Radiological Assessments Suggestion for Improvement on Regulatory Radioactive Waste Clearance Level of the Scrap Metal and Concrete Shell at Radioactive Waste Management in Indonesia

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Abstract

Since it first was operated in 1988, the facility of radioactive waste management installation in National Nuclear Energy Agency (BATAN) Indonesia has many radioactive waste packages in cementation form 1070 of drums 200 liters, 148 of concrete shell 950 liters and 10 of wooden box which is contain with contaminated scrap metal. The waste package has been stored in the interim storage building that the capacity is very limited, so in order to ensure the sustainability of the storage of radioactive waste treatment, it is necessary to discharge waste packages that have fulfilled the regulatory clearance level of radioactive waste. As the wastes have been stored more than 28 years, some of them can be regulatory cleared. Before such regulatory clearance, radiological characteristics of the waste should be analyzed first. In this assessment, the procedure for representative sampling and analysis waste was developed. According to the analysis result, Cs-137 and Co-60 were major radionuclide while some of wastes were contaminated with Th-234, Ra-226, and U-238 with an extremely low concentration. Based on IAEA GSR Part 3, the analysis result shows that radioactive wastes in concrete shell have activity concentration of Cs-137 and Co-60 far as below 0.1 Bq/g. The contaminated scrap metal also have radioactivity alpha contamination as below 0.37 Bq/cm^2. It was estimate individual dose as below 10 μSv/years. This assessment can be applied as suggestion for improving on National Energy Regulatory Agency (BAPETEN) regulatory regarding clearance level of the scrap metal and concrete shell at radioactive waste management in Indonesia.

Keywords

radiological assessment, scrap metal waste, concrete shell waste, regulatory clearance

Process

Radiation Measurement Process on Concrete Shell

Radiation Measurement Process on Scap Metal

Deconta-mination Process

Introduction

The waste package that has been processed so far is radioactive waste packages in cementation form 1070 of drums 200 liters, 148 of concrete shell 950 liters and 10 of wooden box which is contain by contaminated scrap metal. The waste package is stored in the Interim Storage building (IS-1 and IS-2). The storage capacity of IS-1 and IS-2 Buildings are very limited, so in order to ensure the sustainability of the storage of radioactive waste treatment, it is necessary to expend/ discharge waste packages that have fulfilled the clearance level. In the effort of expenditure or release of waste packages, measurement, calculation and asessment of the clearance level on radioactive waste of processed products has been done. Against the radioactive waste that has reached the level of the clearance together this is requested for release of supervision through mechanism of stipulation of the clearance by BAPETEN. Radioactive waste proposed for the determination of clearance shall be in the form of:

a). Relatively large pieces of metal originating from the activity of decommissioning of phosphoric acid purification facility of Petrokimia Gresik, Inc which has done decontamination efforts in Center for Radioactive Waste Technology - BATAN.

b). Package of processed waste in the form of a 950 liters concrete shell containing the cementation result of the evaporative concentrate.

Role and Regulations

- International Atomic Energy Agency General Safety Requirements Part 3, "Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards" [8].
- Government Regulation of the Republic of Indonesia No. 61/2013 on the Radioactive Waste Management[6].
- Government Regulation on the Republic of Indonesia No. 101/2014 on the Management of Hazardous and Toxic Waste[7].
- BAPETEN Chairman Regulation No. 16/2012 on Clearance Level of Radioactive Waste[1].
- BAPETEN Chairman Regulation No. 08/2016 on the Low and Medium Level Radioactive Waste Treatment[3].

Equipments

- Contamination Monitor: Canberra MCB2, Ludlum 2241 and CoMo 300.
- Doserate Monitor: Surveymeter Terra , and
- Gamma Spectrometer: Portable BNC SAM 945N, identiFINDER Mirion HDS-101 G and Multichannel Analyzer (MCA) Ortec

Working Procedure

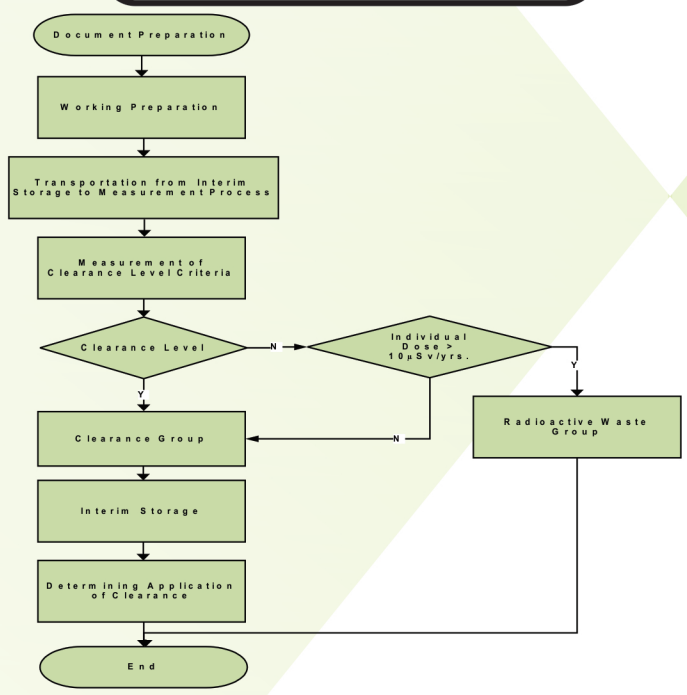

Figure 1. The Working Procedure for Determining Clearance of Radioactive Waste

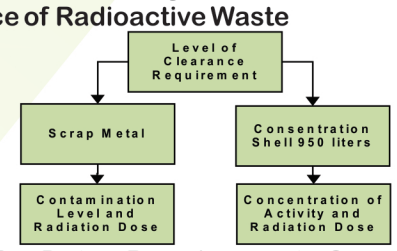

Figure 2. Data Requirement Compliance of Clearance Level for Scap Metals and Concrete Shell 950 liters Radioactive Waste

Analysis and Results

Table 1. The Scrap Metal of Radioactive Waste for Clearance Level.[11]

No. Sample	Weight (kg)	Volume (cm^3)	Average Activity (Bq/cm^2)	Doserate (μSv/hr)
1	26	4896	0.55	0.12
2	34	3627	0.29	0.13
3	36	3220	0.29	0.13
4	15	1935	0.26	0.13
5	27	2115	0.08	0.12
6	55	5775	0.33	0.13
7	15	1892	0.02	0.13
8	38.6	4688	0.31	0.14
9	26	2253	0.06	0.12
10	33	2763	0.24	0.14
11	30.6	4092	0.2	0.13
12	13	1951	0.42	0.13
13	36	4270	0.34	0.13
14	22	3000	0.3	0.13
15	41.6	4278	0.34	0.13
16	36.5	4305	0.29	0.13
17	27.4	3477	0.21	0.13
18	25	3200	0.27	0.13
19	30	4367	0.33	0.13
20	35	4209	0.32	0.13
21	31.6	4402	0.28	0.13
22	39	4836	0.25	0.13
23	35	4563	0.36	0.12
24	39	4526	0.43	0.13
25	20	2790	0.36	0.13
26	11	744	0.32	0.12
27	3	230	0.66	0.13
28	30	3720	0.36	0.12
29	14	20170	0.56	0.11
30	40	13950	0.3	0.12
31	34	4375	0.58	0.13
32	9	75	0.97	0.12
33	18	175	0.11	0.12
34	39	4526	0.17	0.13
35	42	824	0.03	0.13
36	18	408	0.54	0.12

Table 2. The Concrete Shell of Concentrate Radioactive Waste for Clearance Level.[11]

No. Shell	Nuclide	Activity Consentration (μCi/ml)	Composite Activity Consentration (Bq/g)	Doserate (μSv/hr)
1A	Cs-137	5.00.E-06	0.010168	0.14
2A	Cs-137	9.50.E-07	0.001955	0.16
3A	Cs-137	9.09.E-07	0.001905	0.16
4A	Cs-137	6.81.E-07	0.001448	0.15
5A	Cs-137	2.50.E-07	0.000527	0.15
6A	Cs-137	9.00.E-06	0.019067	0.15
7A	Cs-137	2.50.E-05	0.053753	0.15
10A	Co-60	7.70.E-06	0.001378	0.15
11A	Co-60	1.27.E-05	0.002336	0.15
12A	Cs-137	3.42.E-06	0.007657	0.15
13A	Cs-137	3.97.E-06	0.008981	0.16
14A	Cs-137	3.77.E-06	0.009446	0.16
15A	Cs-137	2.14.E-06	0.004855	0.15
16A	Cs-137	3.50.E-05	0.08997	0.16

Radiation doserate background= 0.12μSv/hr.

Radiological Dose Assessment

Table 3. The Radiological Doses Assessment Result

Waste	Assessments	Criteria	Actual
Concrete Shell	Composite Activity Concentration	Co-60 < 1 Bq/g Cs-137 < 1 Bq/g (IAEA GSR Part3[8], BAPETEN[1])	Co-60 0.002336 Bq/g Cs-137 0.08997 Bq/g
Scrap Metal	Average Activity	α < 0.37 Bq/cm^2 (BAPETEN[2])	0.97 Bq/cm^2
Concrete Shell and Scrap Metal	Individual Dose	< 10 μSv/years (IAEA GSR Part 3[8])	6 μSv/years

Using the data parameter assessment likes 40 hours/weeks = 1920 hours work effective per years and inhalation rate 7,400 m^3/year, thickness of cover soil 15 cm/day, 60 cm (final)[5], activity concentration maximum of Co-60 = 0.002336 Bq/g, and Cs-137 = 0.08997 Bq/g, and also no dose due to ingestion was considered but an inhalation pathway and external dose was considered, the total annual dose individual dose due the cleared was estimated around 6 μSv/ years.

Conclusions

Based on the dose assessment results, that radioactive wastes in concrete shell have a radioactivity far as below 0.1 Bq/g and the contaminated scrap metal have radioactivity α contamination as below 0.37 Bq/cm^2 and also it was estimate individual dose as below 10 μSv/years, so it was considerate for clearance. The analysis assessment result shows that radioactive wastes in concrete shell and scrap metal are above meets the limits of clearance level in BAPETEN Chairman Regulation No. 16/2012[1], so there is no need for radiology study such as effective dose calculation to critical group.

References

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