The regulatory role of the Australian Radiation Protection and Nuclear Safety Agency in relation to spent fuel arising from research reactors in Australia

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Abstract. This work describes the approach and role of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) in the regulatory management of spent fuel arising from research reactors in Australia, with particular emphasis on the regulatory oversight of the safe transport of spent fuel arising from the research reactors in Australia, in accordance with the International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Material.

1. Introduction

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) is responsible for the regulation of nuclear installations in Australia under the *Australian Radiation Protection and Nuclear Safety Agency Act 1998* (the Act) [1] and the Australian Radiation Protection and Nuclear Safety Regulations 1999 (the Regulations) [2]. Nuclear Installations covered by the Act include research reactors, radioisotope production facilities, waste management facilities and fuel management facilities. All of Australia's existing nuclear installations are under the control of the Australian Nuclear Science and Technology Organisation (ANSTO).

There are two shut down research reactors that have been principally responsible for Australia's volume of spent fuel. ANSTO operated 10 MW HIFAR for about fifty years. ANSTO also operated an Argonaut type 100 kW reactor (MOATA) for about 34 years with HEU fuel. In the case of the HIFAR reactor the spent fuel arising from operation included both HEU and LEU fuel assemblies. The volume of LEU was much smaller since LEU fuel was only used in HIFAR reactor from 2004 till the time of its final shutdown in early 2007. ANSTO's new 20 MW OPAL research reactor utilises LEU, hence, future volumes of LEU will be greater. The major function of the ANSTO fuel management facility is passive, that is the safe storage of new and spent fuel in engineered purpose-built facilities.

The spent fuel generated from the operation of the research reactors HIFAR and MOATA are stored at the Lucas Heights site (near Sydney) in both wet and dry storage facilities. In addition, the fuel management facility comprises High Activity Handling Cells, which can be used for inspection of spent fuel elements, a fuel assembly cropping facility, and Nuclear Materials Vault and Store used for storing fissile material. The fresh and spent fuel for OPAL remain under the control of OPAL reactor operations since the fresh store and services pool are inside the reactor containment building and up to nine years spent fuel arising can be stored in the services pool.

2. ARPANSA regulation of ANSTO fuel management

The fuel management facilities of ANSTO (known as Fuel Operations) were licensed under ARPANSA legislation taking into account the requirements set out in the Act [1] and in the Regulations [2]. In particular the CEO of ARPANSA must when making licence decisions take into account international best practice in radiation protection and nuclear safety.

Of particular importance in the licence assessment stage of a facility are the plans and arrangements for managing safety. These plans require the demonstration of appropriate arrangements for maintaining effective control, implementation of an appropriate quality system, safety management plan, radiation protection plan, radioactive waste management plan, security plan and emergency plan. The plans and arrangements for managing safety are assessed against Regulatory Guidelines. These guidelines are based on international best practice in radiation protection and nuclear safety, drawing from national and international publications and experience, especially from the International Atomic Energy Agency (IAEA).

In addition, the assessment of the Safety Analysis Report (SAR) of each facility is also an important component of ARPANSA's regulatory assessment. ARPANSA expects that the SAR will demonstrate the appropriate application of defence in depth principles and that the plant, its processes, controls, activities, and the management of future modifications are in accordance with ARPANSA's Regulatory Assessment Principles, and conform to good engineering practice and to appropriate standards and code of practice. These requirements are to ensure that the operations of the facilities are adequately safe during normal operations and accident conditions as they operate under defined limits and conditions.

It is a continuing condition of licence that ANSTO comply with the Code of Practice for Safe Transport of Radioactive Material [3].

Competent Authority functions of ARPANSA relating to ANSTO fuel management activities

Australian spent fuel is sent overseas for reprocessing and/or final storage depending on the country of origin of the fuel. ARPANSA, as the competent Authority for inland surface transport, applies *IAEA Safety Regulations for Safe Transport of Radioactive Materials 1996 Edition* (revised) in the form of ARPANSA Code of Practice for Safe Transport of Radioactive Materials 2001 (RPS 2). ARPANSA approves the shipment and design of a new cask, validate original certificate applying the requirements of the RPS 2.

As the Competent Authority, ARPANSA assesses and approves regulatory submissions from ANSTO for fuel shipments. ARPANSA assessment takes into account plans for shipment comprising safety management including radiation protection, criticality safety, operational controls, and quality assurance and security arrangements according to the requirements set down in the *IAEA Regulations for the Safe Transport of Radioactive Material* [3] and the technical guidance material set out in the *Advisory Material for the Regulations for the Safety Transport of Radioactive Material* [4].

As the Competent Authority, ARPANSA assesses and approves regulatory submissions from ANSTO for the designs of fuel casks. Casks are designed and approved by other nations are issued with validation certifications authorising their use within the Australian jurisdiction, under the provisions of the *IAEA Regulations for the Safe Transport of Radioactive Material* [3] relating to the multilateral approval of certificates issued by other Competent Authorities.

Apart from ARPANSA, the Australian Maritime Safety Authority (AMSA) is the competent authority for the transport of radioactive material by sea. ARPANSA approval for shipment of spent fuel is followed by the approval of AMSA. The Civil Aviation Safety Authority (CASA) is the competent authority for transport of radioactive material by air and is involved in approval of shipment of fresh fuel.

The casks approved and /or validated and used for the shipment of HIFAR and MOATA spent fuel are presented in Table 1 [5].

Table 1: Features of casks used for shipment of spent fuel

Cask	Capacity (no of fuel elements)	Type of Fuel
TN 7/2	60	HIFAR Mark IV
NAC-LWT	42	HIFAR Mark IV, Mark III and MOATA
TN-MTR	52	HIFAR Mark IV, Mark II (partly)
**LHR 120	120	HIFAR Mark II, Mark III, Mark IV

** Not in use since 2004

3. Regulatory Assessment of approvals requested under the ARPANSA Code of Practice for Safe Transport of Radioactive Material

In assessing approvals under the Code, ARPANSA principally considers the submissions in relation to cask design safety, operational safety and transport safety.

Criticality is one of the key aspects of this assessment. ARPANSA requires it to be demonstrated that the nuclear material will remain in a subcritical state during routine, normal and credible accident conditions of storage and transport. For shipment, individual packages and the arrays of packages are taken into account to ensure that a criticality excursion could not occur. This assessment is undertaken for both new and spent fuel assemblies and is reviewed by ARPANSA.

Radiation protection is another key aspect of the assessment and ARPANSA takes into account the proposed health physics coverage, monitoring of personnel and implementation of appropriate procedures during pre-shipment activities and during shipment.

The security arrangements and security preparedness are considered for each part of the shipment to ensure that security measures are adequate. ARPANSA's assessment of the proposed security plan takes into account the security of the design basis threat. This is a risk assessment derived from a National Threat Assessment and conducted by an appropriate Federal security agency. The shipment is escorted by security personnel using exclusive transport vehicles.

Security measures need to conform to the security requirements of the *IAEA Guidelines on the Physical Protection of Nuclear Material INFCIRC 225 Rev.4* [6]. Prior to any shipment security arrangements are assessed and approved by the Australian Safeguard and Non-proliferation Organisation (ASNO), who administer the *Nuclear Non-Proliferation (Safeguards) Act 1987* [7].

The transport plan must set out plans and arrangements for emergency preparedness including notification of local emergency agencies and communication with other government bodies. The emergency arrangements include the measures to be taken during breakdown or accident of the transport vehicle. Relevant procedures and the state emergency plan known as the "DISPLAN" are referred to for the management of emergencies.

4. Regulatory Compliance Monitoring

ARPANSA's key methods of regulatory oversight of the fuel management facilities and the shipment of spent fuels is by prior assessment of the safety case, compliance monitoring through regular

reporting (quarterly and annually), and planned and reactive inspections of the fuel management facilities.

Critical stages of the preparation and loading of the spent fuel for shipment are witnessed by ARPANSA Inspectors to ensure that the spent fuel is loaded in accordance with loading procedures, and in accordance with the requirements of the *IAEA Regulations for the Safe Transport of Radioactive Material* [3]. Reports of observations made during the loading are reported in ARPANSA inspection reports.

Prior to shipment ARPANSA conducts a gamma radiation survey of the designate shipment routes. A survey is also performed post shipment to check for any increased level of radiation due to the shipment of spent fuel. To date the ARPANSA post shipment survey has not detected any presence of radioactivity in the shipment route of ANSTO spent fuel shipments.

5. Conclusion

A total of 2142 spent fuel elements have been safely transported to overseas in eight shipments since the commencement of the operation of the HIFAR and MOATA. ARPANSA regulatory approach to assure safety in operational controls, approval of design of packages and shipment and compliance monitoring is consistent with the international best practice and has been found effective in achieving the object of the Act, that is, to protect people and to protect the environment from the harmful effect of radiation.

REFERENCES

[1] Australian Radiation Protection and Nuclear Safety Act 1998.

[2] Australian Radiation Protection and Nuclear Safety Regulations 1999.

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Regulations for Safe Transport of Radioactive Materials 1996 Edition (revised), IAEA Vienna (2000). AUSTRALIAN RADIATION PROTECTION AND NUCLEAR SAFETY AGENCY, Code of Practice for the Safe Transport of Radioactive Material, RPS 2, (2001).

[4] INTERNATIONAL ATOMIC ENERGY AGENCY, Advisory Material for the Regulations for the Safety Transport of Radioactive Material, Safety Guide TS-G-1.1, IAEA Vienna (2002).

[5] ANSERSON, M., Australian Nuclear Science and Technology Organisation, Private Communication, 2007.

[6] INTERNATIONAL ATOMIC ENERGY AGENCY, Guidelines on the Physical Protection of Nuclear Material, INFCIRC/225/Rev.4 (Corrected), IAEA Vienna (2002).

[7] Nuclear Non-Proliferation (Safeguards) Act 1987.