



SPENT FUEL MANAGEMENT IN INDONESIA

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Regulatory Requirements for Spent Fuel Management

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PROFESIONAL
OPTIMIS
PRODUKTIF

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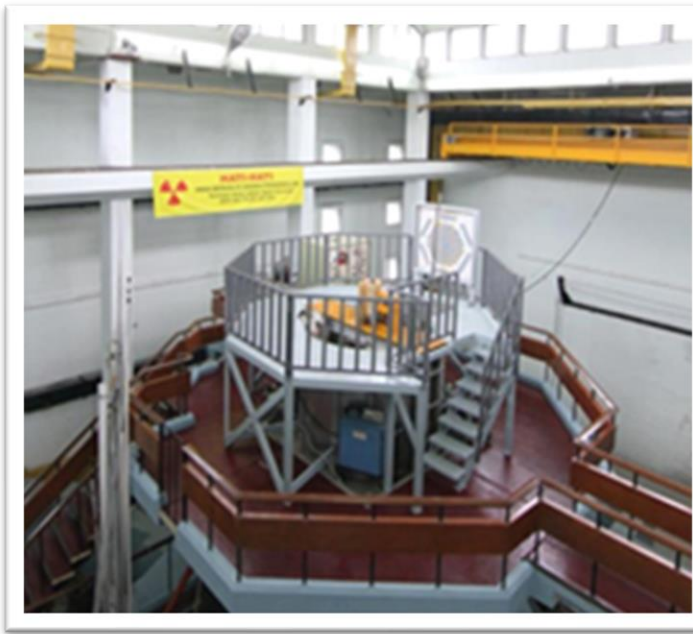
INTRODUCTION

RESEARCH REACTORS IN INDONESIA



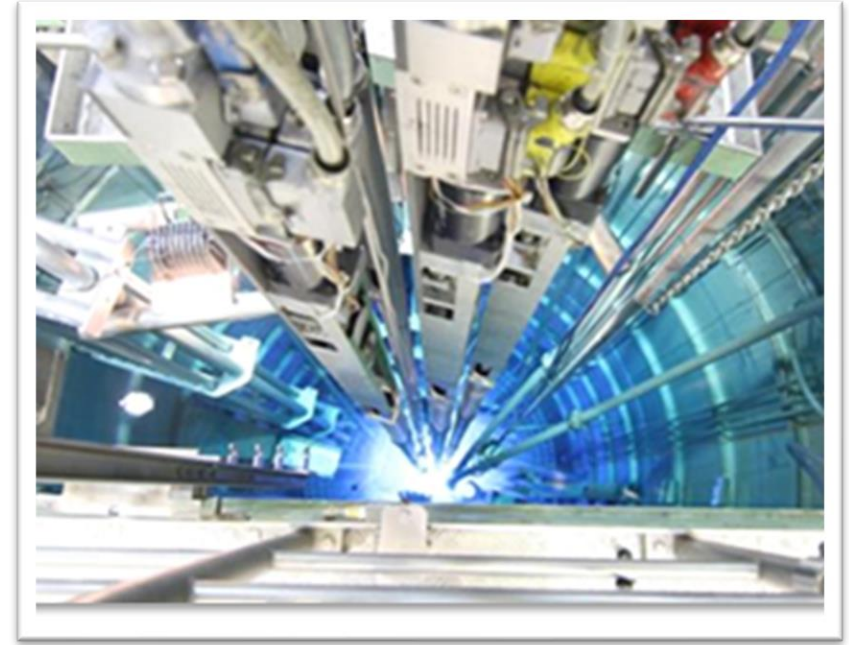
1. KARTINI

- Located in Yogyakarta
- Operated since March 1979
- Power capacity 100 kW
- **Utility** : research and human resource development



2. TRIGA 2000

- Located in Bandung
- Operated since 1969
- Initial power capacity 250 kW
- Upgraded to 1 MW in 1972 and to 2 MW in 2000
- **Utility**: research and radioisotope production.



3. GA Siwabessy

- Located in Serpong
- Operated since 1987
- Power capacity 30MW
- **Utility**: research, radioisotope production, materials testing.

Table 1. Research Reactor Data in Indonesia

PLACE/ SITE	MAKER	TYPE	Critical Date	RECENT POWER	STATUS	UTILITY
BANDUNG	GA	TRIGA	1964	2000 kW	In operation	research and radioisotope production
YOGYAKARTA	GA	TRIGA	1979	100 kW	Temporary shutdown	research and human resource development
SERPONG	INTERATOM	MTR	1987	30 MW	In operation	research, radioisotope production, materials testing

GA: General Atomics

TRIGA: Training, Research, Isotopes, General Atomics

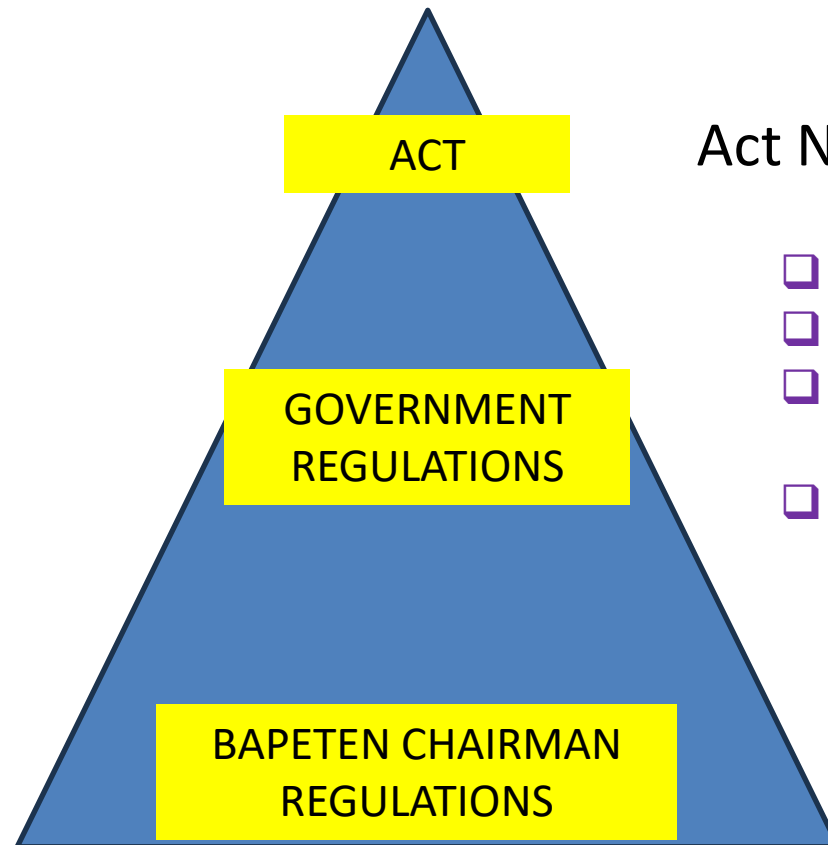
MTR: Material Testing Reactor

Their operation generate SNF



REGULATORY FRAMEWORK OF SNF

REGULATORY FRAMEWORK OF SNF



Act No: 10 Year 1997 on Nuclear Energy

- ☐ GR. No 61 Year 2013 on Management of Radioactive Waste.
 - ☐ GR. No 2 Year 2014 on Licensing on Nuclear Installation
 - ☐ GR. No 54 Year 2012 on Safety and security of Nuclear Installation
 - ☐ President Regulation No 84 Year 2010 on Ratification of Joint Convention on the Safety of Spent Fuel Management and Radioactive Waste Management
-
- ☐ BCR No.04 Year 2013 on Radiation Protection and Safety in Nuclear Energy Utilization
 - ☐ BCR No.8 Year 2016 on the Radioactive Waste Management.

REGULATORY FRAMEWORK OF SNF



The government forms an **executing body** and a **regulatory body**

BRIN as an **executing body** is responsible for conducting research, development, utilization of nuclear energy, and management of radioactive waste

BAPETEN is an independent nuclear **regulatory body** whose functions are to regulate through regulation, licensing, and inspection of all activities Utilization of Nuclear Energy

GR No.61 Year 2013 on Management of Radioactive Waste

REGULATORY FRAMEWORK OF SNF



- ❑ Producers of highly radioactive waste must temporarily store said waste for at least the duration of the operation of the nuclear reactor

(article 24 paragraph 2)

- ❑ The Implementing Agency provides a sustainable storage place for high-level radioactive waste

(article 25, paragraph 1)

- ❑ Determination of sustainable storage place as referred to in paragraph (1) is stipulated by the Government after obtaining approval House of Representative of Republic Indonesia

(article 25 paragraph 2)

REGULATORY FRAMEWORK OF SNF



- ❑ Radioactive waste (SNF) generators must implement temporary storage of Spent Nuclear Fuel at least during the operational life of the nuclear reactor

(Article 32)

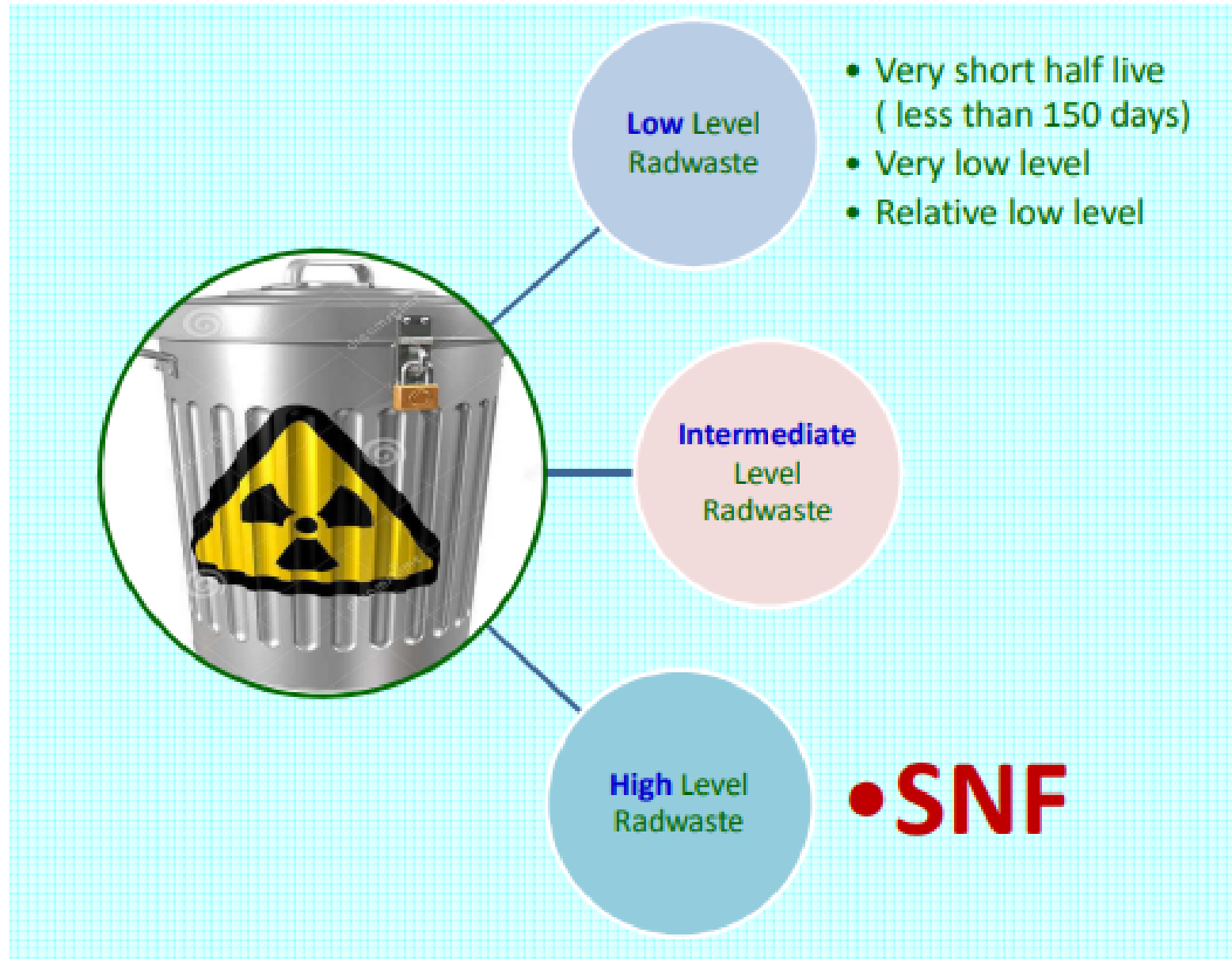
- ❑ After carrying out the temporary storage as referred to in Article 32, the Radioactive Waste Generator must:
 - a. send back the Spent Nuclear Fuel to the country of origin; or
 - b. handing over Spent Nuclear Fuel to BRIN

(Article 33)

- ❑ Before sending back Spent Nuclear Fuel to the country of origin as referred to in Article 33 letter a, the Radioactive Waste Generator must obtain:
 - a. approval for sending back to the country of origin from the Head of BAPETEN; And
 - b. delivery approval from the Head of BAPETEN

(Article 34)

CLASSIFICATION OF RADWASTE



- Act No. 10 Year 1997 classifies radioactive waste as low, intermediate, and high level of radioactive waste.
- Furthermore, GR No. 61 Year 2013 states that high-level radioactive waste includes spent fuel.

NATIONAL POLICY

- ❑ Indonesia applies open cycle on management of nuclear material, no reprocessing process for SNF.
- ❑ Indonesia utilizes nuclear energy for peaceful purposes
- ❑ Indonesia has the policy to prioritize re-exporting the spent fuels to the origin countries or storing them within the authorized facility.



Fresh fuel



Re-export



ISFSF



INTERIME STORAGE

INTERIME STORAGE



The operator reactor has responsibility:

- To store SNF in temporary storage to achieve significant decrease in radiation exposure and decay heat generated by fission product
- This activities usually should be done at least for 100 days
- After the storage periode finished, it should be:
 - Transferred to ISFSF; or
 - Re-exported to the country origin

INTERIME STORAGE

Temporary Storage



KARTINI & TRIGA

- SNF store temporary under water in the bulk shielding pool



RSG-GAS

- Has service pool used for temporary wet storage with capacities 288 SNF assemblies
- Located adjacent to the reactor pool
- Separated by a gate from the main reactor pool



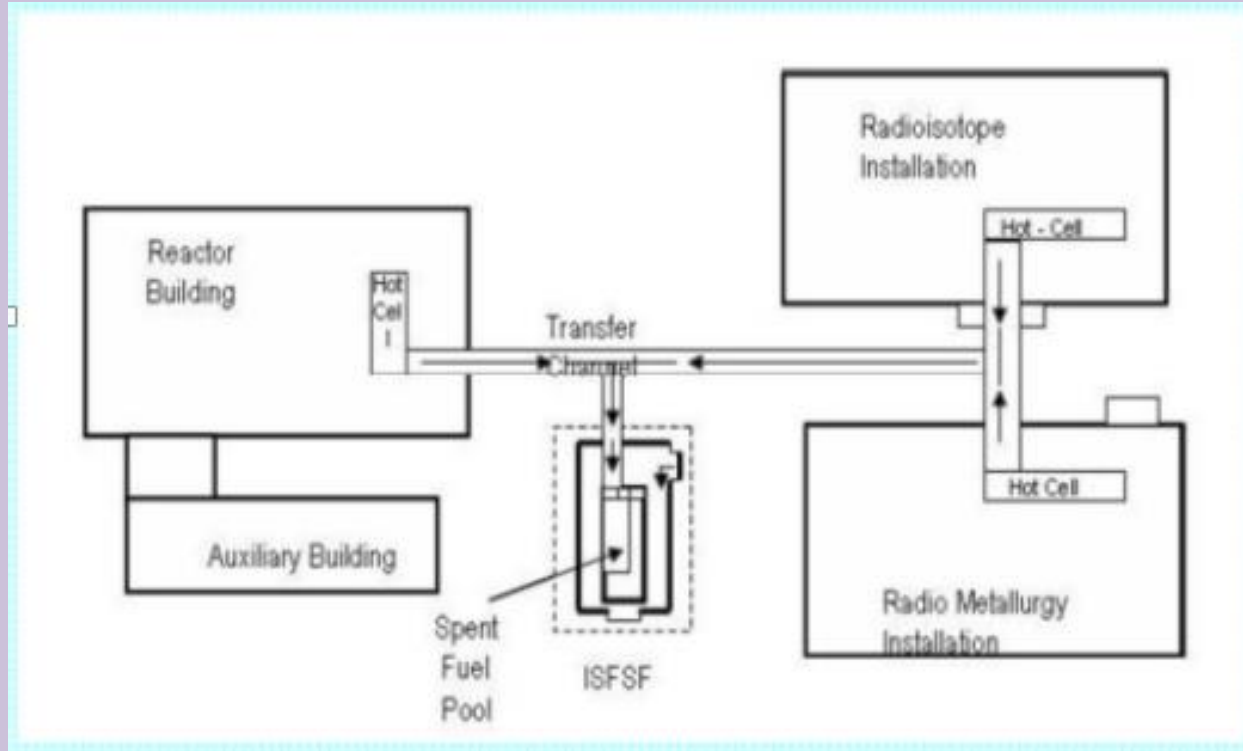
TRANSFER TO ISFSF



The Requirements for transferring SNF to ISFSF

- Shipment approval from Regulatory Body
- The process should be done in valid period (14 days)
- Be evidenced by the handover document (official report) created by BRIN
- The handover document should be reported to Regulatory Body at least 14 days after transfer process

Movement of SNF to the ISSF is carry out underwater by means of Transfer Channel (TC)



- Located nearby RSG-GAS in Serpong
- Operated by BRIN

To operate ISFSF, BRIN should have:

- License for utilization material
- License for operating ISFSF

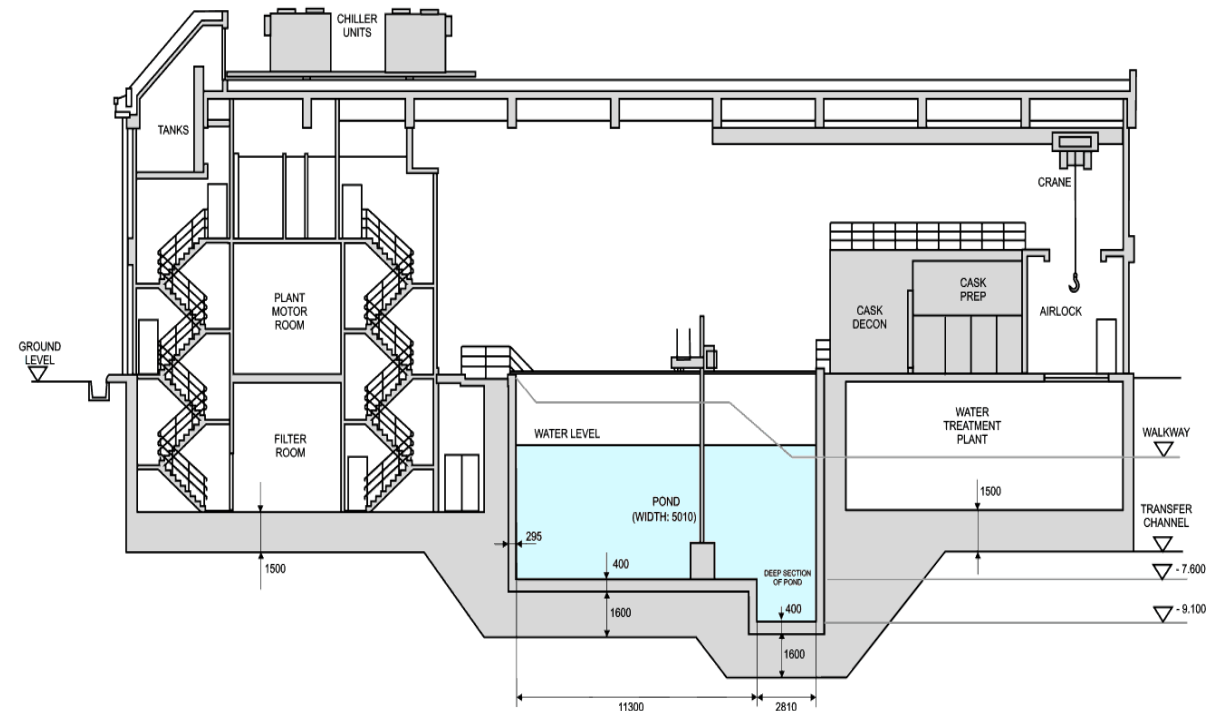
Transfer Channels connects the ISSF to the Reactor Installation (GAS-MPR), Radioisotop Production Installation (RPI), and Radiometallurgy Installation (RMI) buildings.

Interim Storage For Spent Fuel



- ❑ The main function of the ISSF is to receive and store-underwater, Spent Nuclear Fuel (SNF) arising from the operation of the GA Siwabessy Multipurpose Reactor (GAS-MPR)

- ❑ Storage of spent fuel shall be performed according to radiation safety, physical protection, and safeguards regulations.
- ❑ Regulatory body inspect the safety, security, and safeguards aspects of the storage facilities of spent fuels periodically.



ISFSF Lay Out

RSG GAS Fuel Type

Fuel element type	Flat Plate
Dimension (mm x mm x mm)	76.1 x 80.1 x 868
Cladding Material	AlMg₂
Clad thickness (mm)	0.38
Meat dimension (mm x mm x mm)	0.54 x 62.75 x 600
Fuel Meat	U₃Si₂Al
U-235 Enrichment (%)	19.75
Uranium Density (g/cm³)	2.96
U-235 weight per Fuel Element (g)	250
U-235 weight per Control Element (g)	178.6



ISFSF Profile

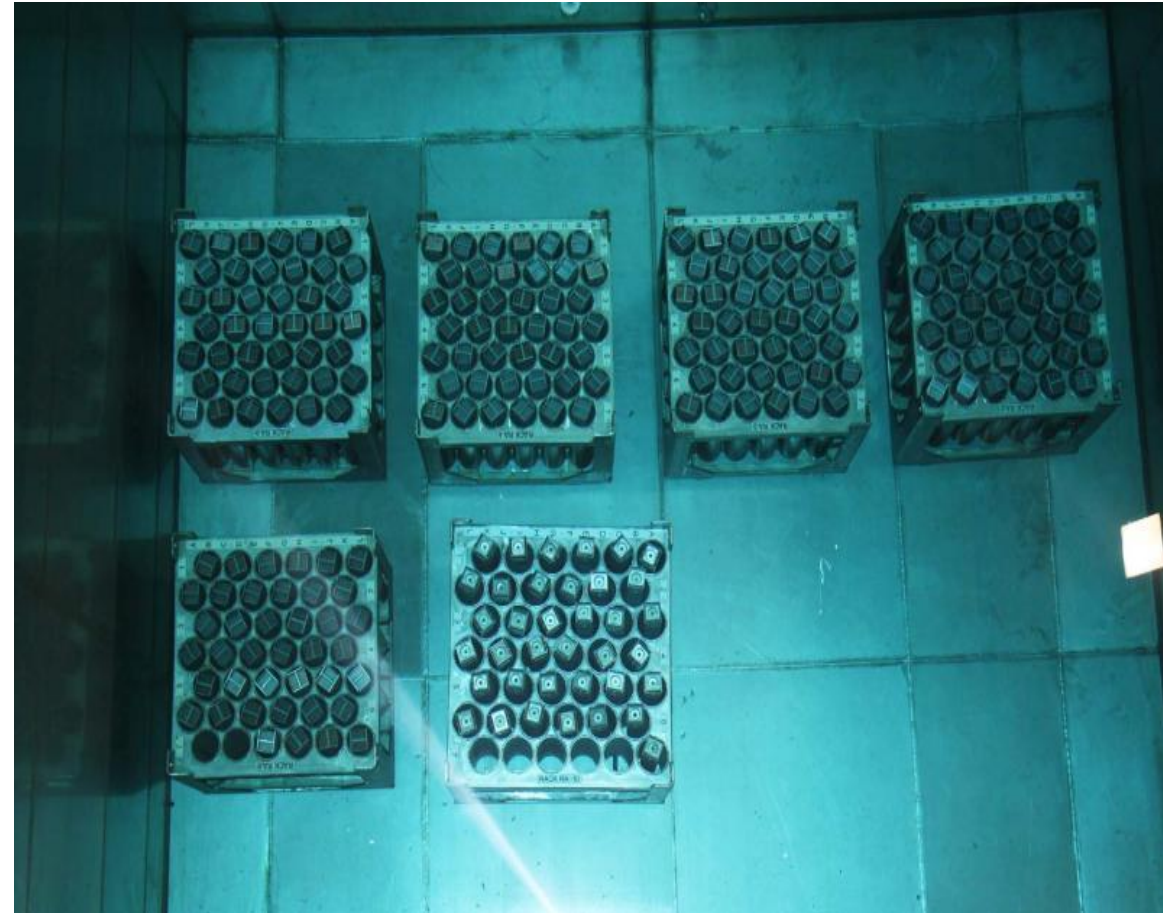
- **Designed by AEA Technology, UK**
- **Operated since 1998**
- **Multi barrier construction: SS-304 liner, pond walls, mild steel, concrete .**
- **Capacity: 1458 spent fuels**
- **SF store at the SS rack**



Nowadays there are 287 spent fuels in the ISSF pond

The boundary conditions for the normal operation of TC-ISSF

No	Parameters	limitations
1	Water temperature of ponds	< 35°C
2	pH pond water	5,5 -7,5
3	Conductivity of pond water	< 8µS/cm
4	Water pond height from top of the spent fuel	>3,6 m
5	Negative air pressure	75 – 125 Pa
6	Air temperature	≤ 25°C
7	Exposure of gamma throughout installation	< 10µSv/hours
8	Air contamination in the working area	< 70 Bq/m ³



The spent fuels will be there for a long time until they are moved to dry storage or disposal facility (At present, Indonesia does not have dry storage and disposal facility)

Tabel 2. Research Reactor Spent Fuels Inventories

Facility Name	Owner	License	Critical Date	Facility Type	Fuel Type	Storage Type	Store Location	Design Capacity (elements)	Inventory (elements)
CMPR	BRIN	BAPETEN	1987	MPR 30	MTR	POOL/POND	At reactor building	300	24
ISFSF	BRIN	BAPETEN	1999	INTERIM STORAGE	MTR/TRIGA	POOL/POND	Serpong site	1458	377
TRIGA 2000	BRIN	BAPETEN	1964	TRIGA MARK II	TRIGA	POOL/POND	At reactor building	330	0
KARTINI	BRIN	BAPETEN	1979	TRIGA MARK II	TRIGA	POOL/POND	At reactor building	90	0



RE-EXPORT

RE-EXPORT

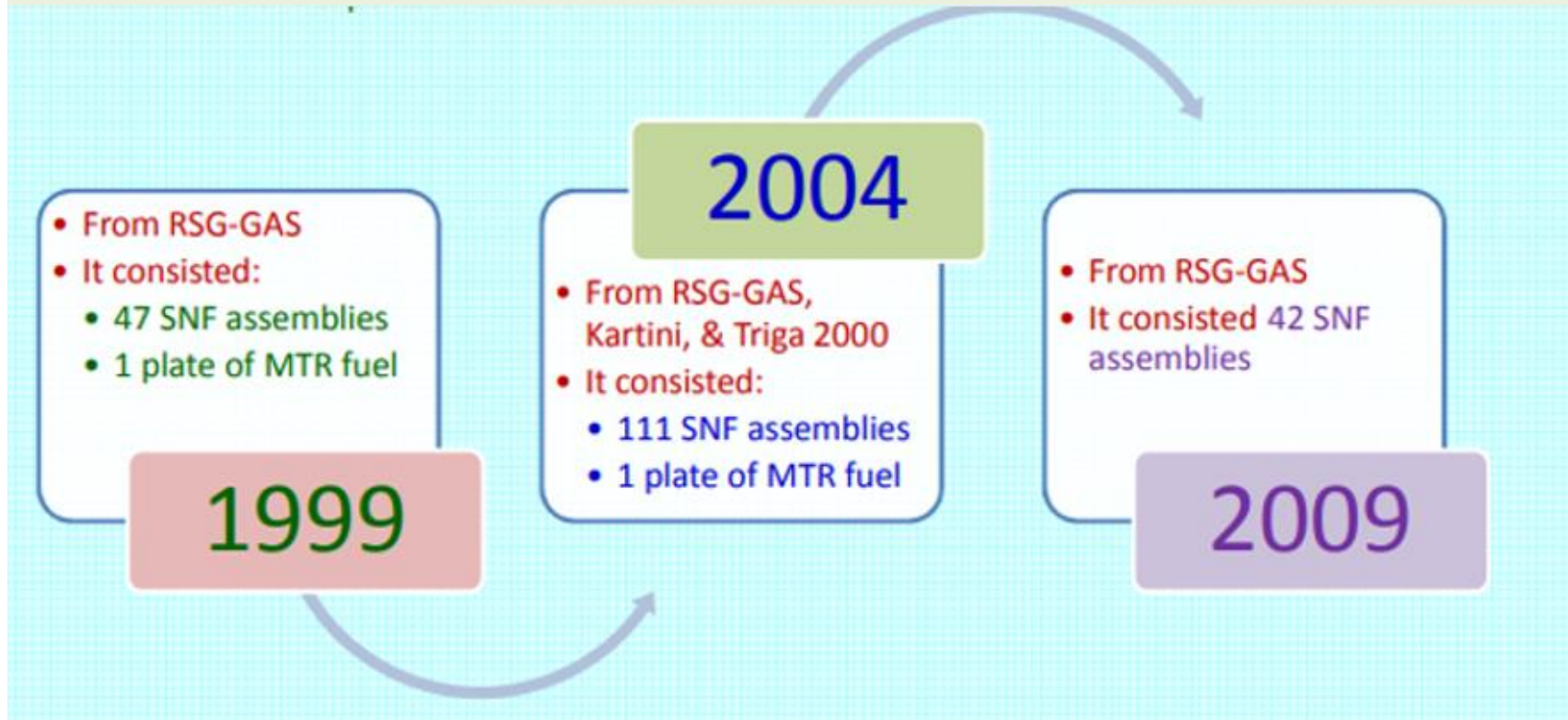


Requirements for SNF Re-export

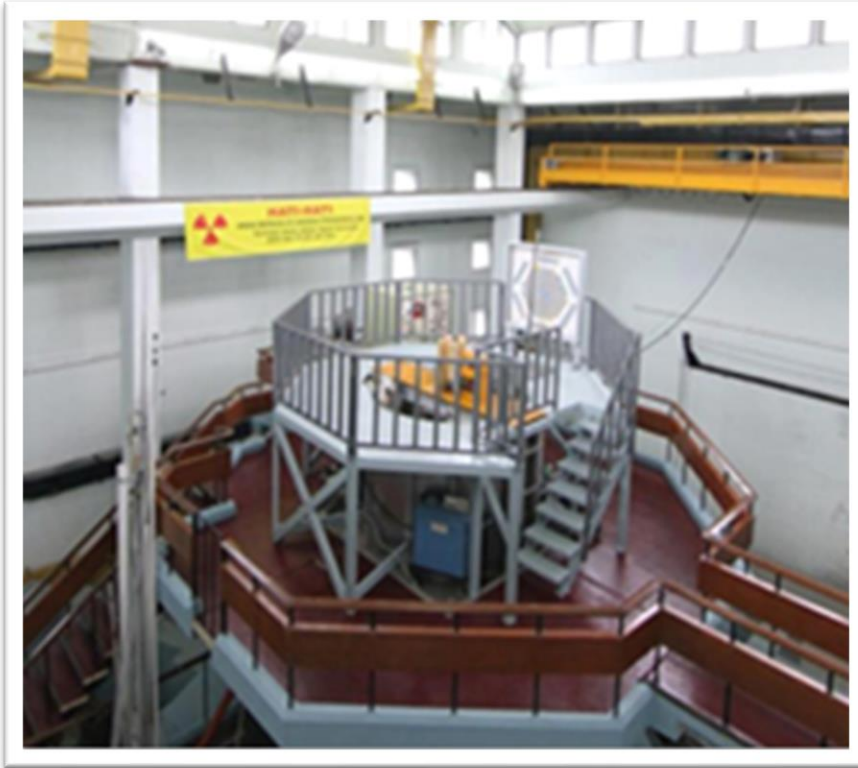
- Re-export approval to the origin country from Regulatory Body
- Shipment approval for transport process from Regulatory Body
- Packaging certificate verified by Regulatory body
- The process should be reported to Regulatory Body at least 14 days after re-export conducted

RE-EXPORT EXPERIENCES

National Research and Innovation Agency of Indonesia (BRIN) has three experiences on re-export of SNF activities. In 1996, US DOE issued a record of Decision (ROD) on Nuclear Weapons Non-proliferation Policy Concerning Foreign Research Spent Nuclear Fuel to recover enrich uranium exported from USA



RECORD AND REPORT SYSTEM



Operator's responsibilities

- ☐ To make recording system (during storage and transportation)
- ☐ It should cover SNF inventory and all related activities
- ☐ Report it to Regulatory Body at least for six months period



CONCLUSIONS

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- ❑ Regulations on Management of Radioactive Waste is legal basis on management of SNF in Indonesia
- ❑ SNF explicitly classified as High Level of radioactive waste
- ❑ Indonesia applies open cycle on management of nuclear material, no reprocessing process for SNF.
- ❑ Regulations covers requirements on temporary or interim storage, re-export, transfer, transport, trans boundary movement, disposal facility and record and report system of SNF



BRIN

BADAN RISET
DAN INOVASI NASIONAL

Thank You

