The Government of the Republic of Indonesia

THE 6th NATIONAL REPORT ON COMPLIANCE TO THE JOINT CONVENTION ON THE SAFETY OF SPENT FUEL MANAGEMENT AND ON THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT

August 2024

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Sumatra
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Foreword

The Government of the Republic of Indonesia, as a contracting party to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Joint Convention) which entered into force on June 18, 2021, and deposited the ratification of on April 1, 2011, submitted the Sixth National Report which addressed the measures taken to implement each of the obligations of the Convention, pursuant to Article 32 of the Joint Convention.

The Joint Convention establishes an international peer review process among Contracting Parties and provides supports to States in taking appropriate steps to bring their spent fuel and radioactive waste management activities into compliance with international safety standards and practices. Indonesia's Sixth National Report demonstrates continued commitment of Indonesian Government to meet its obligations under the articles of the Joint Convention during the reporting period, from April 1, 2020, to March 31, 2024. This report was drafted by the Nuclear Energy Regulatory Agency of Indonesia (BAPETEN) and reviewed by representatives from government agencies. It focuses specifically on the progress of spent fuel and radioactive waste management policy and practices in Indonesia, updates to the Indonesia's Fifth National Report, as well as comments and feedback raised at the Seventh Review Meeting took place in May 2021.

BAPETEN acknowledges the collaboration of the National Research and Innovation Agency of Indonesia (BRIN) in preparation of this report through several working groups and meetings.

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List of Abbreviations

ASEAN	Association of Southeast Asian Nations
BAPETEN	Nuclear Energy Regulatory Agency
BATAN	National Nuclear Energy Agency
BNPB	National Disaster Management Agency
BRIN	National Research and Innovation Agency
CTBT	Comprehensive Nuclear Test Ban Treaty
DNFM	Directorate for Nuclear Facility Management
DSRS	Disused Radioactive Sealed Sources
EFEI	Experimental Fuel Element Installation
I-CoNSEP	Indonesia Center of Excellent on Nuclear Security and Emergency Preparedness
IRRS	Integrated Regulatory Review Service
ISEW	Interim Storage for Embedded Waste
ISHARW	Interim Storage for High Activity Radioactive Waste
ISSF	Interim Storage for Spent Fuel
LDMA	Local Disaster Management Agency
MORC	Material Out of Regulatory Control
MPR	Multi-Purpose Reactor
NCA-A	National Coordinating Authority Abroad
NCA-D	National Coordinating Authority Domestic
NDMA	National Disaster Management Agency
NFTI	Nuclear Fuel Technology Installation
NNWS	Non-Nuclear-Weapon States
NPP	Nuclear Power Plant
NPT	Treaty on the Non-proliferation of Nuclear Weapons
NWP	National Warning Point
OTDNN	National Response Organization for Nuclear Accident
RCNMRWT	Research Center for Nuclear Material and Radioactive Waste Technology
RMI	Radio Metallurgy Installation.
RRTI	Radioisotope and Radiopharmeutical Technology Installation
RWI	Radioactive Waste Installation
RWMI	Radioactive Waste Management Installation
SEANWFZ	Southeast Asian Nuclear-Weapons-Free-Zone
SKNN	National Nuclear Emergency Preparedness System

A. Introduction

This report is the sixth National Report of the Republic of Indonesia that presents the latest development in the management of radioactive waste and spent fuel. As reported in the previous national report and review meeting, Indonesia has ratified "the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management," through the Presidential Regulation No. 84 Year 2010. The regulation demonstrates Indonesia's commitment to fulfil its international obligation on the safety aspects of nuclear energy's peaceful uses. This report also considers the recommendations of the IAEA Integrated Regulatory Review Service (IRRS) Mission and the results of the 7th review meeting.

As stipulated in Act No. 10 of 1997 on Nuclear Energy, the Indonesian Government established the Promoting Body and the Regulatory Body which are directly responsible to the President. The Promoting Body is assigned to carry out the utilization of nuclear energy, while the Regulatory Body is assigned to carry out independent supervision of all activities utilizing nuclear energy. Government Regulation No. 61 Year 2013 on Radioactive Waste Management emphasizes that the Promoting Body is BATAN and the Regulatory Body is BAPETEN. Through Presidential Regulation No. 78 Year 2021 on the National Research and Innovation Agency, BATAN together with other government institutions then merged into BRIN, so that the authority of the Promoting Body was also transferred to BRIN.

BAPETEN, as the regulatory body, develops and continuously evaluates national regulations on spent fuel and radioactive waste management referring to the IAEA requirements and guidelines. Act No. 10 Year 1997 classifies radioactive waste as low, intermediate, and high level of radioactive waste. Furthermore, Government Regulation No. 61 Year 2013 states that high-level radioactive waste is spent fuel. Act No. 10 Year 1997 on Nuclear Energy and Government Regulation No. 61 Year 2013 are currently under amendment or revision. One of the objectives of the amendment is to redefine the classification of radioactive waste by excluding spent fuel from the high-level waste category. The amendment of the Act supports the Act No. 6 Year 2023 on stipulation of Government Regulation in Lieu of Law Number 2 of 2022 concerning Job Creation, which aims to facilitate the public, especially business sector, in obtaining business permits in the nuclear energy sector. Moreover, as an implementation of Government Regulation No. 61 of 2013, BAPETEN developed BAPETEN Chairman

Regulation No. 16 Year 2012 on Clearance Level, and BAPETEN Chairman Regulation No. 8 Year 2016 on Radioactive Waste Management for Low Level and Intermediate Level Waste.

At present, BAPETEN initiates the development of National Policy and Strategy on the Spent Fuel Management and the Radioactive Waste Management to introduce the issues of radioactive waste reduction and national arrangement for the management of spent fuel and the management of the radioactive waste. This national policy and strategy will consider the budgeting, information system, public involvement, radioactive waste generator involvement, human resources issues, and research and development programs. BAPETEN continuously improves and develops its specific regulations and guidance to comply with the Convention obligation. BAPETEN also performs inspections to licensees to verify their compliance with nuclear regulations.

Nuclear facilities previously managed by BATAN are currently managed by DNFM, Deputy for Research and Innovation Infrastructure - BRIN, DNFM is operating several nuclear installations which are three research reactors, radioisotope production, neutron diffraction, experimental fuel, and radio metallurgy facilities. Research reactors are in Serpong, Bandung, and Yogyakarta, with power ranges between 100 kWt – 30 MWt, including RWMI consisting of radioactive waste treatment installation, transfer channel and interim storage for spent fuel, two interim storage buildings for radioactive waste, and supporting facilities. In the management of spent fuel, Indonesia applies two options for the spent fuels to be repatriated or to be stored in the interim storage during the reactors' lifetime. At the end of the reactor's operation, all spent fuels are stored in interim storage before delivered to the final disposal. The determination of the disposal site for Spent Nuclear Fuel is decided by the Central Government after obtaining approval from the House of Representatives of the Republic of Indonesia.

Indonesia utilizes radioactive sources and radiation generators for wide varieties of peaceful purposes in industry, medicine, research, and education. To some extent, the use of radioactive sources for those purposes may generate radioactive waste and DSRS. Indonesian government policy regulates radioactive waste and DSRS to be repatriated to the origin countries whenever applicable. In the case that repatriation is not applicable, radioactive waste and DSRS will be transferred to and managed by RWMI, DNFM-BRIN.

Currently, Indonesia does not have Nuclear Power Plants. However, in its national long-term development plan and national electricity plan, Indonesia is planning to introduce nuclear energy in the energy mix for electricity generation. Several coordination meetings have been held recently between the government institutions and concluded that large, medium, and small NPPs are required in Indonesia in the next ten years. The government has carried out policy

study on potential sites for NPP development based on electricity demand forecast and long-term national development plan.

The Government of Indonesia has a strong commitment to continuously developing its regulatory system, i.e. regulation, inspection, and licensing system. The regulatory system is required to implement the obligations under the Convention. Furthermore, the improvement and development of final disposal facilities and/or long-term storage of spent fuel and radioactive waste shall comply with the Convention to maintain their sustainable performance.

In terms of public participation, the government of Indonesia also takes this matter into account by involving the public in the regulation drafting process. The arrangement of public participation is regulated in BAPETEN Regulation Number 3 Year 2023 on the Procedures for drafting the Regulations and Legal Instruments within the Nuclear Energy Regulatory Agency.

The overview matrix of radioactive waste management is shown in Table A.1. below.

Table A.1. Overview Matrix

Type of Liability	Long Term Management Policy	Funding of Liabilities	Current Practice / Facilities	Planned Facilities
Spent Fuel	• Repatriated to the country of origin. • Stored in each reactor at least during the reactor's operational period. • Dispose in deep geological repository.	Basic infrastructures funded by the government; levies are imposed to the producers.	• Repatriated to the country of origin. • On-site storage – wet (in pools), some of them already stored and managed by DNFM-BRIN in ISSF.	Ongoing study of possible site for final disposal.
Nuclear Fuel Cycle Waste	• Stored on site. • Transferred to and managed by DNFM-BRIN. • Final disposal.	Basic infrastructures funded by the government; levies are imposed to the producers.	Treatment and conditioning in DNFM-BRIN.	Ongoing study of possible site for final disposal.
Application Wastes*	• Transferred to and managed by DNFM-BRIN. • Final disposal.	• Basic infrastructures funded by the government; levies are imposed on the producers. • Funded by the government, for orphan sources.	Conditioning in DNFM-BRIN.	Ongoing study of possible site for final disposal.
Decommissioning Liabilities	Licensees are responsible for immediate dismantling and wastes transfer to DNFM-BRIN.	Licensee	Decommissioning of a facility of uranium extraction as a by-product of phosphate acid production (2009).	N/A
Disused Radioactive Sealed Sources	• Repatriated to the country of origin; or • Transferred to and managed by DNFM-BRIN. • Transferring to other licensees is possible.	Licensee	Registered and securely stored by DNFM-BRIN.	N/A

*Limited to contaminated material

B. Policies and Practices

B.1 Article 32 (Reporting), paragraph 1

B.1.1 Spent Fuel Management Policy

The management of spent fuel aims to safely and securely manage Indonesia's past, current, and future spent fuel through appropriate handling, containment, storage, and final disposal. Doing so will reduce, to as low as practicable and justifiable, the associated health, safety, environmental, financial, and safeguards risks to current and future generations.

As mandated by The Act No. 10 Year 1997 on Nuclear Energy, the objective of spent fuel management in Indonesia is to protect workers, the public, and the environment from radiation hazards in the present and the future without imposing undue burdens on Indonesia's future generations. In handling radioactive waste, Indonesia adopts the principle of protection without imposing undue burdens on Indonesia's future generations and the principle in Safety Fundamental.

The current policy, legislative, and regulatory frameworks for the safe management of spent fuel include licensing activities. The spent fuel management methods shall conform to the highest appropriate standards as determined by BAPETEN. All the spent fuel management activities will be implemented based on the available science and technology options and conducted in an open and transparent manner to achieve these aims.

As an implementation of Article 23 of the Act No. 10 Year 1997 on Nuclear Energy, the Indonesian Government's approach towards long-term management of spent fuel and radioactive waste includes establishing an ISSF managed by RWMI, DNFM-BRIN. This facility will store all spent fuel, national product as well as imported product, for a period sufficient for the Indonesian Government to establish a final disposal facility, consistent with international obligations and best practices. The Indonesian Government has also implemented policy, legislation, and regulations aimed at ensuring the spent fuel is safely managed before transported to national storage or to the country of origin.

B.1.2 Spent Fuel Management Practices

Spent fuel from the research reactors was stored in the facilities before repatriated to the country of origin. Transfer of spent fuel was conducted under the transport and safeguards regulations that comply with international practices and standards.

BRIN operates three research reactors in Serpong, Bandung, and Yogyakarta. Spent fuels from Serpong's research reactor are temporarily stored in the reactor's wet interim storage before being sent to the ISSF as a part of the DNFM-BRIN facility. Spent fuel from Bandung and Yogyakarta is temporarily stored in wet interim storage inside the respective reactors.

Table B.1. Research Reactor Data in Indonesia

Place/Site	Maker	Type	Power	First Criticality	Status
Bandung	GA	Triga	2000 kWt	1964	In operation
Yogyakarta	GA	Triga	100 kWt	1979	In operation
Serpong	Interatom	MTR	30 MWt	1987	In operation

Storage of spent fuel shall be performed according to radiation safety, physical protection, and safeguards regulations. BAPETEN controls the safety, security, and safeguards aspects of the storage facilities of spent fuels periodically.

B.1.3 Radioactive Waste Management Policy

The Act No. 10 Year 1997 on Nuclear Energy regulates the utilization of nuclear energy only for peaceful uses to achieve public prosperity. The uses of nuclear energy shall consider the safety, security, peace, and health of the workers, the public, and protection of the environment.

As required by Article 23 of the Act No. 10 Year 1997 on Nuclear Energy, the management of radioactive waste in Indonesia solely be performed by BRIN. However, BRIN may cooperate with or appoint other parties, such as state-owned companies and/or private companies, in managing such radioactive waste.

Similar to the spent fuel management policy, the policy of radioactive waste management is to repatriate DSRS to the country of origin whenever applicable or stored them in DNFM-BRIN located in B.J. Habibie Science and Technology Area, Serpong. This policy complies with Government Regulation No. 61 Year 2013 on Radioactive Waste Management. This government regulation also allows DNFM-BRIN to practice reuse and recycle of DSRS to promote circular economy approach in radioactive waste management. This regulation requires facilities to implement a waste management process by sorting and segregation before transporting the waste to DNFM-BRIN. For waste generated by nuclear medicine facilities, the regulation requires the facility to apply delay and decay before implementation of clearance.

The objective of radioactive waste management in Indonesia is to protect workers, the public, and the environment from potential radiation risks at present time and in the future,

without imposing undue burdens on Indonesia's future generations. To achieve this, Indonesia adopts the principle of protection without imposing undue burdens on future generations and the principle of Safety Fundamental.

The principle of not burdening the future generation is implemented in several policies, one of them is related to the radioactive waste management of material out of regulatory control, for example in bankrupt licensees. The Government Regulation No. 45 Year 2023 on the Safety of Ionizing Radiation and Security of Radioactive Materials states that in the case that the owner of an Ionizing Radiation Source is declared bankrupt based on a court decision, the Regulatory Body shall coordinate with the curator as the responsible entity. The appointed curator or other competent entity to carry out safety and security measures against the contaminated area and the cost of these measures including the disposal. The cost of the measures taken would be borne by the Regulatory Body in case the owner of radioactive materials cannot be identified.

B.1.4 Radioactive Waste Management Practices

The radiation facilities or nuclear installations are required to minimize generated radioactive waste, including discharged liquid and gas effluent to the environment. Sorting and segregation shall be applied in the management of short-lived radioactive waste, for instance at nuclear medicine facilities, prior to clearance. Facilities which generate DSRS shall safely and securely store the DSRS prior to shipment to the DNFM-BRIN or return to the country of origin or manufacturers.

DNFM-BRIN, which is responsible for managing radioactive waste, shall consider the safety and health of workers and the public and the protection of the environment from radiation hazards during radioactive waste handling, treatment, and disposal. Furthermore, research and development in radioactive waste management shall be carried out to support the safety aspects of present and future nuclear energy programs.

BRIN has implemented the Radioactive Waste Management Program with the following objectives:

1. To assure that no radiation workers receiving excessive radiation doses from radioactive wastes, and
2. To take the lead in practical and safe technologies for radioactive waste management.

BRIN operates eight nuclear installations in Indonesia consisting of three research reactors, and five non-reactor nuclear installations. BRIN also operates radiation facilities which are radioisotope and radiopharmaceutical production facility, radioactive waste

treatment installation, and gamma irradiator to support research medical and industrial purposes.

The first nuclear installation operated in Indonesia was the 250 kWt TRIGA MARK II research reactor at Bandung Nuclear Area in 1965. It was upgraded to 1000 kWt in 1971 and upgraded again to 2000 kWt in 2000, it became known as TRIGA 2000. TRIGA 2000 is a pool-type reactor using H_2O, both as the moderator and coolant. The fuel is U-ZrH with 19.75% enrichment, and the reflector is graphite.

In 1979, Kartini Reactor at Ahmad Baiquni Science and Education Area, Yogyakarta, was commissioned. Kartini Reactor is also a pool (TRIGA MARK II) type reactor with 100 kWt power, and the enrichment of U-ZrH fuel is 19.75%. It utilizes graphite as a reflector and uses H_2O both as the moderator and coolant.

The above two facilities generate short-lived radionuclide and low-level liquid radioactive waste. The treatment of liquid radioactive wastes in those facilities includes collecting in the hold-up tank for delays and decays, and reducing activity into insignificant concentration, then dispersing and discharging to the environment. The solid and organic liquid waste, collected in the containers, are kept and stored in storage facilities. To protect the environment, BAPETEN has established standards of quality for environmental radioactivity and the discharge limit for radioactive release to the environment as stipulated in BAPETEN Chairman Regulation No. 7 Year 2017 on Radioactivity Limit in the Environment.

In B.J. Habibie Science and Technology Area, Serpong, BRIN operates 30 MWt research reactors, and several installations for radioisotope production, neutron diffraction, experimental fuel, and radio metallurgy as well as radioactive waste management. To manage low and intermediate-level waste generated by these facilities, BRIN integrates the waste management in RWMI, DNFM-BRIN.

The RWMI consists of the processing unit facilities of Evaporation System, Compaction System, Incinerator System, Cementation System, Interim Storage for Embedded Waste, and Interim Storage for High Activity Radioactive Waste (ISHARW).

ISHARW commissioning was started in 1997. The facility has 20 dry wells (each well has the capacity of 6 drums of 0.060 m^3) and 3 dry ponds (with 2m x 6m x 6m dimensions). The waste from radioisotope production and nuclear fuel examination is filled into the standard drums of 0.060 m^3 and then stored in dry wells. When their radioactivity has decayed, they are processed in the treatment facility as a low and intermediate waste.

The RWMI manages radioactive wastes generated by radiation facilities for research, medical and industrial applications as follows: DSRS, liquid waste, and solid waste.

Radioactive wastes resulting from BRIN originated from internal nuclear facilities. The RWMI also operates ISSF which was built in 1993 and started cold commissioning in 1998. Previously, ISSF was operated by the Research Reactor Center, but in 2006, the facility was transferred to RWMI.

The radioactive waste inventory data and historical records are managed using a management information system, to accurately and immediately identify radioactive waste that is being transported or stored.

B.1.5 Criteria to Define Categories of Radioactive Waste

In Indonesia, radioactive wastes are generated mainly from research reactor operations, radioisotope productions, nuclear fuel fabrications, medical applications, industrial applications, and research institutions activities. Radioactive waste is classified as low-level radioactive waste, intermediate-level radioactive waste, and high-level radioactive waste. The low-level radioactive wastes are subclassified into (1) very short half-life, (2) very low level, and (3) relatively low level. The intermediate-level radioactive waste consists of DSRS with (1) a half-life less than 15 years, (2) a half-life between 15 and 30 years, (3) a half-life for more than 30 years, and (4) other than DSRS. The high-level radioactive waste is nuclear spent fuel.

For the reactor facility, liquid waste is grouped into low active waste with the activity of 37 kBq/m^3 to 0.37 GBq/m^3, and intermediate active waste with the activity of 0.37 GBq/m^3 to 3700 GBq/m^3. A low level of liquid waste originated from the systems and components of pool drainage, shower and rinsed water, and ventilation systems. The intermediate level of radioactive liquid waste originated from resin flashing, power ramp test, and isotope box decontamination. The spent resin resulting from the water purification system with the maximum activity of 3.7 GBq/m^3 is treated as semi-liquid waste. Solid waste such as used reactor components, filters, papers, contaminated linens are categorized as compactable solid wastes with a maximum exposure rate of 25 mR/h (250 μSv/h), and burnable solid wastes with the maximum activity of 0.0037 GBq/m^3 for alpha emitter and 0.037 GBq/m^3 for beta-gamma emitter.

For radioisotope facilities, low-level liquid radioactive waste originates from the shower and rinsed water, decontamination activities, or others with a maximum of 0.37 GBq/m^3. Intermediate-level waste with high activity resulted from the processing of the irradiation target in the hot cell. And for nuclear fabrication facilities, radioactive liquids are mostly contaminated with chemical waste containing very low uranium contents. The solid waste from Serpong-Site, such as contaminated linens, papers, filters, shoe-cover, and gloves with the maximum exposure rate of 25 mR/h (250 μSv/h) is collected in plastic bags and put into 100L-sized drums, and then brought to the RWMI.

C. Scope of Application

C.1 Article 3 (Scope of Application)

Based on its national policy, Indonesia prioritizes repatriation of the spent fuels to the origin countries or storing them within the authorized facility. Regarding the processing of nuclear-spent fuel activities, Indonesia does not possess a nuclear weapon program, thus Indonesia does not conduct any activity related to spent fuel processing. In 1970, Indonesia signed the Treaty on the Non-proliferation of Nuclear Weapons as a Non-Nuclear-Weapon State (NNWS) and ratified it in 1978 through Act No. 8 Year 1978. Indonesia is a prominent member of the Association of Southeast Asian Nations (ASEAN), supported the formation of Southeast Asian Nuclear-Weapons-Free-Zone (SEANWFZ), and became the party of the Bangkok Treaty, which entered into force in 1997. Indonesia signed the Comprehensive Nuclear Test Ban Treaty (CTBT) in 1996 and ratified it in February 2012. In addition, Indonesia agreed to a Comprehensive Safeguards Agreement for its nuclear facilities, marking the beginning of Indonesia's role as a proponent of the peaceful uses of nuclear technology. Indonesia acceded to the Additional Protocol in 1999, becoming the first state in Southeast Asia to be bound by this more rigorous verification mechanism. Indonesia began implementation of the IAEA Integrated Safeguards, including the Additional Protocol, in 2003. Indonesia continues to advocate strongly for protecting the rights of NNWS to peaceful uses of nuclear technology. Indonesia has been critical of those non-universal non-proliferation mechanisms that potentially limit the access NNWS to technologies for the peaceful uses of nuclear energy. Concerning non-peaceful uses, Indonesia does not produce any spent fuel or radioactive waste from military applications, in accordance with NPT provisions.

D. Inventories And Lists

D.1 Article 32 (Reporting), paragraph 2

The Government Regulation No. 61 Year 2013 articles 19 and 20 requires the waste generator and DNFM-BRIN to conduct an inventory of DSRS at each stage of its waste management. Articles 30 and 31 are applied to disused unsealed sources to conduct inventory and reporting. And in articles 41 and 42, waste generators are obliged to record the spent fuel inventory and the activity of spent fuel transport and storage. The inventory and their management activities shall be reported to BAPETEN at least once in six months.

D.1.1 List of Spent Fuel Management Facilities and Spent Fuel Inventory

Indonesia has only one interim storage facility for spent fuel (ISSF) at the Serpong site to serve the Serpong's research reactor, which is part of DNFM-BRIN. However, there is a pool/pond as the interim storage for spent fuel in the Serpong, Bandung's, and Yogyakarta's reactor sites.

There are 457 items of spent fuels in Indonesia, consisting of 413 items in ISSF, 30 items in the storage pool of the Serpong's research reactor, and 14 items in the storage pool of the Bandung's research reactor. (See Tabel L.2 annex A)

D.1.2 List of Radioactive Waste Management Facilities and Radioactive Waste Inventory

DNFM-BRIN is the only authorized institution to manage radioactive waste in the form of liquid, spent resin, combustible waste, high active waste, and sealed sources. DNFM-BRIN operates RWMI which is equipped with an evaporator, compactor, incinerator, ion exchanger, conditioning facilities, and interim storage. (See Annex C - Figure L.2-L.7)

DNFM-BRIN is also responsible for managing nuclear spent fuel, a container containing scrap-fuel elements from post-irradiation examination, and 2 (two) closed containers containing foil targets from radioisotope production research.

Radionuclide's total activity of the waste stored in RWMI is shown in Section L-Annexes A (Table L.1).

D.1.3 List of Nuclear Facilities in the Process of Being Decommissioned and the Status of Decommissioning Activities

At present, there is no facility to decommission. However, BRIN, since January 2024, has conducted characterization research entitled “Bandung TRIGA 2000 Research Reactor Activity Inventories for Decommissioning Planning”, in the scheme of the IAEA Coordinated Research Project “T24009”. BRIN also conducts assessment studies for 3 research reactors operation and future planning, supported by IAEA expert missions.

E. Legislative and Regulatory System

E.1 Article 18 (Implementing Measures)

Indonesia has ratified and implemented the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management by Presidential Regulation No. 84 Year 2010, enacted on 28 December 2010.

The Nuclear Energy Act contains provisions for nuclear installation licensing that include facilities for managing spent fuel and radioactive waste. The Government also has enacted several regulations derived from the Nuclear Energy Act. Furthermore, BAPETEN has performed regulatory processes to ensure compliance with the Convention.

E.2 Article 19 (Legislative and Regulatory Framework)

The primary legislation governing spent fuel and radioactive waste is Act No. 10 Year 1997 on Nuclear Energy. In 2013 the government issued Government Regulation No. 61 Year 2013 on Radioactive Waste Management. This provision provides waste classification and responsibilities of relevant parties in radioactive waste management.

Chapter VI (Article 22 – 27) of the Act No. 10 Year 1997 on Nuclear Energy regulates radioactive waste provisions and requirements. As stated in Article 22 clause (1), radioactive waste management's main objective is to protect workers, the public, and the environment from radiation hazards. BRIN implements radioactive waste management and may cooperate with or assigned state-owned companies and/or private entities (Article 23).

Government Regulation No. 61 Year 2013 classifies radioactive waste into high level, intermediate level, and low-level radioactive waste. Spent fuel is categorized as high-level radioactive waste. Intermediate and low-level radioactive wastes are divided into three categories (1) disused sealed radioactive sources, (2) disused unsealed radioactive sources, and (3) contaminated/activated materials or contaminated equipment. Detailed provision on the management of intermediate and low-level radioactive waste is regulated by BAPETEN Chairman Regulation No. 8 Year 2016 on Radioactive Waste Management for Low Level and Intermediate Level waste. A licensee producing low and intermediate level waste shall collect, classify, or process, and temporarily store them before sending the waste to BRIN (Article 24 (1)). Types of process for sealed radioactive source waste includes delay and decay and conditioning, while the types of process for unsealed radioactive source waste includes delay and decay, reduction, decomposition, and conditioning. A Licensee producing high-level

radioactive wastes shall store them temporarily in a reactor storage pool for at least in a period of life operating reactor (Article 24 (2)).

BAPETEN has issued BAPETEN Chairman Regulation No. 16 Year 2012 on Clearance Level. According to this regulation, licensees are allowed to release their radioactive waste after getting clearance approval from BAPETEN. The clearance can be applied for contaminated materials, radioactive waste, and unsealed sources. The licensees are allowed to propose a higher clearance level compared to the level determined by BAPETEN in the regulation, under the condition that effective dose received by public members less than 100 μSv/year. RWMI, as a licensee, has implemented clearance on the surface contaminated material reaching the clearance level.

In relation to the disposal of high-level waste, BRIN is required to provide sites for final disposal. The Government determines the selected sites for final disposal with the Parliament approval (Article 25). Storage of radioactive waste in RWMI, DNFM-BRIN is subject to a fee (Article 26). The waste management fee shall be established in government regulation. Transportation and storage activities shall consider the safety of workers, the public, and the environment (Article 27 (1)).

Government Regulation No. 61 Year 2013 provides two options regarding radioactive waste management, which are to repatriate the waste to the country of origin or to transfer the waste to BRIN . However, the Government established a policy that every person or legal entity with the intention to utilize nuclear energy to declare to BAPETEN the commitment to repatriate their wastes to the origin country. Government Regulation No. 61 Year 2013 requires that the evidence of repatriation documents shall be submitted to BAPETEN no later than 14 days after the date of repatriation.

Radioactive wastes from other countries are prohibited from entering the jurisdiction of the Republic of Indonesia (Government Regulation No. 61 Year 2013, Article 46 (1)), unless they were generated from radioactive sources which are produced in Indonesia (Article 46 (2)). For spent fuels, the reactor's operator shall temporarily store the spent fuel on the site during the reactor's operational period (Article 32), and repatriate it to the origin country or transfer it to BRIN (Article 33). There is a possibility to reuse or recycle DSRS after BRIN has performed the safety assessment (Article 12 and 13).

The Government Regulation No. 45 Year 2023 on the Safety of Ionizing Radiation and Security of Radioactive Materials, Article 51, states that the Licensee is obliged to implement radioactive waste management by ensuring that the activity and volume of waste generated are

as low and as minimum as achievable; and conduct sorting and segregation of radioactive waste. The licensee is obliged to fulfil the radioactive waste management requirements.

As stated in the government regulations, law enforcement for any violation of the regulatory requirements could be performed through administrative sanctions, such as written notices, license suspension, and license revocation. While according to article 41 – 44 of Act No. 10 Year 1997, unauthorized utilizations are subject to sanctions.

The legislation and regulations related to radioactive waste and spent fuel management are listed in Table L-4.

E.3 Article 20 (Regulatory Body)

BAPETEN is the only regulatory body responsible for controlling or regulating nuclear energy utilization. BAPETEN is directly responsible to the President of the Republic of Indonesia. The regulatory processes performed by BAPETEN include developing regulations, issuing licenses, and conducting inspections, including unannounced inspections.

BAPETEN has the technical support unit as the center of regulatory assessment to formulate technical policies related to monitoring spent fuel and radioactive waste, including technical issue guidelines and developing codes.

BAPETEN is responsible for ensuring the safety of the workers, the public, and the environment from any harmful radiation effect. As such, BAPETEN needs a sufficient number of competent personnels to perform regulatory duties. To address the need, BAPETEN established an Education and Training Center which conducts competency development activities for BAPETEN's personnels. BAPETEN also develops cooperation with the IAEA to strengthen the personnel competency development, and bilateral cooperation with other countries, among others Japan, South Korea, Australia, Canada, Russia, Slovak, Germany and the USA.

In 2019, BAPETEN, as a regulatory body, hosted a follow-up IRRS mission and ORPAS mission. BAPETEN is also initiating the drafting of the new Act on nuclear energy, as is usually done by BAPETEN in the process of drafting the regulations. BAPETEN involves public participation by holding public consultation events. To fulfil transparency and openness, BAPETEN uploaded draft regulation on the official website of BAPETEN to gain feedback for the draft.

Financial resources of BAPETEN were from the state's budget under the annual budget plans which are approved by the National Planning Agency, Ministry of Finance, and the Parliament. In the licensing processes, licensing fees are imposed on the licensee, where the fees are assigned to the government account as a non-taxes state's revenue.

F. Other General Safety Provision

F.1 Article 21 (Responsibility of the License Holder)

The generator of low-level and medium-level radioactive wastes shall manage radioactive waste to not pose hazards to workers, the public, and the environment and enable further management by the Promoting Body. The management of radioactive waste from the generator includes temporary storage. The purpose of temporary storage is to reduce the radiation level of short-lived radioactive materials before transferring them to BRINs. Particularly for high-level radioactive waste, the generator shall temporarily store those wastes (spent fuels) for at least the period of the nuclear reactor's lifetime.

BRIN shall administer radioactive waste management based on the safety concern and technical capability possessed by BRIN and for the ease in implementation of control. The management is administered in a non-commercial manner. For commercial activities of radioactive waste management, BRIN may designate a state-owned company, cooperatives, and/or any private company in accordance with the existing regulations.

The determination of a final disposal site for high-level radioactive wastes shall be discussed with the Parliament of the Republic of Indonesia to obtain approval. Radioactive wastes from other countries shall not be allowed to be disposed of in Indonesia's territory.

As stipulated in the Government Regulation No. 45 Year 2023 on the Safety of Ionizing Radiation and Security of Radioactive Materials, BAPETEN will take security measures against orphan sources and conduct a search for information. In case the owner of the source is not found, BAPETEN will declare the orphan as radioactive waste. Meanwhile, radioactive waste generated by the licensees, the provision in radioactive waste management shall refer to the Government Regulation No. 61 Year 2013. Hence, based on the ownership, radioactive waste can be categorized into (1) radioactive waste generated by the licensees; and (2) radioactive waste generated from an orphan source.

As stipulated by the Government Regulation No. 61 Year 2013, BRIN is responsible for:

a. carrying out the management of radioactive waste (Article 5),
b. providing technical assistance to waste generator and educational assistance to the public (Article 43),
c. providing storage and disposal facilities (Article 16, Article 27, Article 38, Article 40); and
d. developing procedures and technical guidance on radioactive waste management (Article 12).

Whereas the waste generator according to the regulation shall:

a. minimize the volume and activity of radioactive waste as low as possible,
b. collect, sort, segregate, and store the wastes temporarily prior to being transferred to BRIN (Article 7),
c. develop and maintain an inventory of radioactive wastes (Article 19 clause (1)), and
d. submit inventory of radioactive waste to BAPETEN at least once in six months (Article 19 clause (2)).

Regarding the spent fuel, the licensee shall develop and maintain an inventory of spent fuel, accountability and control system of nuclear material, and physical protection system. The inventory shall be reported to BAPETEN at least once in six months.

Standard Operating Procedures in licensing of radioactive waste have been developed. The SOPs provide guidelines for the licensee to declare a commitment to return the radioactive source to the country of origin once it becomes radioactive waste. The return can be conducted through the importer or independently by the licensee.

As mentioned in Section A, it is a policy of the Regulatory Body that in the licensing process of importation of the radioactive source, the applicant/licensee/importer/distributor shall submit a document, namely "Letter of Agreement from Suppliers for Returning of Radioactive". For example, in industrial radiography, at the time radioactive sources shall be replaced with new ones, BAPETEN requires the licensee to provide a commitment letter to deliver the radioactive waste to the importer or distributor of the source.

F.2 Article 22 (Human and Financial Resources)

Article 115 Government Regulation No. 45 Year 2023 requires the licensee to have qualified and competent personnel in relevant practices. Information regarding personnel's education and training records shall be submitted in a license application. Furthermore, the sufficiency of the required personnel is verified through inspections. The licensing unit's verification process in BAPETEN is stipulated in the Management System of BAPETEN (BAPETEN Chairman Regulation No. 14 Year 2014). A more detailed evaluation of licensing processes regulated in the Government Regulation No. 5 Year 2021. Re-evaluation is conducted during the license renewal and/or when BAPETEN requested (Periodic Safety Review).

The Indonesian Government guarantees adequate financial resources for necessary infrastructures and equipment of the RWMI-DNFM facility in BRIN, as well as for its decommissioning. Waste generators shall provide sufficient funding for paying their waste are

transferred to and managed by RWMI, DNFM-BRIN according to the Ministry of Finance Regulation No. 129 Year 2022 on Tariff for BRIN Services.

F.3 Article 23 (Quality Assurance)

Management system is stipulated in The Government Regulation No. 58 Year 2015 on the Safety and Security of Transport of Radioactive Materials, the Government Regulation No. 61 Year 2013 on the Radioactive Waste Management, the Government Regulation No. 45 Year 2023 on the Safety of Ionizing Radiation and Security of Radioactive Materials, and BAPETEN Chairman Regulation No. 6 Year 2023 on Management Systems for Facility and Activity in the Utilizations of Nuclear Energy. Based on BAPETEN Chairman Regulation No. 6 Year 2023, Management System shall comprise of safety culture, graded approaches, document control, management responsibilities, resource management, process implementation and measurement, assessment and improvement. This concept was adopted from the IAEA GS-R-3. Management System is a subject for licensing and inspection by BAPETEN.

In the case of the implementation of a management system in the testing laboratory for the radioactive materials package operated by BRIN, it has been accredited by ISO 9001: Quality Management System certification, and ISO 17025 certification. BAPETEN certifies or re-certifies a package based on the result of this testing laboratory as required by the Government Regulation No. 58 Year 2015. BAPETEN may validate a package certificate from the country of origin. The certification and validation scheme of the packages are also applied for waste and spent fuel packages. Radioactive waste management has been implemented based on an approved management system and quality control activities, such as package testing. The package testing is carried out according to BAPETEN Chairman Regulation No. 7 Year 2020 on Safe Transport and Administrative Requirement of Radioactive Sources.

F.4 Article 24 (Operational Radiation Protection)

Radiation protection requirements have been specified in the Government Regulation No. 45 Year 2023 that is in line with GSR Part 3. The licensee shall comply with the dose limit and implement the optimization of radiation protection as stipulated in BAPETEN Chairman's Regulation No. 04 Year 2013 on Radiation Protection and Safety in Nuclear Energy Utilization. Numerical values for the dose limit are in line with the IAEA GSR Part 3. However, it still implements a similar process-based (intervention and practice) instead of recommended exposure situation-based, as stated in the IAEA GSR Part 3. BAPETEN, as a regulatory body,

encourages the operator of the nuclear facility and radioactive waste management facility to undertake deliberate efforts in fulfilling the requirement of the dose limit.

The licensee shall implement a radiation protection program to maintain the dose received by workers and the public as low as reasonably achievable. They also shall establish a dose constraint to ensure the objective of radiation protection is achieved. Currently, BAPETEN has established guidelines regarding the implementation of optimization requirements, including the establishment of dose constraint, since the licensee finds difficulties in understanding and applying the optimization principle at the operational stage.

F.5 Article 25 (Emergency Preparedness)

F.5.1 On-site and Off-site Emergency Plans

Provisions on nuclear emergency preparedness and response are outlined in the Government Regulation No. 54 of 2012 on Safety and Security on Nuclear Installation. Based on these regulations, nuclear emergency preparedness and response are classified into three levels: the installation level, the provincial level, and the national level.

For the installation level, the nuclear emergency preparedness program is established and implemented by each licensee, who also has the responsibility to declare a nuclear emergency status. The licensee is requested to submit a daily report of the implementation of nuclear emergency response actions to BAPETEN until the nuclear emergency status is ended. The technical requirement is governed on BAPETEN Chairman's Regulation No. 1 Year 2010 on the Emergency Preparedness and Response.

The Government Regulation No. 45 Year 2023 on the Safety of Ionizing Radiation and Security of Radioactive Materials governs that any licensee shall perform radiation safety on emergency exposure that comprises preparedness, emergency response, and rehabilitation and reconstruction. Preparedness and emergency response are implemented at national, local, and/or installation/facility levels. Preparedness and emergency response shall be adjusted to nuclear energy utilization and categorization of potential radiological hazards. The licensee shall conduct potential radiological hazard assessment as a basis to develop a Preparedness Program, and protection strategies to protect the public and the responder from emergency exposure.

The licensee shall develop, implement, and update Preparedness Program that covers infrastructure (organization; coordination; facility and equipment; procedures; and training and/or nuclear emergency drill) and response function (management of emergency response;

identification, reporting, and activation; mitigation action; protective action; protective actions for the responders and the public; information and instruction to the public; medical handling; public communication; radioactive waste management; non-radiological mitigation; nuclear emergency termination; and emergency analysis).

BAPETEN Chairman's Regulation No. 1 Year 2010 on the Emergency Preparedness and Response regulates that the licensee such as a waste generator, treatment operator, and the center for waste management shall undertake precautionary measures for occurrence of a nuclear accident and radiological emergency. In a nuclear accident and/or radiological emergency, waste generators, treatment operators, and the waste management center shall take appropriate mitigation and remedial actions. Licensees shall report to the BAPETEN Chairman in case of a nuclear emergency at least 1 hour after the incident/accident by phone, facsimile, or email, and submit the written report within 2 days. Currently, BAPETEN Chairman's Regulation No. 1 Year 2010 on the Emergency Preparedness and Response is under revision to commensurate its arrangement with GSR Part 7.

The Government Regulation No. 58 Year 2015 on the Safety and Security of Transport of Radioactive Materials governed that the shipper is required to have an emergency preparedness and countermeasures system for Radioactive Source Transportation. Emergency preparedness and response systems include preparing and establishing emergency response procedures, emergency training and drill, and emergency response.

Since 2005, BAPETEN has widely promoted the "National Nuclear Emergency Preparedness System" (SKNN), including the arrangement of the National Response Organization for Nuclear Accident (OTDNN). This measure is an inter-ministerial mechanism in preparedness and response to radiological and nuclear safety events. OTDNN is led by the National Agency for Disaster Management and supported by NUBIKA (CBRN-Army), POLRI (The National Police, including FEMT and Bomb Squad), Fire Brigades, Emergency Ambulance, BRIN, Ministry of Health, and Ministry of Transportation.

In 2010, the SKNN concept was integrated into the draft of government regulation on nuclear installation's safety and security. The draft of SKNN is mainly based on the IAEA GS-R-2. In 2012, Government Regulation No. 54 on Safety and Security of Nuclear Installation was issued. And the draft of OTDNN is adapted from the updated IAEA Tecdoc 953 draft of OTDNN is not yet established. Coordination among relevant institutions on the issues of nuclear emergency preparedness and response has been implemented based on the program.

At the technical level this mechanism has been implemented as evident, provided by the national nuclear emergency response exercises conducted since 2006. Many operating

organizations and response organizations referred to the draft OTDNN. However, the government has not given legislative effect to the draft OTDNN so far. What we have implemented so far is, since we acknowledged that respond to nuclear emergency is part of the disaster management response under coordination of National Disaster Management Agency (BNPB), we follow the established regulation on disaster management response (Act No. 24 of 2007 on Disaster Management, Government Regulation No. 21 of 2008 on Disaster Management Operations, Presidential Regulation No. 1 of 2019 on the National Disaster Management Agency, and BNPB Chairman Regulation No. 3 of 2016 on Disaster Emergency Management Command System) and regulation on nuclear emergency preparedness and response (Government Regulation No. 54 of 2012 on the Safety and Security of Nuclear Installation).

F.5.2 Preparation and Coordination of Emergency Plan

BAPETEN organizes a series of national exercises, meetings, and workshops to establish robust emergency management and operations, including for spent fuel and radioactive waste management. Furthermore, in implementing the BAPETEN Chairman Regulation No. 1 Year 2010 on the Nuclear Emergency Preparedness and Response, all nuclear installations, including radioactive waste management, conducts emergency exercises annually based on their emergency preparedness program approved by BAPETEN.

For the provincial and national level, as regulated on the Government Regulation No. 54 Year 2012 on Safety and Security on Nuclear Installation, nuclear emergency preparedness program is established by the Chairman of the Local Disaster Management Agency for provincial level and National Disaster Management Agency for the national level. This program involves coordination with relevant institutions and licensees within their territories.

BAPETEN with other related Ministries and Agencies have initiated a national program to build and improve the Nuclear Preparedness System's capability and National Nuclear Security under Government Regulation No. 54 Year 2012 concerning Nuclear Safety and Security through the Indonesia Center of Excellent on Nuclear Security and Emergency Preparedness (I-CoNSEP). The I-CoNSEP consists of four pillars: coordination, technical support, capacity building, and infrastructure. BAPETEN conducts several activities through the I-CoNSEP. First, BAPETEN has a focus on increasing and strengthening the cooperation of related ministries and agencies. Next, BAPETEN improves infrastructure capabilities, equipment for the surveillance system, and human resources quality on nuclear security and emergency preparedness programs. Then, BAPETEN develops the installation and operation

of integrated online early warning systems (Radiation Portal Monitor and Radiation Data Monitoring System) at strategic locations/areas or national vital objects. All the activities are held to build and enhance a reliable, world class national nuclear preparedness system and capability.

Under the Joint Convention on Early Notification and Assistance, the Deputy Chairman of BAPETEN for Licensing and Inspection takes the responsibility as National Coordinating Authority Abroad (NCA-A). At the same time, the Director of Technical Support and Nuclear Emergency Preparedness was assigned as National Coordinating Authority Domestic (NCA-D), and the Coordinator for Nuclear Emergency Preparedness served as National Warning Point (NWP).

In the case of a transport accident, Chapter VI of the Government Regulation No. 58 Year 2015 on the Safety and Security of Transport of Radioactive Materials governs that the transporter shall report to the Regulatory Authorities, the shipper, and the consignee. All parties shall take prompt action. In a nuclear accident and or radiological emergency, waste generators, treatment operators, and the waste management center shall take appropriate mitigation and remedial actions. Licensees shall report to the BAPETEN Chairman in case of a nuclear emergency at least 1 hour after the accident by phone, facsimile, or email, and shall submit the written report at least 2 days after the accident.

BAPETEN is also mandated by Government Regulation No. 45 Year 2023 to perform a response in the case of an orphan source. This Government Regulation is essential in terms of the handling of materials out of regulatory control until it transferred to the RWMI. In Indonesia, scrap metal is one of the raw materials for the metal factory. Since 2009, BAPETEN has been performing the orphan source search. Additionally, BAPETEN holds annual "search campaigns" in some provinces dealing with scrap metal import and export business. BAPETEN secured 3 unidentified orphan sources found in scrap metal yards in Gresik, East Java (2000); Palembang, South Sumatra (2007); and North Jakarta (2007). Several cases of MORC related to radioactive contamination have occurred. Radioactive materials contaminated by Cs-137 or Th-232 have been transferred to and securely stored in RWMI.

Moreover, to improve the quality of nuclear emergency responses, BAPETEN has ~~i~~issued BAPETEN Chairman Regulation No. 1 Year 2015 on the Governance of Emergency Preparedness Team.

F.6 Article 26 (Decommissioning)

Decommissioning requirements have been regulated in BAPETEN Chairman Regulation No. 4 Year 2009 on Decommissioning of Nuclear Reactors and BAPETEN Chairman Regulation No. 6 Year 2011 on Decommissioning of Non-Reactor Nuclear Installation. Decommissioning shall follow stages below:

1. Determination of decommissioning strategy,
2. Development of Decommissioning Program. This document is summarized and included in the Preliminary Safety Analysis Report (SAR) for construction permit and in Final SAR for Operation Permit. The Decommissioning Program is reviewed and updated every 5 years within the operation stage.
3. Decommissioning implementation covers spent fuels/radioactive waste transfer, characterization (estimation and survey), decontamination, and dismantling.
4. Completion of decommissioning covers waste management, final radiation survey, and submission of release statement.

The decommissioning strategy includes:

a. Immediate dismantling, which includes decontamination of all contaminated components to reach an acceptable level, dismantling and removal of all contaminated Structure, System, And Components (SSCs) from the installation to the approved waste storage location,
b. Deferred dismantling, i.e., maintenance of the installation while waiting for the natural decay of radionuclides to reach a certain level of activity and decontamination, dismantling and transferring all of the contaminated SSCs to an approved waste storage location,
c. The entombment in confinement is made of a long last material until the radioactivity decays to a level that exempts the installation from authorization (reaching the clearance level), and
d. Combination.

The licensee shall develop the Decommissioning Program which contains:

1. Installation description,
2. Decommissioning methods or options,
3. Characterization survey plan or its summary,
4. Estimated decommissioning costs,
5. Safety analysis or safety assessment,

6. Environmental assessment or its summary,
7. Radiation protection program,
8. nuclear security and safeguards programs,
9. Nuclear preparedness program,
10. Radioactive waste management plan,
11. Decommissioning activities,
12. Surveillance and maintenance, and
13. Final radiation survey.

The document shall be submitted to BAPETEN as a requirement to apply for a license of nuclear installation based on the Government Regulation No. 2 Year 2014 on Licensing of Nuclear Material and Nuclear Installation. Decommissioning program of ISSF will follow the immediate dismantling option. Decommissioning programs for research reactors have been developed with consideration of all options of decommissioning strategy. The decommissioning program for radiation facilities and radioactive material is under the regulation drafting process.

G. Safety of Spent Fuel Management

G.1 Article 4 (General Safety Requirement)

Any spent fuel management facility shall comply with the Government Regulation No. 45 Year 2023 and the Government Regulation No. 54 Year 2012 that specify the safety and security requirements, i.e., management system, safety and security culture, emergency preparedness, design, construction, commissioning, operation, and decommissioning requirements, and safety and security analysis or verification. The facility shall also meet technical requirements based on defense in depth principle and good engineering practices. Based on the Government Regulation No. 5 Year 2021 on Risk Based Licensing, the spent fuel facility shall submit applications to obtain site, construction, commissioning, operation, and decommissioning licenses, to BAPETEN. BAPETEN then verifies and evaluates these licensing application documents submitted by the applicant.

Article 61 of Government Regulation No. 54 Year 2012 states that the responsibility of the licensee to achieve safety objectives is implemented through effective defense measures to the radiation hazards generated at the ISSF by applying the defense in depth principle. This is conducted by maintaining a subcritical state and controlling chemical properties, transferring radionuclide decay heat, and confining radioactive materials and retaining radiation.

G.2 Article 5 (Existing Facilities), Article 6 (Siting of Proposed Facilities), Article 7 (Design and Construction of Facilities), Article 8 (Assessment of the Safety of Facilities)

The Interim Storage for Spent Fuel (ISSF) was built and put into cold commissioning in 1998. The ISSF's capacity is designed to store 1458 elements, sufficient to store spent fuel for the 25 years of the reactor's operation if there are eight fuels to be discharged per cycle and seven cycles per year. The annual discharge, based on recent experience, is about twenty fuels. Hence, the facility could cover for about fifty years of the reactor's operation. With sufficient capacity available, there are no plans to establish a new facility for the storage of nuclear spent fuel currently. Based on regulations, the licensee shall take appropriate measures to review any existing spent fuel management facility's safety and ensure that all reasonable practical improvements are implemented. As part of its regulatory function, BAPETEN routinely inspects the ISSF.

ISSF management submitted license renewal application to BAPETEN in 2018. BAPETEN approved the license renewal after ensuring that the ISSF ageing management

program's implementation report and periodic safety review met the requirements. The approved license is valid until 2028.

G.3 Article 9 (Operation of Facilities)

The Government Regulation No. 5 Year 2021 on Risk Based Licensing states that the operator shall obtain authorization from BAPETEN prior to the facility's operation. The application document consists of Safety Analysis Report, Operating Limit and Condition Document, Radiation protection and Safety Program, Maintenance Program, Safeguards Document, Physical Protection Plan Document, Management System Document, Ageing Management Program, Decommissioning Program, Emergency Preparedness Program, and Environmental Approval Report. Application of licensing can be submitted if commissioning activities have commenced, and the applicant possesses a license for nuclear material utilization.

The Interim Storage for Spent Fuel was built and started cold commissioning in 1998. The ISSF's capacity is designed to store 1458 elements; sufficient to store spent fuels generated from 25 years of GA Siwabessy reactor's operation. The status of ISSF is presented in Table L-2 of Section L Annex A.

The BAPETEN Chairman Regulation No. 4 Year 2014 regulated operational limits and conditions for non-reactor nuclear installation. The operational limits and conditions derived from tests and operational experience and assessments and followed by safety analysis conducted by the facility.

G.4 Article 10 (Disposal of Spent Fuel)

The provisions for disposal of spent fuel have been accommodated in Act No. 10 Year 1997 on Nuclear Energy and Government Regulation No. 5 Year 2021. The implementation of these provisions is very important when nuclear power program is established.

In Act No. 10 Year 1997, the government determines the location for final disposal facility after obtaining approval from the House of Representatives of the Republic of Indonesia. Government Regulation No. 5 Year 2021 regulates the operating permit for the disposal facility for spent nuclear fuel is valid for a maximum period of 50 (fifty) years from the date of issuance. Extension of the operating permit for the disposal facility for spent nuclear fuel is granted for a maximum period of 50 (fifty) years for each extension. Currently, there is no final disposal facility for spent fuel in Indonesia. However, preliminary siting study for disposal site is being conducted by the government.

As part of the implementation of the bilateral agreement between the government of the United States of America (USA) and Indonesia, spent fuels originating from the USA were repatriated. Those spent fuels have been repatriated in 1999, 2004, and 2009.

H. Safety of Radioactive Waste Management

H.1 Article 11 (General Safety Requirements)

In general, the safety requirement of radioactive waste is regulated in Act No. 10 Year 1997 on nuclear energy and Government Regulation No. 61 Year 2013. The radioactive waste management requirement shall be fulfilled by the licensee in the licensing process as well as during the periodic inspection by BAPETEN to:

1. minimize the generation of radioactive waste, consider interdependencies among the different steps in radioactive waste management,
2. provide for effective protection of individuals, society, and the environment,
3. to consider the biological, chemical, and other hazards.

Indonesia's policy is to manage radioactive waste to protect future generations and minimize the burden. Although disposal is not yet solved, adequate R&D for disposal has been established.

H.2 Article 12 (Existing Facilities and Past Practices)

BRIN with RWMI-DNFM is the only institution capable of managing radioactive waste in Indonesia. RWMI-DNFM receives and manages radioactive waste from all over Indonesia. For DSRS, the recommended practice is to return them to the origin country. If this is not applicable, then RWMI-DNFM can accept DSRS for processing.

The radioactive waste from medical applications consists of DSRS, i.e., Cs-137, Ra-226, Ir-192, and Co-60. For industrial applications, radioactive waste includes DSRS for radiography, logging, gauging, lightning rods, and solid waste from gas-mantle lamp manufacturers.

RWMI-DNFM is equipped with an evaporator, compactor, incinerator, chemical treatment, ion exchange, conditioning facilities for DSRS, and interim storage. (See Section L Annex C)

H.3 Article 13 (Siting of Proposed Facilities)

By optimizing the current facilities, RWMI can manage the current waste generated from industrial, medical, and research applications. RWMI does not have any plans to develop new facilities in the near future.

Government Regulation No. 61 Year 2013 and Government Regulation No. 45 Year 2023 can be referred to facilitate the construction of a new waste treatment facility. As one of the stages of a radioactive waste management licensing, applicants shall obtain a site license. The requirements for obtaining a site license are listed in Annex II of Government Regulation No. 5 Year 2021.

H.4 Article 14 (Design and Construction of Facilities), Article 15 (Assessment of Safety Facilities)

The Government Regulation No. 5 Year 2021 on Risk Based Licensing describes how to obtain a construction permit. The regulation requires the technical plan document for a radiation-protection building, a utility building plan document for operation of utilizing ionizing radiation sources, a radiation dan security radioactive source assessment document, radiation and safety program document, security program document and commissioning program document. In this regulation, for facility operation requirements, licensee are also required to fulfil the requirements of radioactive waste acceptance criteria, Commissioning Report, As-built drawings, Quality Of Conformity Certificate for Ionizing Radiation Sources, Competency and Authority of Personnels, Radiation and Safety Program Documents, Security Program Documents, The Ownership Documents and/or Authorization Documents of Radiation Sources, Radiation Source Safety and Security Study Documents, Management System Documents, Maintenance Program Documents, and Decommissioning Programme Documents.

Research and Development (R&D) in various radioactive waste management fields are carried out to meet future needs. RWMI-BRIN and now BRIN has been operating since 1989. Several research activities to support the routine operation of waste management have been performed. Currently R&D is conducted by researchers from Research Center for Nuclear Material and Radioactive Waste Technology (RCNMRWT), Research Organization for Nuclear Energy, BRIN. R&D on radioactive waste management technology covers the following topics.

a. Spent fuel management: Development of interim storage and dry cask for spent fuel.
b. Radioactive waste treatment facilities:
    - Development of vacuum evaporator for liquid waste processing
    - Study on corrosion of radioactive waste containers
    - Study on siting, design and safety assessment for disposal facility and long-term storage
    - Study on borehole disposal facility for DSRS

- Study on spent resins treatment and its container
- Study on DSRS management: container, reuse & recycle
- Immobilisation method for solidification of radioactive waste (encapsulation, cementation, geopolymer etc.)

c. Other topics related to radioactive waste management: study on decontamination and decommissioning nuclear facilities such as phyto-remediation for contaminated soil, electro-decontamination method, graphene for decontamination, and study on strategy & planning for decommissioning.

H.5 Article 16 (Operation of Facilities)

The RWMI comprises of some facilities (processing units), i.e., Evaporation System (ES), Compaction System (CS), Incinerator System (IS), Cementation System (CeS), ion exchange, Interim Storage for Embedded Waste (ISEW), Interim Storage for High Activity Radioactive Waste (ISHARW).

The evaporation system processing liquid wastes has a maximum activity of 0.74 GBq/m^3 into radioactive concentrates (maximum activity 37 GBq/m^3), and normal water distillates. The evaporator unit is a thermosiphon circulating thermal evaporator with 0.75 m^3/h operating capacity and is designed to reduce the waste volume in a maximum ratio of 50:1 depending on initial salinity.

The ion exchange unit performs liquid waste treatment by feeding the liquid waste from the waste storage tank using a pump to the ion exchange column. In the ion exchange column, there is an exchange of radionuclides of Cs-137, Co-60, and other radionuclides in the form of cations with H^+ ions found in cation resins. The ion exchanger's basic design consists of a resin feed system, a prefilter system, and an ion-exchange column system. The resin feed has a capacity of 100 liters equipped with a centrifugal pump with a capacity: 4 m^3/hour. The prefilter system has a column design with a diameter of 12 inches and a height of 100 cm, the prefilter system used is a cartridge with a pore size of 10 µm. The ion exchange column has a diameter of 14 inches with a height of 120 cm, made of stainless steel which is equipped with safety and process security systems such as fuse, overload, main switch, and interlock system.

The cementation system solidifies evaporator concentrates and spent resins (maximum activity 3.7 GBq/m^3) using 950 L concrete shells. The 350 L shells and 200 L shells are used to immobilize non-compatible solid waste, such as DSRS.

The compaction system is used to treat compactable low-level solid waste. It compresses solid wastes being contained in 0.100 m^3 mild steel drums. In the compacting step,

0.100 m^3 drums are compacted in a 0.200 m^3 steel drum using a 600 kN hydraulic press. This drum is then solidified with cement slurry, closed, and sealed.

The incineration system processes burnable solid wastes having activities of 0.0037 GBq/m^3 for the alpha emitter and of 0.37 GBq/m^3 for the beta, gamma emitter, waste oils, and liquid organic solvents, and animal's carcasses into radioactive ashes and off-gasses. The radioactive ashes are then solidified by cementation in a 100 L steel drum.

Interim storage is used as engineered storage for solidified wastes. The storage covers the 100 L and 200 L steel drums; and 200 L, 350 Land 950 L concrete shells. ISHARW was developed and commissioned in 1997. ISHARW has 20 dry wells (one capacity is 6 drums 60 L) and three dry ponds (one pond size is 2m x 6m x 6m). HLRW from radioisotopes production and nuclear post-irradiation fuel examination are filled in standard 60 L drums and then stored in a dry well of ISHARW. After the decay and delay phase of the radioactivity, the waste will transform into low and intermediate waste and then be treated with the existing waste treatment facility.

H.5.1 Operational Experiences

The RWMI started as a Radioactive Waste Installation (RWI) project in 1986 and commissioned in 1989. Now, DNFM-BRIN with RWMI is responsible for nuclear waste management. However, the research and innovation of radioactive waste technology, BRIN is a nuclear energy research organization that has a mission to promote research, development, and implementation of radioactive waste technology in sustainable, safe, and secure ways to protect human health and the present and future environment without burdening future generations. RWMI departments that deal directly with radioactive waste are responsible for examining packaging and reporting any damage, leakage, or other irregularities with packaging. They are also responsible for examining radioactive waste carrier documents and protecting and securing packaging. Lastly, the research unit is responsible for developing and increasing RWMI's services. These units have the responsibility for managing and improving the safety of radioactive waste in RWMI, DNFM-BRIN.

The average annual number of wastes collected are:

1. Liquid waste from research reactor : 107319 L
2. Resin : 700 L
3. Solid Waste : 174 × 100 L-drums
4. Disused Sealed Radioactive Sources : 163 pieces

In addition to routine processing processes, to reduce the volume of radioactive waste, carry out reuse of Disused Sealed Radioactive Sources (DSRS) and clearance for post-process radioactive waste packages.

1. Experiences on Reuse of DSRS:
   3 units of Cs-137 for training and academic purposes, 2 units of Co-60 for SSDL and academic purposes, 1 unit of Am-Be for logging industry purposes.
2. Experiences on Clearance for Post-Process Radioactive Waste:
   1226 Kg of decontaminated metal scraps, 14 concrete shells of evaporated concentrate

H.5.2 Radiation Exposure to Staff

Figure 1 below shows in Graphical form the average annual dose to the staff. No single person involved in handling and incinerating radioactive waste ever had a radiation dose in excess.

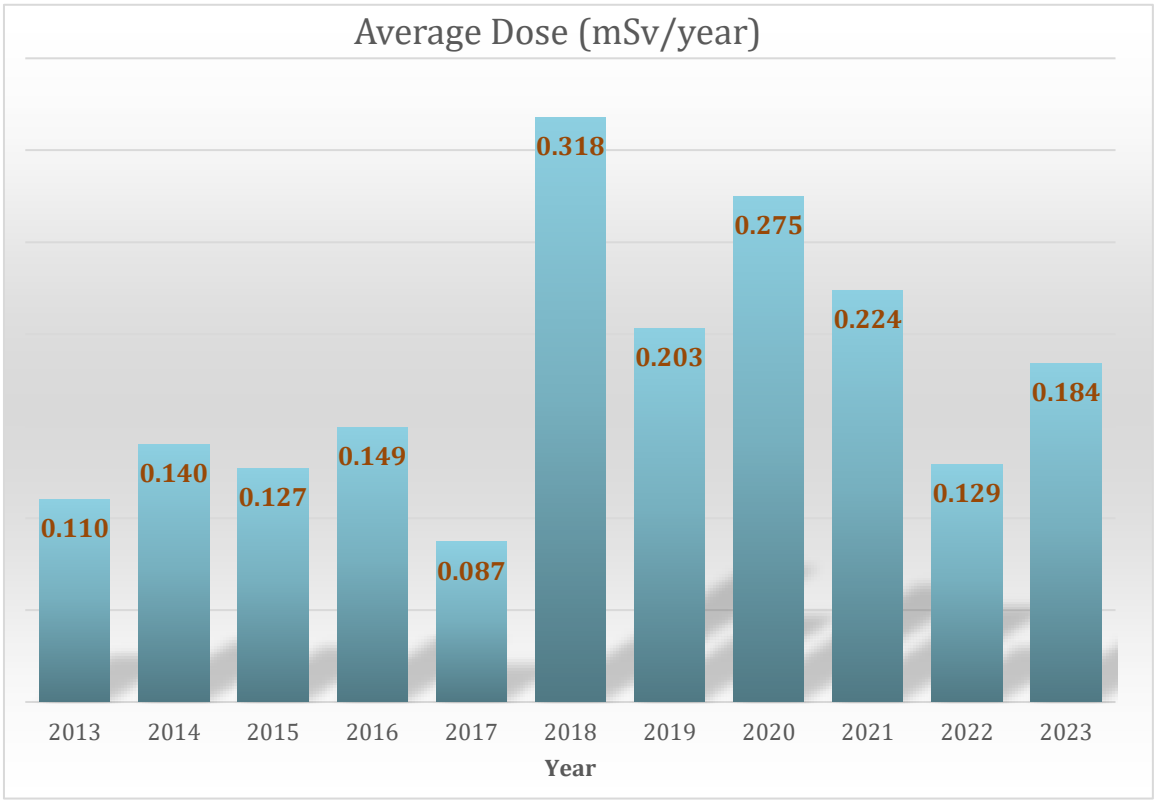

Figure H.1. Average Dose to Staff of RWMI (2013-2023)

Experience with management of waste at the Radioactive Waste facility in Indonesia so far shows that the exposure to staff dose is still below the dose limit.

H.6 Article 17 (Institutional Measures after Closure)

Indonesia has no final disposal facility to present. For the closure of similar facilities, provisions related to the construction, operation, and closure license provisions can refer to Government Regulation No. 5 Year 2021 on Risk Based Licensing.

I. Transboundary Movement

I.1 Article 27 (Transboundary Movement)

The transboundary movement of radioactive waste shall comply with the Government Regulation No. 58 Year 2015 on the Safety and Security of Transport of Radioactive Materials. Several of the IAEA standards and requirements have been referred to in the development regulations process, for instance the IAEA SSR-6 on safe transport of radioactive material 2012 edition and NSS-9 on security in radioactive material transport. Based on the Government Regulation No. 58 Year 2015, BAPETEN conducts the radioactive material transport arrangement to minimize the risks. The arrangement consists of radioactive material transport approval, radioactive material transport certificate notification, validation on the package design certificate, and validation of transport approval issued by the regulatory body's country of origin. To prevent and detect illicit sources and unauthorized packages transported, the regulatory body has installed radiation portal monitors (RPMs) in several seaports.

Furthermore, radioactive wastes from other countries are prohibited from entering the jurisdiction of the Republic of Indonesia (Article 46 (1) the Government Regulation No. 61 Year 2013) unless they were generated from radioactive sources produced in Indonesia (Article 46 (2)). For spent fuels, the generator shall store them temporarily on-site during the reactor's operational period (Article 32). The generator then will repatriate the spent fuels to the origin country or send them to BRIN for final disposal (Article 33). Transboundary movement of spent fuel is also regulated in Article 44 of this Government Regulation.

There has been no transboundary movement related to radioactive waste. Regarding the practice of transporting nuclear materials, in 2021 (September and October) and 2024 (January), there were notifications to BAPETEN of the transport of nuclear materials from France to South Korea and from South Korea to Sweden which pass through Indonesian territory.

J. Disused Radioactive Sealed Sources

J.1 Article 28 (Disused Radioactive Sealed Sources)

DSRS shall be repatriated to the country of origin or exported to manufacturers. If repatriation or export to manufacturers is not applicable, they shall be transferred to and managed by RWMI, DNFM-BRIN (Article 7 Government Regulation N0. 61 Year 2013). For DSRS, reuse and/or recycle may be implemented once BRIN has conducted safety assessment of the DSRS.

Sealed radioactive sources are widely used for medical, industrial, agriculture, and research applications. The IAEA defines a sealed source as "a radioactive material that is permanently sealed in a capsule, or closely bonded, and in a solid form." Safety requirements for DSRS are presented in IAEA Safety Standards publications.

Indonesia's current regulatory control over DSRS is through a requirement on the source's owner to have a confirmed arrangement with the supplier for the source's return at the end of their useful life. However, there are many DSRS, including Indonesia's legacy and orphan sources, due to some reasons that are not possible to be returned to the country of origin, which then shall be stored in RWMI, DNFM-BRIN. Indonesian regulation allows DSRS to be reused or recycled when they meet the specified requirements.

Moreover, to reduce the amount of radioactive waste stored in BRIN facilities, reuse of DSRS is also carried out. The legal basis for this activity is the Government Regulation No. 61 Year 2013 on Radioactive Waste Management and BAPETEN Chairman Regulation No. 8 Year 2016 on Radioactive Waste Management for Low and Intermediate Level Radioactive Waste.

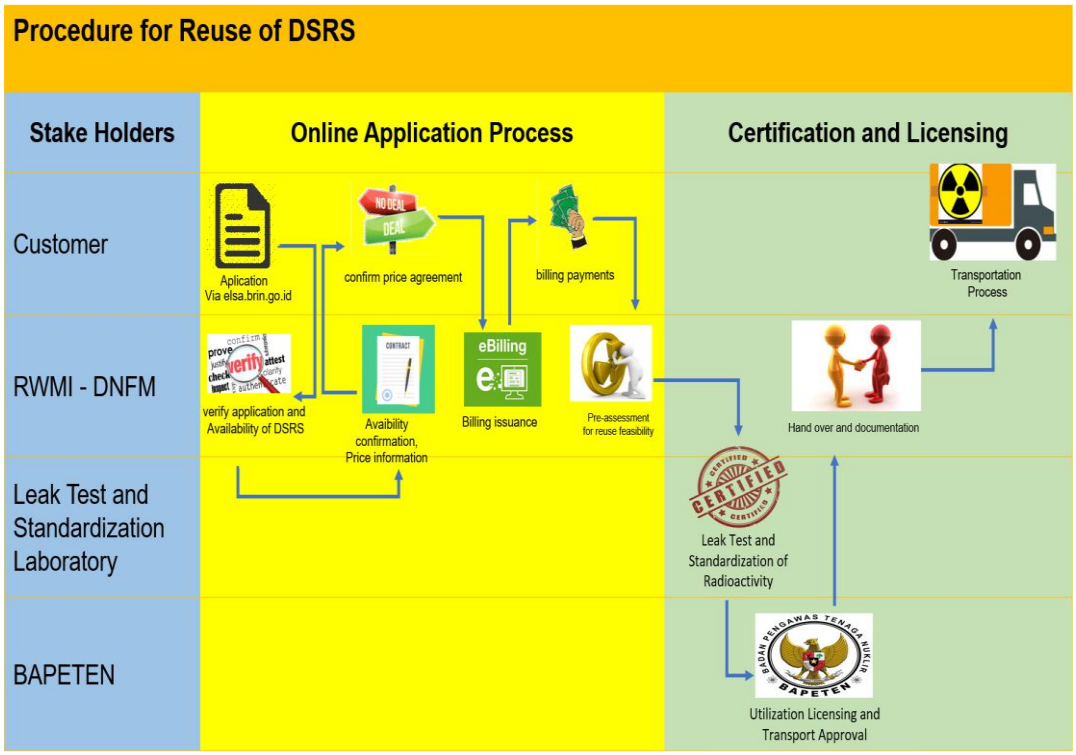

Figure J.1. Procedure for DSRS Reuse

From 2017 to 2024, the reuse process has been carried out for 6 units of DSRS, with details: 4 units of DSRS for educational institutions (Cs-137 or Co-60), 1 unit of DSRS for calibration facilities (Co-60), and 1 unit of DSRS for industrial (Am241-Be). Meanwhile, the practice of DSRS recycling has never been done.

K. General Efforts to Improve Safety

Indonesia has implemented the following measures to address Suggestions and Challenges identified at the 7th Review Meeting.

K.1 Suggestion: Evaluate and plan of the disposal path of spent fuel from the research reactor (if not repatriated)

The ongoing practical management process for spent fuel produced from operation of 3 (three) research reactor is as follows:

a) Spent fuels from Serpong's research reactor are temporarily stored in the reactor's wet interim storage before transferred to the Interim Storage for Spent Fuels (ISSF) which is part of the DNFM-BRIN facility.
b) Spent fuel from Bandung and Yogyakarta reactors is temporarily stored in wet interim storage inside the respective reactors.

Based on the latest available storage data, ISSF still has 72% availability from maximum capacity, while the wet interim storage at all reactors has 95% availability on average.

For possible future consideration of spent fuel management and disposal path, BRIN is conducting research studies on potential development of interim storage and dry cask for spent fuel.

Referring to Act No. 10 Year 1997, the government of Indonesia shall select the location for final disposal facility after obtaining approval from the House of Representatives. Until now, Indonesia does not have or operate any final disposal facility for spent fuel. However, preliminary site study for potential final disposal sites is being conducted by the government, for future consideration.

K.2 Challenges 1: Management of radioactive waste

a. Limited capacity on radioactive waste facility

BRIN implemented the following efforts to optimize RWMI storage management, to provide more space for waste storage:

- Maintaining swift processing flow for pre-processed solid waste, to ensure the entire waste management process runs effectively and meets the targets,
- Continuing best practice in radioactive waste clearance,
- New proposal to utilize other buildings at Serpong Nuclear Complex for facility expansion.

b. Potential radioactive waste from the plan of decommissioning the research reactor

BRIN is conducting characterization research entitled "Bandung TRIGA 2000 Research Reactor Activity Inventories for Decommissioning Planning" which was started since January 2024 and supported by the IAEA Coordinated Research Project "T24009" as part of effort to anticipate the potential radioactive waste from future decommissioning plan of the research reactor.

c. Radioactive waste from bankrupt industries

Indonesian government has stipulated the Government Regulation No. 45 Year 2023 on the Safety of Ionizing Radiation and Security of Radioactive Materials states that in the case that the owner of an Ionizing Radiation Source is declared bankrupt based on a court decision. This regulation further regulates BAPETEN as the regulatory body shall coordinate with the curator as the responsible entity in designation of competent personnels to implement safety and security measures and in the cost needed for measures implementation. Furthermore, BAPETEN has a task force team to identify potential bankrupt license holders.

BAPETEN Chairman Regulation No. 1 Year 2022 on Management of Risk-Based Business Licenses in the Nuclear Sector has mandated the waste generator to have a financial guarantee for the final handling of radioactive sources. However, the technical guidance on how to implement the financial guarantee has not been developed.

d. Radioactive waste from Material Out of Regulatory Control (MORC)

Government Regulation No. 45 Year 2023 on the Safety of Ionizing Radiation and Security of Radioactive Materials regulates BAPETEN as Regulatory Body shall secure the radioactive material whose owner is unknown. Further, BAPETEN will investigate the ownership or licensing of radioactive materials. Investigations are carried out in coordination with other authorized institutions. If the owner of the radioactive material is found through investigation, whether it is the licensee or another person/party, then they are responsible for the handling of the radioactive material. Otherwise, when the investigation cannot identify the owner, specifically in the legacy waste case, then the Regulatory Body will be responsible for managing/handling the radioactive material. The cost of the measures would be borne by the Regulatory Body if the owner of radioactive materials cannot be identified.

e. Legacy waste stored in BRIN facilities

BRIN formed a special team to resolve the legacy waste challenges and to provide sustainable solutions, involving radioactive waste experts with experiences in waste management at national level. BRIN's effort in this matter is being supported by BAPETEN who organized technical meetings with BRIN to provide guidance to ensure the legacy waste management met the requirements as stated in national regulations.

f. Issues in transport of radioactive waste

To address issues related with transportation of radioactive waste, the government of the Republic Indonesia stipulated the Government Regulation No. 58 Year 2015 on the Safety and Security of Transport of Radioactive Materials. Several the IAEA standards and requirements have been referred to in the development regulations process, for instance the IAEA SSR-6 on safe transport of radioactive material 2012 edition and NSS-9 on security in radioactive material transport. The regulation designates BAPETEN as a regulatory body to implement arrangements for transportation to minimize risks. This law also regulates radiation safety management in the transportation of radioactive materials as a guideline for addressing issues related to the transportation of radioactive waste.

K.3 Challenges 2: Inadvertent contaminated material entering clean recycle waste streams (e.g., scrap metal)

BRIN has demonstrated a practical approach to solve the scrap metal challenges. As part of the implementation of BAPETEN Regulation No. 16 Year 2012 on the establishment of clearance level. In 2019, BRIN applied for clearance approval of contaminated metal scrap from a phosphate purification plant's decommissioning, which was processed with decontamination efforts several years ago using the chemical treatment method. Of the 70 pieces of metal scrap that were re-measured, there were 65 pieces of metal scrap weighing 1226 kg, which met the clearance level. After evaluating the application, at the end of 2019, BAPETEN issued a clearance approval for the 65 pieces of metal scraps. BRIN will propose a similar scheme to proceed clearance approval for recent metal scrap management that is significantly increasing. Furthermore in 2023, BRIN had approval to clearance 14 concrete cells containing evaporation concentrate.

In the regulatory sector, BAPETEN will develop regulations as a guide for industries (e.g., metal industries) to detect and decontaminate radioactive substances that have the potential to enter production lines.

K.4 Other efforts to Improve the Safety of Nuclear Spent Fuel Management and the Safety of Radioactive Waste Management

The establishment of the national policy and strategy is crucial for solving the radioactive waste issues, including the development of a final disposal facility. Moreover, currently, the Government Regulation No. 61 Year 2013 on Radioactive Waste Management is in the stage of drafting an academic paper to develop this government regulation.

In the development of the information system, BAPETEN and BRIN have developed some information systems. BAPETEN processes all licensing activities through B@LIS Online. BAPETEN is in the process of developing an integrated system for radioactive waste accounting that contains all information about radioactive waste or materials that are temporarily stored in facilities. BRIN has already developed radiation monitoring by an integrated system between radiation equipment with a computer system, to control and to monitor the radiation area of Radioactive Waste. BRIN continues the present progress of development and integrates the information system into a new database platform coordinated by the Center of Data and Information. BRIN also has the system as a database for the radioactive waste inventory in RWMI. In the future, there will be interconnection between systems in BAPETEN and BRIN.

To improve the inspection program, BAPETEN develops an inspection system to support licensee participation in inspection through the submission of safety verification report. Moreover, since the Covid-19 pandemic, online inspections have been developed and continued until now.

In terms of transparency of public information, BRIN and BAPETEN have commitments to inform the public regarding its activities, e.g., IAEA missions in supporting the improvement of radiation protection and nuclear facility revitalizations. In 2018, a review mission namely ORPAS Review mission was conducted to appraise the regulation and the implementation of the occupational radiation protection arrangements in Indonesia. The findings, recommendations and good practices were identified and has been composed in the ORPAS report to Indonesia. The document consists of four chapters of the main text, supported by sixteen Appendices that consist of the detailed findings of the mission, and five Annexes. The report has been made public and can be accessed through the ORPAS main page. Other missions that the reports are also available in IAEA site and can be accessed by the public are the IORRS mission and OMAR mission. Below are links that contain reports and news available for the public.

- https://www.bapeten.go.id/berita/bapeten-gandeng-iaea-gelar-pre-orpas-mission-134926
- https://www.bapeten.go.id/berita/orpas-akhiri-misinya-di-indonesia-130702
- https://www.iaea.org/newscenter/news/iaea-delivers-final-peer-review-report-to-indonesia-on-decommissioning-and-radioactive-waste-management
- https://www.brin.go.id/news/110530/dukungan-iaea-untuk-revitalisasi-fasilitas-nuklir-brin

L. Annexes

Annex A – Inventory of Radioactive Wastes and Spent Fuels

Inventory of radioactive waste held in the Center for Radioactive Waste Technology (RWMI, DNFM-BRIN).

Table L.1. Inventory of Radioactive Wastes

Radionuclide	Activity Category 1-2 (GBq)	Activity Category 3-5 (GBq)	Total Activity (GBq)
Cd-109		0.1087	0.1087
Fe-55		2.8638	2.8638
Cf-252		0.9050	0.9050
Sr-90		281.4367	281.4367
Pm-147		64.1816	64.1816
Kr-85		1284.9961	1284.9961
Ir-192		28.4139	28.4139
Cs-137	137966.3400	24518.6940	162485.0340
Co-60	657544.8371	129622.9236	787167.7607
Cm-244		0.3680	0.3680
Se-75		0.0014	0.0014
Ge-68		0.0046	0.0046
Ra-226		213.9192	213.9192
Am-241		5862.4267	5862.4267
Am-Be		5425.6684	5425.6684
C-14		0.3687	0.3687
Ni-63		5.5092	5.5092
Pu-238		0.5359	0.5359
Ba-133		0.0892	0.0892
Th-232		0.0619	0.0619
Th-228		2.3215	2.3215
C0-57		0.7621	0.7621
Na-22		0.0005	0.0005
Eu-157		0.2604	0.2604
H-3		0.00000135	0.00000135

Note: data as per May 31, 2024.

Table L.2. Research Reactor Spent Fuels Inventories

Facility Name	Owner	License	Critical Date/ Commissioning	Facility Type	Fuel Type	Storage Type	Storage Location	Storage Update	Design Capacity (elements)	Inventory (elements)
MPR	BRIN	BAPETEN	1987	MPR 30	MTR	Pool pond	At Reactor Serpong	2020	300	30
ISSF	BRIN	BAPETEN	1998	Interim Storage for Spent Fuel	MTR/TRIGA	Pool/pond	Serpong site	2023	1458	413
TRIGA-2000	BRIN	BAPETEN	1965	Triga Mark II	TRIGA	Pool/pond	At Reactor Building	2020	330	14
Kartini	BRIN	BAPETEN	1979	Triga Mark II	TRIGA	Pool/pond	At Reactor Building	2020	90	0

Note: data as per May 31, 2024

Table L.3. Radioactive Waste Management Installation and Inventories

Site Name	Facility Name	Location	License Holder	Facility Type	Waste Class Name*	Waste Type	Capacity	Volume
RWMI	Interim Storage 1	Serpong, Banten	BRIN	Interim Storage	LLW	Storage**	1900 × 100 L drums 230 × 950/350 L shells 118.8 m^2 for DSRS	12 × 950 L-concrete shells contain immobilized concentrate waste. 144 × 950 L-concrete shells contain immobilized semi-liquid waste / spent resin 4 × 950 L-concrete shells contained immobilized Uncompacted solid waste 1569 × 100 L-drums contain solid raw waste
					ILW			25 × 350 L- concrete shell contain 1053 pieces DSRS DSRS= 78 pieces
	Interim Storage 2	Serpong, Banten	BRIN	Interim Storage	LLW	Storage**	2054 × 200 L drums 208.35 m^2 for DSRS	681 × 200 L-drums contain immobilized uncompacted solid waste 839 × 200 L-drums contain immobilized compacted solid waste
					ILW			14 × 200 L-shell drums contain 531 pieces of Radium 11 capsules contain 384 pieces DSRS: 1359 pieces
	ISHARW	Serpong, Banten	BRIN	Interim Storage	ILW	Storage**	20 wells = 70 m^3 drums 3 pools = 129.6 m^3	7 capsules contain 272 pieces DSRS: 23 pieces Reflector: 1 piece
NFI	EFEI	Serpong, Banten	BRIN	Interim Storage	ILW/LLW	Storage***		30610 L liquid waste 2 drums @ 100 L solid waste
	RMI	Serpong, Banten	BRIN	Interim Storage	ILW/LLW	Storage***	-	6 drums @ 100 L solid waste
MPR	MPR	Serpong, Banten	BRIN	Interim Storage	ILW	Storage***	-	11505 L liquid waste 15 drums @ 100 L solid waste 4100 L resin
RRTI	RRTI	Serpong, Banten	BRIN	Interim Storage	LLW/ILW	Storage***	-	1 drum 100 L solid waste 40 L liquid waste

Site Name	Facility Name	Location	License Holder	Facility Type	Waste Class Name*	Waste Type	Capacity	Volume
PT INUKI	FEPI	Serpong, Banten	BRIN	Interim Storage	LLW/ILW	Storage**	-	71 bags HEPA filter compactable solid waste 66 bags compactable and combustible solid waste 1 bag uncompactable solid waste 4 drums 100 L compactable solid waste 4 drums 100 L compactable and combustible solid waste 37 drums 100 L combustible solid waste 6 bags combustible solid waste
	RII	Serpong, Banten	BRIN	Interim Storage	LLW/ILW	Storage**	-	40670 L liquid waste 2 drums 100 L compactable solid waste 29 drums 100 L combustible solid waste 6 drums 200 L charcoal 32 jerrycans 20 L charcoal 129 bags HEPA filter 1600 pieces capsule FPM SS 2724 capsule Al 130 drums of other radioactive solid waste
Bandung research reactor	CANST	Tamansari, Bandung	BRIN	Storage	LLW/ILW	Storage***	Solid waste = 4000 Kg Liquid waste = 202 m^3	17 drums @ 100 L solid waste 1 drums @ 200 L solid waste 1 bag HEPA filter 1 drums @ 100 L resin 2560 L liquid waste
Yogyakarta research reactor	CAST	Babarsari, Yogyakarta	BRIN	Storage	LLW/ILW	Storage***	-	7 drums @ 100 L solid waste 6 HDPE drums @40/60 L solid waste 800 L liquid waste
KST GA Siwabessy		PasarJumat, Jakarta	BRIN	Storage	LLW/ILW	Storage***	-	29 drums @ 100 L solid waste 254.871 L liquid waste

* Based on Indonesian classification of radioactive waste
** Data as per May 31, 2024
*** Data as per July, 2024

Annex B – List of National Laws, Regulations, and Guides

Table L.4. List of Legislations and Regulations Concerning Radioactive Waste and Spent Fuel Management

No.	Name of Regulation
1.	Act of the Republic of Indonesia No. 10 Year 1997 on Nuclear Energy
2.	Act of the Republic of Indonesia No. 2 Year 2007 on Sisaster Management
3.	President Regulation No. 1 Year 2019 on the National Disaster Management Agency
4.	President Regulation No. 84 Year 2010 on Ratification for Joint Convention on The Safety of Spent Fuel Management and The Safety of Radioactive Waste Management
5.	Government Regulation No. 45 Year 2023 on the Safety of Ionizing Radiation and Security of Radioactive Materials
6.	Government Regulation No. 5 Year 2021 on Risk Based Licensing
7.	Government Regulation No. 58 Year 2015 on the Safety and Security of Transport of Radioactive Materials
8.	Government Regulation No. 2 Year 2014 on the Licensing of Nuclear Installation and Nuclear Material Utilization
9.	Government Regulation No. 61 Year 2013 on the Radioactive Waste Management
10.	Government Regulation Number 54 Year 2012 on the Safety and Security of Nuclear Installations
11.	Government Regulation Number 21 Year 2008 on Disaster Management Operations
12.	BAPETEN Chairman Regulation No. 6 Year 2023 on Management Systems for Facility and Activity in the Utilizations of Nuclear Energy
13.	BAPETEN Chairman Regulation No. 1 Year 2022 on the Management of Risk-Based Licensing in the Nuclear Sector
14.	BAPETEN Chairman Regulation No. 3 Year 2021 on Implementation of Risk-Based Licensing in the Nuclear Energy Sector
15.	BAPETEN Chairman Regulation No. 7 Year 2020 on Safe Transport and Administrative Requirement of Radioactive Sources
16.	BAPETEN Chairman Regulation No. 7 Year 2017 on Radioactivity Limit in the Environment
17.	BAPETEN Chairman Regulation No. 8 Year 2016 on Radioactive Waste Treatment for Low Level and Intermediate Level Waste
18.	BAPETEN Chairman Regulation No. 1 Year 2015 on the Governance of Emergency Preparedness Team.
19.	BAPETEN Chairman Regulation No. 2 Year 2014 on Core Management and Fuel Handling and Storage for Research Reactor
20.	BAPETEN Chairman Regulation No. 4 Year 2013 on Radiation Protection and Safety of Nuclear Energy Utilization
21.	BAPETEN Chairman Regulation No. 16 Year 2012 on Clearance Level

No.	Name of Regulation
22.	BAPETEN Chairman Regulation No. 2 Year 2011 on Safety Requirements on the Operational of Non-power Reactors
23.	BAPETEN Chairman Regulation No. 6 Year 2011 on Decommissioning of Non-Reactor Nuclear Facility
24.	BAPETEN Chairman Regulation No. 4 Year 2010 on the Management Systems for Facility and Activity in the Utilizations of Nuclear Energy
25.	BAPETEN Chairman Regulation No. 1 Year 2010 on the Emergency Preparedness and Response
26.	BAPETEN Chairman Regulation No. 4 Year 2009 on Decommissioning of Nuclear Reactors
27.	BAPETEN Chairman Regulation No. 11 Year 2007 on the Safety of Non-Reactor Nuclear Facility
28.	BAPETEN Chairman Regulation No. 3 Year 2006 on the Licensing of Non-Reactor Nuclear Facility
29.	BNPB Chairman Regulation No.3 Year 2016 on Disaster Emergency Management Command System

Annex C – Figures

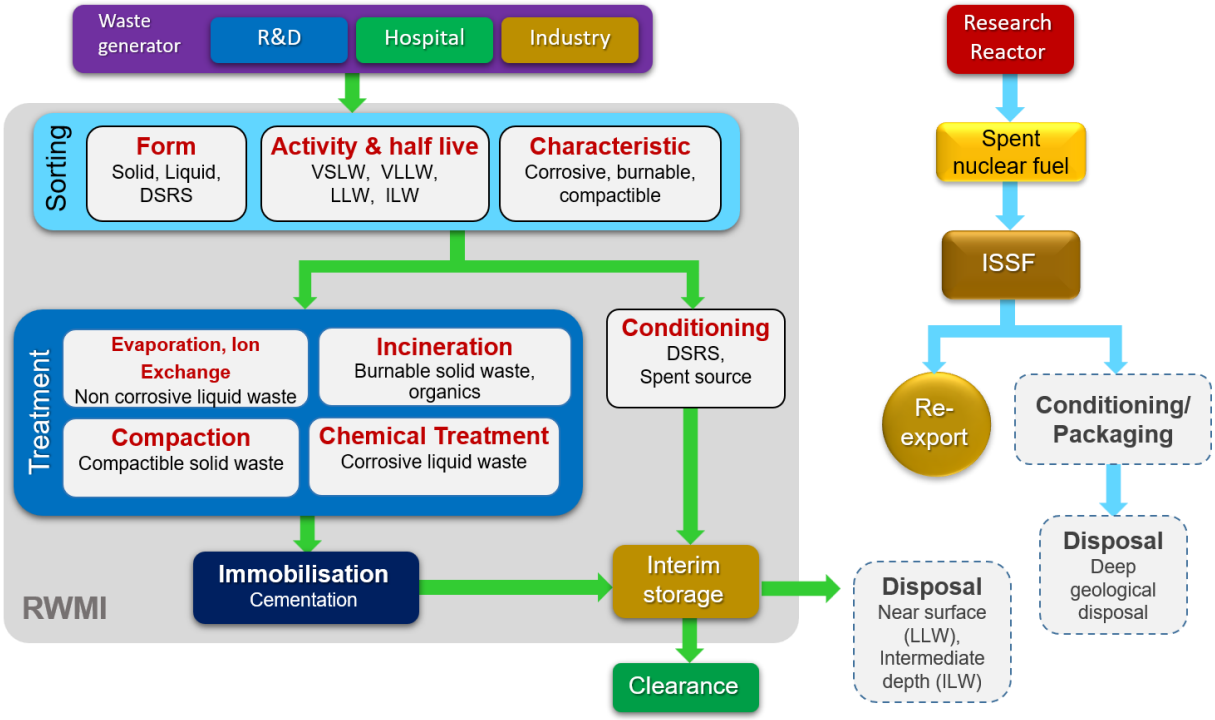

Figure L.1. Principles of Management of Low and Intermediate Level Wastes

Figure L.2. Interim Storage Building No.1

Figure L.3. Interim Storage Building No.1 (Pre-Treatment)

Figure L.4. Interim Storage Building No.1 (Post Treatment)

Figure L.5. Interim Storage Building No 2

Figure L.6. Inside Interim Storage Building No.2

Figure L.7. Interim Storage for High Activity Radioactive Waste Building

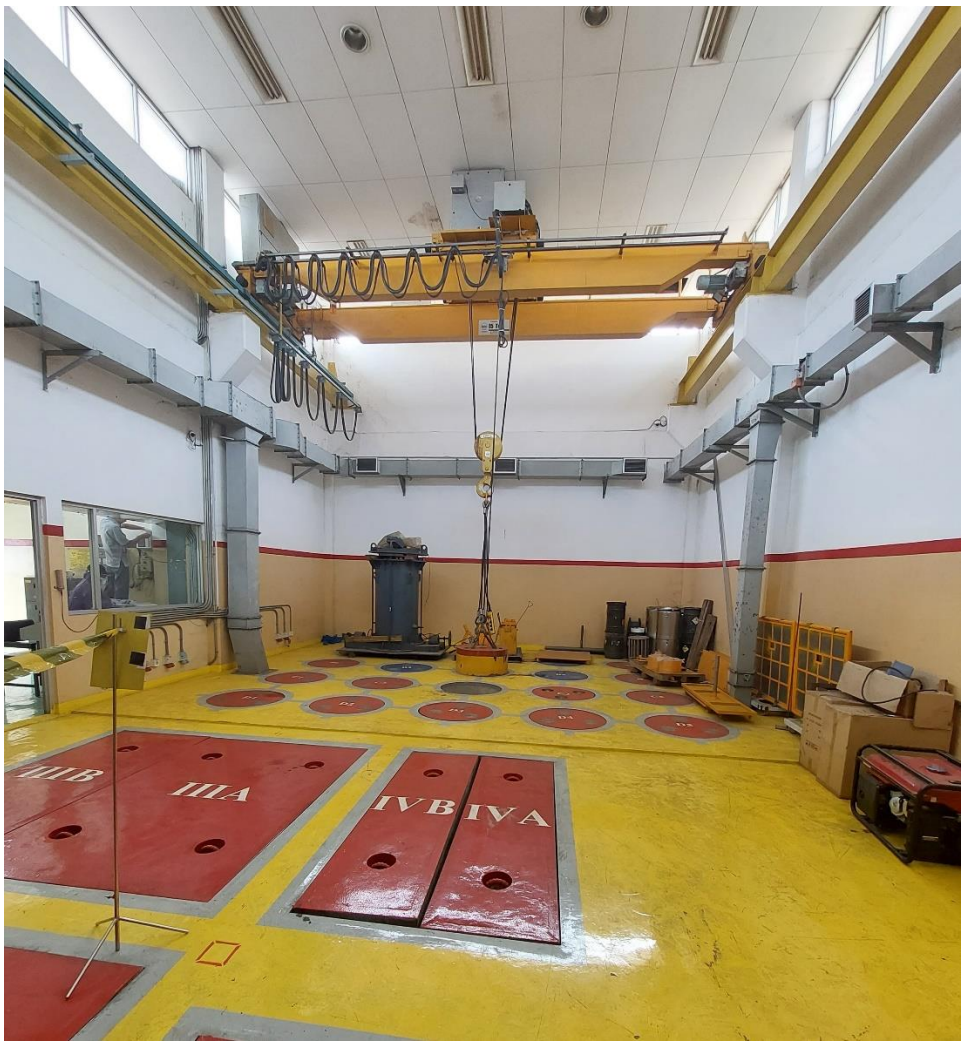

Figure L.8. Interim Storage for High Activity Radioactive Waste

Figure L.9. Interim Storage for Spent Fuel Facility

Figure L.10. Multipurpose Research Reactor

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