Australian Government
Australian Radiation Protection and Nuclear Safety Agency

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Inspection report

Licence holder: Australian Nuclear Science and Technology Organisation (ANSTO)	**Licence number:** F0271
Location inspected: Australian Synchrotron	**Date/s of inspection:** 17-19 September 2019
	Report no: R19/11448

An inspection was conducted as part of ARPANSA's baseline inspection program to assess compliance with the *Australian Radiation Protection and Nuclear Safety Act 1998* (the Act), the Australian Radiation Protection and Nuclear Safety Regulations 2018 (the Regulations), and conditions of facility licence F0271.

The scope of the inspection included an assessment of ANSTO's performance at the Australian Synchrotron against the Facility Performance Objectives and Criteria (POCs). The inspection consisted of a review of records, interviews, and physical inspection of the facility and associated sources.

Background

The Australian Synchrotron creates a beam of electrons with very high energy. When these electrons travel on a curved path, in the presence of a magnetic field, extremely intense radiation is produced. This radiation, synchrotron light, is directed down beamlines. There are nine beamlines for scientific research and two beamlines for beam diagnostics.

The Australian Synchrotron is a prescribed radiation facility (as per the Act and Regulations) that includes the following major subsystems:

- 100 MeV linear accelerating structure,
- 100 MeV to 3 GeV booster synchrotron (Booster Ring); and
- A 3 GeV storage ring that produces synchrotron radiation from infrared to hard X-rays.

The Australian Synchrotron licence covers the three major subsystems listed above along with several controlled apparatus and controlled materials used for research projects carried out at the facility.

The main codes and standards applicable to this facility and the associated sources are those that appear in section 59 of the Regulations.

Observations

Performance reporting and verification

The Australian Synchrotron has routinely reported relevant details of the safety performance of the facility to ARPANSA. These reports provide details of the changes that are occurring at the facility, the experiments that are occurring and details of the incidents that have occurred at the facility, regardless of whether radiation is involved. The reports provide adequate detail in these areas. However, the

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inventory of sources appears to be lacking detail in some areas. For instance, serial numbers, recommended working lives (RWL), physical and chemical forms for all sources. This is identified as an area for improvement below.

A Radiation Safety Assurance Committee (RSAC) has been established to oversee the safe operation of the radiological aspects of the facility. For instance, if a fault with the personnel safety system (PSS) occurs RSAC approval is required prior to restarting. The RSAC is designed to be an administrative and consultative body. It is an expert/management review of aspects associated with radiation protection at the facility rather than providing an independent challenge to the safety arguments put forward. No person, independent of the Australian Synchrotron, is a member of the RSAC. The IAEA has published General Safety Requirements Part 2 *Leadership and Management for Safety*. This recommends that 'arrangements shall be established in the management system for an independent review to be made before decisions significant for safety are made. The requirements on the independent nature of the review and on the necessary competences of the reviewers shall be specified in the management system'. This is identified as an area for improvement below.

Configuration management

The Australian Synchrotron previously had a management system accredited to AS/NZS 4801. However, as part of the transition into the ANSTO organisation, the ANSTO management system has been adopted. This uses a scheduled program of WHS inspections to identify areas for improvement and makes use of safe work permits and access to the keys that control the PSS to ensure that radiation is not passing down the beamlines while work is being performed.

A system exists to monitor the operation of the equipment. Separate safety systems also exist for the machine and each beamline. These are designed to protect people from accidental situations where they may be exposed to high dose rates. These are constructed to a high safety integrity level and constantly checks that the inputs and outputs of the system are in the expected state. Hence, the components have a predictable, low rate of failure on demand. A recent change to the design of the door lock on a beamline hutch was assessed by the RSAC.

Within the accelerator area, the beamlines and hutches there are elevated radiation levels. The staff, users and contractors working in the facility are protected by shielding consisting of lead, concrete, tungsten and steel. The Australian Synchrotron has tried to adopt a common method of identifying panels that perform a shielding function for the beamlines. These panels are immediately identifiable by the colour they are painted. Provided this is consistently maintained this is a positive practice.

During the inspection, inspectors sought to understand what the licence holder knew about operating limits and conditions (OLCs). While primarily employed for nuclear reactors, ANSTO has implemented OLCs at many of its facilities. Following a desktop review, Synchrotron documentation pointed to OLCs as being instruction, procedures and managerial limits. However, this differs from the definition provided by the IAEA Safety Guide NS-G-4.4 *Operating Limits and Conditions and Operating Procedures for Research Reactors* (2008) which is '…a set of rules setting forth parameter limits, and the functional capability and performance levels of equipment and personnel approved by the regulatory body for safe operation of an authorized facility'. In essence, the limits and conditions to which the facility is bounded ensure the safety of the facility.

Inspection testing and maintenance

The facility comprises of many physical, mechanical and electrical systems and components in order to operate. The core components are off the shelf products. However, some materials perform better than others when exposed to the radiation produced by the facility. Electronic personal dosimeters are available in the control room. These can be worn when performing maintenance assessments or works near items that may become activated due to exposure to radiation.

Some of the systems and components are subject to planned maintenance which can be scheduled, for instance, the doors to the hutches are on a 6 monthly rolling schedule that is automatically generated within their business management system. Many things, however, cannot be maintained and are fixed when they fail. For instance, emergency stops, magnets and switches on doors. If the safety system observes that a component has not functioned properly (i.e. a gate valve not fully opening or closing within the specified time) this is identified and the component can be replaced.

There has been some examples of learning through external experience. For instance, there has been collaboration with a similar installation. The staff responsible for the design and maintenance of the respective safety systems share knowledge and experiences. There has also been involvement in the commissioning of an instrument at the other installation. This is a positive practice.

Training

There are various categories of radiation workers at the facility. There are users, contractors and different types of staff performing different roles. For instance, there are scientific roles, there are accelerator physicists and operators as well as engineering and staff working on the control systems. Some of the training requirements are common to all, while some of the roles require specific training. For example, some operators and maintenance personnel have attended accelerator schools and workshops held overseas to acquire and develop their specialised knowledge.

The Australian Synchrotron has long used an electronic portal for providing training. This is linked to the individual electronic site access system. Hence, it enables controls to be put in place to prevent people from accessing areas when they have not done the required training. For example, the Laboratory Manager demonstrated how access to the laboratories is enabled after the laboratory safety course has been completed. The electronic portal can provide reports of whose training has lapsed. The training records for radiation safety were reviewed, and although there were some people who may not be expected to work at the site frequently, it was identified that approximately 20% of the staff at the Australian Synchrotron had allowed their radiation safety training to lapse. This is identified as an area for improvement below.

The Australian Synchrotron is moving towards transitioning onto the Learning Management System (LMS) commonly used by ANSTO. This system allows greater managerial controls over training. A manager is able to review the training records of the staff that directly report to them and also allows senior managers to examine the training records of all staff within their branch of the organisational structure. When a manager or senior manager observes that requisite training has lapsed the LMS allow them to send a reminder to the employee to do the training.

The machine is controlled by a team of operators, 24 hours a day and 7 days week. The operators have a number of operating procedures describing critical functions associated with the facility. Training in these areas uses a task-focussed approach that results in getting the machine running again. The manager, or an experienced operator, conducts the training one-on-one and observes that it is done correctly. A matrix is used to record when the tasks are conducted by each individual. When the manager considers the individual competent, they are allowed to operate the machine. Although the quality of the training could not be assessed during the inspection, this needs based approach to adult learning and the provision of support when needed, is expected to be an efficient method of performing training amongst a highly educated cohort.

Event protection

The nature of the site and the facility does not make it particularly susceptible to being affected by external events such as bushfires and flooding, and if they should occur, the combination of the facility design and the operations are expected to manage the event without radiological consequences. An internal fire protection system is in place. This is maintained by an external contractor on a monthly basis.

Security

A layered approach to security is being developed that utilises the existing ANSTO security framework that is required to meet the Australian Government Protective Security Policy Framework. For this facility, an independent security expert conducted an assessment and subsequently a site security plan and a facility security plan have been developed. The second revision to the site security plan is currently in draft form, and while it has been reviewed and approved by senior Synchrotron management, final approval and publication have not yet occurred. This is identified as an area for improvement below. In practice, a variety of physical security measures are in place to control security at the Australian Synchrotron. This utilises access controls, cameras, infrared security sensors, alarms and a security guard force.

Radiation protection

The 'normal operation' of the Synchrotron involves maintaining a desired number of electrons within the storage ring. When operating in this manner, there is stable, predicable and low level of radiation in the occupied areas of the facility. In order to make up for the small number of electrons that are lost, additional electrons are added from time-to-time. This is done to maintain a relatively stable number of electrons in the storage ring. This results in consistent production of synchrotron light for experimental use. Occasionally, however, the synchrotron operates in a less effective manner. When a large number of electrons are lost from the storage ring, there is a sudden increase in the radiation present in occupied areas adjacent to where the electrons were lost. Hence, the efficient operation of this facility is highly likely to also result in low occupational exposures.

The primary radiological hazard at the Australian Synchrotron is the facility itself. Occasionally, however, samples used for synchrotron experiments contain low levels of radioactivity. This is discussed below. A number of sources are also used in conjunction with the facility. These include calibration sources, an X-ray fluorescence analyser, lasers and ultraviolet lamps, and a disused diffractometer that contains 20 Am-241 sources which are used to mark reference points.

ARPANSA has acknowledged that like any manufactured article, a sealed source has a finite life and provided guidance for licensees who wish to use a source beyond the Recommended Working Life (RWL) provided by the manufacturer, or in instances where the RWL has not been provided or is not known. This sets out the expectation that sealed sources can be used past their first RWL provided that the source, or the nearest accessible part to the source is wipe tested annually, records of the wipe test are maintained and the source is clearly marked on the inventory.

The diffractometer discussed above, is stored in a crate located away from the general thoroughfare. It has been there for a number of years. The crate was marked with a trefoil identifying that radioactive material was inside and instructions to consult the safety office before opening crate. In this instance, the sources are attached to the equipment within a crate within a temperature controlled building. Therefore, over the last few years the sources have not been subjected to a harsh environment. However, the sources were manufactured in 1979, and unless the manufacturer has provided an alternate RWL, ARPANSA recommends a RWL of 15 years for Am-241 sources. Hence, these 20 sources are in their third working life and no routine tests have been conducted to confirm that the sources are not leaking. No documented arrangements, supported by a radiological risk assessment, for the management of the sources until a decision on the future of the diffractometer was decided, were available. This is identified as an area for improvement below.

Use of the synchrotron radiation for experimentation is controlled to approved users only. In order to obtain access to 'beam time', a user is required to provide details of the samples and any equipment they intend to bring onto the site. The approval of the request is based on the scientific merit of experiments and the adequate management of any safety risks (including radiation). Very few samples are radioactive, and the vast majority of those that are, contain such low levels of radioactivity they are exempt from ARPANSA's oversight. Despite this, contamination monitoring equipment is available to the users and anyone who brings radioactivity on-site is required to certify that it, and all associated waste, has been removed from the site at the conclusion of the experiments.

Emergency preparedness and response

ANSTO has prepared a Safety Assessment and a Safety Analysis Report describing the risks associated with the facility and how they are managed. Both of the reports categorise the facilities in accordance with ARPANSA's Regulatory Assessment Principles (2001). This document has been withdrawn from use and international best practice recommended instead. The IAEA has published General Safety Requirements Part 7 *Preparedness and Response for a Nuclear or Radiological Emergency* (2015). The facility has not been categorised in accordance with the currently recommended IAEA methodology. This is identified as an area for improvement below.

The Australian Synchrotron has tried to create a culture whereby all alarms are treated as real events. Two emergency organisations (one for each of the main buildings on the site) have been created. These can be implemented in the event of an emergency. The emergency plan is yet to be finalised. The previous plan expired in December 2018 and no after hours or lone worker procedure exists. These issues are identified as an area for improvement below. The wardens have been provided with radios for communication and vests for identification of roles. Additional radios and vests are located around the main building in the event that a warden is away from their desk when an emergency occurs.

Previously, an external organisation has been used to manage the emergency training arrangements for the site. An emergency exercise had been conducted in July 2019. Attendance at the exercise was recorded. This exercise used a scenario whereby a car crash on the adjacent road resulted in a loss of electrical power to the site. Simulated inputs were used to trigger the exercise and challenge the organisation's response. The exercise was conducted in conjunction with emergency response organisations and was observed by the external party who identified lessons that could be learned from the experience.

Moving forward, the Australian Synchrotron will not be using the third party contractor. An Emergency Planning Committee has been established and the Australasian Inter-service Incident Management System has been adopted which utilises an 'all agencies' approach to responding to large emergencies. Further scenario based exercises with support from the Lucas Height site are planned for the future.

Findings

The licence holder was found to be in compliance with the requirements of the Act, the Regulations, and licence conditions.

The inspection revealed the following **areas for improvement**:

1. Oversight of documentation, including source inventory details, the security plan, emergency plan, Safety Assessment and Safety Analysis Reports and consideration of the need for managing risks to lone workers.
2. Development and documentation of a system for providing independent review of decisions significant for safety.
3. Oversight of completion of training requirements for personnel working at the site.
4. Development of a documented plan for the management of the Am-241 sources on the disused diffractometer until a decision on the future of the diffractometer is determined.

It is expected that improvement actions will be taken in a timely manner.

No written response to this report is required

THIS REPORT WILL BE PUBLISHED ON THE ARPANSA WEBSITE