12. How is the Volume of Low-Level Radioactive Waste Minimized?

Low-level radioactive waste is the unavoidable by-product of many commercial processes, and can be generated in both solid and liquid forms. Its disposal is expensive, and it is sensible to minimize the total amount of low-level waste produced, stored, and disposed of. The same approaches are taken to minimize low-level waste as can be taken to minimize other industrial wastes or ordinary household waste. These approaches include the four "R's": **replace, reduce, reuse,** and **recycle**.

First, efforts are made to avoid using procedures or processes that result in the production of low-level waste. Next, the total volume of low-level radioactive waste that must be disposed of is decreased by decontaminating and reusing and/or recycling the non-radioactive contents of the waste. Finally, the remaining waste undergoes various treatments to decrease its volume prior to storage.

This Fact Sheet will describe the processes used to minimize volume and activity of low-level radioactive waste.

Minimization During Production

➤ Replace

One way to reduce low-level radioactive waste is to avoid using radioactive materials. However, radioactive materials are generally used only in processes or products that require the special properties of these materials. Replacement with a non-radioactive material is often not feasible.

In processes that use radioactive materials, selection of the correct equipment may reduce production of low-level radioactive waste. For example, a crane should not be used to relocate a radioactive source when a small lift could perform the same task. The lift, being smaller, requires less decontamination and, therefore, the use of less cleaning material, leading to a smaller volume of waste requiring disposal.

Once the correct equipment for a task has been determined, the next priority is proper operation of that equipment, which can reduce the amount of low-level radioactive waste produced. Volume is also reduced by replacing only the damaged parts of broken equipment. For example, instead of discarding an entire pump, only the damaged seal should be disposed of.

Another method of reducing low-level radioactive waste generation is **isolation**. Monitoring systems can be installed to provide early detection of releases of radioactive material, thereby reducing the amount of surrounding material that is contaminated by the leakage. As a result, there will be less low-level waste from cleanup operations. Additionally, automation of various processes can reduce the number of people who must handle radioactive materials, thus reducing the amount of protective clothing required.

Segregation is another effective method for reducing low-level radioactive waste volume. Segregation refers to the process of separating radioactive waste from non-radioactive trash. This is important because when the non-radioactive and radioactive trash are mixed, the non-radioactive trash may become contaminated, and all of the trash must be treated as low-level waste.

➤ Reduce Volume

When no further recycling or reuse is possible, low-level radioactive waste is treated to reduce its volume as much as possible before disposal. It is important to note that while treatments reduce the volume of low-level radioactive waste, the activity of this radioactive material remains essentially unchanged.

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➤ Reuse and Recycle

Reusing and recycling are other methods of decreasing the amount of low-level radioactive waste that requires disposal. By cleaning and reusing contaminated equipment and supplies, the amount of material requiring disposal is significantly reduced. For example, some protective clothing can be washed and reused, and metal tools can be decontaminated. It is also possible to recycle cleaning agents that are used in decontamination processes and use them several times before disposal is required.

Before low-level radioactive waste can be placed in a disposal facility, it must be in an acceptable form. Regulations require that the waste be solid and the containers be structurally stable so that they do not collapse after being placed in a disposal facility. When the waste meets these requirements, the risk of human exposure to radiation is reduced.

Because very little low-level radioactive waste is generated in a structurally stable form, the waste must be treated to convert it to an acceptable form for disposal.

Solid Low-Level Radioactive Waste

Most of the low-level radioactive waste generated by nuclear power plants, industries, hospitals, and research institutions is in dry, solid form such as paper, plastic, cloth, and glass. To reduce the amount of space required to dispose of the low-level waste, four processes can be used: compaction, incineration, shredding, and steam reforming. These processes will *not* occur on-site at New Jersey's low-level radioactive waste disposal facility.

Compaction involves compressing the waste to reduce its volume, much like a kitchen trash compactor reduces the volume of household garbage. Compaction is a relatively inexpensive and widely available option which is used by many low-level radioactive waste generators.

Originally used to treat solid waste, **incineration** can be used to reduce the volume of solid low-level radioactive waste. When any material is incinerated, the by-products are gases and ash. When radioactive material is incinerated, the gas and ash contain radioactive materials that must be treated. The gas is filtered to remove radioactivity in particle form; the filters become contaminated and must be treated as radioactive waste. The ash is then mixed with concrete or other solidifying agents to prevent any radioactive materials from blowing away.

Usually both compaction and incineration are performed in conjunction with **shredding**. Shredding involves cutting solid low-level radioactive waste into smaller pieces. This allows for more efficient compaction and a more uniform burn for incineration.

Steam reforming is a treatment technology which has been previously used to process hazardous and medical wastes. Like incineration, steam reforming involves exposing the waste to elevated temperatures. However, unlike incineration, combustion does not occur with steam reforming. Rather, the temperature is elevated only enough to release all organic gases and water vapor from the waste. The organic gases are then mixed with the super-heated steam to destroy them. The remaining waste resembles incinerator ash, and is suitable for burial at a disposal facility.

It should be noted that nuclear power plants, industries, hospitals, and research institutions also generate non-radioactive solid waste. Any non-radioactive trash that is put in a container with radioactive waste must be treated as radioactive waste because it might have become contaminated. One way to reduce the volume of low-level radioactive waste to be treated is to keep non-radioactive trash segregated from radioactive waste. While **segregation** is not a treatment of low-level waste, it is a way to reduce the volume.

Another source of low-level radioactive waste is contaminated equipment. If a piece of equipment used in a contaminated area is

no longer needed there, it can either be disposed of as low-level waste or decontaminated and used in other, uncontaminated areas.

Decontamination is the process in which radioactive materials are removed from all interior and exterior surfaces of the equipment. Although decontamination is time-consuming and can cause some exposure to workers, it can reduce the volume of low-level waste that must be disposed of.

Liquid Low-Level Radioactive Waste

Liquid low-level radioactive waste is generated primarily by nuclear power plants during purification of cooling water. Lubrication oil and sludges from filters are other examples of liquid low-level waste.

As much water as possible is removed from the liquid waste, and the remaining material is solidified. Methods for removing water include **evaporation** and **filtration**. The remaining material is immobilized with **solidifying agents** such as cement or asphalt. The cement or asphalt is in a structurally stable form which can then be sent to a disposal facility.

It should be noted that no liquid radioactive waste will be accepted into New Jersey's low-level radioactive waste disposal facility.

Short-Lived Low-Level Radioactive Waste

Medical and research facilities produce both solid and liquid low-level radioactive waste, but some of their wastes have short half-lives; that is, they decay quite quickly. These wastes are stored where they are generated until they decay. (The actual storage time depends on the half-life and amount of the radioactive materials present. In general, materials with less than 120 days half-life can be held for decay in storage.) This method of handling low-level waste is called **storage for decay**. It reduces the volume and activity of waste to be sent to a low-level waste disposal facility.

Waste Treatment Implementation by Generators

The rapidly rising cost of disposal have encouraged widespread treatment of waste and substantial reductions in disposal volume. In 1980, almost 200,000 cubic feet of low-level radioactive waste was disposed of by New Jersey generators. By 1994, this figure had been progressively lowered to less than 25,000 cubic feet.

➤ For More Information

If you would like to read more about treatment of low-level radioactive waste, some of the references listed below may be helpful.

- Edward L. Gershey, et.al., *Low-Level Radioactive Waste: From Cradle to Grave*, Van Nostrand Reinhold, NY, 1990.
- Office of Technology Assessment, *Partnerships Under Pressure - Managing Commercial Low-Level Radioactive Waste*, 1989.
- Raymond L. Murray, *Understanding Radioactive Waste*, Battelle Press, Columbus, Ohio, Fourth Edition, 1994.

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