

A Review on International Trends in NORM Residue Disposal

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1. Introduction

'The Act on Safety Control of Radioactive Rays around Living Environment' requires safe management of Naturally Occurring Radioactive Materials (NORM). 'Research Center for Safe Control of Radiation Sources around Living' has been established at SNU to perform basic research for preparation of regulatory guide regarding NORM. The scope of research activities at the Center includes NORM as raw materials and residues.

Although the radioactivity concentration is relatively low in general, disposal of NORM residues can be troublesome because of their large quantities. Current international trends in NORM residue disposal are reviewed in this paper. Careful consideration on safety of the worker, the public and the environment is required for each disposal options.

2. Analysis on Disposal Options

2.1 Application of IAEA Standards to NORM Residue

Phosphogypsum, fly ash and red mud are typical NORM residues that rise from phosphate industry, coal power plant and alumina production facility, respectively. Pipe scale from oil and gas industry is another example of NORM residue. According to the waste hierarchy, recycling of these residues should be the first to consider. The residues can be disposed of only if recycling or reuse is not feasible.

Applying the classification scheme for radioactive waste to NORM residue, IAEA expects NORM residues to belong to low level waste (LLW) or very low level waste (VLLW). Then, possible disposal option would be near surface or landfill disposal [1] (see Fig.1).

NORM residues with activity concentrations below exemption or clearance level would be exempt wastes. In case of bulk materials, as most NORM residues, the concepts of exemption and clearance can merge into a single set of regulations. IAEA recommends materials with activity concentration below 1 Bq/g (Uranium and Thorium series radionuclides) or 10 Bq/g (K-40) be considered unnecessary to regulate [2].

2.2 Near Surface Disposal

Near surface disposal refers to disposal of solid or solidified radioactive waste in a facility near or at the

land surface. NORM residues with relatively high radioactive concentrations are suitable for near surface disposal.

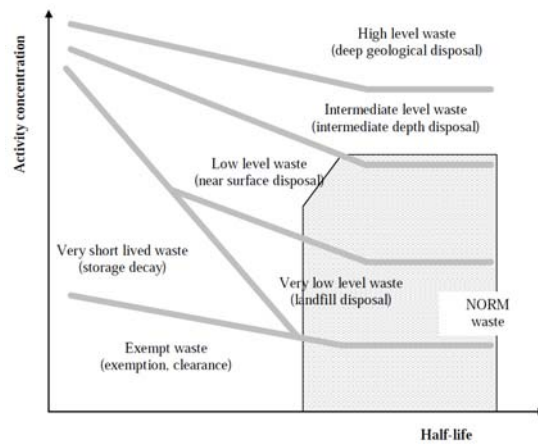


Fig. 1. The IAEA classification scheme for radioactive waste and its application to NORM waste [1].

In the Netherlands, NORM residues with activity concentrations more than 10 times the exemption level should go through predisposal treatment at COVRA, an organization responsible for interim storage of all types of radioactive waste including NORM residues. Various NORM residues including pipe scale, calcinate and phosphogypsum are solidified and stored in separate packages [3].

Most NORM residues in Norway are pipe scales from oil industry. Scales of low specific activity exceeding the repository level (5 Bq/g each for Ra-226, Ra-228 and Pb-210) are stored at the Stangeneset NORM disposal site, a facility constructed as a near surface rock cavern repository [4].

2.3 Landfill Disposal

Landfill disposal is a common option for NORM residue as for normal industrial waste or hazardous waste. Landfill facilities can be constructed with natural barriers or engineered barriers such as concrete cells or silos [1].

Since the half-lives of many natural radionuclides exceed the practical monitoring period of the landfill sites, long-term management plan should be prepared considering the effect on public health around the sites afterwards. Assessment of the public health effect should be made by scenarios encompassing natural

causes such as climatic and seismic events and human intrusion such as irrigation and livestock watering [1]. A preliminary assessment was made of the safety in living at or near landfill sites based on typical properties of NORM residues in Korea [5]. RESRAD-OFFSITE was used for the numerical estimation of radiation doses and excess cancer risks.

Many countries are authorizing NORM residues to be disposed at the landfill sites of conventional use for industrial or hazardous waste. In the Netherlands and Norway, NORM residues with activity concentration between the exemption level and the repository level, as defined as 10 times the exemption level, can be disposed of at authorized conventional landfill sites (see Fig.2) [3, 4]. In this case, NORM residues can be disposed the same way as other industrial wastes but under the supervision of the national radiation protection authority, which would require basic radiation protection measures including radiological monitoring.

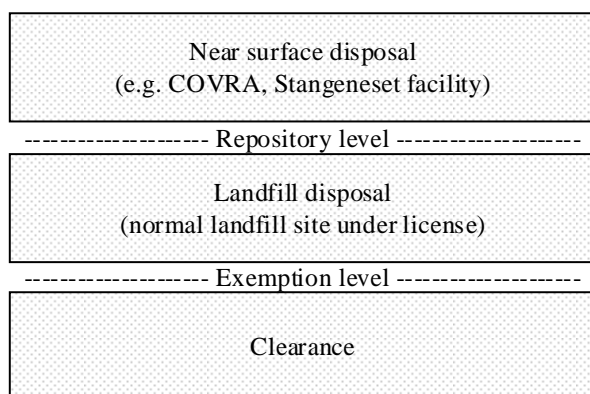


Fig. 2. The classification scheme of NORM residues in the Netherlands and Norway.

With clear criteria regarding exemption and disposal options, NORM industries can work toward maintaining the activity of residues between the exemption level and the repository level [4]. The residues can be disposed of at landfills accordingly.

2.4 Further Application of Repository Level

The repository level, 10 times the exemption level as defined by the Netherlands and Norway, can be adopted as a threshold of regulatory control for small amount of radioactive materials. In the Netherlands, NORM with an activity concentration of up to the repository level is exempted from regulatory control if the total amount is less than 1 ton [3]. Operation of such threshold enables achieving practicality of regulation without violating the basic system of safety control boundaries.

3. Discussion

International trends in the policy regarding NORM residue disposal are to organize the regulations being coherent with the graded approach in radioactive waste disposal. Requirements for safe disposal of NORM residues should be consistent with those of decommissioning wastes from nuclear power plants.

Systematic regulation is needed for safe and cost-effective disposal of NORM residues in bulk. Measurement techniques for radioactivity concentration of NORM residues in bulk amount should be standardized as well. Further discussion would help determine whether the repository level is a beneficial option not only for cost-effectiveness but also for public acceptance.

Acknowledgment

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