher concentration and through appropriate filtration.
- Remote monitoring devices for plant and active liquid systems. Indicator panels, auxiliary units, control equipment and other non-active components are set up in non-classified areas.

Sections 12.3 and 12.4 of the SAR provide additional information relating to the design and layout of the Reactor Facility from a radiological perspective. Initial estimates of annual effective doses as a result of routine operation have been assessed in Section 12.5 of the SAR.

7 RADIOLOGICAL CLASSIFICATION OF AREAS

ANSTO Safety Directive 5.4 explains the system of radiological classification of areas employed to control, prevent, limit or review occupational exposure (actual or potential) to ionising radiation. This system of radiological classification ensures that occupational dose limits and dose constraints are not exceeded, and is part of the process of ensuring that doses to individuals are kept As Low As Reasonably Achievable (ALARA).

7.1 INITIAL CLASSIFICATION OF AREAS

The initial area classifications have been prepared to conform to the ANSTO methods outlined in SD 5.4, and are based on conservative estimates of the anticipated levels of radiation and contamination and the occupancy of staff in those areas. In addition to these classifications, Local Rules apply to certain areas, depending on:

- The potential and actual exposures in the areas during different reactor states;
- The work performed in the area during different reactor states;
- The estimated occupancy factors within the areas during different reactor states.

Two sub-classifications that may be used within these Local Rules are Restricted and Forbidden Areas. The initial estimated radiological classifications for areas in the Facility are included in a table in Chapter 12 of the SAR.

7.1.1 Restricted Area

Restricted Areas are those where personnel occupancy is controlled and restricted for certain activities. In these areas, radiological conditions may change as a result of activities outside the immediate area. Access to a restricted area is permitted when specific administrative controls and procedures for the classified area are carried out. Special area and individual monitoring requirements (e.g. direct reading dosimeters) or specific plant operating conditions (e.g. reactor

in shutdown state or pneumatic transfer system disabled) may be required. Planning and assessment may be to a greater extent than for blue and red area classifications.

7.1.2 Forbidden Area

Forbidden areas are locations where potential dose rates or contamination levels may fluctuate to values higher than those expected in radiation/contamination red areas. Personnel access to Forbidden areas is prevented during specific reactor states or plant operating conditions through the use of physical barriers and administrative controls.

7.2 RECLASSIFICATION OF AREAS

The initial radiological classification for contamination and radiation areas has been performed based on dose, occupancy and utilisation of plant during operation. It will be reviewed and updated following radiological monitoring during commissioning and operation.

The relevant area supervisors, along with the RPA, may review the radiation and contamination classification of areas, as per SD 5.4, during commissioning and routine operation dependant upon the radiological data obtained from installed and portable monitoring and the final occupancy factors. This review may result in changes in area classification to either higher or lower categories. During commissioning, these classifications are to be applied progressively as the potential of the hazard is identified.

Areas may be temporarily reclassified to reflect temporary changes in radiological conditions throughout the Facility, with the changes in classifications and application of controls being commensurate with the temporarily changed conditions. Certain operations in classified areas may raise or lower the hazard and potential radiation exposure for workers. A temporary upgrade or downgrade in classification may be considered. Warning notices and protective measures are modified accordingly to reflect this upgrade or downgrade, and proper notifications must be made. A typical example is the Reactor Beam Hall during operations for the replacement of neutron beam in-pile assemblies, when the Radiation Classification in the area is raised to reflect the dose rates present during replacement operations.

7.3 SAFETY HAZARD NOTIFICATION

Any potential safety hazards, including radiological, present within areas of the Reactor Facility are identified and illustrated graphically on hazard notice boards in areas according to Safety Directive 7.15 – Safety Hazard Notice Boards. The hazard notice boards are prominently posted at the entrance to areas in the Reactor facility and display the radiological classification of the area, potential hazards and recommended PPE to be worn in the area, along with contact details for the responsible officers.

7.4 PERSONNEL AND ITEM CIRCULATION INSIDE THE FACILITY

The Reactor Building has three accesses:

a) through the main entrance building and office area on the eastern approaches to the facility;

b) through the Neutron Guide Hall or west ramp to the Experimental Physics Facilities in the Reactor Beam Hall; and

c) through the southern vehicle access to the isotope loading areas. This access is for the delivery and pick up of isotopes and silicon and the ingress/egress of components, items, waste, laundry and flasks.

Radioactive materials, plant items and waste materials may enter or leave the building through any of the accesses to or from the building. Personnel are not permitted to enter or leave the facility via the southern vehicle access.

The main access has a physical security entrance/exit control that enables to determine which persons are present inside the facility. Access through the Neutron Guide Hall to the Reactor Beam Hall is limited to scientific staff for experimental devices and instruments, and reactor staff for operational reasons.

Personal dosimeter (TLD badges) and Electronic Personal Dosimeter (EPD's) are located at an access point for personnel accessing the Reactor Facility (Dosimetry requirements are in accordance with SD 5.4 & 5.5).

Within the facility, the different areas are segregated according to the classification of contamination areas. Specific control points are located in the SAS rooms on +13 and –5 levels and through the contamination control barrier/entrance to the Blue area on the +4 level. The designation of contamination controlled zones has been designed to minimise the spread of radioactive contamination throughout the facility and prevent any egress outside of the controlled zone. As described above, these areas may be re-classified and control zones re-defined based on the operational experience gained through commissioning and operation.

Items can be moved in and out of the classified radiation and contamination areas through the two personnel access control locations described above and through the south vehicle access ramp at level +4 for loading/unloading items (e.g. flasks, waste, laundry) onto vehicles. The other vehicle access is on the west ramp at level 0 into/out of the Reactor Beam Hall. Requirements for monitoring of items that are moved out of classified areas are defined in SD 5.4.

Items moved into these access locations en route to areas at different levels may require use of lifts, stairs and possibly lifting equipment, depending on weight and volume. If the movement of items involves the temporary removal of foot/overshoe barriers, area supervisors may require prior notification. Movement between buildings and transport off-site of radioactive materials (as defined in ARPANSA RPS No. 2) should be in accordance with SD 5.6.

Segregation of plant items during maintenance, with special areas designed for each purpose close to areas of use at the different levels, is a design feature. There is one large item decontamination area for cleaning radioactive contamination so items can be reused. This is a separate contained area at level +4 with decontamination bay design features to control and contain contamination.

8 LOCAL RULES

8.1 SAFETY DIRECTIVES, PROCEDURES AND INSTRUCTIONS (LOCAL RULES)

The RPA advises on Reactor Facility procedures, Standing Operating Procedures (SOPs), instructions and written work systems (these all comprise the local rules) for all activities where radiological safety assessment is required. ANSTO Safety Directives and Standing Operating Procedures in support of the Response Plan for Incidents/Accidents at ANSTO/LHSTC are followed in all radiological assessments and work practices by all staff.

8.2 LOCAL RULES WHEN WORKING IN SPECIFIC AREAS IN THE FACILITY

The Area Supervisor, in consultation with the RPA, prepare and review local rules and/or procedures for all Restricted and Forbidden areas. The Area Supervisor or RPA may also recommend Local Rules of other areas of the facility or specific tasks identified as a result of the operational experience gained during commissioning and operation.

The local rules specify the required reactor states or plant conditions required for access. They incorporate specific access controls, radiological monitoring requirements, precautions and recommendations for operations being performed in the areas. These areas include:

- **Restricted Area** Locations (SAR Chapter 12 initial identification) comprise four locations at –5 Level, one location at 0 Level, three areas at +10 Level and one at +13 Level.
- **Forbidden Area** Locations are also indicated in the SAR, and comprise one location at –7 Level, two at –5 Level, three at +4 Level and two at +13 Level.

Restricted and Forbidden Areas can be entered following administrative procedures to ensure the Reactor or specific plant and equipment is either shut down, isolated or in an appropriate operating state. A radiological assessment and administrative approvals to gain access via the release of a key to access a locked door or shielded enclosure are required. Some tasks may involve the removal of heavy shielding. The areas are also given a contamination and radiation classification prior to entry, and the safety requirements for these classifications also apply.

These local rules are incorporated into the Quality Management System for the Reactor Facility, and staff working in the areas are trained on the local rules for those areas.

8.3 HEALTH PHYSICS PROCEDURES SPECIFIC TO THE FACILITY

There are task related procedures for all the planned activities in the facility, as part of the Reactor Facility QMS. The procedures and instructions that describe these tasks are identified and assessed, and include the relevant radiation safety requirements. There are also topics, such as those shown in Table 2, which are applicable to specific activities and describe Reactor Facility safety requirements for a range of activities and or work in functional areas. These are included in documents within the Reactor Facility QMS.

Table 2. Reactor Facility Radiation Protection Topics for inclusion into procedures, instructions and guidelines documents

Reactor Facility Specific Topic (for inclusion in procedures)
Access, working and exit from Restricted and Forbidden areas.
Guidance on Reference levels for Monitoring of radiation dose rates and contamination levels.
Response and recording Radiation Events (AORs)
Response and recording Contamination Events (AORs)
Guidance on Reference levels for Decontamination of items.
Decontamination of clothing and personal belongings
Storage and Use of radioactive sources
Selection, Use and Maintenance of PPE (Reactor Facility PPE)
Visitor, contractor and non-occupationally exposed worker individual radiation monitoring requirements.
Monitoring requirements for movement of RAM within Reactor Facility and associated areas.
Clearance of items leaving the Reactor Facility through the Vehicle Dock
Assessment of tasks/activities involving radioactive/contaminated items during breakdown maintenance
Radiation Safety Committee guidelines
Service Level agreements between Reactor Facility and RPSS, S&RS

8.4 WORK PLANNING TO INCORPORATE RADIATION SAFETY ASSESSMENT.

There are several levels of radiation safety assessment, dependent on the radiological hazards associated with planned activities.

Routine procedures and instructions may include recommendations and actions to minimise exposure and optimise protection methods. The RPA should review and contribute to new and modified procedures and instructions.

Activities that are non-routine and/or where conditions may vary (or require plant modifications) may require staff to initiate 'work requests and work orders', which will be reviewed by System Engineers and Reactor Maintenance personnel. This planning process will identify the requirements for radiological assessment by the RPA and/or HPS through the safety system review (such as Safe Working Permit, (SWP), Safe Work Method Statement (SWMS), and/or application to Safety Assessment Committee (SAC)) or other Reactor Facility processes in order to incorporate the RP advice into a written system of work (Reference SD 7.11, 2.1).

8.5 ABNORMAL OCCURRENCE/ACCIDENT/INCIDENT/EVENT REPORTING.

Procedures and instructions for response to and reporting of abnormal occurrences, incidents, accidents and emergencies are part of the Reactor Facility local rules. Emergency Planning and response for Reactor Facility and other ANSTO facilities and supporting procedures are dealt with elsewhere in this application (Ref SD 3.1, 4.1, SAR Chapter 20 and Reactor Facility Emergency Plan)

9 MONITORING PROGRAMS

9.1 INTRODUCTION

Monitoring is the collection of information about radiological conditions in the workplace and the assessment, interpretation and evaluation of this information (workplace/area monitoring). This, together with information on exposures to individuals (individual monitoring), assists in confirming safe working practices and engineering standards and that radiological hazards are under effective control in a way which complies with international best practice and regulatory requirements.

The monitoring programs that demonstrate adequate protection and optimisation of those protection measures are described in two parts. The first is based on measurements (known as 'surveys') taken in the workplace or area where personnel work (workplace/area monitoring). The second is based on measuring exposure to radioactivity, or radioactivity in or on an individual (individual monitoring, also known as personal dosimetry). The monitoring program is specified in the QMS and includes type, frequency, analysis and reporting arrangements.

Within each monitoring program, there are three types of monitoring undertaken; routine, task related and special.

- Routine monitoring is the foundation of the operational monitoring program, and consists of planned monitoring that confirms the radiological conditions and levels of individual dose to meet radiation protection requirements and objectives.
- Task related monitoring applies to a specific activity, and can be used to provide data on the safe management of the activity and decisions on protection techniques (and their optimisation).
- Special monitoring is mainly undertaken as part of investigations to provide detailed information to assess or define facilities or procedures, possibly during abnormal conditions.

Environmental monitoring for potential exposure pathways from the operation of the Reactor Facility is also performed.

9.2 WORKPLACE/AREA MONITORING

9.2.1 Routine Area Monitoring

The purpose of routine area monitoring in the Reactor Facility is as summarised in Section 9.1 above and more specifically is:

- to confirm effective control of sources of radiological hazards in all areas with safe working procedures and engineering features,
- to confirm the area classifications and any changes in radiological conditions,
- to review area classifications, and
- to evaluate actual and potential dose rates, surface and air contamination levels.

The areas and frequency of monitoring is assessed at commissioning, and refined at initial operation, to form a schedule of area monitoring. Instrumentation to perform measurements include on-line systems such as RMS (Gamma dose rate, ARM, PAM, Neutron Detectors, Portal contamination monitors, tritium monitors) and portable and semi-portable dose rate and surface and air contamination instruments.

9.2.2 Task Related Area Monitoring

Task related area monitoring is any dose rate, air or surface contamination measurements using similar (or same) equipment to that described for routine area monitoring. ALARA and Dose reduction assessment monitoring for a specific activity or group of activities is an example of this type of monitoring.

9.2.3 Special Area Monitoring

This type of monitoring (to evaluate actual or potential exposures) is undertaken during plant commissioning for shielding verification, also before or during plant modification or modification to operations. Special area monitoring may occur under abnormal conditions (e.g. a stuck irradiated can). Measurements are taken using similar (or same) equipment to that described for task area monitoring, in order to assess contamination and dose rate levels.

9.3 INDIVIDUAL MONITORING

Individual (routine, task and special) monitoring is the measurement, assessment and evaluation of radiological exposure information to an individual. If an individual is deemed an occupationally exposed worker, monitoring is performed on him/her as part of the routine dosimetry program as described in SD 5.5 Personal Dosimetry. Monitoring may also be performed for reassurance purposes or to show compliance with non-occupationally exposed worker (public) dose limits.

For occupationally exposed workers, routine individual monitoring is carried out for assessment of external exposure and the exposure from radioactivity inside an individual (internal dosimetry if applicable as per SD 5.5).

Routine external monitoring using TLDs for effective (beta, gamma and neutron) and extremity (beta and gamma) dosimetry is carried out. Where required, individual monitoring using electronic dosimeters for effective (gamma) dose assessment is also carried out (reference SD 5.5). TLD issue/assessment periods are usually monthly or three-monthly.

Task and special external individual monitoring may be warranted for ALARA or incident/event or process assessment of exposures to different parts of the body and whole body (effective).

Individual monitoring for internal dosimetry is performed by whole body and thyroid counting for gamma emitting contaminants and bioassay samples of urine tested for tritium, as described in SD 5.5. Regular routine individual monitoring for potential internal exposure is performed if indicated by an assessment of the risk of intake of radioactivity from surface and airborne radionuclides. Special monitoring may be performed if an intake is indicated or suspected and for reassurance purposes following an incident.

Reference levels for individual (occupationally exposed worker) values exist in the form of Investigation Levels. The investigation levels are set at 1mSv per month for effective dose, and 40mSv per month for skin or extremity doses (Ref SD 5.1). Investigations are performed by RPA, and results are discussed with line management in order to assess contributing factors and protective actions if required. A reference level for individual effective value, known as an ALARA assessment value, is set at 2 mSv per year (Ref SD 5.2).

9.4 RADIATION MONITORING INSTRUMENTATION

The radiation monitoring equipment that is used in the Reactor Facility consists of a combination of fixed and portable instrumentation designed to monitor the radiological conditions and the personnel throughout the facility.

A comprehensive Radiation Monitoring System (RMS) has been designed for the Reactor Facility, and comprises sub-systems designed for the purpose of monitoring Gases, Liquids, Areas and Personnel throughout the facility. The RMS is described fully in the SAR Chapter 12.

The functions of the RMS are complemented by the use of portable radiation monitoring equipment that has the ability to monitor beta, gamma and neutron dose rates and surface and airborne contamination levels throughout the facility, items and individuals.

Personnel doses are monitored using Thermoluminescent Dosimeter (TLD) badges and, in special cases, direct reading dosimeters. Techniques for detecting and measuring potential internal contamination are available (Reference SD 5.2 for personal monitoring programs).

9.4.1 Radiation Monitoring System (RMS) Instrumentation

The plant fixed area instrumentation measures and registers external gamma dose rates in relevant areas. This instrumentation forms part of the Area Radiation Monitoring (ARM), a sub-system of the Radiation Monitoring System (RMS). The ARM provides real time data to the Reactor Control and Monitoring System (RCMS) through intelligent, digital, software operated detector arrays. This data includes logging the level, status and alarms from all the area radiation monitors. These radiation monitors have local displays, and trigger visual and audible alarms if dose rates are higher than pre-determined values that can be set up independently for every location. An independent set of analogue ARM units are Post Accident Monitoring System (PAM) and Reactor Protection System (RPS) conformed. These units, installed at critical locations inside Reactor Facility, send their signals directly to the PAM and RPS for processing. In addition, neutron detection are located in the reactor beam hall to determine possible neutron fields originating from experimental devices associated with beams and to which personnel could potentially be exposed. In order to reduce the possibility of contamination spread, measurement of potential external contamination of persons are routinely performed as close as possible to the contamination source by means of portable equipment (refer 9.4.6). Walk through contamination monitors (portals) are also provided located at the main entrances to the Reactor Facility. These 2 (two) portals are part of the Personnel Contamination Monitoring (PCM), a sub-system of the RMS dedicated to personnel monitoring.

9.4.2 Portable Radiation Monitoring Instrumentation

Portable monitors are used to complement/validate the information provided by fixed detectors and to survey specific operations or procedures, including gamma and neutron dose rate and

surface and airborne contamination monitors. High range gamma dose rate monitors are used when required for higher dose rate and incident response assessment. Portable instruments are also used to measure items leaving areas where contamination is expected, as well as to release material to users outside the Reactor Facility. Potentially contaminated surfaces are surveyed using portable instruments or applying smear sampling techniques and remote assessment. Portable air samplers are also provided to assess particulate and iodine contaminant concentrations in air. Facilities for monitoring tritium in air are available for routine monitoring of tritium levels during maintenance in the heavy water rooms at –5 Level and in the blue chemistry laboratory at +4 Level.

9.4.3 Maintenance of Instrumentation

All fixed and installed radiation monitoring instrumentation are subject to a maintenance program that includes calibration. The maintenance programs for components supplied by INVAP are outlined in the maintenance manuals for those pieces of equipment. Commercial or 'off-the-shelf' equipment is maintained as recommended by the manufacturer. Calibration of instrumentation is performed as required under RPS 1 (see Ref.2).

9.5 ENVIRONMENTAL MONITORING PROGRAM

Environmental monitoring and management is described in detail in the Environmental Management Plans and Arrangements. The estimated potential releases to the environment and potential exposures to members of the public as a result of the operation of the Reactor Facility have been assessed and are reported in Chapter 12 of the SAR.

10 REVIEWING AND AUDITING THE EFFECTIVENESS OF THE RADIATION PROTECTION PLAN

10.1 PERFORMANCE INDICATORS

10.1.1 Individual Monitoring

Dose results from dosimetry programs are periodically reviewed and compared to investigation levels and dose constraints. An indicator of the effectiveness of the Radiation Protection Plan and specifically the monitoring programs, dose minimisation and limitation may be the number of investigations and the relevant actions following each investigation.

Average and maximum individual effective dose values (mSv per year or month) for various work groups may be identified over a specified time period as performance indicators by the Reactor Facility management and RSC.

10.1.2 ALARA and Event Reports

Results of ALARA assessments and the number of assessment reports required for occupationally exposed workers in the Reactor Facility may be an indicator of the effectiveness of optimising the radiation protection techniques adopted.

Events that are subsequently assessed as incidents or accidents will be reported following safety response and assistance under the procedure in SD 4.1, ANSTO Event Response System. The outcomes of radiological incident or accident events and the findings and recommendations may be considered as an indicator of radiation safety in Reactor Facility.

10.2 PERIODIC REVIEW OF THE PLAN

A periodic review of this plan will be undertaken at a frequency in line with the Quality Management System for Reactor Facility.

11 TRANSPORT AND MOVEMENT OF RADIOACTIVE MATERIALS

The movement of radioactive materials within the Reactor Facility and of materials leaving the facility is in accordance with existing ANSTO systems. Items and waste products leaving the facility or moving between contamination controlled areas require health physics monitoring and clearance. That clearance is recorded on the ANSTO Contamination Clearance Certificates and/or the Waste Operations service forms. The only exceptions to this are products leaving the facility via the pneumatic transfer system. The transport of radioactive materials at ANSTO is covered by SD 5.6 Safe Movement and Transport of Radioactive Materials.

11.1 RADIONUCLIDES, PLANT ITEMS AND EQUIPMENT AND WASTE MATERIALS

The transport of irradiation products from the facility through the use of transport flasks is performed under arrangements equivalent to the present ones. The facilities in the southern vehicle access facility are designed to perform the radiological clearance of products from the area. A health physics monitoring station is located in the area.

A solid waste storage room is located adjacent to the vehicle air lock and is used to store waste prior to its clearance to leave the facility via collection by WOTD (Ref RWM Plan).

11.2 IRRADIATED FUEL

The Reactor Facility fuel management program design has a cycle of 144 days at power, and includes 5 sub-cycles. At the conclusion of each sub-cycle, three spent fuel assemblies are removed from the core. These fuel assemblies are initially stored in the reactor pool, prior to being relocated to the spent fuel storage facility in the service pool. The spent fuel storage facility has the capacity to store 10 years of spent fuel. The service pool is designed so that a 20-tonne spent fuel cask may be loaded into the pool to permit the removal of spent fuel for storage outside the Reactor Facility or to be shipped for reprocessing. The movement of spent fuel is performed under the supervision of health physics surveyors or suitably qualified and experienced staff. The preparation, monitoring and transportation of spent fuel in casks is in accordance with the Code of Practice for the Safe Transport of Radioactive Material.

For additional information on the handling of spent fuel from the Reactor Facility, refer to the Ultimate Disposal Plan.

12 TRAINING

Basic training in Radiation Safety follows the ANSTO arrangements as described in SD 7.3 on Safety Training Policy, SD 5.5 on Personal Dosimetry and the Reactor Facility Training Plan. Training in Reactor Facility Radiation Safety is commensurate with the responsibilities of the role an individual is performing. Health physics monitoring in the Reactor Facility is performed by Reactor Operators and Health Physics Surveyors, and hence the level of training for those staff is more detailed than that for other staff. Other staff working in the Reactor Facility are provided radiation safety training in line with the current training programs at ANSTO.

Reactor Operators perform health physics monitoring on nominated, routine tasks throughout the Reactor Facility. The Reactor Operators are provided with detailed theoretical training in radiation protection, which is complemented by practical training. That practical training is task specific and facility specific for the monitoring tasks that the Reactor Operators perform in the Reactor Facility. This includes:

- the operation and interpretation of portable and fixed radiation monitoring instrumentation;
- performance of routine radiation, surface and airborne contamination monitoring tasks; and
- performance of task specific radiological monitoring in the Reactor Facility.

All health physics surveyors at ANSTO undergo a training program that includes theoretical and practical training. This training program is concluded with an assessment to determine if the individual is competent to perform the duties of a health physics surveyor. Health physics surveyors are trained in the operations, instrumentation and radiological requirements of the Reactor Facility.