



Australian Government

**Australian Radiation Protection
and Nuclear Safety Agency**

Quarterly Report

of the

Chief Executive Officer of ARPANSA

July to September 2016

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ARPANSA
619 Lower Plenty Road
Yallambie VIC 3085
email: info@arpansa.gov.au

Further information about this publication

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The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) is the Australian Government's primary authority on radiation protection and nuclear safety. ARPANSA regulates Commonwealth entities using radiation with the objective of protecting people and the environment from the harmful effect of radiation. ARPANSA undertakes research, provides services, and promotes national uniformity and the implementation of international best practice across all jurisdictions.

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Letter of transmittal

25 November 2016

The Hon Dr David Gillespie
Assistant Minister for Rural Health
House of Representatives
Parliament House
Canberra ACT 2600

Dear Minister

The *Australian Radiation Protection and Nuclear Safety Act 1998* (the Act) requires the Chief Executive Officer (CEO) of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) to submit to the Minister, at the end of each quarter, a report on:

- the operations during the quarter of the CEO, ARPANSA, the Radiation Health and Safety Advisory Council (the Council), the Nuclear Safety Committee (the NSC) and the Radiation Health Committee (the RHC)
- details of any direction given by the Minister to the CEO under section 16 of the Act
- details of any direction given by the CEO under section 41 of the Act
- details of improvement notices given by inspectors under section 80A of the Act
- any breach of licence conditions by a licensee, of which the CEO is aware
- all reports received by the CEO from the Council and the NSC under Part 4, paragraphs 20(f) or 26(1)(d) of the Act, and
- the facilities licensed under Part 5 of the Act.

I am pleased to provide you with a report, meeting the requirements of the Act, covering the period 1 July to 30 September 2016.

Please note that subsection 60(6) of the Act requires you to cause a copy of the report to be laid before each House of the Parliament within 15 sitting days of the day on which this report was given to you.

Yours sincerely



Gillian Hirth
Acting CEO of ARPANSA

The operations of the CEO and ARPANSA

ARPANSA sits within the Department of Health portfolio.

ARPANSA has a single outcome, as set out in the 2016-17 Portfolio Budget Statement (2016-17 PBS):

Protection of people and the environment through radiation protection and nuclear safety research, policy, advice, codes, standards, services and regulation.

The Radiation Protection and Nuclear Safety Program, contained within the 2016-17 PBS, describes four program objectives which ARPANSA pursues to deliver its outcome. These program objectives are:

- protect the public, workers and the environment from radiation exposure
- ensure radiological and nuclear security, and emergency preparedness
- promote the effective use of ionising radiation in medicine, and
- ensure effective and proportionate regulation and enforcement activities.

The report on the operations of the CEO and ARPANSA is based on these program objectives.

Protect the public, workers and the environment from radiation exposure

Australian National Radiation Dose Register

ARPANSA maintains the Australian National Radiation Dose Register (ANRDR) which collects, stores and reviews radiological dose histories for occupationally exposed workers in Australia.

The ANRDR currently holds dose history records for more than 35,000 workers. This includes full coverage of workers from all licensed uranium mining and milling operations, and partial coverage of workers from Commonwealth licence holders, and the mineral sands mining and processing industry.

ARPANSA continues to expand the ANRDR, with a goal to include all occupationally exposed workers. Progress continues to be made in the aviation sector and an initial stakeholder identification process identifying key industry representative groups has been completed for the medical sector.

A review of how stakeholders join the ANRDR was also completed. Other options to join the ANRDR are being considered and now include a service level agreement approach. This would see a formal agreement established between the stakeholder and ARPANSA.

Monitor and Mitigate Population Exposures to Electric and Magnetic Fields and Electromagnetic Radiation

ARPANSA published on its website an analysis of its Electromagnetic Radiation (EMR) Health Complaints Register Data for 2015-16. The register provides a collation of reports of health concerns related to possible EMR field exposures in the range of 0-300 GHz. Members of the public who believe they have suffered ill-effects as a result of exposure to EMR can lodge a written complaint to ARPANSA for inclusion on the register.

On 16 August 2016 the ARPANSA CEO, Dr Carl-Magnus Larsson met with Mr Chris Althaus, CEO of the Australian Mobile Telecommunications Association. Information and views were exchanged on radiation safety related to the fifth generation mobile networks (5G); the lack of research funding being awarded in recent years; and development of national standards.

On 7 September 2016, an ARPANSA scientific officer delivered a guest lecture on radiation safety at Monash University. The lecture is part of a teaching block on environmental influences on health for students enrolled in the Masters of Public Health course.

Solar Ultraviolet Radiation and Sun Protection

ARPANSA measures solar ultraviolet radiation (UVR) at 11 sites around Australia. During this quarter, trials and assessment of new equipment to modernise the operation of the network continued. The UVR index data generated by the network is used to raise awareness in the Australian population of the levels of UVR exposure and the risks associated with excessive sun exposure.

Standards Development

ARPANSA, working with Standards Australia, led the drafting work to update *AS/NZ 2243.4 Safety in Laboratories: Ionising Radiation*. As the standard had not been updated for over a decade, major revision of the document was required. The draft was finalised by the drafting committee, having clarified several points and approved several editorial changes. The draft document is expected to go out for public comment in late 2016.

An ARPANSA expert chaired the Standards Australia Committee meeting TE-007 – Human Exposure to Electromagnetic Fields. The Committee met via teleconference to discuss a number of International Electrotechnical Commission draft standards and form a position on a number of draft documents awaiting vote. The Committee agreed to:

- a positive vote for:
 - 106/366e/CDV "Determination of RF field strength, power density and Specific Absorption Rate (SAR) in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure"
 - 106/377e/PAS "SAR measurement procedure for Long Term Evolution devices"
- abstain from voting on:
 - 106/363e/CDV "Determining the peak spatial-average SAR in the human body from wireless communications devices, 30 MHz - 6 GHz - Part 3: Specific Requirements for using the Finite Difference Time Domain Method for SAR Calculations of Mobile Phones"
- not provide comments on:
 - 106/371e/CD "Recommended Practice for Determining the Peak Spatial Average SAR in the Human Body from Wireless Communications Devices, 30 MHz - 6 GHz - Part 4: General Requirements for Using the Finite-Element Method for SAR Calculations and Specific Requirements for Modelling Vehicle-Mounted Antennas and Personal Wireless Devices".

Ensure radiological and nuclear security, and emergency preparedness

Security of Radioactive Material

ARPANSA's Source Control section participated in a whole of government chemical, biological, radiological and nuclear (CBRN) Counter-Terrorism Architecture Seminar at the New South Wales Operations Command centre. The engagement focused on roles and responsibilities, coordination and interoperability between organisations. Changes to previous architectures were also canvassed and agreed amongst the various agencies involved in the discussions. As an expert advisor and a competent authority, ARPANSA continues to build strong working relationships in both the preventative-security and consequence-management realms of counter-terrorism capabilities within Australia.

The security of radioactive sources is also an element of ongoing ARPANSA regulatory inspections.

International Monitoring System

As part of Australia's ongoing commitment to the Comprehensive Nuclear-Test-Ban Treaty (CTBT), ARPANSA operates and maintains radionuclide air particulate monitoring stations that are part of the CTBT International Monitoring System (IMS). Stations are located in Melbourne, Perth, Townsville, Darwin, the Cocos Islands, Macquarie Island, and Mawson Base (Antarctica). Two noble gas monitoring facilities are co-located with air particulate monitoring stations in Melbourne and Darwin.

ARPANSA continued to operate the Australian CTBT Radionuclide Laboratory which is a certified laboratory for the analysis of air particulate samples. The laboratory analysed five samples this quarter. Results from the Proficiency Test Exercise conducted this quarter have not yet been released by the CTBT Organisation.

ARPANSA is responsible for advising the Government on whether a suspected nuclear explosion overseas can be verified from its radionuclide signature. On 9 September 2016, media reported that the Democratic People's Republic of Korea (DPRK) had potentially conducted a nuclear weapons test. ARPANSA modelled the path of any potential radioactive material release to support verification of the event and assess potential health impacts to the Australian people or environment. No radionuclide signature attributable to the latest DPRK test has yet been detected on the CTBT IMS.

Visiting Ships Panel (Nuclear)

The Australian Government has in place an interdepartmental standing committee called the Visiting Ships Panel (Nuclear) (VSP(N)) to oversee arrangements for visits to Australia by nuclear-powered warships (NPW) and other nuclear-powered vessels. ARPANSA is a member of the VSP(N) and chairs the Technical Working Group (TWG) which provides advice and support to the VSP(N). During this quarter both the VSP(N) and TWG met to review plans and arrangements and to schedule port validation activities in preparation for NPW visits anticipated in 2017.

Emergency Preparedness

ARPANSA was invited to present at a nuclear forensics workshop hosted by the Australian Nuclear Science and Technology Organisation (ANSTO). During the visit, side meetings were held to discuss mutually beneficial projects and ways to enhance collaboration between ARPANSA and ANSTO, particularly in the area of radionuclide threat detection technology.

Stakeholder engagement and planning activities were undertaken in preparation for two upcoming exercises that ARPANSA will be participating in. One will be a national level, table-top exercise in October 2017 relating to the response to a simulated radiological or nuclear security incident. The second exercise involved planning activities for an international exercise called the 'Pacific Protector' coordinated under the Proliferation Security Initiative (PSI). This annual exercise series rotates between PSI partner nations, and will be hosted by Australia in 2017.

Promote the effective use of ionising radiation in medicine

Radiotherapy

As a part of the Radiotherapy section's regular calibration services for radiotherapy providers and industry users of radiation, ARPANSA calibrated five survey meters and six therapy dosimeters this quarter. Four of the six therapy dosimeters were calibrated directly in linear accelerator radiation beams allowing more accurate radiation measurements for patient treatment.

Australian Clinical Dosimetry Service

The Australian Clinical Dosimetry Service (ACDS) is a joint initiative between the Department of Health and ARPANSA to provide radiation specialists with a source of independent checks for equipment and patient doses. This enables an integrated national approach to promoting safety and quality in radiotherapy, which is expected to lead to further improvements in radiotherapy treatment outcomes. During this quarter, the ACDS finalised 21 audits of radiotherapy equipment, meeting the audit target frequency agreed to with the Department of Health. The ACDS has conducted five audits with the new Intensity-Modulated Radiation Therapy (IMRT) and IMRT Flattening Filter Free modalities. The ACDS has also greatly improved its clinical practice coverage this quarter by developing several new audit techniques. Field trials in the small field modality have been conducted in the Level Ib audit and field trials of volumetric modulated arc therapy have been conducted in both Level II and III audits. The ACDS received National Association of Testing Authorities (NATA) accreditation against the ISO-17025 standard in September 2016.

Medical Imaging

The Medical Imaging section has been heavily engaged in drafting work for the revised Medical Exposure Code. Responses to regulatory comment on the initial draft were completed in August 2016. A revised draft and a comments resolution table were sent to regulatory authorities in September 2016. The revised draft was also sent to relevant professional societies and associations for comment.

During 2015-16 ARPANSA replaced obsolete diagnostic imaging X-ray equipment. Over this quarter the Medical Imaging section commissioned the new equipment and developed a calibration capability for devices used for measuring the radiation output of hospital-based diagnostic X-ray equipment.

Ensure effective and proportionate regulation and enforcement activities

ARPANSA invited a second round of submissions on the draft Code for Radiation Protection in Planned Exposure Situations (Planned Exposure Code). An earlier version of the draft Planned Exposure Code was released for public comment between 21 April 2015 and 5 June 2015, with the resulting changes being sufficient to warrant a second round of public comment. The Planned Exposure Code sets out the requirements in Australia for protecting occupationally exposed persons, the public and the environment in planned exposure situations. The primary means of controlling exposure in planned exposure situations is through good design of facilities, equipment, operating procedures and training.

Regulator Performance Framework

ARPANSA undertook its first annual self-assessment in accordance with the Australian Government Regulatory Performance Framework between 24 and 29 July 2016. The self-assessment team consisted of ARPANSA staff, an overseas expert and a licence holder representative. Several areas for improvement were identified. A report has been prepared and will be subject to external validation and ministerial approval prior to publication.

Regulatory Guides

ARPANSA has revised the Regulatory Guide: 'Plans and Arrangements for Managing Safety'. This guide outlines the key aspects that should comprise an organisation's plans and arrangements for managing safety. The draft revised guide has been sent to licence holders for comment. The deadline for submitting comments was 19 October 2016.

A draft Regulatory Guide: 'Applying for a Licence for a Radioactive Storage or Disposal Facility' is also being finalised. This Regulatory Guide will provide guidance on the information to be submitted with a licence application, in order to meet the regulatory requirements.

Significant Licensing Activities

Approvals were given under Regulation 51 and 54 to:

- ANSTO for a Regulation 51 request for interim approval for operation of the Mark 3 Bulk Irradiation Facility rig for 12 irradiated target plate operations at the Open Pool Australian Lightweight (OPAL) reactor
- ANSTO for a Regulation 51 request for extension of the intermediate level solid waste storage facility at Lucas Heights Science and Technology Centre
- ANSTO for a request to conduct reactor block drilling, sampling and analysis at the shutdown High Flux Australian Reactor (HIFAR) reactor under Licence Condition 1

- ANSTO for a request for asbestos remediation work for the shutdown HIFAR reactor under Licence Condition 1
- ANSTO Health for a request to move to normal operations for 12 irradiated target plate processing following successful hot commissioning
- the Department of Immigration and Border Protection for the use of a Computed Tomography CT X-ray unit.

Inspections

During this quarter, ARPANSA completed 18 inspections of radioactive sources and facilities in accordance with its Regulatory Delivery Model. Inspection reports are posted on the ARPANSA website at: www.arpansa.gov.au/regulation/inspections.

Inspections revealed two potential instances of non-compliance. In addition, 36 areas for improvement were identified. These were provided to the licence holder to encourage continuous improvement. Inspection outcomes are reviewed and trended to inform the future inspection programme.

Stakeholder Engagement - Licences

ARPANSA met with representatives of:

- ANSTO in July 2016 to discuss the Little Forest legacy site with regard to recent changes to the Act and any potential impact on the existing licence.
- ANSTO in August 2016 to review the OPAL reactor quarterly report submitted for the period 1 April to 30 June 2016.

Stakeholder Engagement - Regulatory Documents

ARPANSA has drafted a document entitled 'Information for Stakeholders: Radioactive Storage and Disposal Facilities'. This document explains relevant principles, concepts and processes that apply to the management (storage and disposal, and other associated activities) of radioactive waste. Stakeholder comment will be sought on this document before it is published.

Radioactive Material Import Permits

The importation of radioactive material into Australia requires permission under Regulation 4R of the Customs (Prohibited Imports) Regulations 1956. These regulations are made under the *Customs Act 1901*. Under the Customs (Prohibited Imports) Regulations 1956, the Minister for Health may authorise ARPANSA officers to approve import permissions.

During this quarter, ARPANSA authorised officers issued 126 permits for non-medical radioisotope including: 63 urgent permits, 59 standard permits and four twelve month permits.

During this quarter, ARPANSA authorised officers issued 254 permits for medical radioisotopes including zero urgent permits, 11 twelve month permits and 243 single shipment permits.

Transport of Radioactive Material

ARPANSA approved the transport of a disused teletherapy source from New Zealand to ANSTO under special arrangement. Three transport security plans were endorsed.

International engagement

ARPANSA's international engagement provides the Agency with the means of influencing the international radiation protection and nuclear security and safety framework, and strengthens our engagement with domestic stakeholders in order to grow awareness and collaboration on national interests and policy objectives. The following is a summary of key international engagement activities undertaken in this quarter.

International Atomic Energy Agency Technical Meeting of the International Low Level Waste Disposal Network, 4-8 July 2016, Gyeongju, South Korea

ARPANSA attended the International Atomic Energy Agency (IAEA) technical meeting of the International Low Level Disposal Network. The meeting focused on disposal strategies, repository design aspects, evolution of repository designs, disposal facility optimisation and disposal activity optimisation. Examples of disposal facilities operating in various advanced countries were discussed. Travel was funded by ARPANSA.

National Consultancy Meeting on the Draft Safety Regulations for Research Reactors in Vietnam, 11-15 July 2016, Vienna, Austria

ARPANSA participated in this meeting to review the draft Vietnam Agency for Radiation and Nuclear Safety (VARANS) safety requirements for the design of a new research reactor. Detailed conclusions and recommendations were provided to the VARANS counterparts. Travel was funded by the IAEA.

Regional Workshop to Review and Update the National Action Plan to Control Public Exposures, 11-12 August 2016, Jakarta, Indonesia

ARPANSA participated in two days of a regional workshop to review and update the National Action Plan to Control Public Exposures. The meeting discussed the issues of radiation protection of the general public due to radionuclides in food and drinking water. The travel was funded by the IAEA.

47th Session of the Comprehensive Nuclear-Test-Ban Treaty Organization Working Group B, 22 August 2016 – 2 September 2016, Vienna, Austria

ARPANSA participated as part of a delegation which included representatives from the Australian Safeguards and Non-proliferation Office (ASNO) and Geoscience Australia. Working Group B brings together Member State representatives to discuss technical and operational issues related to the Comprehensive Nuclear-Test-Ban Treaty Organization's (CTBTO) IMS. ARPANSA assists Australia to meet its treaty obligations, which include the operation of atmospheric radionuclide measurement stations and laboratory. ARPANSA is the third largest operator of radionuclide stations across the IMS. The meeting includes updates on station performance, technology refreshment and provisional operations. Travel was funded by ARPANSA.

International Atomic Energy Agency Expert Mission to the Bandung TRIGA Research Reactor, 30 August – 2 September 2016, Bandung, Indonesia

ARPANSA provided expert technical advice on the safety of instrumentation and control system, and operational radiation protection for the Bandung TRIGA Research Reactor, including in relation to preparedness and response for a nuclear or radiological emergency. The mission resulted in a number of recommendations related to improvement and development of local rules and procedures, access to controlled areas and upgrading of radiation monitoring instrumentation. Invitation to this mission is recognition by the IAEA of ARPANSA's expertise in the areas of radiation protection and nuclear safety. Further, it provides opportunity to ARPANSA to demonstrate regional leadership in radiation protection and nuclear safety. Travel was funded by the IAEA.

IAEA Integrated Regulatory Review Service mission, 4-14 September 2016, Tallinn, Estonia

An ARPANSA staff member led an international team of experts on this Integrated Regulatory Review Service (IRRS) mission. The mission conducted a peer review of Estonia's radiation protection and nuclear safety regulatory infrastructure and practices against the IAEA Safety Standards. The mission was largely funded by the IAEA.

International Atomic Energy Agency Technical Meeting, Vienna, Austria, 5-9 September 2016 (attended via videoconference)

ARPANSA attended this meeting which discussed the Draft Safety Guide on arrangements for communication with the public during a nuclear or radiological emergency. ARPANSA presented Australia's national arrangements for public communication in an emergency and other member states presented on their own national arrangements. Attendance was via videoconference (no cost).

Emergency Preparedness Meetings, 5-14 September 2016, Copenhagen, Denmark; Paris, France; Oslo, Norway

ARPANSA participated in the Accident Reporting Guidance and Operating System (ARGOS) Consortium meeting from 5-7 September 2016. The ARGOS consortium meeting was attended by eight consortium member countries, and PDC-ARGOS (software vendor). It was agreed that the ARGOS consortium would exist for a period of up to three years, allowing time for each user to agree on an individual licence agreement directly with PDC-ARGOS. From 8-9 September 2016, an ARPANSA staff member visited the Institute for Radiological Protection and Nuclear Safety in France to discuss potential collaborations in the areas of radon mapping, source term analysis and atmospheric modelling. From 12-14 September 2016, an ARPANSA staff member visited the Norwegian Radiation Protection Authority to further advance collaborative projects in the area of nuclear powered vessel port visits; this also included a visit to a Norwegian naval base. Travel was funded by ARPANSA

18th International Symposium on Packaging and Transport of Radioactive Materials, 18-23 September 2016, Kobe, Japan

ARPANSA attended this symposium and presented a paper on 'Regulatory Assessment of a Dual Purpose Cask TN 81 for Interim Storage of Intermediate Level Waste' which was well received. There were approximately 600 participants and wide range of safety and security topics were addressed regarding nuclear and radioactive materials packaging and transport. Topics included regulation and

licensing, package design and transport, ageing management, lessons learned from major events (e.g. Fukushima, Japan). This event provided opportunity to receive direct feedback on ARPANSA's regulatory process and the standard of the regulatory process against international best practice. The knowledge and information obtained from this conference enhances ARPANSA's regulatory and technical capability. Travel was funded by ARPANSA.

International Atomic Energy Agency Emergency Preparedness Review Mission for the Republic of Indonesia, 18-28 September 2016, Jakarta, Indonesia

ARPANSA participated in this peer review mission to evaluate Indonesia's progress implementing the IAEA's General Safety Requirement Part 7, for preparedness and response to a nuclear or radiological emergency. A number of recommendations and suggestions to enhance Indonesia's capabilities were presented to the government in a final report. Travel was funded by the IAEA.

World Health Organization Steering Committee Meeting, 20-23 September 2016, Athens, Greece

ARPANSA is a member of the World Health Organization (WHO) Steering Group that is developing Fundamental Safety Principles and Basic Safety Requirements for protection against the harmful effects of non-ionising radiation exposure. This activity is motivated for the need to develop harmonised standards, and their application within an international protection framework. The meeting focused on reviewing key policy and technical comments received from stakeholders on the draft Fundamentals Safety Principles and developing a roadmap to develop the Basic Safety Requirements. The WHO initiative will strongly influence the development of national guidance in Australia. This travel was partly-funded by ARPANSA.

60th Regular Session of IAEA General Conference, 26-30 September 2016, Vienna, Austria

ARPANSA CEO and Chief of Staff attended the 60th Regular Session of the IAEA General Conference, 26-30 September 2016. The Australian delegation was led by the Head of Mission in Vienna, Ambassador Stuart, who also delivered the Australian statement to the Conference. Resolutions were passed in a number of important areas of safety, security, safeguards, technical cooperation and others. ARPANSA held a series of bilateral meetings with counterparts in the region (Indonesia, New Zealand, Vietnam) and other countries and bodies (e.g. USA, Spain, the Nordic states, the European Commission). A number of opportunities for strengthening existing cooperative arrangements and establishing new arrangements presented themselves. It also gave an opportunity to discuss ongoing cooperation with the IAEA itself, including preparations for the IRRS Mission to Australia in 2018. Travel was funded by ARPANSA.

Details of directions given by the Minister

No directions were given by the Minister under section 16 of the Act during this quarter.

Details of directions given by the CEO

No directions were given by the CEO under section 41 of the Act during this quarter.

Details of improvement notices given by inspectors

No improvement notices were given by inspectors under section 80A of the Act during this quarter.

Details of any breach of licence conditions by a licensee

ANSTO was found to be in breach of subsection 30(2) of the Act for the OPAL reactor by failing to comply with a licence condition required by Regulation 50(1). This licence condition requires the licence holder to review and update its plans and arrangements at least once every three years. The inspection identified that the facility security plan had not been updated to meet this requirement.

Breaches of licence conditions with minor safety or security implications were also identified:

- A licence holder was found to be breach of section 30(2) of the Act by failing to comply with Regulation 49 which requires the licence holder to ensure plans and arrangements are implemented to the extent reasonably practicable. The licence holder reported that it had not fully implemented its plans and arrangements by not calibrating its radiation monitors at the required frequency, and by not controlling the hazardous materials taken in the controlled area. However due to the operational status of the facility, it was concluded that this had no immediate safety implications.
- A licence holder was found to be in breach of subsection 30(2) of the Act by failing to comply with a licence condition that requires the licence holder to operate within maximum activity limits. The licence holder reported that it had exceeded the maximum activity limit; however the limit was exceeded by less than ten per cent and the safety implications were considered to be minimal.

Facilities licensed under Part 5 of the ARPANS Act

No facilities were issued with licences during the period.

The operations of the Council and Committees

Radiation Health and Safety Advisory Council

The Radiation Health and Safety Advisory Council (RHSAC) did not meet during this quarter. The next RHSAC meeting will be held in Brisbane on 17-18 November 2016.

Reports to the CEO from the Radiation Health and Safety Advisory Council under paragraph 20(f) of the Act

The RHSAC did not provide any out-of-session reports to the CEO during this quarter.

Radiation Health Committee

The Radiation Health Committee (RHC) did not meet during this quarter.

The next RHC meeting will be held in Brisbane on 16 November 2016.

Nuclear Safety Committee

The Nuclear Safety Committee (NSC) did not meet during this quarter. The next NSC meeting will be held in Sydney on 4 November 2016.

Reports to the CEO from the Nuclear Safety Committee under paragraph 26(1)(d) of the Act

The NSC did not provide any reports to the CEO during this quarter.