Safety and Sustainability Considerations in the Operation Management of Spent Nuclear Fuel Interim Storage Facility in Indonesia

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T. Sundari, A. Wijayanto, Budiyono, A. Setyawan

National Research and Innovation Agency (BRIN), Jl. M.H. Thamrin No. 8, 10340, Jakarta, Indonesia.

titi020@brin.go.id

1. Background

ISSF operations are inevitable from generating radioactive waste, and sustainable solutions for radioactive waste management are necessary to achieve sustainable development goals.

The paper presents operating experience in safe management of the radioactive waste and the efforts towards sustainability at the ISSF operation.

The efforts and some recommendations are highlighted.

2. Methodology

The method used is performed by identification of the systems or processes at the ISSF focused on process that generate radioactive waste followed by an evaluation of the safety performance of these systems.

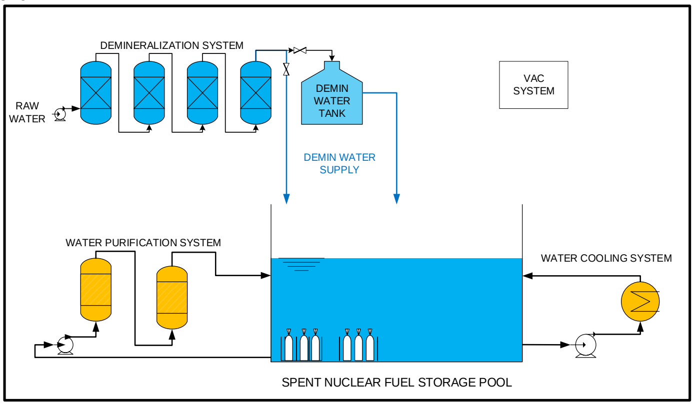
3. Results and Discussion

The radioactive waste management process is based on Government Regulation no. 61 of 2013 concerning Management of Radioactive Waste and Decision of the Head of BAPETEN No. 03/Ka-BAPETEN/V-99 concerning Provisions for the Safety of Radioactive Waste Management.

3.1 *Process and Waste Identification*

Transfer channel-interim storage for spent nuclear fuel (TC-ISSF), a wet storage designed to accommodate spent nuclear fuel resulting from 25 years of G.A. Siwabessy Multipurpose Reactor (GAS-MPR) operations plus 1 core unload. The storage pond serves to temporarily store the SNFs and other irradiated materials. The capacity of this storage pool can store 1448 SNFs.

Currently, the type of SNFs stored in ISSF is only SNFs from GAS-MPR with the MTR type. Two types of stored fuel elements namely U308-Al oxide fuel and U3Si2-AL silicide fuel. The ISSF's pool has 5 m wide, 14 m long and -7.6 m depth [1-3]. An overview of the storage pond system with the main processes directly related to the pond.



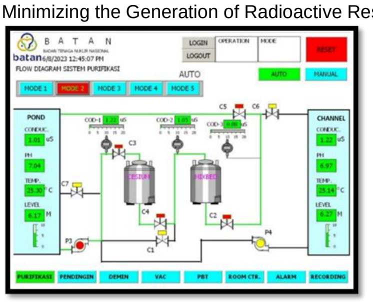
Main process of the TC-ISSF in Indonesia

Effluent/waste output data from various waste discharge points are as follows:

a. Gas effluent ➔ stack exhaust, alpha beta monitoring.
b. Liquid effluent➔ decontamination, hand wash, cleaning and spills, etc.
c. Semi-liquid waste➔ radioactive spent resin.
d. Solid waste➔ prefilter, skimmer filter, shoe covers, gloves, etc

3.2 Effort for safety and sustainability

3.2.1. Minimizing the Generation of Radioactive Resin Waste



Pond water purification system in TC-ISSF.

Cesium bed radiation exposure monitoring.

Limit operating conditions (LOC) in purification system:

No.	Parameter	Value
(a.)	Pressure difference before and after column, ΔP	Maximum 1.5 bar
(b.)	The difference in conductivity or concentration of radionuclide activity before and after the column	> 0
(c.)	Purification filter column dose rate	Maximum 200 µSv/hour
(d.)	Purification system flow rate	4-6 m^3/hour

For controlling personnel safety, the maximum dose rate for the surface of the purification column is set at 200 µSv/hour. Calculations using MicroShield 7.02 software, a dose rate of 200 µSv/hour is equivalent to the total activity of Cs-137 in a resin bed of 25 mCi.

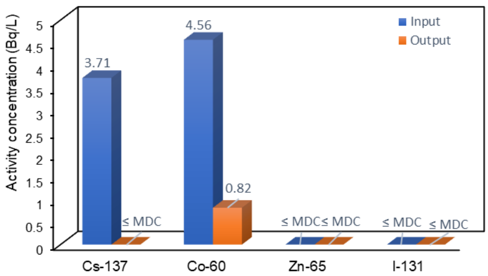
Currently, the measurement of the exposure rate on the surface of the Cesium resin column results in an average exposure rate of 233.50 ± 7.94 µSv/hour.

Some conditions and considerations based on safety and sustainability:

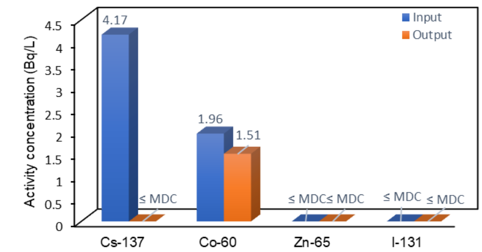
- Distance between the purification bed and the monitoring point (at which point many officers carry out activities, approximately 1 meter from the bed), the dose rate at the monitoring point does not exceed 10 µSv/hour.
- Radius of 1 meter the cesium column is not a working area where workers often stay for a long time.
- More frequent replacement of resin results in more radioactive waste spent resin being formed.
- The purification resin is replaced when the resin is saturated and is no longer able to absorb contaminant/impurities.
- For safety purposes, columns that have high exposure can be shielded against areas that are passed by workers.
- study was carried out by analysing the radionuclide levels before (input) and after passing through the cesium column (output)

Analysis result of conductivity and pressure difference:

Mode	Conductivity (µs/cm)		Pressure difference, ΔP (bar)	
	Input	Output	Cesium	Mixed bed
1 (Through Cesium bed)	1.28	1.25	0.65	0.30
	1.25	0.86	0.65	0.30
2 (Cesium & Mixed bed)	1.26	1.19	1.10	0.25
	1.24	0.85	1.10	0.25



*Radionuclide in **pond** water purification process(Mode 2).*



*Radionuclide in **TC** water purification process (Mode 5).*

- both modes 1 and 2: output has lower conductivity than input.
- the pressure difference is below 1.5 bar.
- Cs-137 contained in the input was no longer detected at the output.
- Co-60 radionuclide decreased at the output.
- This shows that the resin can still absorb radionuclide contaminants.

Recommendations:

1. Replace the resin when is completely saturated/unable to absorb.
2. resin saturation parameters: Conductivity, ΔP, radionuclide in-out.
3. Revise the LOC, becomes exposure at working area.
4. Bed radiation shielding.

3.2.2. Provision for early detection of leakage➔ sipping test for SNFs.
3.2.3. Waste segregation practices➔ shoe covers, skimmer filter, etc.
3.2.4. Minimization of leaks and spills➔ water sampling sent back to pond.
3.2.5. Avoidance of the release of contamination➔ effluent monitoring.
3.2.6. Periodic review of operational practices➔ review the resin transfer system.

4. Conclusions and Acknowledgements

- ➢ Some efforts in the operations of Indonesia's TC-ISSF to ensure a safer and more sustainable future are minimizing the generation of radioactive waste, provision for early detection of leakage and contaminant migration, waste Segregation Practices, minimization of leaks and spills, avoidance of the release of contamination, and periodic review of operational practices. Especially for water purification system, there are some recommendations presented.
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