Australian Government
Australian Radiation Protection and Nuclear Safety Agency

REGULATORY ASSESSMENT REPORT:

Facility Licence Application A0293

Applicant: Australian Nuclear Science and Technology Organisation

Nuclear Installation: Little Forest Legacy Site

REGULATORY SERVICES

R15/05291

June 2015

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Executive Summary

In 1999, the Australian Nuclear Science and Technology Organisation (ANSTO) submitted an application for a facility licence. However, at that time, no regulatory decision was made as the licensing basis was uncertain. A revised application was received on 10 October 2014. The revised application was for authorisation to 'possess or control' a nuclear installation. The installation is the Little Forest Legacy Site (LFLS). This site was previously known as the Little Forest Burial Ground (LFBG).

The LFLS is located about 1.6 km north of the main ANSTO site at Lucas Heights, NSW. The facility was established by the former Australian Atomic Energy Commission (AAEC) for the near surface burial of low level wastes. This was consistent with international practice at the time.

The facility was operational between 1960 and 1968. During this time, a number of shallow trenches were excavated and about 1600 cubic metres of material was buried. The material consisted of equipment and waste contaminated with low levels of radioactivity, effluent sludge, chemicals and beryllium. After emplacement of the waste, a 1 metre thick layer of local clay rich soil was used to cover the waste.

The LFLS is considered to be an 'existing exposure situation'. This means that the situation is already in existence when a decision on control has to be made. Therefore, this assessment does not consider the suitability of the site, whether the design of the trenches was appropriate, whether the containers used to hold the waste were appropriate, nor whether the waste should have been placed there at all.

This Regulatory Assessment Report has therefore considered the site, as it exists today. In doing so, the reviewer has considered whether ANSTO has suitably demonstrated that the site can be possessed and controlled in an acceptable manner with regard to radiation safety until the long-term future of the site has been determined. This has been done through an assessment of the material that ANSTO provided with their application.

When considering the licence application, and making a decision as to whether to issue a licence, the CEO of ARPANSA is required to take into consideration certain matters prescribed in the *Australian Radiation Protection and Nuclear Safety Act 1998* and the Australian Radiation Protection and Nuclear Safety Regulations 1999. An ARPANSA reviewer has prepared this Regulatory Assessment Report for the CEO of ARPANSA (or his delegate) to address these matters.

The ARPANSA reviewer finds that the application has acceptably addressed the matters needing to be taken into account by the CEO of ARPANSA in deciding whether to issue a facility licence. The ARPANSA reviewer concludes that the application includes suitable plans and arrangements to ensure that the facility may be possessed and controlled by the applicant without undue risk to the health and safety of the people and the environment. The ARPANSA reviewer recommends that the CEO of ARPANSA issue a facility licence to ANSTO authorising it to possess or control the Little Forest Legacy Site subject to the licence conditions specified in section 7.2 of this report.

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1. Introduction

The applicant, Australian Nuclear Science and Technology Organisation (ANSTO), has applied for a facility licence under section 32 of the *Australian Radiation Protection and Nuclear Safety Act 1998* (the Act) to possess or control the Little Forest Legacy Site (LFLS). This facility was previously known as the Little Forest Burial Ground (LFBG).

1.1 Purpose

The purpose of this report is to document the assessment of information contained in ANSTO's application against the criteria set out in the Australian Radiation Protection and Nuclear Safety Act 1998 (the Act) and the Australian Radiation Protection and Nuclear Safety Regulations 1999 (the Regulations). Consideration is given to the matters to be taken into account by the CEO under section 32(3) of the Act, that is, international best practice in radiation protection and nuclear safety, and those matters set out in regulation 41.

The reviewer has relied on the following documents and information in making recommendations to the CEO:

- The information contained in the initial application
- The information contained in the revised application
- Information obtained from the applicant following the receipt of the application
- Meetings and discussions with the applicant
- Other documents referred to in the body of this report
- The information gathered during a site visit conducted on 09 February 2015

1.2 Receipt of Application

In accordance with the requirements of the Act, ANSTO submitted an application for a facility licence in 1999. However, at that time, no regulatory decision was made. A revised application was received on 10 October 2014. The application was in an acceptable form and it was accepted that the original application was accompanied by the appropriate fee.

As required by regulation 40, the CEO published a notice in The Australian and the Gazette. Both notices were published on 19 January 2015 and advertised the receipt of a facility application from ANSTO and the CEO's intention to make a decision on the application.

Additional information subsequently obtained from the applicant forms part of the application.

1.3 Assessment Process

The following documents have been used in the assessment of this application:

- the Act [1] & Regulations [2]
- Regulatory Guideline: Plans and Arrangements for Managing Safety [3]
- Regulatory Guide: Licensing of Radioactive Waste Storage and Disposal Facilities [4]

ARPANSA has kept the Nuclear Safety Committee[1] (NSC) informed of this application. The NSC discussed the application at the meeting held on 31 October 2014, and again at the meeting held on 5-6 March 2015.

2. Review of Information

This section describes the review of information provided in the application and subsequently received from the applicant.

2.1 Applicant Information

The application was made on behalf of ANSTO by Chief Executive Officer, Dr Adrian Paterson. ANSTO is part of the Department of Industry Portfolio. Mr Hefin Griffiths, Head, Nuclear Services is named as the Nominee. The required information was provided about ANSTO's Radiation Safety Officer/s.

2.2 Address of Facility

The LFLS is located at a distance of 1.6 to 1.95 km north of the former HIFAR reactor building at Lucas Heights, NSW. The location can be seen in the Figure A1.1 located at Appendix 1 to this report.

2.3 Description of the facility and its site

The LFLS is situated on a cleared block of land with an area of almost 50,000 square metres. The facility was established in the late 1950's by the former Australian Atomic Energy Commission (AAEC) for the near surface burial of low level wastes. This was consistent with international practice at the time.

The facility was adjacent to other, unrelated, disposal sites. These sites were used for the disposal of industrial liquid wastes (e.g. grease, paints, solvents, materials contaminated by dioxins and residues

[1] The Nuclear Safety Committee is established under the *Australian Radiation Protection and Nuclear Safety Act 1998* to 'advise the CEO and the Council on matters relating to nuclear safety and the safety of controlled facilities'. Members are: the CEO of ARPANSA; a person to represent the interest of the general public; a representative of the Radiation Health Committee; a person to represent the local government or the local administration of an area affected by a matter related to the safety of a controlled facility; and up to 8 other members.

from the production of herbicides), the disposal of night soil (human excreta) and municipal waste disposal.

The facility was operational between 1960 and 1968. During this time, a number of shallow trenches were excavated. These trenches were nominally 25 metres long, 0.6 metres wide and 3 metres deep. These trenches can be seen in Figure A1.2 located at Appendix 1. The trenches occupy approximately 5000 m^2 of land. This is about 10% of the site.

About 1600 cubic metres of material were buried. The material consisted of equipment and waste contaminated with low levels of radioactivity, effluent sludge, chemicals and beryllium. Accurate records of the isotopic content of the radioactive waste buried at the site have not been provided. However, ANSTO has been able to provide the details shown in Table 1. After emplacement of the waste, a 1 metre thick layer of local clay soil was used to cover the waste.

Table 1: Summary of radioactivity buried at the LFLS

		Total
Estimated Activity (GBq)	group I*	0.75 GBq
	group II*	39.10 GBq
	group III*	111.50 GBq
Fissile Content	plutonium	6.9 g
	uranium-233	5.2 g
	uranium-235	92.0 g
Fertile Content	uranium	59.3 kg
	thorium	48.1 kg
beryllium content as Be/BeO		1070.0 kg
liquid volume		8.6 m^3

* The former AAEC categorised radionuclides based upon radiotoxicity. Details of the categorisation are shown at Table A1.1 located at Appendix 1.

The AAEC, and later ANSTO, has managed and maintained the site since it was closed. This has included mowing the grass that covers the facility, and the addition of topsoil to the surface in the event of subsidence occurring. Environmental monitoring has also been conducted. This has included gamma dose rate surveys, water monitoring (groundwater and creeks), soil sampling and particulate air sampling [5, 6]. The groundwater monitoring has been enabled by the placement of boreholes at various locations at the site. These are both within the fenced area of the facility and outside the fence. Refer to Figure A1.3 located at Appendix 1 for a schematic showing the location of the boreholes. In August 2011, a 'trench sampler' was installed within the trench area [7]. This provides information on what is happening within the trench itself.

2.4 Information relevant to the type of authorisation

Regulation 39 of the ARPANS Regulations indicates that the CEO of ARPANSA may ask an applicant to provide the following information when seeking authorisation to possess or control a controlled facility:

a) The arrangements for maintaining criticality safety during loading, moving or storing nuclear fuel and other fissile materials at the controlled facility.

b) The arrangements for safe storage of controlled material and maintaining the controlled facility.

ANSTO has analysed the criticality safety arrangements for the facility. This analysis has concluded that criticality is not possible given that only very small amounts (gram quantities only) of fissile materials are recorded to have been buried at the LFLS. This analysis has considered all normal conditions and credible abnormal conditions. Given that the quantity of plutonium known to have been emplaced at the facility is significantly below the single parameter limit for criticality, the reviewing officer considers that this is a reasonable assessment. Furthermore, based upon the above, it is considered acceptable that ANSTO has not provided arrangements for maintaining criticality safety since they have demonstrated that criticality will not occur.

Given the above, ANSTO has focussed upon the arrangements for safe storage of controlled material and maintaining the controlled facility. ANSTO has provided a series of plans describing the arrangements in place safely possess and control the LFLS. These plans are:

- Effective Control Plan
- Safety Management Plan
- Radiation Protection Plan
- Waste Management Plan
- Security Plan
- Emergency Plan
- Safe Storage & Maintenance Plan

The site has been under a program of care and maintenance since the cessation of disposal operations 45 years ago. In order to ensure that the wastes do not represent a risk to ANSTO personnel, the local community or environment, ANSTO has put in place maintenance and environmental monitoring programs as well as physical and surveillance controls. If the monitoring program detects elevated levels of radioactivity at the surface, localised remediation will be conducted. This will be done through the addition of local clay soil. However, given the nature of the trench disposal system, and the historical migration of plutonium to the surface soils, it is judged to be important that ANSTO closely monitor the facility to ensure that it continues to perform its safety function. In order to do this, ANSTO needs to be able to identify the migration of plutonium (if it should occur). As this can occur in a dynamic manner, it is recommended that a licence condition is placed upon ANSTO requiring an approved environmental monitoring programme be undertaken.

ANSTO has committed to developing a strategy to manage the site over the medium and long-terms. The strategy for the medium-term is expected to concentrate on maintaining the structural integrity of the trenches and minimising the amount of water entering the trenches. This may be achieved by engineered works. The long-term management of the site will be informed by the results of the medium-term plan and will address the future of the site up to the point where a final decision has been made with regard to the waste. To ensure that the medium-term plan is developed in a timely fashion it is recommended that a licence condition is placed upon ANSTO requiring the provision of a plan for the future management for the LFLS. It is recommended that a time limit be placed upon the provision of this plan. It is considered that approximately 3 years is suitable timeframe for this to occur.

3. Plans and Arrangements

Item 4 of the general information that may be requested by the CEO refers to plans and arrangements for managing safety of the controlled facility to ensure the health and safety of people and protection of the environment. It is expected that there are plans and arrangements that describe how the applicant proposes to manage the controlled facility.

3.1 Effective control arrangements

The applicant must describe the organisational arrangements for managing the safety of the conduct and dealings to ensure the health and safety of people and the protection of the environment. This should include a description of responsibilities and lines of authority, and information on a quality system covering all activities that may impact on safety [3].

The applicant submitted an effective control plan (LFBG-PC-LA-D1) as part of the application. This document addressed the following aspects: Statutory and Regulatory Compliance; Management Commitment; Accountabilities and responsibilities; Resources; Communication; Process Implementation; Documentation and Document Control.

The CEO of ANSTO applied for the application, and although, ANSTO has acknowledged that ultimate responsibility rests with their CEO, responsibility for ensuring compliance with the ARPANS legislation has been delegated to the Nominee. With this comes the responsibility to maintain effective control of the site.

At a practical level, the routine operational and safety matters are coordinated by the LFLS Facility Officer. This will include environmental monitoring, project activities and administrative matters. The LFLS Facility Officer reports to the Nominee.

ANSTO has identified that a potential conflict of interest exists. This is because the Nominee also fulfils the role of Chair for the Safety Assurance Committee (SAC). The SAC is responsible for reviewing and approving assessments and plans and arrangements for various ANSTO facilities (including the LFLS). Although, this potential conflict of interest exists, ANSTO has advised that they have put procedures in place to manage the situation. This involves the Nominee recusing himself from SAC meetings when the LFLS is being discussed. ARPANSA is aware of the potential conflict of interest. This potential conflict of interest exists for other ANSTO facilities. ARPANSA has previously accepted the arrangements with regard to the other facilities. The reviewer considers that these arrangements are adequate for the LFLS also.

ANSTO has provided an organisational chart which shows the positions of staff with responsibility for management of the LFLS. Each staff member has a distinct role which is described in their position description.

The facility will be managed by ‘Waste Operations’. This group also provides the radioactive waste management services to the ANSTO facilities and projects at the LHSTC. Waste Operations will be supported by the ‘Radiation Protection Services’. This group prepared the Radiation Protection Plan,

and has also provided input into the other plans. This group will also conduct the radiological surveys and will provide close support to the work teams.

ANSTO has advised that staff and monetary resources have been provided to the Waste Operations group. These resources have been identified for the purposes of safely performing the 'Possess or Control' activities and meeting the ARPANSA requirements associated with the LFLS. For example, the Radiation Protection Plan identifies the necessary involvement by radiation specialists. Waste Operations has the resources for these activities to be performed.

ANSTO has advised that safety is discussed and emphasised at forums held by the CEO and other management. Furthermore, ANSTO's *Occupational Health, Safety and Environment Policy* is evidence of a commitment to safety. Safety training programs are used to clarify the intent of the policy and provide further information. This policy is supplemented by other policies on the subjects of security, quality, human resources and business. ANSTO has advised that the ANSTO Executive WHS&E committee monitors the performance of the organisation in key areas.

ANSTO has indicated that a hazard identification and risk assessment is performed for each potentially hazardous process or activity. This identifies the required equipment, including Personal Protective Equipment (PPE). This assessment is subject to internal review.

ANSTO has processes for ensuring there is sufficient funding available for the necessary equipment and people resources needed for the on-going care and maintenance works associated with facilities.

ANSTO has processes in place for communicating safety issues. This is done verbally at staff meetings and tool-box talks. The documentation for this facility is available to the relevant staff. This is held on ANSTO computer servers and paper files.

ANSTO has identified the environmental monitoring, maintenance and security arrangements for the facility. ANSTO expects that their event response system will rapidly inform management of safety incidents and accidents.

ANSTO has advised that they have a WHS Management System that has been certified to ISO 9001. In order to maintain this certification audits of this system are required. These are conducted internally, by ANSTO staff, and externally, by the certifying organisation. ANSTO has indicated that they also have an Environmental Management Strategy and associated environment monitoring program.

Safety related records are managed according to ANSTO's General Workplace Health & Safety Quality Manual. Specific radiation safety records are managed in accordance with Radiation Protection Services Records Management. This includes the dosimetry records, survey results and log books etc.

The reviewing officer considers that ANSTO has adequately demonstrated that appropriate provisions are in place for ensuring that this aspect of radiation safety will be appropriately managed.

3.2 Safety management plan

The application should include a Safety Management Plan that demonstrates that safety management practices are in accordance with internationally accepted principles and practices and duty of care obligations [3].

ANSTO submitted a safety management plan (LFBG-PC-LA-D2) as part of the application. This document addressed the following aspects: Safety Policy and Objectives; Monitoring and Measurement; Risk Assessment and Mitigation; Managing Change; Learning and Continuous Improvement; and Training and Education.

ANSTO is responsible for the safety of its workers and the public. ANSTO has committed to undertaking all activities in compliance with the WHS Act and Regulations, and in conformance with the ANSTO WHS Management System (WHSMS). ANSTO has identified this as a method of implementing the safety requirements of the ANSTO strategic plan and safety policy. The safety policy and safety arrangements are accessible to staff as they are on the ANSTO intranet. ANSTO's WHSMS is used to deal with deviations, accidents and incidents. Safety related events/incidents are reported and investigated and actions for improvements identified.

ANSTO has pointed towards their corporate plan as evidence of an adequate safety culture; specifically, the pledge to place the utmost importance on ensuring that all ANSTO facilities and activities are safe. ANSTO has identified that an important part of their safety culture is having people with a questioning attitude who adopt a rigorous and prudent approach to work. ANSTO has indicated that safety briefings, toolbox talks, safety inspections etc. are methods they use to engender such an approach to work.

ANSTO has designated Waste Operations management responsible for the control of hazards at the LFLS. Normal ANSTO processes will be followed when managing the hazards at the LFLS. The activities conducted by ANSTO's Waste Operations are performed within the Business and Continuity Management System (B&CMS). This is based on AS/NZS ISO 9001 - Quality Management System Standard and AS/NZS ISO 14001 - Environment Management System. Internal audits are conducted by trained auditors. These audits are used to measure how well the products and services delivered by ANSTO's Waste Operations conform to the planned arrangements.

ANSTO has committed to performing safety inspections of the LFLS. The LFLS is visually inspected on a regular basis. Furthermore, routine monitoring and maintenance works are performed by the Institute of Environmental Research (IER) and ANSTO Facilities Management. ANSTO has committed to monitoring the radiation protection arrangements for the site in the future. This will be done by the LFLS Facility Officer, other Waste Operations staff and the radiation protection advisor. These personnel will consider dose and contamination data, survey results, dosimetry results, workplace inspections and any incident reports.

ANSTO has performed a hazard identification and risk assessment. This used the Features, Events and Processes (FEP) analysis method. The Safety Assurance Committee (SAC) reviewed and approved this assessment. This will be supplemented by the use of the Safe Work Method and Environmental Statement (SWMES) process to ensure that personnel have an understanding of the

controls used to manage hazards. These will be used for any field work at the LFLS. Daily toolbox safety talks are used to support the understanding of hazard management. Data will be collected and analysed to measure key performance indicators.

ANSTO has systems in place to ensure that suitably qualified and authorised personnel perform work which could be potentially hazardous. The qualifications, knowledge and experience of personnel are gauged upon recruitment. This is complemented by induction training (including radiation protection and the use of personal protective equipment). Task specific training is provided for personnel required to perform specialised tasks. ANSTO has a training management system to record the training performed.

ANSTO has committed to following relevant ARPANSA guidance (such as Regulatory Guidance for Radioactive Waste Management Facilities, and the Regulatory Assessment Principles for Controlled Facilities). Furthermore, ANSTO intends to conform to relevant IAEA safety requirements and guidelines.

The Health Physics Surveyors (HPS) monitor the LFLS. A higher level of radiation safety training is provided to the HPS. This includes comprehensive theoretical and practical training.

ANSTO has indicated that periodic surveys of the organisation's safety culture are conducted.

The reviewing officer considers that the applicant has adequately demonstrated that appropriate provisions are in place for ensuring that this aspect of radiation safety will be appropriately managed.

3.3 Radiation protection plan

The applicant is responsible for ensuring that arrangements are in place for meeting their responsibilities towards radiation protection and nuclear safety [3].

ANSTO submitted a radiation protection plan (*LFBG-PC-LA-D3*) as part of the application. This document addressed the following aspects: Principles of radiological protection; radiation safety officer; radiation safety committee; planning and design of the workplace; classification of work areas; local rules and procedures; personal protective equipment; monitoring of the workplace, individuals and the environment; protection of wildlife; and transport.

The dose constraints are 15 mSv and 0.3 mSv per annum respectively. These constraints are below the limits contained within the *Recommendations for Limiting Exposure to Ionizing Radiation (1995) and National Standard for Limiting Occupational Exposure to Ionizing Radiation (republished 2002)* [8]. These are ANSTO's organisation wide dose constraints. The reviewer observes that in two recent publications of the International Commission on Radiological Protection (ICRP) [9] and [10] describes optimisation as a 'source-related process'. Furthermore, these publications indicate that the judgements made as part of the optimisation should reviewed in an iterative process. This appears to be in contrast to ANSTO's approach. However, it is observed that ANSTO has committed to the optimisation principle and has indicated that it will implement this by applying controls to manage radiological hazards. Therefore, although ANSTO's approach to the application of dose constraints appears to be out of step with modern radiation protection philosophy, the practical

implementation of controls to manage radiological hazards is accepted as adequate for the purpose of this possess or control licence.

ANSTO has a Safety Assurance Committee (SAC). The SAC reviewed, and approved, the plans and arrangements for the LFLS. ANSTO has committed to designating a Health Physicist and a Health Physics Surveyor to perform services to the LFLS. Amongst other things, the Health Physicist provides advice on radiation protection issues, safe working practices and the optimisation of protection. The Health Physicist is an experienced professional trained in radiation protection. If the Health Physicist and the Health Physics Surveyor find that conditions are significantly different from the expected state they will have the authority to suspend work.

ANSTO has a duty of care to all workers (employees and contractors) as well as visitors to the site. A process is in place to manage any external contractors. This will be coordinated with the designated LFLS Facility Officer and ANSTO Safeguards and Security Group. ANSTO has posted notice boards indicating that the LFLS is Commonwealth land and informing the public that access is prohibited.

ANSTO has a process for classifying areas according to the contamination of radiation hazard they present. This classification is used to manage exposure to ionising radiation and is used in the optimisation of doses. The LFLS is a supervised area. ANSTO has concluded that because the LFLS is classified as a 'white' contamination area and 'white' radiation area, there is no requirement for individual monitoring to be performed. ANSTO has a guideline for what personal protective equipment (PPE) is to be worn when working in a radiological classified area. However, ANSTO has concluded that no PPE is required during the possess or control phase of the LFLS. Despite this, ANSTO has advised that access to the LFLS will be limited to only those workers required to be present (i.e. LFLS Facility Officer, ANSTO Security and Safeguards Group). These people will be provided with appropriate training and supervision.

ANSTO's analysis did not identify any exposure pathways for wildlife in their natural habitats. ANSTO has committed to monitoring the environment as part of the LFLS surveillance program. ANSTO has provided details of the monitoring program for the LFLS. This will include bi-annual visual inspection; bi-annual ground water monitoring; radiation monitoring using thermoluminescent dosimeters; quarterly airborne contamination monitoring to detect beryllium and plutonium; and soil sampling if a depression, with elevated dose rate, is identified during ground water sampling.

ANSTO has committed to complying with their internal guide (AG 2515 *Safe Movement and Transport of Radioactive Material (Guide))* when transporting radioactivity onsite and the Code of Practice (RPS2 *Safe Transport of Radioactive Material*) when leaving the site.

The reviewing officer considers that the applicant has adequately demonstrated that appropriate provisions are in place for ensuring that this aspect of radiation safety will be appropriately managed.

3.4 Radioactive waste management plan

The applicant must provide arrangements to protect the health and safety of people and to protect the environment from hazards arising from the handling, treatment, storage, discharge and disposal of any radioactive waste expected to arise from any conduct. The arrangements should address

appropriate codes and standards; the physical, chemical and radiological characteristics of the waste; methods of minimising the volumes and activities of radioactive wastes generated; the treatment, storage, disposal and discharges of radioactive wastes; and the control, monitoring, recording and reporting of wastes [3].

ANSTO submitted a radioactive waste management plan (*LFBG-PC-LA-D4*) as part of the application. This document addressed the following aspects: Management of radioactive waste; Limiting exposure to radioactive waste; Packaging and containment of radioactive waste; Interim storage of radioactive waste; Documentation of radioactive waste; Routine discharges of radioactive waste to the sewer, atmosphere, municipal tip and disposal by incineration.

There is no plan to actually generate radioactive waste at LFLS. However, it is acknowledged that some wastes may be generated through either the environmental sampling program or through unplanned maintenance/repair works. Some solid wastes will be generated through the routine sampling, monitoring and maintenance tasks. ANSTO envisage that this will consist of potentially contaminated gloves, papers, PPE and smears from wipe tests. ANSTO has indicated that they intend to bag and label these wastes to enable them to be collected by Waste Operations as part of the normal waste collection service. Liquid wastes will be generated through the sampling of boreholes at the LFLS. After analysis, ANSTO intends to drain these liquids to the low level liquid waste line at the Lucas Heights site to be treated in the effluent plant. Unplanned maintenance or repair works have the potential to generate some radioactive wastes. ANSTO has committed to following their established planning and approval processes in the event that this needs to occur.

ANSTO has committed to applying the ALARA principle (where applicable) to the routine radiation exposure of ANSTO staff, members of public and the environment. Furthermore, ANSTO has described how they intend to limit exposure to the wastes generated at the LFLS. Some of the methods include the use of time, distance and shielding as well as administrative controls (e.g. training and procedures) and personal protective equipment.

ANSTO has indicated that any soil removed during localised remediation actions will be appropriately packaged. This waste will then be transported to the Lucas Heights site and processed in accordance with the licence held by ANSTO's Waste Operations.

Waste procedures and records are legible, readily identifiable and retrievable at any time for operational or auditing purposes. The records of routine inspection, monitoring and environmental sampling undertaken at the LFLS facility are documented and stored in accordance with the Waste Operations Business and Compliance System. The waste details, including waste characteristics, chain of custody, identification, storage location are captured in the Radioactive Waste Tracking System.

ANSTO has committed to not discharge liquid radioactive waste to the sewer. Any waste generated as part of the environmental monitoring program will be managed in accordance with the usual practices (i.e. procedures and work instructions) used by ANSTO's Waste Operations. Further to this, ANSTO has committed to not routinely release radioactive waste to the atmosphere, discharge waste to the municipal tip or incinerate radioactive waste.

The reviewing officer considers that the applicant has adequately demonstrated that appropriate provisions will be in place for ensuring that radioactive waste will be appropriately managed.

3.5 Security plan

The applicant must provide arrangements for the security of the controlled facility, controlled material or controlled apparatus to prevent unauthorised access, damage, theft, loss or unauthorised use. The arrangements should include administrative and physical controls and barriers and any requirements of the Australian Safeguards and Non-proliferation Office [3].

ANSTO submitted a security plan (LFBG-PC-LA-D5) as part of the application. This document addressed the arrangements to maintain security.

ANSTO engaged an external security consultant to perform a security risk assessment. This assessment identified key risks to the facility. The design of the LFLS protective security system took into account the risk assessment (and associated recommendations) along with the applicable threat assessment.

ANSTO listed, and provided details, of the ANSTO officers who have accountability and responsibilities in relation to the security of the LFLS. Furthermore, a variety of contact details were provided for use in the event of a security incident.

ANSTO has committed to providing an induction and annual security awareness training to all staff with access to the site. Furthermore, details of the physical, administrative, information, IT and personnel security that will be implemented were provided.

The reviewing officer considers that the applicant has adequately demonstrated that appropriate provisions will be in place for ensuring that security will be appropriately managed.

3.6 Emergency plan

The applicant must have emergency plans and procedures that address all foreseeable emergencies to ensure the protection of personnel, the public and the environment. Adequate facilities and equipment must be available and an appropriate state of preparedness maintained [3].

ANSTO submitted an emergency plan (*LFBG-PC-LA-D6*) as part of the application. This document contained information on the emergency plans, emergency procedures and emergency preparedness.

Responsibility for the facility has been assigned and with this responsibility comes the duty to implement and maintain the emergency procedures for the facility. If the emergency response needs to be escalated then the ANSTO LHSTC emergency response arrangements will be applied. These arrangements utilise the ANSTO Site Operations Centre which is manned 24/7. An Incident Controller (staffed 24/7 by a suitably qualified and experienced person) has the authority to take control of the emergency and command further ANSTO resources if required. Furthermore, they can seek operational support and advice from ANSTO's Emergency Operations Manager and the senior management Consequence Assessment Team (CAT). Health physics support for radiation incidents is

available 24/7. They are contactable by mobile phone and can respond in a vehicle containing the necessary radiation detection and decontamination equipment.

An assessment of the risks due to the facility has been performed. This included normal planned activities and the impact of external events on the site. A bushfire emergency has been specifically described. The roles and responsibilities of various groups during, and after, the event have been identified. It has been recognised that a bushfire may lead to increased movement of radioactivity away from the trench area. However, ANSTO's assessment indicates that, should this occur, it is expected to result in negligible doses.

There is a commitment to the ongoing review of emergency arrangements, including updating the contact lists and responses to safety alarms. Future planning of major activities has occurred and the consequent hazards have been assessed. Furthermore, a system is in place for the planning and approval of any unanticipated maintenance tasks.

ANSTO staff involved in emergency response are trained in the response procedures and are familiar with the existing arrangements (including processes for escalation). Exercises involving all of ANSTO's emergency response resources, and involving external emergency services, are conducted periodically. Furthermore, emergency exercise drills specific to the LFLS will also be conducted. ANSTO has committed to having back-up for all emergency roles.

The reviewing officer considers that the applicant has adequately demonstrated that appropriate provisions will be in place for ensuring that emergencies will be appropriately managed.

4. Associated Sources

There are no sources associated with this facility.

5. Matters to be taken into account by the CEO

The following matters, prescribed by the Act and Regulations, are to be taken into account by the CEO in deciding whether to issue a licence for facility under section 32 of the Act.

5.1 International Best Practice

Section 32(3) of the Act requires the CEO, in making a decision on a facility licence, to take into account international best practice in relation to radiation protection and nuclear safety.

There are a significant number of international documents which provide guidance on near surface disposal of radioactive waste. These are referenced in [11], [12], [13], [14], [15], [16], [17], [18], [19], [20], [21] and [22]. In Australia, these documents are further supplemented by references [4] and [23]. In addition, references [24] and [25] provide guidance on the upgrading and remediating of near surface disposal facilities which should be taken into consideration by ANSTO in its future management of the LFLS site.

ANSTO has undertaken to develop a series of plans addressing the management of the LFLS over the 'short-term' (approximately 3 years), the 'mid-term' and the 'long-term' (the point where a final determination has been made as to the disposition of the LFLS and the material contained therein).

Under the short-term plan, ANSTO will maintain the current monitoring and maintenance activities (including the addition of top-soil to any trenches that collapse) and continue the research into the behaviour of the radioactivity at the site. Under the mid-term plan, ANSTO has committed to undertake an engineering assessment to implement measures to prevent water entry to the trenches and improve stability of the trenches. These plans will be implemented and overseen by the LFLS Task Group.

The reviewer considers that this licensing decision is one of many steps that will be part of the future management of the facility. No intervention activities have been proposed to date. Therefore, they cannot be assessed. However, it is concluded that ANSTO has demonstrated that the current arrangements are providing an adequate level of safety to their workers and the public. Furthermore, it is also concluded that the implementation of a staged approach to the future management of the LFLS based upon the research performed by the environmental monitoring group is consistent with international best practice in the management of existing exposure situations.

5.2 Information asked for by the CEO

Sub-regulation 41(3) of the Regulations requires the CEO to take certain matters into account when issuing a facility licence. The reviewing officer considers that the applicant has provided all of the required information.

5.3 Undue Risk

The applicant must demonstrate that the radiation risks arising from the proposed conduct have been considered, including the probability and magnitude of potential exposures arising from accident scenarios or abnormal occurrences [paragraph 41(3)(b) of the Regulations].

The characteristics of each existing exposure situation are unique. Therefore, the best option for achieving the best level of protection under the prevailing circumstances is specific to the situation. To deal with this, the ICRP has created the term 'reference level' as a way to describe the dose, or the level of risk, due to an existing exposure situation. The reference level represents the accepted level of risk due to the exposure situation at hand. In this instance, it is recommended that the CEO of ARPANSA set the following reference levels for the LFLS:

> For occupational exposure, the effective dose should be less than 20 mSv per year, averaged over 5 consecutive calendar years. However, the effective dose for a person subject to occupational exposure should not be greater than 50 mSv in any single year.
>
> For public exposure, the effective dose should be less than 1 mSv per year.

The current levels of exposure to the critical group or individual from the LFLS lie easily within the recommended ICRP limits for occupational exposure and public dose, and hence it is recommended that these are adopted.

The above values provide a point of reference that can be used when assessing whether the LFLS represents an undue risk. ANSTO has advised that they have put in place measures to control the doses from the facility. Principally, this will be done by limiting access to the site, and therefore, limit the number of personnel exposed to radiation at the site. ANSTO has assessed the doses expected to be incurred by ANSTO personnel working at the facility as well as doses expected to be incurred by members of the general public. The analysis showed that the doses to workers and to the public due to the LFLS are expected to be below the abovementioned levels. Furthermore, ANSTO has also assessed the doses that could eventuate if the level of radioactivity in the top soil was significantly higher than recently measured values. These doses are also assessed to be well below the recommended reference levels. Moreover, ANSTO has assessed the risk due to a variety of external events (i.e. loss of offsite power, seismic events, flooding, aircraft crash, military strike and bushfire). This analysis identified that there were no issues associated with most external events. Although, it was identified that a bushfire could lead to an increase in doses, as the existing surface contamination would be more susceptible to being suspended and transported offsite by the wind, the analysis demonstrated that if this scenario was to occur it would only result in negligible to low doses. The calculated doses are less than the recommended reference levels.

Further to the above, there are programmes in place to monitor the site to try to understand what is happening within the trenches. The ultimate goal of this is to predict the movement of radioactivity at the site, and if necessary, mitigate the doses to worker and the public due to that radioactivity. Based on the above, it is concluded that the information provided in the application establishes that acceptable controls are in place for the proposed conduct.

5.4 Net Benefit

The applicant must demonstrate that the proposed conduct produces sufficient benefit to individuals or to society to offset the radiation harm that it might cause, that is, the conduct must be justified, taking into account social, economic and other relevant factors [paragraph 41(3)(c) of the Regulations].

When considering the net benefit of the proposed conduct described in this application, one should take into account that the facility houses radioactive waste and that it is an existing exposure situation. Each of these aspects, and the way in which they shape the decision making process, are discussed below.

Firstly, there is no net benefit, as such, from ANSTO Possessing or Controlling the LFLS. This is typical for radioactive waste management. The ICRP has considered the issue of justification of waste management and reiterated its position [26]:

> *"The Commission has previously stated… that radioactive waste management and disposal operations are an integral part of the practice generating the waste. It is wrong to regard them as a free standing practice that needs its own justification. Therefore,*

justification of the practice should include the management options of the waste generated, e.g. geological disposal. The justification of a practice should be reviewed over the lifetime of that practice whenever new and important information becomes available: such information may arise for societal, technical and scientific reasons. If the management of waste was not considered in the justification of a practice that is no longer into operation, the Commission recommends to optimize the protection of humans and the environment independently of considering the justification of such practice."

The benefit was associated with the research undertaken by the Australian Atomic Energy Commission into the development of atomic energy in Australia – this was a consideration at the time and cannot at this point in time be reversed (i.e. it has resulted in a 'legacy' or an 'existing exposure situation').

Secondly, the principle of justification is applicable to all exposure situations (planned, existing and emergency). For planned exposure situations, justification is considered in terms of the exposure to the source itself (i.e. no planned exposure situation should be introduced unless it produces sufficient net benefit). However, as the LFLS is considered to be an existing exposure situation, justification is considered in terms of the pathways of exposure (i.e. when deciding whether to take some action in order to avert further exposure, the disadvantages of the action should be considered, and the action should be justified in the sense that it is expected to do more good than harm). In this instance, the decision to be evaluated is not whether a physical action should be made (and the implications of that action), it is about bringing LFLS into a regulatory framework. The advantage of this, is that future actions, that may affect the pathways of exposure, can be undertaken within a framework based upon best practice in the regulation of radiation safety.

In addition to the above comments, the reviewer observes that although some radiological exposures are anticipated to be received by workers during the 'Possess or Control' of the LFLS (i.e. during general inspection, monitoring and sample collection activities over the trench area) the doses have been estimated as being negligible. The activities to ensure that the continued safe management of the facility occurs can on this basis be considered justified.

The above arguments have satisfied the reviewer that (a) the practices that created the radioactivity stored at the LFLS were justified, hence, the radioactive waste must be accepted as part of that practice; (b) this licensing decision brings the LFLS into a modern regulatory framework based on best practice radiation protection and (c) any doses incurred in ensuring the safe management of the facility in the future are negligible.

5.5 ALARA

The applicant must show that the magnitude of individual doses, the number of people exposed, and the likelihood that exposure will happen, are as low as reasonably achievable, having regard to economic and social factors [paragraph 41(3)(d) of the Regulations].

The *optimisation* principle in essence means that all reasonable effort (from cost and societal perspectives) should be made to reduce doses, the number of people exposed, and the likelihood of

exposure; exposures should be *as low as reasonably achievable,* or ALARA. In order to mitigate any negative consequences for individuals, doses must be maintained within certain bounds. For a planned exposure situation, these bounds would be the dose limits, as recommended by the ICRP, and as adopted by the Regulations. For an existing exposure situation, the ICRP recommends the use of reference levels rather than dose limits. The previous section on undue risk recommends reference levels for the LFLS. Similar to dose limits, these levels were defined in terms of individual dose. Despite this distinction, the reference levels should be used in a manner similar to dose limits (i.e. the responsible organisation should optimise protection strategies so that individual doses will be below these values).

Optimisation applies to all exposed categories of people. ANSTO has assessed the foreseeable doses to workers and the public. These doses are within the range considered to be minor to negligible. Furthermore, ANSTO has assessed the doses to wildlife. These doses have been considered against the *derived consideration reference levels* that have been defined by the ICRP to guide efforts to optimise protection of the environment [27]. Each type of exposure is addressed individually below.

Exposure of workers

ANSTO has committed to the principle of optimisation and intends to keep the magnitude of individual doses, the number of people exposed, and the likelihood of exposure occurring, as low as reasonably achievable (ALARA), whilst taking economic and social factors into account. ANSTO has assessed the doses that would be expected to be incurred by workers in conducting the maintenance activities at the site (i.e. inhalation of radioactivity whilst mowing the lawns and ingestion of radioactivity after becoming contaminated whilst collecting samples and performing environmental measurements). ANSTO's analysis concludes that the doses would be negligible. However, despite this, ANSTO has committed to using task dependent dose constraints and safe work method and environmental statements (SWMES) and risk assessments to identify radiological hazards and implement optimised levels of control. This is done to ensure that doses to workers are ALARA.

Exposure of the public

A number of environmental monitoring instruments and devices are located at the site. These are used as part of the environmental monitoring programme which provides an assurance that the site does not represent a significant hazard to the public. ANSTO's Institute of Environmental Research has been studying the site in order to predict the movement of radioactivity at the site, and if necessary, mitigate the doses from the radioactivity. ANSTO has used the information previously collected to inform their assessment of the radiological hazard of the facility. The assessment of doses to the public examined foreseeable scenarios such vandalism and intrusion, a plume of contaminated dust, the migration of contaminated groundwater and the leaching of tritium. ANSTO's analysis concludes that the doses due to these hypothetical scenarios would be negligible. However, it is evident from the analysis that some of the controls that have been previously implemented (i.e. erection and maintenance of a fence around the facility, addition of topsoil on the trench area) have reduced the likelihood and consequence of these scenarios occurring.

Exposures from accidents

ANSTO has assessed a variety of hypothetical external events and the impact that they could have on the LFLS. Furthermore, ANSTO has calculated predicted doses that are expected to be incurred in

the event that the level of radioactivity in the topsoil significantly increased. The doses calculated under these conditions were well within the reference levels recommended in this report. The assessment that these external events and increased levels of radioactivity in the topsoil was not likely to increase expected doses suggests that ANSTO has already optimised the facility in this regard.

Environment

The *2007 Recommendations of the International Commission on Radiological Protection* [10] acknowledged a need to consider a broad range of environmental situations. Shortly thereafter, a basis for evaluating and managing the actual or potential impact of radiation on the environment was published. This was the *Environmental Protection - the Concept and Use of Reference Animals and Plants* [27].

Consistent with the aforementioned modern approach to environmental protection, ANSTO has performed two screening-level dose assessments for biota affected by the LFLS. These were based on two differing scenarios. The first scenario assumed that whilst the majority of the radioactivity was located within the trenches, some radioactivity had moved up to the surface soils. The second scenario assumed that radioactivity had been transported off the site and into a local creek. ANSTO has conservatively assumed that amphibians and invertebrates are continuously exposed to a hypothetical concentration of radioactivity in the water and creek bed.

The results of the above analysis are as follows. The first scenario concluded that the calculated total dose rates for the majority of the representative plants and animals were below the derived consideration reference levels (DCRL) established by the ICRP. However, it was identified that an acacia tree with roots that were within the trenches (i.e. continually accessing the radioactivity) was around the DCRL. This is not of concern, as environmental protection from radioactivity is based upon the conservation of species and maintenance of biological diversity. Given the small area of the LFLS, this facility is not going to compromise environmental protection objectives. The second scenario was a conservative analysis as this creek is often dry. Despite this, ANSTO has assumed that amphibians and invertebrates are continuously exposed to a hypothetical concentration of radioactivity in the water and creek bed. The analysis concluded that the frog was well below the screening level but that the larvae was approaching the screening value. This was not of concern as the migration of radionuclides other than tritium is not significant at this stage. This is a hypothetical scenario that has been based upon conservative assumptions. Due to the low anticipated effect, it is concluded that this shows that ANSTO has already optimised the facility in this regard. However, it is expected that ANSTO's environmental monitoring program will detect the movement of significant activities of radionuclides other than tritium before they constitute an environmental hazard.

The above arguments have satisfied the reviewer that the planned and accidental exposures of workers and the public, and the environment are optimised (i.e. they are as low as reasonable achievable).

5.6 Capacity to Comply

The applicant must demonstrate a capacity to comply with the regulations and any conditions likely to be imposed on the licence. This should include sufficient financial and human resources to manage the proposed conduct [paragraph 41(3)(e) of the Regulations].

ANSTO has referred to the following as evidence of their capacity to comply with the Regulations and any licence conditions imposed by the CEO of ARPANSA:

- ANSTO is a Commonwealth agency with functions and activities set down by the ANSTO Act and Regulations
- ANSTO is licensed by ARPANSA to operate other nuclear installations and facilities (including the OPAL Reactor and the Mo-99 Manufacturing Facility)
- ANSTO undertakes other licensed activities such as production of nuclear medicines, research in radioactive waste processing and conditioning, irradiation services, environmental monitoring and dosimetry services

The reviewing officer has considered the above claims and concludes that the above arguments demonstrate that ANSTO has the capacity in terms of sufficient financial and human resources to manage the facility, comply with the regulations and any conditions likely to be imposed on the licence.

5.7 Authorised signatory

The application must be signed by an officer holder of the applicant or a person authorised by an office holder of the applicant, and in the latter case, an instrument of authorisation must be provided [paragraph 41(3)(f) of the Regulations].

Regulation 39(4)(b) requires an application made for a Department or Commonwealth Body to be made by the Secretary, chief executive or an equivalent person for the Department or body.

The application was signed by ANSTO's Chief Executive Officer, Dr Adrian Paterson. Therefore, the reviewing officer considers the requirement has been satisfied.

5.8 The content of any public submissions

If the application is for a facility licence for a nuclear installation - the content of any submissions made by members of the public about the application [paragraph 41(3)(g) of the Regulations].

Regulation 40 requires the CEO of ARPANSA to advertise receipt of the licence application for the LFLS and to invite submissions from the public in the Australian Government Gazette and a national newspaper. ARPANSA published the following notices:

- A notice in The Australian newspaper on 19 January 2015.
- A notice in the Australian Government Gazette on 19 January 2015.
- A notice on the ARPANSA website 19 January 2015.

In making a decision on the licence application, paragraph 41(3)(g) of the Regulations requires the CEO of ARPANSA to take into account any submissions received from the public about the application. One submission was received. This is transcribed, along with a response, at Appendix 2. These comments did not identify any issues that were not addressed by ANSTO's application. Therefore, the reviewing officer considers that the consultative process associated with this licensing decision has been successfully completed.

6. Conclusions

The application and information provided in support of the application provide evidence that:

1. The application was in a form approved by the CEO under Regulation 39(1), including payment of the relevant application fee.
2. ANSTO included all of the information required by the CEO under section 34 of the Act.
3. International best practice in radiation protection and nuclear safety has been taken into account.
4. The information establishes that by ANSTO possessing and controlling the LFLS there is no undue risk to the health and safety of people or to the environment. This has been considered for both normal operation and potential accident scenarios.
5. ANSTO has shown a net benefit in the possession or control of the LFLS.
6. The magnitude of individual doses, the number of people exposed and the likelihood that exposure will happen have been shown to be as low as reasonably achievable.
7. ANSTO has shown a capacity for complying with the regulations and licence conditions.
8. The application was signed by the requisite office holder.

7. Recommendations

7.1 Issue of Licence

It is recommended that a Facility Licence be issued to the ANSTO in respect of licence application A0293 authorising ANSTO to possess or control a controlled facility, namely the LFLS, subject to the licence conditions below.

7.2 Licence Conditions

It is recommended that the following licence conditions are applied to the LFLS licence:

Environmental Monitoring Programme

1. The licence holder must undertake an environmental monitoring programme approved by ARPANSA.

Compliance Reporting

2. The licence holder must provide to the CEO of ARPANSA within twenty-eight (28) days of the end of each financial year, or such other period as determined by the CEO of ARPANSA, and in a form acceptable to the CEO, information about compliance for the previous year. The annual report shall include:

    - A status update on the integrity of the facility trenches
    - Any changes in environmental circumstances of the facility
    - Information collected through the environmental monitoring programme and the results of monitoring data analysis

3. The licence holder must provide the CEO of ARPANSA a plan for the future management of the Little Forest Legacy Site by 30 June 2018. This plan should include options for future disposition of the inventory of nuclear and radiological waste, including contingency plans to accommodate changes in Australia's national radioactive waste management policies and legislative framework.

REGULATORY OFFICER		
NAME: Andrew McCormick	SIGNATURE: Original Copy Signed	DATE:
REVIEWED BY		
NAME: Jim Scott	SIGNATURE: Original Copy Signed	DATE:
APPROVED BY		
NAME: Jack Dillich	SIGNATURE: Original Copy Signed	DATE:

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Appendix 1:

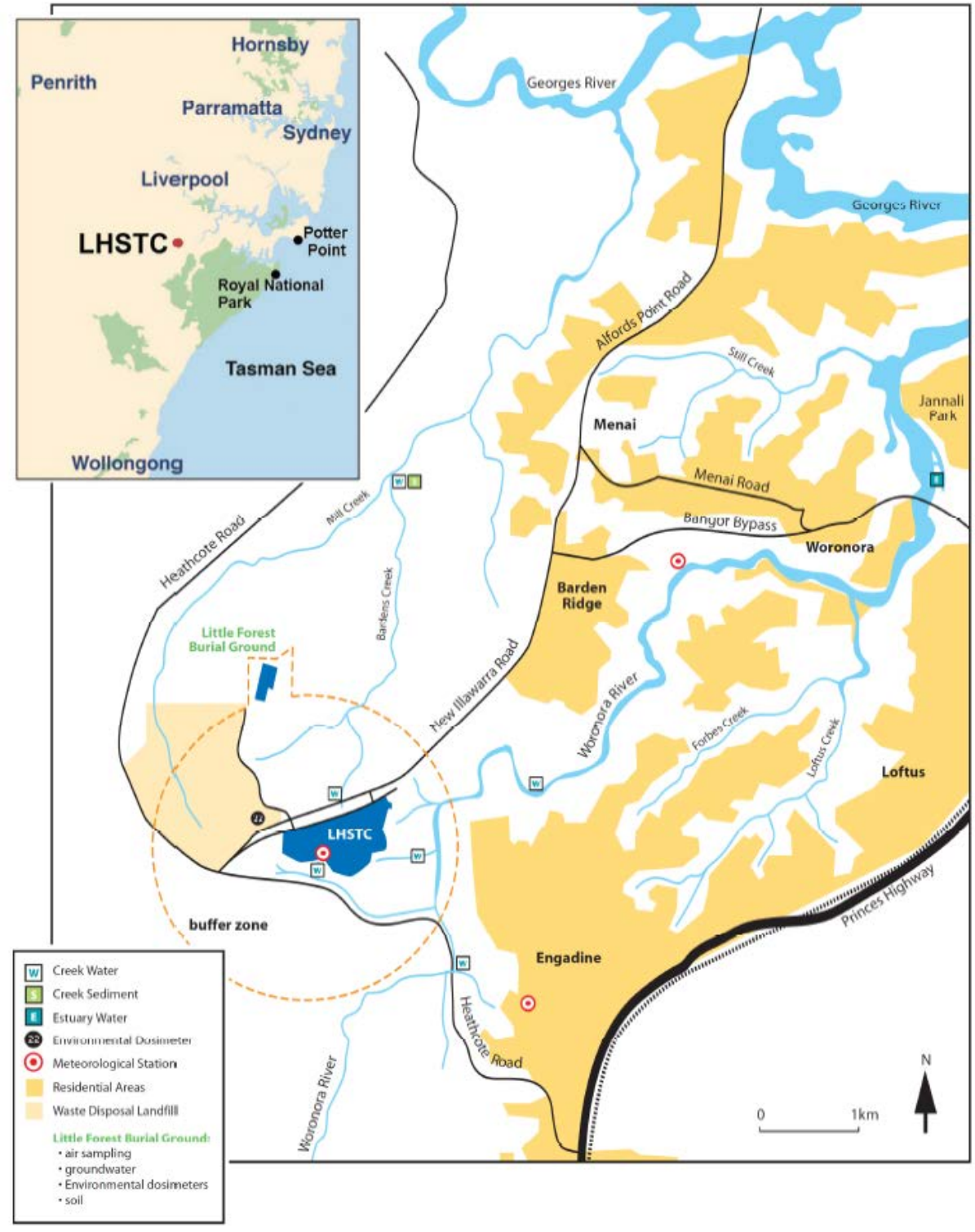

Figure A1.1: Map showing the general location of the LFLS (formerly known as the 'Little Forest Burial Ground') [28].

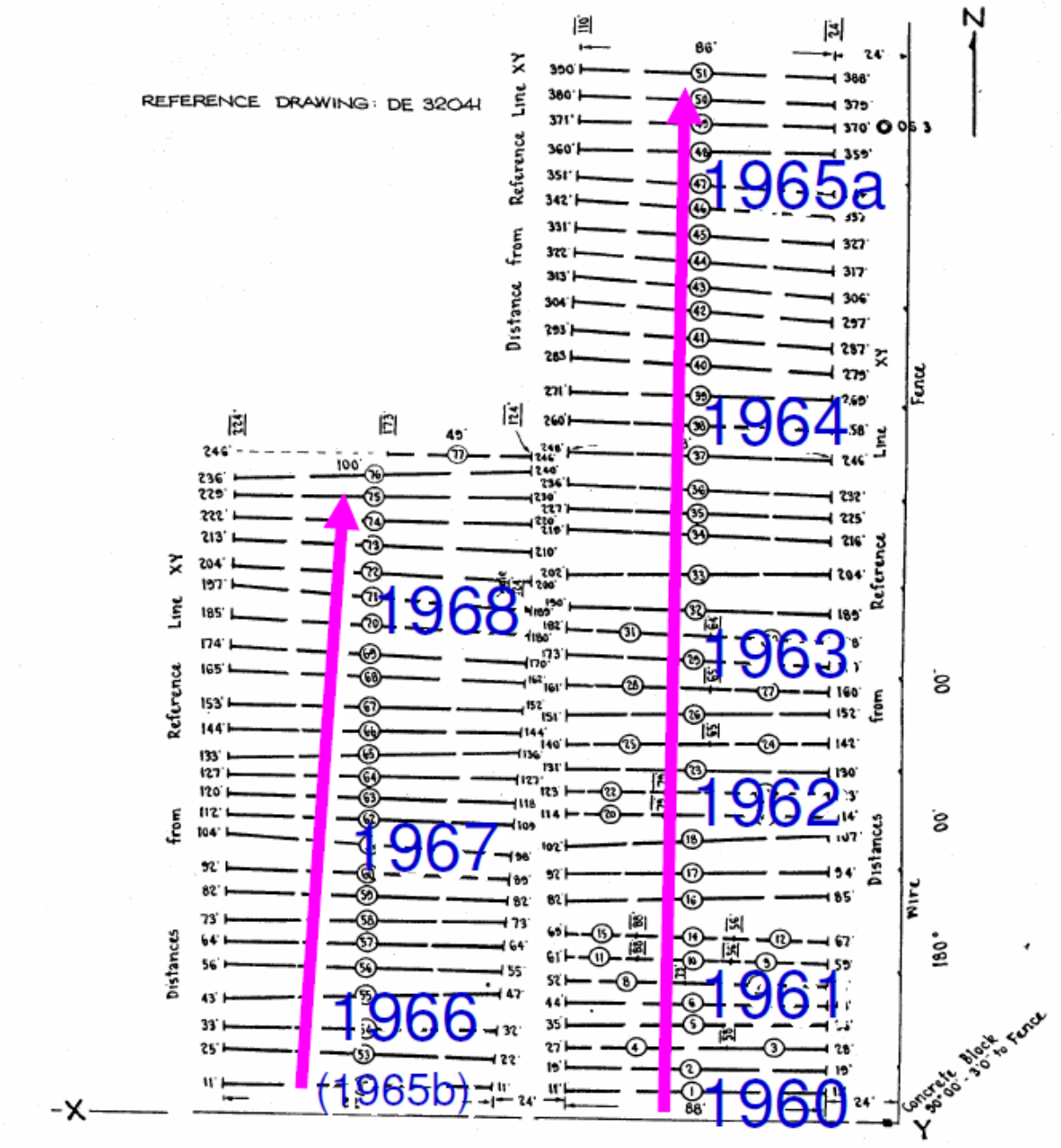

Figure A1.2: Diagram showing the general layout of the trenches at the LFLS and the order in which they were filled [28]. However, trenches S1 and S2 are not shown in this diagram. These are located to the south of the area shown. These were filled in 1967 and 1968 respectively.

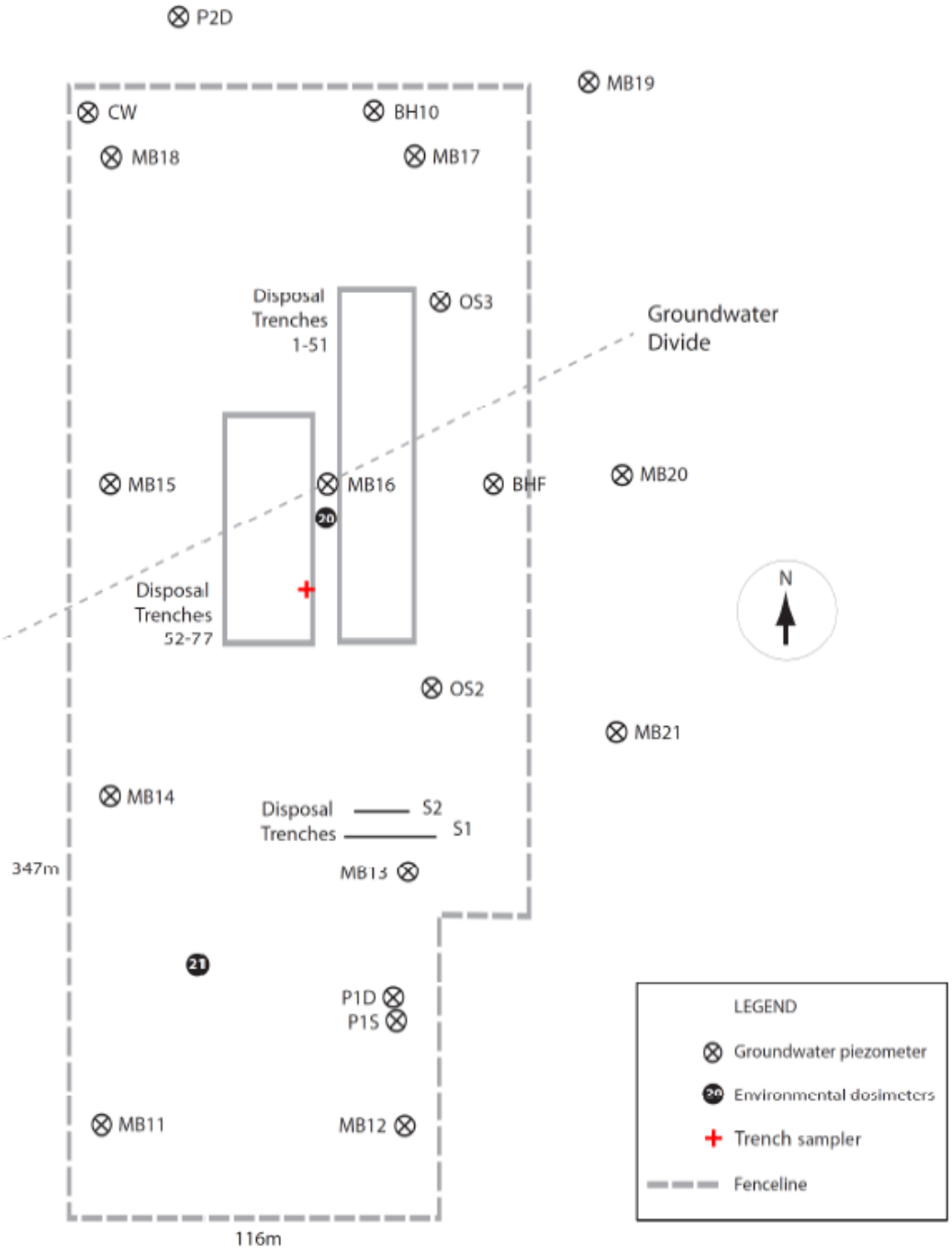

Figure A1.3: Diagram showing the location of the trenches in relation to the groundwater bores [28].

Table A1.1 Categorisation of radionuclides disposed at the LFLS [29].

Selection of Radioactive Nuclides	
Group I	Ac-227, Am-241, Np-237, Pa-230, Pa-231, Po-210, Pu-239, Pu-240, Pu-241, Ra-226, Ra-228, Th-228, Th-230, U-232.
Group II	A-41, Bi-210 (RaE), Eu-154, Mixed Fission Products, Pa-233, Pb-210, Ra-223, Ra-224, Rn-222, Sr-90, U-233, Xe-135.
Group III	Ba-140, Ce-144, Cl-36, Co-60, I-131, I-133, In-114m, Ir-192, Kr-85, Ru-106, Sb-124, Sb-125, Sc-46, Sr-89, Th-nat, Tl-204, U-235, U-238, U-nat, Xe-133, Y-91, Zr-95.
Group IV	Au-198, Be-7, Br-82, C-14, Ca-45, Cl-38, Co-58, Cr-51, Cs-135, Cs-137, Cu-64, F-18, Fe-55, Fe-59, K-42, La-140, Mo-99, Na-24, Nb-95, Ni-63, P-32, Ru-103, S-35, T- (in any form other than Group VII), Tc-99, Te-132, Zn-65.
Group V	A-41 (uncompressed), Xe-135 (uncompressed).
Group VI	Kr-85 (uncompressed), Xe-133 (uncompressed).
Group VII	T (as T2 or HT, or tritium activated luminous paint or tritium gas adsorbed on a solid carrier).

Appendix 2

Public Comment	ARPANSA Comment
This submission is in support of the Possess or Control licensing of the Little Forest Legacy Site. It is a matter of history that the LFLS (formerly LFBG) had not been included in the initial ARPANSA licensing of ANSTO facilities and it is a matter of history that the site exists in its current form. The site was established for disposal of the stated materials between 1960 and 1968 when this form of disposal was accepted world practice but ceased further disposal at the end of that period due to changing world views of this practice. Since that time the site has been maintained, monitored, evaluated and secured by the AAEC and subsequently ANSTO. It is maintained in a safe condition and will continue to be maintained in a safe condition until recovery, processing, and repackaging for disposal at a suitable long term disposal facility is feasible. Given that a suitable National facility has yet to be established in Australia for the disposal of the country's radioactive waste any such processing of the LFLS is not feasible or practical at this time. On this basis the LFLS must continue to be maintained in the current status, and as a site containing radioactive materials it is only sensible and logical to license it under the possession or control category. There is no reason not to license it.	The reviewer acknowledges the comments made in this submission. These comments did not identify any issues that were not addressed by ANSTO's application. The reviewer is thankful that a member of the public has engaged in the consultative process.