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Replacement Research Reactor Project

ENVIRONMENTAL MANAGEMENT PLAN

Prepared By
Australian Nuclear Science and Technology Organisation

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1 INTRODUCTION

1.1 PURPOSE

The purpose of this Reactor Facility Environmental Management Plan (RF-EMP) is to describe the organisational arrangements for the integration of Environmental Aspects for the Reactor Facility into existing Environmental Management Plans (EMPs) currently in place within ANSTO's Environmental Management System (EMS). All key documents relating to the ANSTO EMS can be accessed by ANSTO staff on the EMS web-site (ANSTO, 2004a).

These EMPs are collectively referred to as EMS-EMPs and, individually, according to their respective numbers (eg EMS-EMP-01 refers to 'Radioactive Airborne Emissions'). ANSTO has obtained ISO14001 certification for its EMS (17 June 2004), as required under Condition 28 of the Conditions arising from the Environmental Impact Assessment of the Proposal for the Replacement Research Reactor. All the EMS-EMPs have a broader scope than is directly relevant to the Reactor Facility operating licence application because they address ANSTO's operations beyond the Reactor Facility, as well as including a range of non-radiological environmental aspects.

This environmental management plan differs from the other plans that are part of the Reactor Facility licence application because of the EIS requirement that all ANSTO activities are certified to the ISO14001 environmental standard. The Reactor Facility environmental controls will be integrated into the EMS-EMPs that are in place for the rest of ANSTO rather than be considered separately. Those EMPs which are relevant to the Reactor Facility 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 (paper and hydrocarbons)

EMS-EMP-07 Water Use

EMS-EMP-08 Electricity Use

To accomplish this requirement whilst meeting the needs of ARPANSA to have a defined plan for implementing environmental management of the Reactor Facility, an approach was taken which mirrors the existing EMS-EMPs for ANSTO. This plan will be integrated into the ANSTO EMS-EMPs (as is currently the case for HIFAR).

This plan is organised using the same major applicable headings that are in place for existing relevant ANSTO EMS-EMPs. Under each heading, those EMS-EMPs are directly addressed with reference to the Reactor Facility specific requirements. This Reactor Facility Environmental Management Plan is compliant with ISO14001. The Reactor Facility environmental management process will be fully audited, both internally and externally, in accordance with the ISO14001 requirements and will be subject to continual improvement to enhance ANSTO's environmental performance.

The environmental aspects of the RRR Project up to the end of the cold commissioning phase have been fully covered by the INVAP/JHEDI (2003) Construction Environmental Management Plan (CEMP).

1.2 SCOPE

This plan applies to the management of potential environmental impacts of the Reactor Facility within the context of the entire ANSTO EMS. Activities with potential environmental impacts associated with the Reactor Facility include the following:

- Reactor operation
- Irradiation for radioisotope production
- Neutron Activation Analysis (NAA)
- Neutron beam utilisation
- Maintenance
- Handling of radioactive waste
- Transport of radioactive materials within and from the Reactor Facility

1.3 ACRONYMS AND DEFINITIONS

AHD - Australian Height Datum.

AHSEC - ANSTO Health Safety and Environment Committee.

ALARA - As Low As Reasonably Achievable.

ARPANSA - Australian Radiation Protection and Nuclear Safety Agency.

CEMP - Construction Environmental Management Plan.

Environmental Aspect - element of an organisation's activities, products or services that can interact with the environment (note: a significant environmental aspect is an environmental aspect that has or can have a significant environmental impact).

Environmental Impact - any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services.

Environment - Surroundings in which an organisation operates, including air, water, land, natural resources, flora, fauna, humans and their interrelation.

EIS - Environmental Impact Statement.

EMC - Environmental Management Committee.

EMP - Environmental Management Plan.

EMS - Environmental Management System. The part of the overall management system that is responsible for developing, implementing, achieving, reviewing and maintaining the environmental policy.

NL - Notification Level (NL). Airborne discharge level which, if reached, require that ANSTO notify ARPANSA. NLs are set for individual stacks, and for specific radionuclides and release periods. Annual NLs are such that the effective dose rate to the public would not exceed the ALARA objective of 0.02 mSv/yr, even if all releases from the site were at the notification level.

PSAR - Preliminary Safety Analysis Report.

SAR - Safety Analysis Report.

SCP - Stormwater Control Plan.

SMC - Senior Management Committee.

WOTD - Waste Operations and Technical Development section at ANSTO.

The above list includes definitions and acronyms most relevant to this EMP.

2 LEGAL AND OTHER REQUIREMENTS

The ISO14001 Standard for environmental management systems requires the identification of environmental regulations and requirements that are relevant to ANSTO's environmental aspects. For this purpose, all environmental legal and other requirements that ANSTO complies with have been entered into a web-enabled database known as WEDEMS (ANSTO, 2003). Legal requirements pertaining to the Reactor Facility have also been entered into WEDEMS. For updated information on legal and other requirements, ANSTO subscribes to a commercial Environmental Law updating service, with a customised profile providing information on the changing legislative requirements.

The main legislative and regulatory requirements for ANSTO in relation to environmental management are contained within the following documents:

- Australian Radiation Protection and Nuclear Safety Act 1998 and Regulations 1999
- ANSTO Handbook (RB-STD-24-01). Rev. 1 Section 2.2 Standard Licence Conditions; Section 2.3 Special Licence Conditions; and Section 2.4 Authorisations Applying to the Organisation (ARPANSA 2001a)
- ARPANSA Nuclear Installation Licences and ARPANSA Facility Licences
- RRR EIS (PPK 1998)
- Conditions arising from the Environmental Impact Assessment of the Proposal for the Replacement Research Reactor (1999)
- Sydney Water Act 1994 (NSW)

The WEDEMS database has a variety of access options and can be viewed according to environmental aspect category (e.g. airborne emissions, waste produced, groundwater, stormwater and resource utilisation). The environmental, legal and other requirements relevant to operation of the Reactor Facility are listed under relevant EMS-EMP titles/section headings and in Appendix 1. There is some repetition where specific requirements are relevant to more than one EMS-EMP (e.g. certain requirements for reporting to ARPANSA).

2.1 RADIOACTIVE AIRBORNE EMISSIONS

The requirements from the ANSTO Register of Environmental Legal and other Requirements for airborne emissions are listed in Appendix 1. Many of the requirements are from the ARPANSA Licence Handbook and Airborne Radioactive Discharge Authorisation for ANSTO (ARPANSA 2001a, b).

Emissions from ANSTO stacks are authorised under the airborne radioactive discharge authorisation issued by ARPANSA (2001b) and in the section '2.4 - Authorisations Applying to the Organisation' of 'The Licence Conditions Handbook' (ARPANSA 2001a).

The site has a system of notification levels, approved by ARPANSA, which set the level at which the regulator is notified of increases in airborne releases. The maximum potential dose, which was used to calculate the notification levels, is 0.02 mSv/yr for the most exposed member of the public.

The design features of the Replacement Research Reactor will ensure significantly lower airborne emissions from the Reactor Facility than have been achievable for the HIFAR reactor (more details are given in Chapter 12 of the SAR).

With respect to non-radiological airborne emissions, ANSTO complies with the *Public Health (Microbial Control) Regulation 2000 (NSW)*, which requires an operation and maintenance schedule for controlling biological contaminants (such as *Legionella*) in cooling towers (see Appendix 1 Req. No. A22).

2.2 MANAGING RADIOACTIVE WASTE

The legal and other requirements for the management of radioactive waste are detailed in Appendix 1. ANSTO has a policy (APOL 2.2) on managing radioactive waste which includes safe treatment and storage of radioactive waste, minimisation of waste generated, maintenance of inventories of waste from source to disposal and broad public understanding and acceptance of ANSTO policy and practices.

The types of waste considered for the Reactor Facility are similar to those already captured in EMS-EMP-02 relating to the operation of HIFAR.

The types and quantities of waste produced have been estimated and are detailed in the *Radioactive Waste Management Plan* submitted as part of this licence application.

ANSTO is committed to regularly assessing the types and quantities of waste being generated, and evaluating and implementing improved ways of operating to bring about reductions where possible. This occurs, for example, through the Safety Assessment process which includes an assessment of waste generation of each proposed activity.

2.3 PREVENTION OF CONTAMINATION OF GROUNDWATER

Of the four legal and other requirements listed in the EMS-EMP-04, only D01, D02 and D03 are relevant to the Reactor Facility. These requirements related to the establishment and review of groundwater monitoring at the LHSTC prior to and during the Reactor Facility construction phase. All three requirements have been met.

2.4 SURFACE RUNOFF AND SEDIMENT

Appendix 1 lists legal and other requirements relevant to stormwater management and specific to the Reactor Facility operations. The listed requirements cover aspects such as potential sources of radioactive contamination in surface waters, erosion control, water quality monitoring, and compliance with relevant sections of the *Protection of the Environment Operations Act 1997 (NSW)*.

2.5 RESOURCE UTILISATION (PAPER AND HYDROCARBONS; WATER; ELECTRICITY)

There is no formal regulatory requirement relating to resource utilisation of paper and hydrocarbons. Although it is not mandatory for ANSTO to comply with the 'Green Office Guide' (ANZMEC/NAEEEC 2001) and the 'Fuel Consumption Guide' (Australian Greenhouse Office 2003), ANSTO is committed to the principles of those guides and has adopted them as policy.

Appendix 1 lists legal and other requirements relevant to water use during Reactor Facility operations. Although there are currently no specific legal requirements to limit the industrial use of potable water, ANSTO is committed to the minimisation of water usage during Reactor Facility operations, in keeping with principles of ecologically sustainable development. Water use for maintenance of grounds at the Reactor Facility will be subject to relevant water restrictions applicable in NSW.

ANSTO is required to comply with the policies set out in the 'Measures for Improving Energy Efficiency in Commonwealth Operations' guide. In the Preliminary Safety Analysis Report

(ANSTO/INVAP 2003a), there is a commitment to minimise the energy requirements and consumption. This has been incorporated in the design of the Reactor Facility to reflect climate and through maximising usage of energy demand minimisation technologies. There is also a commitment to investigate the possibility of a 'green power' purchase agreement with Energy Australia for the operation of the Reactor Facility (listed in Appendix 1).

3 ENVIRONMENTAL ASPECTS AND IMPACTS

Environmental aspects of existing ANSTO operations have been assessed and ranked for their significance during the ISO14001 process. To date, the Reactor Facility has been excluded from this process, as it is subject to its own Construction Environmental Management Plan. However, environmental considerations have been extensively incorporated in the design of the Reactor Facility to minimise environmental impacts such as airborne emission of Ar-41 and tritium, and to minimise handling of spent fuel.

As part of the ISO14001 process, the environmental aspects of operation of the Reactor Facility identified in this plan will be incorporated into the site-wide system prior to commencement of Stage B1 commissioning. A risk assessment process will be used to determine the significant environmental aspects (as defined by ISO14001) of the operational reactor, as was previously undertaken for HIFAR.

The following sections are based on information from the Environmental Impact Statement (EIS; PPK 1998, 1999), the Preliminary Safety Analysis Report (PSAR; ANSTO/INVAP 2003a) and the Safety Analysis Report (SAR; ANSTO 2004b). As required by ISO14001, these aspects will be regularly reviewed and revised as necessary in an ongoing process of continual improvement in environmental performance.

3.1 RADIOACTIVE AIRBORNE EMISSIONS

As stated in the EIS (PPK 1998) and outlined in Chapter 14 of the PSAR (ANSTO/INVAP 2003a), the overall impact of radioactive airborne emissions from the Reactor Facility will be less than from the emissions from the current HIFAR. The major reduction will be in the production and emission of argon-41 (Ar-41), which was, for HIFAR, the single largest contributor to the radiological impact to the public (although this was very low, being less than 0.01 mSv/yr). Emissions of Ar-41 are expected to be only a small fraction of emissions from HIFAR, with a concomitant reduction in the airborne dose to members of the public (ANSTO/INVAP 2003a).

Limiting of tritium emissions was considered in the design of the Reactor Facility and under normal operation, emission of tritium will be greatly reduced from HIFAR levels, due to the presence of heavy water in the sealed system of the reflector vessel only (ANSTO/INVAP 2003a). During major maintenance of the Reflector Cooling and Purification System the potential for emission of tritium will be mitigated by facilities, procedures and practices to minimise emissions.

There has been no significant emission of I-131 from HIFAR and emissions from the Reactor Facility are expected to be of a similar minimal level.

Another environmental aspect relating to airborne emissions is the potential release in the event of a Beyond Design Basis Accident. The probability and severity of this release is considered in the EIS (PPK 1998), PSAR (ANSTO/INVAP 2003a) and SAR (ANSTO 2004b).

In summary, the Reactor Facility meets all the criteria for both the low probability of an accident and for the consequences in the unlikely event of an accident. The overall radiological impact of the Reactor Facility will be far smaller than HIFAR, due to the major reductions in Ar-41 and H-3 emissions.

3.2 MANAGING RADIOACTIVE WASTE

The types and quantities of waste produced from the commissioning and operation of the Reactor Facility have been estimated and are detailed in the Radioactive Waste Management Plan included in this application for a Facility Licence.

The types of waste considered by the Radioactive Waste Management Plan include:

a) low and intermediate level solid wastes (such as spent ion exchange resins, used reactor components, filters, target cans, control rods, irradiation rigs and contaminated items);

b) low and intermediate level liquid wastes (from sources such as the demineralised water plant, potentially active washbasin, shower and floor drain liquids, laboratory waste, etc); and

c) gaseous wastes from different sources, including pools, coolant systems and experimental facilities.

The *Radioactive Waste Management Plan* submitted as part of this licence application details the strategy for handling, processing, storage and disposal of radioactive wastes. Controls on the generation, containment and avoidance of environmental releases are dealt with in the Procedures and Operating Instructions identified under the Reactor Facility QMS NR-P-01 for each identified process. Thus, Operating Procedures and Instructions are written to include ISO14001 issues and conform to the requirements for implementation of and integration into the ANSTO ISO14001-certified Environmental Management System.

3.3 PREVENTION OF CONTAMINATION OF GROUNDWATER

Considerable background detail on the groundwater hydrology in relation to the geology and soil structure of the LHSTC (including the Reactor Facility site) is available in the PSAR Chapter 3 (ANSTO/INVAP 2003a).

Groundwater level and quality monitoring at the LHSTC was established in 2000 with the installation and development of a groundwater piezometer network, which includes the Reactor Facility site. Hoffman et al. (2003) summarises the information for LHSTC groundwater flow patterns, hydrogeochemistry, radioactivity and response to heavy rains. A detailed report bringing together the range of groundwater investigations at the LHSTC is in preparation (Parsons-Brinkerhoff/ANSTO 2004).

An Environmental Management Plan for 'Prevention of Contamination to Groundwater' (EMS-EMP-04) will be updated to incorporate material relevant to operation of the Reactor Facility.

Groundwater flow at the LHSTC is primarily dependent on topographic features. 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. Data from a borehole located near the head of a gully show a peak of flow, from the plateau to the gully, a few days after the rainfall event. The groundwater level returned to its original height after about 10 days (Hoffmann et al. 2003).

Groundwater quality at LHSTC is typical of a sandstone aquifer, ie somewhat acidic (pH = 3.88 to 6.30) and with low Electrical Conductivity (EC = 300 to1000 microS/cm), reflecting its origin in local rainfall that is flowing slowly through the system (rate = 0.01 to 4 m/yr), (Hoffmann et al. 2003).

Gross alpha and beta radioactivity in groundwaters were all below 0.3 Bq/L (Becquerels per litre) in September 2002, ie below current Australian Drinking Water Guideline screening levels (NHMRC/ARMCANZ 1996, updated 2001). Tritium activity in the LHSTC

groundwaters ranged from 2.6 to 611 Bq/L (ie <10% of the specific tritium guide level for drinking water, given by the NHMRC and ARMCANZ in 1996). It is anticipated that radiological environmental aspects, such as the low levels of tritium occurring in groundwater at the LHSTC, will gradually reduce due to lower emissions from the Reactor Facility.

3.4 SURFACE RUNOFF AND SEDIMENT

The LHSTC, including the Reactor Facility site at its western edge, is on a watershed between Bardens Creek and Melinga Molong Gully catchments. Surface waters flow either north via a tributary of Bardens Creek (which joins Mill Creek and flows to the Georges River) or south into Melinga Molong Gully and then into the Woronora River (ANSTO/INVAP 2003a, PSAR Chapter 3). The Reactor Facility site has a gently sloping central portion, with slopes increasing to ca 5% to the northeast, and ca 10% near the southwest corner. Surface elevations range from approximately 158m (AHD) within the central gently sloping part of the site, to approximately 151m (AHD) to the northeast and 153m (AHD) to the southwest (ANSTO/INVAP 2003b, Stormwater Control Plan).

The Environmental Management Plan for 'Surface Runoff and Sediment' (EMS-EMP–05) will be updated to incorporate material relevant to operation of the Reactor Facility.

Operation should not involve any environmental aspects other than those already recognised and managed for the rest of the LHSTC. Typically, stormwater flows can be associated with erosion and sediment movement as well as transfer of excess nutrients and seeds of exotic weeds into native bushland. These aspects may be temporarily exacerbated by burning (hazard reduction or bushfire), if this is soon followed by rain of sufficient intensity. The controls and procedures to address these issues are discussed in section 5.4.

Radiological environmental aspects, such as the low levels of tritium routinely found in surface runoff from the LHSTC (from <10 to 610 Bq/L, ie <10% of Australian Drinking Water Guidelines, NHMRC/ARMCANZ 1996; Hoffmann et al. 2003), are expected to be greatly reduced with the transition to exclusive operation of the Reactor Facility.

3.5 RESOURCE UTILISATION (PAPER AND HYDROCARBONS; WATER; ELECTRICITY)

According to EMS-EMP-06 'Resource Utilisation (Paper and Hydrocarbons)', paper usage at ANSTO has been identified as a significant environmental aspect. Resource utilisation associated with the Reactor Facility will be subject to the minimisation objectives applicable across ANSTO. ANSTO is also committed to achieving the recommendations in the Australian 'Fuel Consumption Guide' (Australian Greenhouse Office 2003).

EMS-EMP-07 'Water Use' supports measures aimed at monitoring the use of potable water at ANSTO. Operation of the Reactor Facility will be accommodated by infrastructure and services currently existing at the LHSTC. Existing water supply, electrical supply and liquid effluent disposal systems meet the needs for operation. Water conservation design features were considered in the PSAR Table 14.5/1 'Environmental Management Issues Considered During Design' (ANSTO/INVAP 2003a), which summarised the objectives and design features incorporated for minimisation of water consumption.

EMS-EMP-08 'Electricity Use' supports measures aimed at controlling and monitoring electrical energy efficiency at the Reactor Facility, as a means of minimising costs of ANSTO's operations as well as reducing any additional contribution to green house gas emissions. The electrical energy usage at ANSTO will increase due to operation of the Reactor Facility; the associated neutron beamline equipment and buildings; as well as the redevelopment and expansion of radioisotope production facilities.

4 MANAGEMENT ARRANGEMENTS

An ISO14001 coordinator within the reactor operating organisation will facilitate the incorporation of the Reactor Facility into the ANSTO EMS. The coordinator will ensure that the procedures and instructions of the Quality Management System comply with the requirements of the EMS.

4.1 RADIOACTIVE AIRBORNE EMISSIONS

The major objective of the airborne emissions management system is to ensure that the radiation dose to the public and the environment in general is as low as reasonably achievable (ALARA) and below the relevant ANSTO ALARA dose objectives which are 0.02 mSv/yr from all activities (ANSTO 2001). The ALARA objective for research reactor operation is 0.01 mSv/yr. The design features of the Reactor Facility, i.e. pool-type reactor with closed reflector cooling circuit, decay tanks, hot water layer, etc with a containment isolation system and airborne activity monitoring system, facilitate achievement of the ALARA objective.

Substantial environmental improvements in airborne emissions will be achieved in operation of the reactor. The specific objectives and targets in the ANSTO Environmental Management Plan (ANSTO EME-EMP-01) listed below will be achieved and significantly lower emission targets for Ar-41 and H-3 emissions have been set. (Ref Para 8.1 of Radioactive Waste Management Plan, RRRP-7272-EDEAN-001-A. of Operating Licence Application Part B: Plans & Arrangements)

Objectives and Targets

	Objective	Target
1	To ensure the assessed annual radiation dose to a member of the public due to the airborne radioactive discharges is as low as reasonably achievable (ALARA).	Maintain the assessed annual dose at less than 0.02 mSv
2	To reduce the airborne release of argon-41 from reactor operations.	Reduce airborne emissions of argon-41 by 75% through the commissioning and sole operation of the Replacement Research Reactor
3	To reduce the airborne release of tritium from reactor operations	Reduce airborne emissions of tritium by 75% through the commissioning and sole operation of the Replacement Research Reactor

A detailed comparison between airborne discharges from HIFAR vis-à-vis those predicted from the replacement Reactor Facility is provided below. It shows that for the major nuclides of concern, Argon-41 and Tritium, the reductions are approximately 97.4% and 99% respectively. The table shows that the total reduction for all nuclides is approximately 97.5%.

Annual Stack Discharge Estimates – Comparison of Significant Nuclides with HIFAR and EIS

	HIFAR	EIS	Reactor Facility
Ar^{41} [Tbq]	164	82	4.2
Tritium [TBq]	4.32	4.32	0.037
I^{131} [Mbq]	14	14	10
Sr^{90} [Mbq]	2.03	2.03	1.5

4.2 MANAGING RADIOACTIVE WASTE

Currently, waste production figures are from best estimates from INVAP. Once the Reactor Facility is operating and processes are fully implemented, waste production and resource usage can be accurately assessed and targets established with a view to minimising the amount of waste produced and resources used.

4.3 PREVENTION OF CONTAMINATION OF GROUNDWATER

The aim of the groundwater monitoring and management system is to ensure that any emissions are identified early by the monitoring program. This will assist in maintaining groundwater emissions at levels such that there will be no additional radiation dose to the public from groundwater discharge.

4.4 SURFACE RUNOFF AND SEDIMENT

The objectives of surface water monitoring and management are to;

a) monitor water quality (eg sediment/turbidity and nutrients) for as long as necessary to show that stormwater run off has stabilised (Requirement # C06: EA Condition No.4 – Operational Impacts (non-radiological)).

b) ensure that the physical systems in place maintain stormwater flows at the current level (In requirement # C02: EIS Commitment on Geology, Soil Water, Chapter 8, as summarised in Chapter 18 Vol.3 Table 18.1 of PPK 1999).

c) provide for on-site containment and treatment of any small accidental spills or releases of contaminated liquid (In requirement # C02: EIS Commitment on Geology, Soil Water, Chapter 8, as summarised in Chapter 18 Vol.3 Table 18.1 of PPK 1999).

d) demonstrate that any releases of radioactive material are within the limits set by NSW EPA regulations (Requirement # C08: *Clean Waters Regulations 1972 (NSW)*, under the *Protection of the Environment Operations Act 1997 (NSW)*).

4.5 RESOURCE UTILISATION (PAPER AND HYDROCARBONS; WATER; ELECTRICITY)

The management arrangements for resource utilisation will not be different for the Reactor Facility than for any other part of ANSTO.

EMS-EMP-06 ‘Resource Utilisation (Paper and Hydrocarbons)’ gives the ANSTO-wide objective: to enhance the recycling of paper at ANSTO sites, thereby decreasing the net paper consumption per employee.

EMS-EMP-07 ‘Water Use’ gives the ANSTO-wide objective: to develop a strategy to minimise the use of water, which will be facilitated by quantification of water usage across ANSTO facilities.

EMS-EMP-08 ‘Electricity Use’ gives the ANSTO-wide objective: to develop a strategy to minimise the use of electricity. ANSTO's operations do not fall into an ‘end-use-category’ as defined in Table 1 of the ‘Measures for Improving Energy Efficiency in Commonwealth Operations’ guide for which energy targets have been set by the Commonwealth Government. However, ANSTO has put in place cost-effective monitoring, control and reporting strategies to increase the efficiency of electricity use in its operations.

5 ENVIRONMENTAL MANAGEMENT CONTROLS AND PROCEDURES

Section 14.5.3 of the PSAR (ANSTO/INVAP 2003a) notes that a wide range of commitments and approval conditions were derived from the environmental impact assessment process for the Reactor Facility. These commitments extended beyond the Reactor Facility and included other ANSTO activities and services. Accordingly, ANSTO has revised its EMS to reflect current best practice and has achieved certification to the ISO14001 Standard. As part of the next stage of this process, the environmental management aspects of the Reactor Facility addressed in this plan will be integrated into ANSTO's overall EMS.

The ongoing review of ANSTO's environmental systems within the EMS includes the identification and review of emission sources, evaluation of transport pathways by which material can potentially enter the environment, determination of the environmental impacts of activities, and the operation of reporting, information and feedback systems to ensure that environmental monitoring is used to improve environmental performance. This process occurs through the operation of key committees, including the ANSTO Health Safety and Environment Committee (AHSEC – see 7.3 below) and the Environmental Management Committee (EMC - see 7.4 below).

With respect to operation, provisions for protection of the environment have been made in the design of the Reactor Facility and through administrative controls invoked via the Quality Management System (QMS). The design of the reactor minimises radiation dose to personnel, public and the environment. Engineered Safety Features (ESFs) are also incorporated in the reactor design to prevent or mitigate the radiological consequences of any postulated accidents (see ANSTO 2004b, Chapter 7). The ESFs ensure:

a) adequate heat removal from the core and rigs;

b) the capability to shut down the reactor and maintain it in a safe shutdown condition; or

c) containment within the reactor building of radioactive material resulting from abnormal events.

A detailed set of Emergency Response Procedures covers actions to be taken in the event of a major accident.

The Reactor Facility QMS identifies some eighteen procedure groups associated with processes required for operation and support. These form part of the plans and arrangements for operation and are detailed in ANSTO (2004b) Chapters 13 and 18.

Within the operations manuals, procedures and instructions, cautions and warnings provide guidance on correct procedures and preventative actions to minimise the environmental impact of the relevant system or process.

5.1 RADIOACTIVE AIRBORNE EMISSIONS

The environmental management controls and procedures for airborne emissions from the Reactor Facility are integrated into the operating procedures. Monitoring of airborne releases has been incorporated into the Reactor Control and Monitoring System. Hence, any release of radionuclides above the control system set points will be immediately brought to the attention of the operators. Details of the systems have been provided in the SAR (ANSTO 2004b).

5.1.1 Microbial Emissions from cooling towers

The cooling systems for the Reactor Facility are designed to allow control of biota in the water systems. The monitoring and chemical control of biological contaminants such as

Legionella will be conducted as described in EMS-EMP-01 for radioactive airborne emissions.

5.2 MANAGING RADIOACTIVE WASTE

The management of radioactive waste is addressed in the *Radioactive Waste Management Plan* submitted as part of this licence application. Solid and liquid wastes will be transferred to Waste Operations and Technology Development Section (WOTD) for treatment, storage and disposal in accordance with established procedures under ARPANSA Licence FO0044-4C.

5.3 PREVENTION OF CONTAMINATION OF GROUNDWATER

The drainage system of the Reactor Facility is designed to collect groundwater from above Reference Level (RL) 152 (1 metre below the Reactor and Neutron Guide Hall floor level) and drain it into the stormwater drainage system (ANSTO/INVAP 2003a, PSAR Chapter 14).

As described in EMS-EMP-04, the LHSTC groundwater sampling plan and monitoring protocols were originally established by PPK (2000). This sampling has incorporated the Reactor Facility site since its inception. The monitoring programme is summarised in the annual Environmental and Effluent Report series, of which Hoffmann et al. (2003) is the most recently published. Monitoring currently comprises quarterly monitoring of standing water level and field chemistry parameters, ie pH, Electrical Conductivity (EC), Oxidation-Reduction Potential (ORP or Eh) and temperature. Annual monitoring includes analysis for major ions, tritium, gross alpha, beta, and gamma with specific radionuclides identified if sufficiently abundant for spectral analysis. A technical note (Malone 2004) describing the Environmental Management Controls and Procedures relevant to groundwater at the LHSTC and including those relevant to the Reactor Facility, is in preparation.

5.4 SURFACE RUNOFF AND SEDIMENT

Stormwater management facilities built for the Reactor Facility construction phase will be integrated with other stormwater control for the LHSTC, with the aim of maintaining the general environmental quality of aquatic systems within the LHSTC buffer zone (ANSTO/INVAP 2003a, PSAR Chapter 3). EMS-EMP-05 details the current quality procedures and instructions and physical systems used to monitor and manage surface water flows at the LHSTC.

Incorporation of the Reactor Facility site into the LHSTC stormwater management system will involve upgrading the two sedimentation dams built in the buffer zone during the construction phase and construction of two on-site bunds (Humesceptre STC7) one of which will be upgraded to retain 2500 L of oil in the event of a major leakage in a transformer sited in the catchment. Temporary construction-phase stormwater drainage works will be upgraded to permanent drains in similar positions. Stormwater flowpaths will be assessed and drainage works upgraded as necessary along the planned transport route for nuclear material movement between the Reactor Facility and WOTD to ensure capture of any radioactive spillage.

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.

5.5 RESOURCE UTILISATION (PAPER AND HYDROCARBONS; WATER; ELECTRICITY)

EMS-EMP-06, 07 and 08 detail a series of initiatives that are being implemented at the LHSTC in respect of resource usage. The Quality Management System for operation of the Reactor Facility has been prepared with these initiatives in mind. The management controls and procedures are to:

a) recycle cardboard and paper in accordance with the service protocols being developed as part of the Corporate Services quality accreditation to AS 9001:2000;

b) procure recycled products, including potentially developing a catalogue of products that are manufactured in whole or in part with recycled components, and incorporating measures of performance;

c) comply with the Fuel Consumption Guide's recommendation that 28% or more of the motor vehicle fleet has a fuel consumption of 10.7 litres per 100 kilometres travelled; and

d) monitor trends in power and water usage throughout the LHSTC and monitor the effectiveness of energy saving strategies.

6 ENVIRONMENTAL MONITORING AND AUDITING SCHEDULE

The report 'Environmental and Effluent Monitoring at ANSTO sites' is published annually. The most recent report (Hoffmann et al. 2003) ANSTO/E-752 for 2002-2003 summarises the Environmental Monitoring programme (see Table B), as well as the ARPANSA-required verification of monitoring data. This series has presented the results of ANSTO's environmental monitoring since the late 1950s, and has developed into the primary public reporting reference, incorporating data and interpretation of both source and environmental monitoring at the LHSTC and the NMC. It fulfils the ARPANSA licensing requirements for all of ANSTO's facilities.

Environmental monitoring of ANSTO sites is the subject of a quality procedure within ANSTO's AS/NZS ISO9001:2000 compliant Quality Management System, which incorporates the existing series of quality instructions. Auditing is scheduled according to ANSTO's Quality and Environmental Management systems. The internal auditing is in accordance with the requirements of the standard and with ANSTO *Internal Audit Process (AR-1004)*.

Some audits are required by a pre-determined audit schedule; others can be initiated by the EMC, AHSEC, senior management, or at the request of individual staff members if the circumstances warrant. The audit report is forwarded to the officer responsible for the process or other appropriate officer for comment on the findings in a 'Recommendation Report'. The audit report and Recommendation Report are considered by the EMC as part of the 'Continual Improvement component', and the views of the EMC are communicated to the appropriate officer to finalise the implementation of agreed recommendations. The audit outcomes are reported in the EMC minutes and are considered by the AHSEC if appropriate.

7 ORGANISATIONAL RESPONSIBILITIES FOR THE REACTOR FACILITY

7.1 MANAGER, REACTOR OPERATIONS

The Manager, Reactor Operations is the Facility Nominee for the Reactor Facility and has overall responsibility for safety. This includes ensuring effective implementation of the Environmental Management Plan and provision of sufficient resources to ensure its effectiveness at all times.

7.2 REACTOR FACILITY STAFF

The line managers, group leaders and area supervisors are appointed to carry out tasks and procedures related to ANSTO's responsibility for environmental management.

All staff are required to take a proactive approach to environmental issues and undertake activities in an environmentally sound manner.

7.3 ANSTO HEALTH SAFETY AND ENVIRONMENT COMMITTEE (AHSEC)

The principal role of the Committee is to review the conduct and outcomes of ANSTO's internal safety review process and the regular licensing reports submitted by divisions to ARPANSA in fulfilment of their reporting requirements. It also monitors the environmental performance of all activities on the LHSTC site and the NMC, and advises the Executive Director on the effectiveness of the overall safety and environmental arrangements. Its membership and Terms of Reference are set out in ANSTO Safety Directive 2.1.

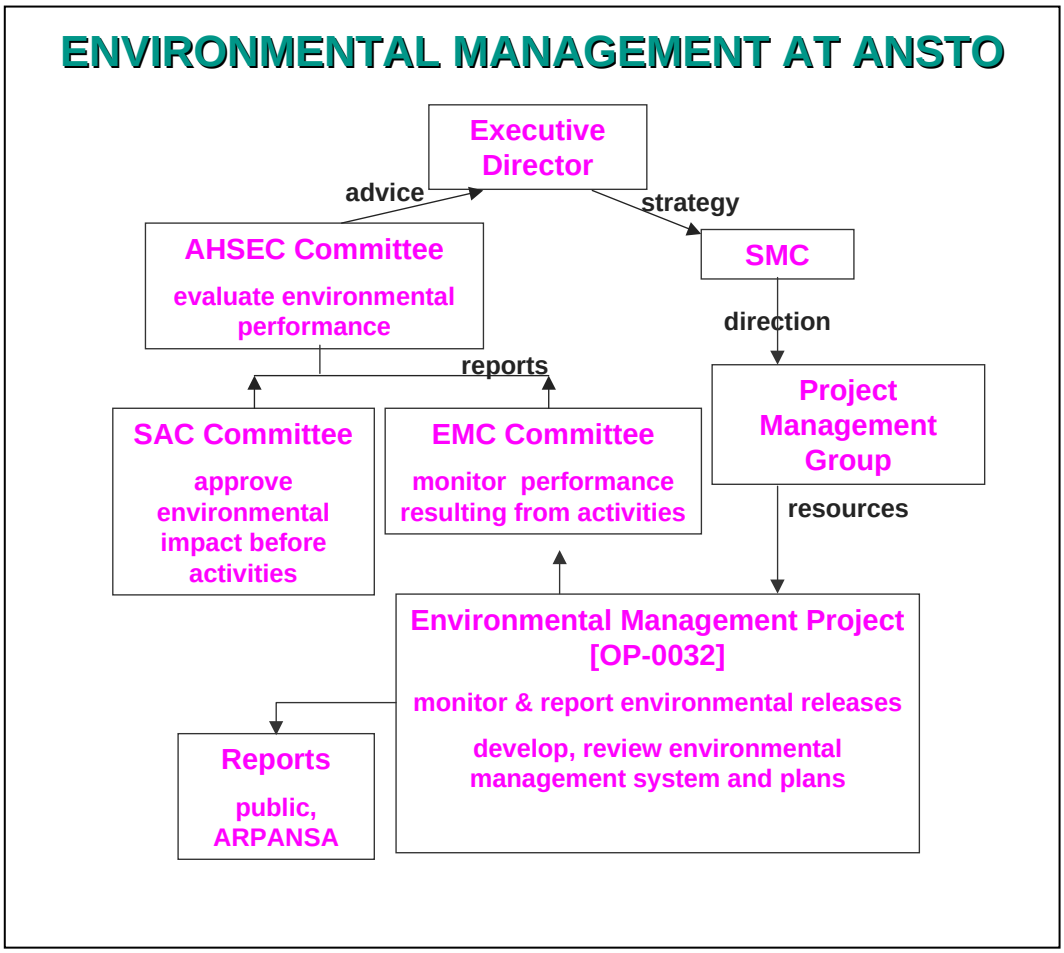
7.4 ENVIRONMENTAL MANAGEMENT COMMITTEE

The Environmental Monitoring Committee is a multi-divisional committee, with the primary role of coordinating the environmental monitoring associated with the Lucas Heights Science and Technology Centre. It advises AHSEC on issues associated with the environmental performance of ANSTO facilities and the implementation of relevant sections of ANSTO's Health, Safety and Environment Policy. Its membership and method of operation is set out in ANSTO Safety Directive 2.1.

8 MANAGEMENT REVIEW

Higher level management review within ANSTO is undertaken according to the *Management Review Process (AR-1006).* Management review of the EMS system occurs within the hierarchical structure illustrated in the Figure below. Key committees include the EMC, SMC, and AHSEC.

An important trigger for management review is the outcome of the EMS internal audit process.



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APPENDIX 1: OBLIGATIONS RELATING TO THE REACTOR FACILITY FROM THE REGISTER OF ANSTO ENVIRONMENTAL LEGAL AND OTHER REQUIREMENTS

Req. No.	Requirement	Citation/Source	Conditions
2.1 Radioactive Airborne Emissions			
A01	Plan for managing airborne radioactive discharge	ANSTO Handbook RB-STD-24-01 Rev Section 2.4 Authorisations Applying to the Organisation 1. Plan for Managing Airborne Radioactive Discharges	The licence holder must develop, maintain and implement a plan for managing airborne radioactive discharges from the Lucas Heights Science and Technology Centre and the National Medical Cyclotron. The plan must ensure that: i) radiation doses due to airborne radioactive discharges are as low as reasonably achievable, below dose constraints agreed by the CEO, having regard to economic and social factors; ii) all airborne radioactive discharges are appropriately characterised; iii) all pathways of exposure to real or hypothetical critical groups of people or individuals are identified and written justification is provided for the choice of those critical groups or individuals; iv) written justification is provided for exclusion from the monitoring regime of specific radionuclides which may be discharged; v) documentation is provided demonstrating how doses to persons on or near the site who are not considered to be radiation workers are taken into account; vi) airborne discharges are classified according to the relative contributions of radionuclides to radiation doses; vii) continuous sampling of airborne radioactive discharges is undertaken at the points of release and measurement of the samples subsequently conducted; viii) where releases are not continuously sampled or measured, the conduct or dealing is controlled to ensure compliance with this discharge authorisation and written justification of the controls is provided; ix) airborne radioactive discharges are recorded as weekly cumulative discharges; x) radiation doses to critical groups and individuals are assessed; xi) analyses of trends in discharges and

Req. No.	Requirement	Citation/Source	Conditions
			assessed doses and the examination of any variances or excursions is undertaken; xii) results of environmental monitoring to confirm the effectiveness of the plan for managing airborne radioactive discharges are provided; xiii) the plan for managing airborne radioactive discharges must be put in place within a time frame agreed with CEO.
A02	Quality system requirement for plan for managing airborne radioactive discharge	ANSTO Handbook RB-STD-24-01 Rev.1 Section 2.4 Authorisations Applying to the Organisation 2. Quality System	**2. Quality System** The plan for managing airborne radioactive discharges must be within a quality system, and the elements of the plan must conform to recognised standards agreed with the CEO.
A03	Monitor weekly cumulative airborne emissions	ANSTO Handbook RB-STD-24-01 Rev.1 Section 2.4 Authorisations Applying to the Organisation 3. Monitoring	**3. Monitoring** Airborne radioactive discharges must be continuously sampled, and the activity of weekly cumulative discharges determined.
A04	Dose model for airborne emissions	ANSTO Handbook RB-STD-24-01 Rev 1 Section 2.4 Authorisations Applying to the Organisation 4. Dose Model	**4. Dose Model** The assessed radiation dose to a member of the public must be calculated using a validated model acceptable to the CEO. Computer codes and assumptions should use measured and realistic data where available, otherwise conservative data should be agreed with the CEO and used.
A05	Optimisation to achieve ALARA if exceed 0.02 microSievert to public	ANSTO Handbook RB-STD-24-01 Rev1 Section 2.4 Authorisations Applying to the Organisation 5. Exceeding the Objectives	**5. Exceeding the Objectives** a) If the assessed annual radiation dose to a member of the public due to the airborne radioactive discharges exceeds the ALARA dose objective of 20 microSievert per year authorised in section 3 above, the Licence Holder must perform an optimisation study to the satisfaction of the CEO. b) The optimisation study must demonstrate that the following are as low as reasonably achievable after taking into account economic and social factors: (a) the magnitude of the individual doses; (b) the number of people who are exposed; and (c) the likelihood of incurring exposures to radiation. c) The optimisation study must be reported to the CEO.

Req. No.	Requirement	Citation/Source	Conditions
A06	Investigation required if airborne emission notification level exceeded	ANSTO Handbook RB-STD-24-01 Rev Section 2.4 Authorisations Applying to the Organisation 6. Exceeding a Notification Level	**6. Exceeding a Notification Level** a) If a four-weekly, quarterly or annual notification level is exceeded for one or more radionuclides, an investigation must be made to determine the cause of the increased discharge and appropriate actions must be taken to limit the release to below the notification level, as soon as practicable. b) If any periodic notification level is exceeded by a factor of five, action must be taken immediately to limit further release to below the notification level and to return conditions to normal.
A07	Notify ARPANSA CEO if airborne emission Notification Level exceeded	ANSTO Handbook RB-STD-24-01 Rev 1Section 2.4 Authorisations Applying to the Organisation 7. Notifying the CEO of an Exceedance	**7. Notifying the CEO of an Exceedance** a) The CEO must be notified of the release, cause of release and of the actions taken to limit the release within seven days of the detection of a notification level being exceeded. b) If a notification level is exceeded by a factor of five, the CEO must be notified of the release and of the actions taken to limit the release within twenty four hours of the detection of the release, or on the next working day.
A08	Record keeping for Airborne emissions on official ANSTO files	ANSTO Handbook RB-STD-24-01 Rev 1Section 2.4 Authorisations Applying to the Organisation 8. Record Keeping	**8. Record Keeping** Records of the airborne discharges must kept as detailed in the plans and arrangements required in section 4.1, to the satisfaction of the CEO. Records of airborne radioactive discharges must be maintained by the licence holder for 10 years and annual reports that contain the summarised airborne radioactive discharges and assessed radiation doses for at least 70 years. The records are to be retained and available in a form that can be readily audited by the CEO.
A10	Regular review of the plan for managing airborne radioactive discharge	ANSTO Handbook RB-STD-24-01 Rev 1 Section 2.4 Authorisations Applying to the Organisation 10. Continuous Improvement	**10. Continuous Improvement** a) The licence holder must ensure appropriate arrangements to maintain awareness of knowledge of current and emerging emission reducing technology for airborne radioactive discharges. b) The licence holder must periodically review the plan for managing airborne radioactive discharges so that any improvements in emission reducing technology, rationale or changes in conducts and dealings can be assessed in line with improving environmental performance, to the satisfaction

Req. No.	Requirement	Citation/Source	Conditions
			of the CEO.
A11	Regular review of the airborne radioactive discharge requirements	ANSTO Handbook RB-STD-24-01 Rev 1 Section 2.4 Authorisations Applying to the Organisation 11. Review of Discharge Requirements	**11. Review of Discharge Requirements** The licence holder must keep under review any changes to the environment, operational conditions, critical group or anything which impacts upon the quantity of discharges of radioactive material, or assessed doses, and report such changes to the CEO.
A12	Report airborne emissions to ARPANSA on 4 weekly, quarterly and annual basis	ANSTO Handbook RB-STD-24-01 Rev 1 Section 2.4 Authorisations Applying to the Organisation 12. Reporting to the CEO	**12. Reporting to the CEO** a) The licence holder must report the cumulative airborne radioactive discharges to the CEO four weekly, quarterly and annually as radioactivity discharged and percentages of notification levels. b) The quarterly and annual reports must include a summary of discharges, estimates of radiation doses, analysis of trends, and review of variances and excursions to determine the causes. c) The results of the Licence Holder's environmental monitoring program for airborne radioactive discharges must be reported to the CEO annually.
A13	Specification of notification levels for airborne emissions	ANSTO Handbook RB-STD-24-01 Rev 1 Section 2.4 Authorisations Applying to the Organisation 13. Notification Levels	**13. Notification Levels** a) All actual radioactive airborne discharges under the effective control of ANSTO must be accounted for in setting the notification levels. b) The licence holder must sample and measure each discharge location for alpha radioactivity and notify the CEO of any measurement above the ambient levels due to naturally occurring radon decay products, taking into account any discharge filtration prior to sampling. c) The annual notification level for each discharge location at LHSTC and NMC are specified in the Tables 1 to 4 below. The following periodic notification levels, based on a fraction of the annual level, also apply: [Tables 1 to 4 and periodic notification levels can be found in the ANSTO Handbook]
A16	Comply with EA Condition 1 that ANSTO must construct and operate Reactor	EIS Commitment on management of Reactor Products, Spent Fuel and Wastes Chapter 10, as summarised in	Complying with all relevant legislative and regulatory requirements, in particular, ensuring that all discharges are within authorised limits, regular radioactive releases to the environment are monitored and reported;

Req. No.	Requirement	Citation/Source	Conditions
	Facility in accordance with undertakings and commitments provided in PPK (1999).	Chapter 18 Vol.3 Table 18.1 of PPK (1999)	Ensuring that radiation exposures would be kept 'As Low as Reasonably Achievable', taking into account economic and social factors; Making sure that the maximum off-site dose to a member of the public would remain less than one percent of the current public dose limit recommended by the National Health and Medical Research Council of one millisievert per year; ensuring that comprehensive assessment of future emissions would be undertaken and independently reviewed by the regulatory authority (Australian Radiation Protection and Nuclear Safety Agency) as part of the approval process before construction;
A22	Microbial control operation & maintenance of systems for air handling, evaporation cooling, humidifying, warm water & air cooling	*NSW Public Health (Microbial Control) Regulation 2000 (Part 3 Section 9 and Part 4 Section 10).*	Carry out installation and operation as per AS/NZS 3666.1.95 and 3666.2.95. When maintenance is carried out, minimise contamination of adjoining area and ambient environment by aerosols, dust particles or effluent. *Legionella* levels not more than 10 colony forming units/mL.
G35	Provide radiation protection of the environment to comply with the ANSTO Handbook	ANSTO Handbook RB-STD-24-01 Rev 1 Section 2.2, Standard Licence Conditions 3. Radiation Protection Arrangements	The licence holder must develop, maintain and implement its radiation protection arrangements current, and in a form acceptable to the CEO and verifiable by Audit, including, but not limited to: v) arrangements for radiation protection of the environment;
G37	Environmental monitoring of all site activities involving radioactive materials.	ANSTO Handbook RB-STD-24-01 Rev.1 Section 2.2 Standard Conditions Amendment 5a: Environmental Management	Identify potential sources of radioactive contamination to groundwater, surface water, soil and atmosphere and formally include sources in environmental management system.
G39	Independent Environmental monitoring audit.	ANSTO Handbook RB-STD-24-01 Rev.1 Section 2.2 Standard Conditions Amendment 5c: Environmental Management	Licence holder must ensure that an independent body verifies the results of the environmental monitoring, according to a plan and schedule agreed to by the CEO.
H13	Operation of Reactor	Cumulative Impacts and Ecologically	Ensure the maximum off-site dose to a member of the public when the reactor is

Req. No.	Requirement	Citation/Source	Conditions
	Facility	Sustainable Development Chapter 20, as summarised in Chapter 18 Vol.3 Table 18.1 of PPK (1999)	operating would remain less than one per cent of the public dose limit adopted by the National Health and Medical Research Council of one millisievert/yr.
H15	Production of Radiopharmaceuticals and other reactor products in Reactor Facility	EIS Commitment on management of Reactor Products, Spent Fuel and Wastes Chapter 10, as summarised in Chapter 18 Vol.3 Table 18.1 of PPK (1999)	Ensure that all radiopharmaceuticals produced using the replacement reactor are produced in accordance with the same national and international standards that currently apply, and in accordance with any new legislation which may replace these standards in the future; and Ensure that all reactor products transported from the Lucas Heights Science and Technology Centre comply with the requirements of national standards and the IAEA Regulations for the Safe Transport of Radioactive Material.
H26	Provide 4 weekly, quarterly and annual reports to ARPANSA on airborne, liquid and solid waste	ANSTO Handbook RB-STD-24-01 Rev 1 Section 2.2, Standard Licence Conditions 8. Reporting on Airborne, Liquid and Solid Waste	8. Reporting on Airborne, Liquid and Solid Waste The licence holder must provide to the CEO within twenty-eight (28) days of the end of each quarter year, and by 30 September each year, a quarterly and annual report on all airborne, liquid and solid waste arising from conducts and dealings by the organisation. Note: The reports detailed in the previous condition must include estimates of radiation doses to the public from the wastes utilising a method approved by the CEO.
H29	Quarterly reporting to ARPANSA on operation of controlled facility	ANSTO Handbook RB-STD-26-01 Rev 0 Section 4, Standard Licence Conditions for Facility Licences 4.1.1 REPORTING 18. Periodic reporting to CEO	22. Periodic Reporting to CEO The licence holder must provide to the CEO within twenty-eight (28) days of the end of each quarter year, the following information for the previous quarter year: (v) the activity of any radioactivity released to the environment during the quarter, reported against the airborne and liquid effluent discharge authorisation for the controlled facility.
H30	Annual reporting to ARPANSA on operation of controlled facility	ANSTO Handbook RB-STD-26-01 Rev 0 Section 4, Standard Licence Conditions for Facility Licences 4.1.1 REPORTING 19. Annual reporting to CEO	22. Annual Reporting to CEO The licence holder must provide to the CEO by 30 September each year an annual report for the past financial year summarising the following information in relation to the controlled facility: (vi) results of environmental monitoring and radiation surveys;

Req. No.	Requirement	Citation/Source	Conditions
			(vii) collective, average and maximum radiation doses to groups of similar personnel and the public arising from the conducts at the controlled facility.
2.2 Managing Radioactive Waste			
B01	Develop, document and implement arrangements for routine discharges	ANSTO Handbook RB-STD-24-01 Rev.1 2.3 Special Licence Conditions 13.23 Action Plan	13. The licence holder must provide to the CEO evidence that the following items have been addressed in a timeframe acceptable to the CEO. 13.23 Routine Discharge of Radioactive Waste to the Sewer Develop, document and implement arrangements for the following: i) Inclusion of activity concentrations as well as maximum activity levels of radioactive waste in the Trade Waste Agreement. ii) Inspection and routine maintenance of plumbing systems for which ANSTO has responsibility.
B03	Comply with limits on radioactivity and non-radioactive pollutants as specified in Sydney Water Corporation (SWC) trade wastewater agreement	*NSW Sydney Water Act 1994* – ANSTO/SWC Consent to Discharge Industrial Trade Wastewater Agreement No. 4432, 31/5/01	Comply with limits on Ammonia, BOD, Grease, Suspended Solids, Zinc, Gross Alpha, Gross Beta, Tritium as specified in agreement. Comply with sampling regime specified in agreement. Report results to SWC on monthly basis
E01	Plan and schedule for meeting all Licence Conditions for management and storage of radioactive wastes.	ARPANSA Facility Licence (FO 0044-WOTD) for Controlled Facility of Waste Operations & Technology Development, Special Licence Conditions 3.1 to 3.8, Schedule 3.	3.1. The licence holder must provide to the CEO for agreement, by 1 May 2002, a plan and schedule for meeting all Licence Conditions for Waste Operations and Technology Development (WOTD) operations. 3.2. The licence holder must provide the CEO, on a quarterly basis, commencing 1 August 2002, with written evidence of the progress on implementation of the plan mentioned above. 3.3. The licence holder must (a) provide to the CEO, on a quarterly basis, and in a form acceptable to the CEO, an updated inventory of all radioactive waste, fissile and other nuclear material, and retrievable sources held, commencing 1 May 2002. (b) provide to the CEO a summary of all changes made to the inventory during the preceding quarter. (c) indicate retrievable sources on the waste inventory and obtain CEO approval for any

Req. No.	Requirement	Citation/Source	Conditions
			source retrievals, before they are carried out, until procedures acceptable to the CEO are in place. 3.4. The licence holder must complete Safety Analysis Reports (SAR) covering all facilities of WOTD. These SARs must take into account the ARPANSA Regulatory Assessment Principles (RB-STD-42-00, October 2001) and develop: (a) accident management measures to deal with contamination of surface or ground water resulting from leakage from Building 57 intermediate level liquid waste (ILLW) storage tanks. (b) accident management measures and emergency preparedness for WOTD, including for a loss of shielding, the primary barrier or criticality accident in the spent fuel storage area of Building 27. 3.5 The licence holder must perform criticality assessments relevant to nuclear material in Building 59B, issue Criticality Certificates as appropriate and arrange peer review of these assessments. 3.6 The licence holder must install criticality detection and monitoring devices in the vicinity of Building 57 ILLW waste storage tanks. 3.7 The licence holder must put in place emergency preparedness, and an emergency response plan, to address a major leak of intermediate level liquid waste from the Building 57 storage tanks. 3.8 The licence holder must develop and maintain a waste management plan for transfer of solidified fission product waste from molybdenum-99 production, stored in the Building 41 Hot Cell area, to Building 27 solid waste store for interim storage.
E03	Radioactive waste management	ANSTO Handbook RB-STD-24-01 Rev 1 Section 2.2, Standard Conditions 6 Radioactive Waste management Arrangements	The licence holder must develop, maintain and implement its radioactive waste management arrangements current, and in a form acceptable to the CEO and verifiable by audit, including, but not limited to; Arrangements for the management of radioactive wastes arising from all existing and anticipated conducts and dealings. Arrangements for consultations with local government and other statutory authorities on radioactive waste issues Arrangements for the return of sources and radioactive wastes within the Organisation and from other organisations.

Req. No.	Requirement	Citation/Source	Conditions
E04	Radioactive Waste Management	ANSTO Handbook RB-STD-24-01 Rev 1 Section 2.3, Special Conditions 13.20 'Radioactive Waste Management'	Develop, document and implement the following: A waste minimisation policy; Operating procedures and work instructions for all services supplied by Waste operations section within a quality system; Service level agreements, clearly defining safety responsibilities and providing for full characterisation of waste, for all services provided by Waste Operations Section.
E10	Procedures/ instructions for management of radioactive waste storage	ARPANSA Facility Licence No. FO0044-4C Fuel Management Section, Special Condition 3.11(a)	Document procedures and instructions for management of radioactive wastes, maintaining an inventory of wastes and characterisation of wastes stored in the facility.
E12	Minimise production of radioactive waste during Reactor Facility operation	EIS commitment on Cumulative Impacts and Ecologically Sustainable Development Chapter 20, as summarised in Chapter 18 Vol.3 Table 18.1 of PPK (1999)	Minimise the production and volume of future waste taking into account economic and social factors;
E13	Minimise production of non-radioactive wastes during Reactor Facility operation	EIS Commitment on Management of Reactor Products, Spent Fuel and Wastes Chapter 10, as summarised in Chapter 18 Vol.3 Table 18.1 of PPK (1999)	Ensure that the current system of processing non-radioactive wastes, treatment and disposal continues to be within all regulatory guidelines and generally moves towards the reduction of waste quantities and recycling of materials generated.
E14	Minimise production of radioactive waste during Reactor Facility operation	EIS Commitment on management of Reactor Products, Spent Fuel and Wastes Chapter 10, as summarised in Chapter 18 Vol.3 Table 18.1 of PPK (1999)	Minimise production and volume of future wastes, taking into account economic and social factors; implement ANSTO's Waste Management Plan in a way which ensures that best practice is adopted by the year 2000 as defined in the Radioactive Waste Safety Standards and Guidelines which have been developed by the International Atomic Energy Agency; and transport all low level and short-lived intermediate level radioactive waste to the National Radioactive Waste Repository, when it becomes operational, and transport all long-lived intermediate level radioactive waste to the National Category S Store when it becomes operational.
E15	Ensure that at	International Joint	Contracting party to provide effective

Req. No.	Requirement	Citation/Source	Conditions
	all stages of spent fuel management and radioactive waste management, individuals, society and the environment are adequately protected against radiological hazards Prime responsibility for the safety of spent fuel and radioactive waste management rests with the holder of the relevant licence.	Convention on the Safety of Spent Fuel Management & on the Safety of Radioactive Waste Management, Articles 4, 6, 7, 8, 11, 13, 14, and 15. Article 21 [Convention signed by Australia but not yet ratified]	protection of individuals, society and the environment by applying at a national level, suitable protective methods approved by the regulatory body, and which give due regard to internationally endorsed criteria and standards. Evaluation required of the likely safety impact of spent fuel and radioactive waste management facilities on individuals, society and the environment for the proposed siting of such facilities. For spent fuel management and radioactive waste facilities, appropriate steps to be taken to ensure that the design and construction of such facilities provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases. A systematic safety assessment and environmental assessment, appropriate to the hazard presented by the facility, is required prior to operation and operation of a spent fuel and radioactive waste management facility.
E16	Management of waste from reprocessing and conditioning of spent fuel from Reactor Facility	EIS Commitment on management of Reactor Products, Spent Fuel and Wastes Chapter 10, as summarised in Chapter 18 Vol.3 Table 18.1 of PPK (1999)	Waste from reprocessing/conditioning of spent fuel will be returned to Australia in a form suitable for placement in a National Category S Waste Store for long-lived intermediate level waste; maximum advantage will be taken of waste minimisation opportunities in relation to the waste form resulting from reprocessing/conditioning, while remaining consistent wit the International Atomic Energy Agency limits applicable to long-lived intermediate level radioactive waste; and waste from reprocessing/conditioning of spent fuel returned to Australia will not be stored at the Lucas Heights Science and Technology Centre.
E17	Prepare Transport Plan for movement of spent fuel casks to wharf Obtain certification of	*Commonwealth Environment Protection and Biodiversity Conservation Act 1999* Chapters 2 and 4. *Code of Practice for the Safe Transport of*	Prepare environmental assessment report and comply with conditions of approval of Minister of Environment & Heritage. Note, Current Environmental Assessment Report has been approved for all further shipments of spent fuel under the repealed *Environment Protection (Impact of Proposals) Act 1974.* ARPANSA approval of Transport Plan for transport of spent fuel to the wharf for each

Req. No.	Requirement	Citation/Source	Conditions
	Spent fuel transport casks	*Radioactive Substances 1990* (DASETT). *IAEA Regulations for the Safe Transport of Radioactive Materials (1996)* *International Maritime Dangerous Goods Code 2000 (IMO)*	shipment also required. Certification of transport casks by ARPANSA (for road transport) and Australian Maritime Safety Authority (AMSA) for sea transport.
H16	Management of Spent Fuel	Cumulative Impacts and Ecologically Sustainable Development Chapter 20, as summarised in Chapter 18 Vol.3 Table 18.1 of PPK (1999)	Transport spent fuel from the Lucas Heights Science and Technology Centre as soon as practical allowing for the constraints of fuel cooling, radiation safety and economic transport;
H17	Spent Fuel Management for Reactor Facility	EIS Commitment on management of Reactor Products, Spent Fuel and Wastes Chapter 10, as summarised in Chapter 18 Vol.3 Table 18.1 of PPK (1999)	Spent fuel would only be stored at the Lucas Heights Science and Technology Centre for the minimum time required to satisfy operational, and technical, radiation safety and economic constraints; Spent fuel would be stored at the Lucas Heights Science and Technology Centre for not more than nine years before it is transported abroad for reprocessing/conditioning; Arrangements to transport spent fuel from the Lucas Heights Science and Technology Centre would commence as soon as the inventory reached five years arisings; A requirement would be included in the tender specifications for design and construction of the replacement reactor that bidders demonstrate a solution exists for the ultimate disposition of spent fuel arisings. Shipment by shipment basis contracts for spent fuel shipments and reprocessing/conditioning would be avoided. Consideration would be given to entering into a contract with an overseas reprocessor covering the lifetime spent fuel arisings of the reactor
H26	Provide 4 weekly, quarterly and annual reports to ARPANSA on airborne, liquid and solid waste	ANSTO Handbook RB-STD-24-01 Rev 1 Section 2.2, Standard Licence Conditions 8. Reporting on Airborne, Liquid and Solid Waste	8. Reporting on Airborne, Liquid and Solid Waste The licence holder must provide to the CEO within twenty-eight (28) days of the end of each quarter year, and by 30 September each year, a quarterly and annual report on all airborne, liquid and solid waste arising from conducts and dealings by the organisation.

Req. No.	Requirement	Citation/Source	Conditions
			Note: The reports detailed in the previous condition must include estimates of radiation doses to the public from the wastes utilising a method approved by the CEO.
H30	Annual reporting to ARPANSA on operation of controlled facility	ANSTO Handbook RB-STD-26-01 Rev 0 Section 4, Standard Licence Conditions for Facility Licences 4.1.1 REPORTING 19. Annual reporting to CEO	22. Annual Reporting to CEO The licence holder must provide to the CEO by 30 September each year an annual report for the past financial year summarising the following information in relation to the controlled facility: (vi) results of environmental monitoring and radiation surveys; (vii) collective, average and maximum radiation doses to groups of similar personnel and the public arising from the conducts at the controlled facility.
2.3 Prevention of Contamination of Groundwater			
The legal and other requirements specifically relating to groundwater have been met.			
2.4 Surface Runoff and Sediment			
C02	Stormwater control during operation of Reactor Facility	EIS Commitment on Geology, Soil Water, Chapter 8, as summarised in Chapter 18 Vol.3 Table 18.1 of PPK (1999)	Ensuring stormwater management maintains post-development stormwater flows at or below existing flows or up to the 100 years average recurrence interval event; ensuring no increase in nutrient or sediment loads occur due to the proposal; and constructing two new stormwater bunds, one for each catchment, to provide for on site containment and treatment of any small accidental spills or releases of contaminated liquid
C06	Stormwater from Reactor Facility site	EA Condition No.4 – Operational Impacts (non-radiological)	Monitoring of water quality must continue into the operational phase until sufficient data has been collected to indicate that the site, and stormwater run-off, has stabilised
C08	Comply with NSW EPA Regulations at former SPCC agreed sampling points for discharge of stormwater from site through the 3 stormwater bunds, A, B, C.	*NSW Clean Waters Regs. 1972*, under *NSW Protection of the Environment Operations Act 1997*.	Comply with 10 times radioactivity limits for Class 'C' Controlled, surface waters as specified in Schedule 3. Alpha 1.1 Bq/L, Beta 11.1 Bq/L. Comply with Section 8 Class C 'Controlled Waters' limits on restricted substances as specified in Schedule 2 of Regulations.
G17	Environmental	EIS Commitment on	Specific management measures would

Req. No.	Requirement	Citation/Source	Conditions
	Management – Biodiversity Conservation	Flora and Fauna, Chapter 12, as summarised in Chapter 18 Vol.3 Table 18.1 of PPK (1999)	include: Monitoring erosion and sedimentation control measures; Monitoring revegetated areas within the fuel-reduced zone to ensure levels of weed invasion are minimised; reusing mulch produced by bushfire hazard reduction activities in revegetation; carrying out bushfire hazard reduction activities to ensure protection of native flora and fauna; and managing the buffer zone toward the protection and long term maintenance of biodiversity and natural ecosystem processes.
G20	Identification, classification and control of Noxious weeds	*NSW Noxious Weeds Act 1993*, *Sect 10. Order No.16* in Government Gazette, No. 120, listing noxious weeds and their category declared for Sutherland Shire	Land Owner has responsibility for controlling noxious weeds in the various categories. Category W1, owner must notify LGA within 3 days and fully and continuously suppress and destroy all W1 weeds. Category W2, owner must fully and continuously suppress and destroy all W2 weeds, eg (Pampas grass, Lantana, Blackberry, Castor oil plant). Category W3, owner must prevent the spread and reduce the number and distribution of W3 weeds, eg Bitou bush. Category W4a, 4b, 4c, 4d and 4f,specific actions re sale propagation and control.
G37	Environmental monitoring of all site activities involving radioactive materials.	ANSTO Handbook RB-STD-24-01 Rev.1, Amendment 5a: Environmental Management	Identify potential sources of radioactive contamination to groundwater, surface water, soil and atmosphere and formally include sources in environmental management system.
G39	Independent Environmental monitoring audit.	ANSTO Handbook RB-STD-24-01 Rev.1, Section 2.2 Standard Conditions. Amendment 5c: Environmental Management	Licence holder must ensure that an independent body verifies the results of the environmental monitoring, according to a plan and schedule agreed to by the CEO.
H30	Annual reporting to ARPANSA on operation of controlled facility	ANSTO Handbook RB-STD-26-01 Rev 0, Section 4, Standard Licence Conditions for Facility Licences 4.1.1 REPORTING 19. Annual reporting to CEO	22. Annual Reporting to CEO: The licence holder must provide to the CEO by 30 September each year an annual report for the past financial year summarising the following information in relation to the controlled facility: (vi) results of environmental monitoring and radiation surveys; (vii) collective, average and maximum radiation doses to groups of similar personnel and the public arising from the conducts at the controlled facility.

Req. No.	Requirement	Citation/Source	Conditions
2.6 Water Use			
F04	Minimisation of water useage during operation	EIS Commitment on Infrastructure and Services, Chapter 15, as summarised in Chapter 18 Vol.3 Table 18.1 of PPK (1999)	Minimisation of water and energy use (refer ecologically sustainable development below).
2.7 Electricity Use			
F03	Sustainable water/energy reusage during operation	Cumulative Impacts and Ecologically Sustainable Development Chapter 20, as summarised in Chapter 18 Vol.3 Table 18.1 of PPK (1999)	Investigate the potential reuse of secondary cooling system water Investigate the possibility of a 'green power' purchase agreement with Energy Australia Install low water usage devices, such as dual flush toilets, low flow taps, trigger action hoses and drip irrigation and install energy efficient lighting.