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Replacement Research Reactor Project

SAR CHAPTER 14
ENVIRONMENTAL MANAGEMENT

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For
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TABLE OF CONTENTS

End of Table of Contents

14 ENVIRONMENTAL MANAGEMENT

14.1 INTRODUCTION

A key aspect of managing the operation of the Replacement Research Reactor Facility (Reactor Facility) is commitment to environmental principles and minimisation of the impact of the project on the environment. These commitments were incorporated into the design and construction of the Reactor Facility and continue to be addressed in the operational phase. This chapter describes the arrangements for the environmental management of the Reactor Facility, which will be part of ANSTO's Environmental Management System (EMS).

This Chapter outlines:

a) The regulatory framework applicable to environmental management during the operational phase.

b) The environmental management system in place within ANSTO

c) The assessment and management of environmental impacts from the Reactor Facility during its operation.

End of Section

14.2 BACKGROUND

The proposal to design and construct a Reactor Facility on the Lucas Heights Science and Technology Centre (LHSTC) site was subject to an environmental impact assessment under the Environment Protection (Impact of Proposals) Act 1974. ANSTO was designated the proponent and engaged PPK Environment and Infrastructure Pty Ltd and specialist sub-consultants to prepare the Draft EIS (PPK 1998a, 1998b).

The Draft EIS concluded that the construction and operation of the proposed replacement reactor would result in a range of benefits to the Australian community. It further concluded that the environmental assessment of the construction and operation of the replacement reactor showed that the scale of environmental impacts is acceptable, provided that the management measures and commitments made by ANSTO were adopted.

The Draft EIS was exhibited for public review. Further studies, relating to issues in the public submission process, were undertaken for the Supplementary EIS (PPK 1999). The Draft EIS (two volumes – the Main Report and the Appendices), and the responses to the submissions (volume three – Supplement) together represent the Final EIS. The Final EIS confirmed the findings of the Draft EIS.

The Environment Assessment Branch of the Department of Environment and Heritage evaluated the Final EIS, took into account the findings of three independent peer reviews, and produced an Environment Assessment Report (Environment Australia 1999). The Minister for Environment and Heritage decided that there were no environmental reasons preventing the granting of Commonwealth approval for the proposal to construct and operate a replacement research reactor at LHSTC, subject to a number of recommendations regarding construction and operating practices. These recommendations were accepted by the Minister of Industry, Science and Resources. ANSTO has complied with these requirements, incorporating them into its Environmental Management System.

In granting a Construction Licence, the CEO of ARPANSA imposed a licence condition that required ANSTO to obtain and maintain accreditation to the ISO 14001 Standard for environmental management systems. ANSTO obtained accreditation in June 2004 and operates its EMS within the ISO 14001 framework.

End of Section

14.3 REGULATORY PROCESSES APPLYING TO OPERATION

14.3.1 Commonwealth and State Legislation

Activities carried out on the LHSTC site comply with the provisions of relevant Commonwealth legislation. Where Commonwealth legislation is not present, the provisions of relevant state legislation are captured by ANSTO's policy and the Ministerial and ARPANSA Approval Conditions. This legislation includes the following:

1. Commonwealth Legislation and Agreements.
   a) Environment Protection and Biodiversity Conservation Act 1999.
   b) Australian Heritage Council Act 2003.
   c) Environment Protection (Sea Dumping) Act 1981.
   d) Aboriginal and Torres Strait Islander Heritage Protection Act 1984.
   e) Australian Nuclear Science and Technology Organisation Act 1987.
   f) Nuclear Non-Proliferation (Safeguards) Act 1987.
   g) South Pacific Nuclear Free Zone Treaty Act 1986.
   h) Ozone Protection and Synthetic Greenhouse Gas Management Act 1989.
   i) Hazardous Waste (Regulation of Exports and Imports) Act 1989.
   j) Occupational Health and Safety (Commonwealth Employment) Act 1991.
   k) National Environment Protection Council Act 1994.
   l) Australian Radiation Protection and Nuclear Safety Act 1998.
   m) National Environmental Protection Measures
   n) National Water Quality Management Strategy 1992.
   o) Inter-Governmental Agreement on the Environment.
   p) National Model Regulations for the Control of Workplace Hazardous Substances.

2. NSW Legislation (Where Commonwealth Legislation is not in force)
   a) Soil Conservation Act 1938.
   b) Clean Waters Regulations 1972
   c) National Parks and Wildlife Act 1974.
   d) Environmentally Hazardous Chemicals Act 1985.
   e) Environmentally Hazardous Chemicals Regulation 1999
   f) Catchment Management Authorities Act 2003.
   g) Crown Lands Act 1989.
   h) Radiation Control Act 1990.
   i) Local Government Act 1993.
   j) Radiation Control Regulation 1993.
   k) Sydney Water Act 1994.
   l) Threatened Species Conservation Act 1995.

m) Protection of the Environment Operations (Waste) Regulation 1996
n) Clean Air (Plant and Equipment) Regulation 1997
o) Contaminated Land Management Act 1997.
p) Contaminated Land Management Regulation 1998
q) Road and Rail Transport (Dangerous Goods) Act 1997.
r) Ozone Protection Regulation 1997
s) Protection of the Environment Operations (General) Regulation 1998
t) Protection of the Environment Operations (Control of Burning) Regulation 2000
u) Protection of the Environment Operations (Noise Control) Regulation 2000

14.3.2 Specific Requirements

In addition to the general legislative requirements, specific requirements arise from commitments made by ANSTO and conditions applicable to the approvals obtained for the project. These could involve approval or consultation with various Commonwealth and State agencies for specific parts of the operating process. Specific requirements include the approval, referral and consultative procedures contained within commitments made by ANSTO in the Environmental Impact Assessment, conditions set by the Minster for the Environment and Heritage in approving the construction of the reactor facility and conditions set by ARPANSA at various stages of the licensing process. These requirements would be identified on a case by case basis.

End of Section

14.4 ANSTO'S ENVIRONMENTAL MANAGEMENT

Environmental management of ANSTO's activities is governed by ANSTO policies. These policies specify a management commitment to the ANSTO Environmental Management System (EMS) that applies to all ANSTO activities, including the Reactor Facility. The ANSTO EMS complies with the principles of the international ISO14001 standard for environmental management systems (AS/NZS ISO 1996).

In accordance with the ISO 14001 standard, environmental goals arising from the environmental policy and detailed performance requirements related to the goals are referred to as "Environmental Objectives and Targets". Defining the Objectives and Targets for ANSTO required an extensive consultative process, since the operations of the organisation are technically complex and subject to extensive regulatory requirements. The programme for achieving the objectives and targets is documented in a series of Environmental Management Plans (EMPs). The EMPs address the potential environmental impacts of ANSTO operations, including airborne emissions, radioactive waste, surface water, groundwater, and resource usage. A number of these EMPs are relevant to the operation of the Reactor Facility. These are;

EMS-EMP-01 Radioactive Airborne Emissions

EMS-EMP-02 Managing Radioactive Waste

EMS-EMP-04 Prevention of Contamination of Groundwater

EMS-EMP-05 Surface Runoff and Sediment

EMS-EMP-06 Resource Utilisation

EMS-EMP-07 Water Use

EMS-EMP-08 Electricity Use

EMS-EMP-03, covering the Little Forest Burial Ground, is not relevant to the Reactor Facility.

The environmental program includes monitoring airborne emissions from stacks, collecting meteorological data, groundwater measurements, monitoring surface water run-off, managing the buffer zone environment and collecting data on effluent released to the sewer. Studies are undertaken to assess the impact of environmental releases and potential releases from ANSTO. An ongoing process of review ensures that the monitoring program and ANSTO's environmental management are continuously improved in accordance with recent technical developments.

Samples of sediment, air, surface water and marine biota are collected at sampling locations including the Woronora River, Potter Point ocean outfall, LHSTC stormwater outlets and creeks draining both the LHSTC and the Little Forest Burial Ground. The on-site meteorological station collects data all year round and these data are combined with airborne emissions data to model airborne effective dose to the public. External gamma radiation doses are directly measured at the perimeter of LHSTC using thermoluminescent dosimeters. Radioactivity and radionuclides routinely analysed in various media by ANSTO include: gross alpha activity, gross beta activity, argon-41, caesium-137, cobalt-60, iodine-131, potassium-40, tritium and xenon-133, as well as naturally occurring uranium/thorium series radionuclides.

Regular reports on environmental performance are made to regulatory authorities and other key organisations. These include a liquid effluent report, which is prepared monthly and provided to Sydney Water, and a quarterly report to ARPANSA on airborne emissions from the site. An annual report on Environmental and Effluent Monitoring for ANSTO Sites is prepared for public distribution.

14.4.1 Radioactive Airborne Emissions

The objective of the management of airborne emissions is to ensure that the radiation doses to members of the public and the environment are as low as reasonably achievable (ALARA), social and economic considerations being taken into account. The relevant ALARA dose objective is 20 µSv per year from all ANSTO activities. This ALARA objective is subdivided as follows:

a) 10 µSv per year due to the operation of the Reactor Facility;

b) 10 µSv per year due to radiopharmaceutical production, and

c) Less than 1 µSv per year due to all other conducts and dealings at the LHSTC.

The critical group for airborne emissions from the LHSTC site is a group of hypothetical people continuously present at the boundary of the buffer zone (1.6 km from HIFAR).

ARPANSA has set notification levels for the amount of radioactivity released from each discharge point. If all releases from the site were at the notification level for the whole year, then the dose to a member of the critical group would be equivalent to the ALARA objective.

14.4.2 Managing Radioactive Waste

The objectives of ANSTO’s management of radioactive waste are to;

a) ensure the total radioactive content and radioactivity concentration in the effluent released to the sewer from LHSTC and the NMC complies with the Trade Waste Agreement,

b) reduce the generation of low level radioactive solid waste,

c) reduce the inventory of intermediate level liquid waste from production of molybdenum-99,

d) reduce the generation of intermediate level solid waste from production of molybdenum-99, and

e) assess the relative contributions of individual effluent discharges within LHSTC to enable understanding of various sources and thereby enable the minimisation of discharges at source.

These objectives are achieved through the study of all processes and operations resulting in the production of waste, allowing characterisation of the waste produced together with its amount and the resources used.

14.4.3 Prevention of Contamination of Groundwater

The aim of the groundwater monitoring system is to ensure that groundwater direction and flow rate across the site is known and that any emissions are detected. The target is to maintain groundwater emissions at a level of no additional radiation dose from groundwater discharge to a member of the public.

The quality of groundwater is protected by the use of appropriately constructed storage facilities for both solid and liquid wastes, and is monitored by a groundwater sampling program involving a network of piezometers around the LHSTC site.

14.4.4 Surface Runoff and Sediment

The objectives of surface water monitoring and management are to;

a) monitor water quality (e.g. sediment / turbidity and nutrients) for as long as necessary to show that stormwater runoff has stabilised following construction (Environment Australia, 1999: Condition No.4, p199).

b) ensure that the physical systems in place maintain stormwater flows at or below the current levels (Commitments on Geology, Soils and Water (Chapter 8 of Draft EIS), as summarised in Table 18.2 of PPK, 1999).

c) provide for on-site containment and treatment of any small accidental spills or releases of contaminated liquid (Commitments on Geology, Soils and Water, (Chapter 8 of Draft EIS) as summarised in Table 18.2 of PPK, 1999).

d) demonstrate that any releases of radioactive material are within the limits set by NSW EPA regulations (NSW Clean Waters Regs. 1972, under NSW Protection of the Environment Operations Act 1997).

14.4.5 Resource Utilisation, Water and Electricity Use

The requirements for management of resource utilisation centre around the need to reduce paper consumption, increase re-cycling of cardboard and paper, increase use of recycled products and reduce the petrol consumption of ANSTO vehicles.

The requirements regarding water and electricity use are that their consumption should be monitored and managed with the intent of reducing their use.

End of Section

14.5 REACTOR FACILITY ENVIRONMENTAL MANAGEMENT

This section details how the Reactor Facility meets the relevant requirements of ANSTO's EMS. Of the EMPs, the first two (radioactive airborne emissions and radioactive waste) are most directly affected by the management of the Reactor Facility. The remaining EMPs are managed by ANSTO at the organisational level.

14.5.1 Radioactive Airborne Emissions

The following airborne emissions are expected to be produced by the operation of the Reactor Facility:

a) Argon-41 and other noble gases (krypton and xenon isotopes)

b) Tritium and tritiated water vapour

c) Airborne particles (aerosols)

d) Iodine isotopes

e) Noxious gases from vacuum pumps and fume cupboards

Areas where airborne radioactive particles and gases may be generated during normal operation have absolute filtration and, where applicable, activated charcoal absorption filters to ensure that the levels of radioactive emissions in the ventilation extract are minimised.

The Air Effluent Monitoring System allows online measurement of aerosols, tritium, noble gases and iodine concentrations in the Reactor Facility stack, as well as gamma spectrometry of the effluents. If above normal concentrations are detected, administrative procedures are in place to enable investigation, identification of causes and initiation of remedial action. If very high concentrations are detected, the containment isolation is triggered by the First Reactor Protection System. This function ensures protection of the general public and the environment by containing the airborne radioactive products that could be released into the environment.

A comparison between airborne discharges from HIFAR with those predicted from the replacement Reactor Facility is given in Table 12.2/6 of Chapter 12.

Full details of the management of radioactive emissions are contained in Chapter 12, Section 12.4.

14.5.2 Radioactive Waste

The EMP for Managing Radioactive Waste (EMP-02) covers solid and liquid, low and intermediate level radioactive waste and details actions and responsibilities for controlling and managing radioactive wastes from ANSTO facilities and activities. This includes the generation of low level liquid waste and its treatment and discharge to the sewer. The plan covers treatment and conditioning of waste but does not cover shipment to the future Waste Repository.

Solid waste at ANSTO is segregated into:

a) Non-radioactive Solid

b) Low Level Solid Waste

c) Intermediate Level Solid Waste

Non-radioactive solids are processed through ANSTO's waste clearance system before being released off-site in accordance with ANSTO's waste management procedures.

Low activity solid wastes are classified and managed in accordance with ANSTO's waste management procedures. Low level solid waste is stored within the Containment until collection by ANSTO's Waste Operations and Technology Development section (WOTD).

Consumable solid waste is sealed inside plastic lined fibreboard drums that are labelled to provide identification of the waste origin, the dose rate and the radioactive content before being transported to ANSTO approved storage areas. Compaction takes place in the Waste Management Section (Building 57). All compacted low-level solid waste is stored in 200 litre drums at the LHSTC in a designated storage facility in Building 59.

Intermediate level solid wastes is stored in the service pool where a shearing facility is available to cut large items into smaller sizes for more efficient storage. Long lived intermediate level solids are transferred to WOTD in a shielded container for storage in Building 27.

The Reactor Facility is designed to minimise the production of liquid waste. Collection systems allow for the segregation of liquid waste according to the radioactivity level and for monitoring, and temporary storage of liquid wastes.

As described in EMP-02, waste waters at LHSTC are segregated into three categories:

a. Waste waters from "active" drains in laboratories where radioactive materials are routinely handled. They normally contain low levels of beta and gamma emitting radionuclides. The pipeline that transports these waters is known as the "B" line.

b. Trade waste waters arising from laboratories and workshops in which radioactive materials are not normally handled. The pipeline that transports these waters is known as the "C" line.

c. Non-radioactive sewage, produced from shower, toilet and tea room facilities across site

Most radioactive liquid waste generated at the Reactor Facility is low-level waste acceptable for discharge through the low-activity line (B-line) for treatment by WOTD.

Sources of liquid waste from the Reactor Facility are as follows:

a) cooling water blow down

b) secondary system drains

c) liquid waste from the de-mineralised water plant

d) ventilation water system drain

e) de-mineralised water recovered from cleaning operations

f) wash basin and shower liquids

g) floor drain liquids

h) non-radioactive liquids from laboratories

i) LOCA liquids in the unlikely event of an accident

j) radioactive liquids from laboratories and other areas

These liquids, that may contain radioactive or chemical contamination, are managed through LHSTC B or C lines. Normally non-radioactive liquid wastes (for discharge to C-Line) and low level liquid waste (for discharge to B-line) effluent streams are measured on-line and independently by dedicated Waste Streams Monitor (WASMO) gamma detectors at the inlet to their corresponding waste storage tanks.

Heavy water leaks are unlikely in view of the design of the heavy water system. Effluents containing heavy water, which are likely to contain tritium, are collected separately from other liquids, stored and separately transferred to ANSTO Waste Operations. The expected volume during normal operation is small.

A waste stream monitor (WASMO) is installed in each of the temporary liquid waste storage tanks. This system monitors the activity of the liquid arriving at the tank. This recording is automatic and the signal is transmitted to a centralised data system along with the date, time and activity. The system allows detection of any discharge exceeding the admissible limits of that line and the operator to take prompt corrective action.

Full details of the management of radioactive wastes are contained in Chapter 12, Section 12.4.

14.5.3 Prevention of Contamination of Groundwater

Groundwater flow at the LHSTC is primarily dependent on topographic features. Presently, approximately 40% of the area within the LHSTC fence is paved, with the remainder covered by grass or sparse native vegetation. For several days following heavy rain, water seeps from the soil into the heads of the gullies surrounding the LHSTC. Discharge via a deeper groundwater path, over a much longer time scale and further down the gullies, ultimately contributes to the base-flow of the Woronora River. The characteristic response of the LHSTC groundwater to heavy rainfall is an immediate local rise in groundwater level followed by a falling level as this water is redistributed into the aquifer within a few hours. Further details on the groundwater hydrology in relation to the geology and soil structure of the LHSTC (including the Reactor Facility site) are given in Chapter 3.

The Reactor Facility has a reduced possibility of contamination of groundwater relative to HIFAR because spent fuel is stored in a pool adjacent to the reactor rather than being transported to, and stored at, a separate location on-site. The pool water is continually circulated through a filtration and ion exchange system.

Groundwater level and quality monitoring at the LHSTC was established in 2000 with the installation and development of a groundwater piezometer network, which included the Reactor Facility site. Regular reporting on groundwater level and quality continues to be given in ANSTO's Environmental and Effluent Monitoring Reports.

14.5.4 Surface Runoff and Sediment

Stormwater drainage at the LHSTC was rationalised in the mid 1990s and small capacity concrete bunds were built on the three main stormwater outlet points. Stormwater drainage associated with the Reactor Facility will be captured, managed and monitored in accordance with routine practice for the broader LHSTC site. Specifically, this will involve construction of two on-site bunds and upgrading the two off-site sediment dams built for the construction-phase. Temporary stormwater drainage works will be upgraded to permanent drains in similar positions. These works are planned for completion in 2005.

Stormwater bunds provide temporary retention of stormwater/groundwater seepage, enabling containment and treatment of small accidental spills or releases of contaminated liquid. The bunds also act to reduce flow velocity and as sediment traps. The bunds provide convenient points for environmental monitoring at daily, weekly and monthly intervals, depending on the general radioactivity or specific radionuclides being quantified. Stormwater bunds are drained daily, or when necessary to maintain retention capacity. The bunds are allowed to discharge freely in rainy periods. Sediment accumulated in these bunds is cleaned out annually or as necessary and the sediment characterised for radioactivity before disposal or storage.

Radiological environmental aspects, such as the low levels of tritium routinely found in surface runoff from the LHSTC, are expected to be significantly reduced when the transition to exclusive operation of the Reactor Facility is achieved.

A program of radiological characterisation of stormwater and soil/sediment associated with stormwater outlets, is in place and is reported annually as part of ANSTO's Environmental and Effluent Monitoring Report series.

14.5.5 Resource Utilisation, Water and Electricity Use

Programs are in place within ANSTO to monitor resource utilisation and water and electricity use with a view to decreasing them. Electricity and water consumption of the Reactor Facility will be sufficient to facilitate safe but efficient operation.

14.5.6 Overview

The environmental commitments made by ANSTO in relation to the Reactor Facility and operations have been incorporated into the design, construction, operation and decommissioning planning, including ecologically sustainable development (ESD) initiatives, and compliance with statutory requirements.

The operation of the Reactor Facility ensures that environmental impacts during operations are low by international standards. The following processes control environmental impact during operation:

a) Managing airborne emissions from the stack. Details of the monitoring of emissions from the stack are contained within Chapter 12. Emissions from the stack are monitored with the results regularly reviewed and fed back to operations.

b) Managing solid radioactive waste. Details of the management of solid radioactive waste are contained within Chapter12. The solid radioactive waste system is designed to minimise potential environmental impacts and includes regular review of quantities of generated waste and feedback of results to operations.

c) Managing liquid waste to the B and C lines including blow-down water from the cooling towers. Details of the management of liquid radioactive wastes are contained within Chapter 12. The liquid radioactive waste system is designed to minimise potential environmental impacts and includes regular review of quantities of generated liquid waste and feedback of results to operations.

d) Procedures to assess off-site dose to members of the public. ANSTO has adopted an As Low As Reasonably Achievable (ALARA) objective of 20 μSv per year for airborne emissions from all activities on the site.

e) Monitoring and management of groundwater emissions. The system ensures that any potential emissions are picked up by the monitoring program. The intent is to maintain groundwater emissions at a level such that there will be no additional radiation dose from groundwater discharge to a member of the public.

f) Control of surface runoff and sediment from the Reactor Facility. This system provides for the temporary containment and characterisation of potential liquid spills. Monitoring of surface water quality enables the detection and quantification of any release of radioactive material.

g) Spent fuel is transported from the Reactor Facility as soon as practical allowing for the constraints of fuel cooling, radiation safety and economic transport.

h) Power and water usage by the Reactor Facility is regularly reviewed as part of the ANSTO Environmental Management System to ensure efficient resource utilisation taking into account operational and other requirements.

The hazards and risks associated with the Reactor Facility during normal operation are addressed in Chapter 12.

The hazards and risks under accident conditions are addressed in Chapter 16.

End of Section

14.6 CONCLUSIONS

The ANSTO Environmental Management System is based on a commitment to a high standard of environmental performance via the implementation of physical and procedural controls, supplemented by monitoring and review to demonstrate and improve performance.

The environmental impacts from the operation of the Reactor Facility are expected to be small. Regular reports on liquid effluent and airborne emissions from the LHSTC are made to regulatory authorities and other key organisations. An annual report on Environmental and Effluent Monitoring for ANSTO Sites is prepared for public distribution.

End of Section

14.7 REFERENCES

AS/NZS ISO 1996	Australian/New Zealand Standard ISO 14001:1996. *Environmental Management Systems - Specification with Guidance for Use*. Standards Australia, Sydney, 1996
Environment Australia 1999	Environment Australia – Environment Assessment Branch, *Environment Assessment Report: Proposed Replacement Nuclear Research Reactor at Lucas Heights*. Environment Australia, Canberra, 1999.
PPK 1998a	PPK Environment and Infrastructure Pty Ltd, *Replacement Nuclear Research Reactor: Draft Environment Impact Statement,* Prepared for the Australian Nuclear Science and Technology Organisation. (Volume 1, Main Report) PPK, Sydney 1998
PPK 1998b	PPK Environment and Infrastructure Pty Ltd, *Replacement Nuclear Research Reactor: Draft Environment Impact Statement,* Prepared for the Australian Nuclear Science and Technology Organisation. (Volume 2, Appendices) PPK, Sydney 1998
PPK 1999	PPK Environment and Infrastructure Pty Ltd, *Replacement Nuclear Research Reactor: Draft Environment Impact Statement,* Prepared for the Australian Nuclear Science and Technology Organisation. (Volume 3, Supplement) PPK, Sydney 1999

End of Section