PREDISPOSAL RADIOACTIVE WASTE MANAGEMENT

Recognition of the importance of the safe management of radioactive waste means that, over the years, many well-established and effective techniques have been developed, and the nuclear industry and governments have gained considerable experience in this field.

Minimization of waste is a fundamental principle underpinning the design and operation of all nuclear operations, together with waste reuse and recycling. For the remaining radioactive waste that will be produced, it is essential that there is a well-defined plan (called a waste treatment path) to ensure the safe management and ultimately the safe disposal of radioactive waste so as to guarantee the sustainable long term deployment of nuclear technologies.

A State's nuclear waste management policy and national regulations will influence the chosen treatment option, but the general strategy is to concentrate and contain radioactive waste and isolate it from people and the environment. To implement this strategy, the waste generator (nuclear power plant operator, mining company, medical facility, etc.) needs to carry out a number of predisposal activities that may include characterization, pretreatment, treatment, conditioning and storage.

All of these activities are carried out by trained personnel following established guidelines for radiation protection, safety and security. The IAEA has established tight regulations for radioactive waste management to ensure that all operations meet strict standards with regard to safety and security.

Before selecting a waste management strategy or technology, it is essential to know and understand the waste source and rate of waste generation, as well as the amounts and characteristics of the waste. This allows for the selection of an appropriate treatment strategy to ensure that the final waste form will be compatible with the chosen disposition path.

Once the characteristics are understood, the waste needs to be transformed into a form suitable for disposal. The first stage is preparation of the waste for treatment. This may include segregation to separate contaminated from non-contaminated items, size reduction, or the adjustment of chemical properties like pH to aid later processing.

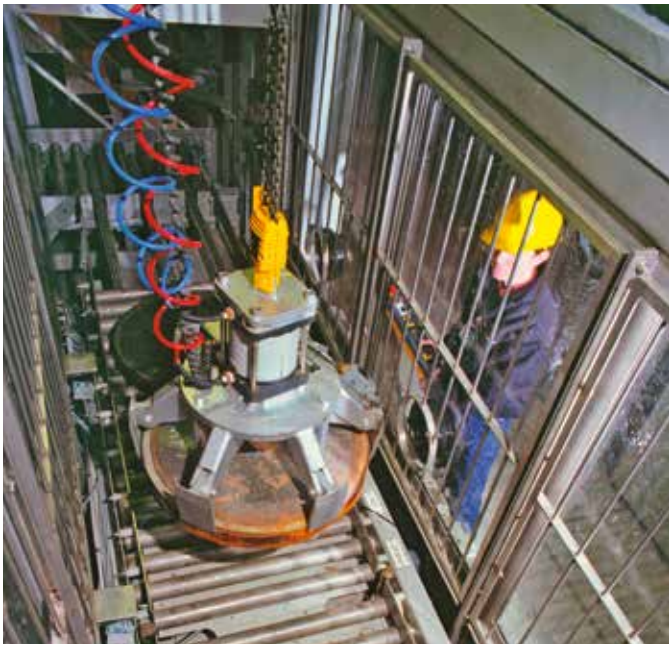
Pretreatment activities may also utilize a decontamination process where radionuclides are removed from the surfaces of buildings or components using physical (e.g. sand blasting) or chemical means (e.g. washing with a special solution that is able to selectively remove the radionuclides from surfaces).

Left: 200-litre drums are often used to collect radioactive waste

(Photo: Advanced Mixed Waste Treatment Project, Department of Energy, USA)

Right: High-force supercompaction can reduce a 200-litre drum to a height of less than 10 cm

(Photo: Dounreay Site Restoration Ltd and Nuclear Decommissioning Authority (NDA), UK)



Vitrification is a practical and effective option for conditioning radioactive and hazardous chemical wastes.

(Photos: Pacific Northwest National Laboratory, USA)

Decontamination techniques are especially useful when the radioactive contamination is spread unevenly over a large surface area, such as floors or pipework, as the application of these techniques will substantially reduce the volume of waste requiring treatment.

Once the waste is suitably prepared, the next step is treatment. In general, treatment processes tend to reduce the volume of radioactive waste to enhance the safety or reduce the costs of further management phases such as storage or disposal.

Treatment usually results in the production of two streams: a small volume stream containing the majority of the radionuclides, which will be further conditioned for storage and disposal, and a larger volume decontaminated stream, which can be routed to discharge or disposal as non-radioactive waste.

A variety of waste treatment processing techniques are available for use depending on the nature of the waste and the waste form requirements of the chosen disposal site.

Two common examples are incineration of solid waste and evaporation of liquid waste. While incineration reduces solid waste volumes by concentrating the radioactivity in a small volume of ash, evaporation of the liquid waste results in a small volume of radioactive liquid concentrate. In a subsequent conditioning step, the ash or liquid concentrate is further processed to convert it into a form in which the radioactivity is effectively immobilized. This step is known as conditioning.

Conditioning reduces the risk associated with the waste and prepares the waste for later handling, transportation, storage and disposal. Most commonly, this is accomplished by mixing the waste with cement powder and water, and allowing the mixture to set to a solid block in a suitable container.

Alternative conditioning techniques include radionuclide immobilization in glass, bitumen, a polymer or a mineral matrix. All of these techniques have the effect of reducing the potential for migration or dispersion of radionuclides to the environment. The radioactive waste package consisting of immobilized waste in a container is the final product from such processing.

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