

# Description of Surface-Level Waste Disposal

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English 202C

October 22, 2024



**Figure 1.** Vogtle Nuclear Power Plant in Georgia, sourced from wikipedia.org ([Vogtle Electric Generating Plant - Wikipedia](#))

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# **Introduction**

## **Definition of surface-level disposal:**

Surface-level waste disposal is a nuclear waste disposal process in which waste from nuclear power plants is classified by its radiation output, stored in radiation-absorbing materials known as moderators until its radiation level is sufficiently reduced, temporarily housed in air-tight containers known as dry casks, and buried up to ten meters underground in a sealed concrete structure.

## **What is the purpose of surface-level disposal?**

Surface-level disposal protects people from harmful levels radiation exposure and prevents contamination of groundwater while minimizing the costs of constructing the disposal site.

## **How is nuclear waste classified? (and info about waste types)**

Nuclear waste is generally classified into three categories: LLWs (low-level radioactive waste), ILWs (intermediate-level waste), and HLWs (high-level waste). While all radioactive waste is dangerous, LLWs emit relatively low amounts of radiation. ILWs and HLWs emit much higher, much deadlier amounts.

Here's an informal way of thinking about these classifications: if a barrier such as a wall or metal container is enough to prevent adverse health effects, the waste is in LLW range; if greater precaution is necessary, it's an ILW or HLW.

## **Where does surface-level disposal take place?**

Surface-level disposal is a multi-step process—where it takes place depends on the step.

- If ILWs and HLWs are being stored for the purpose of reducing their radiation output to that of an LLW, they will be held at a special repository or processing center.
- If the LLW is being temporarily withheld until a disposal site is available, it's held on a plot of land (within steel and concrete containers) on the premises of the nuclear plant where it originated from.
- When choosing the site for surface-level disposal, remote areas with little risk of groundwater intrusion are the top candidates.

**Who carries out surface-level disposal?**

If the waste is produced by a nuclear power plant, then the workers at that power plant are responsible for handling the waste until it can be disposed of. The DOE (Department of Energy) is then responsible for the excavation and construction of the disposal site and transportation of the waste to the site

**What is a moderator?**

A moderator is a substance that is very good at absorbing the radiation from ILWs and HLWs. It is utilized in storage (Step 2 of "Process Steps") to turn ILWs and HLWs into LLWs. Water is the most used moderator.

**Why is it important to avoid groundwater contamination?**

Groundwater feeds into our nation's lakes and rivers, so contaminating it with radioactive waste increases the probability that the water we use in our daily lives is unsafe for consumption. Surface-level disposal sites are designed to prevent the intrusion of groundwater into the site so that this contamination doesn't occur.

# Process Steps

## 1. Classifying the Waste Type

Nuclear waste must first be classified as LLW, ILW, or HLW so that it can be properly handled. If it's an ILW or HLW, it must either be disposed of much further underground (deep geologic disposal) or be stored (discussed in the next step) for as long as it takes for it to reach LLW-levels of radiation output.

## 2. Reducing Radioactivity of ILW and HLWs

As detailed earlier, ILWs and HLWs *cannot* be disposed of at the surface-level. They must either be disposed of much further underground (which is much more expensive than surface-level disposal) or be “stored”. The wastes are submerged under water, a very effective moderator, for multiple decades until most of their radiation has been absorbed, effectively making them LLWs. Once this transition is completed, it is safe for these wastes to be disposed of at the surface-level.



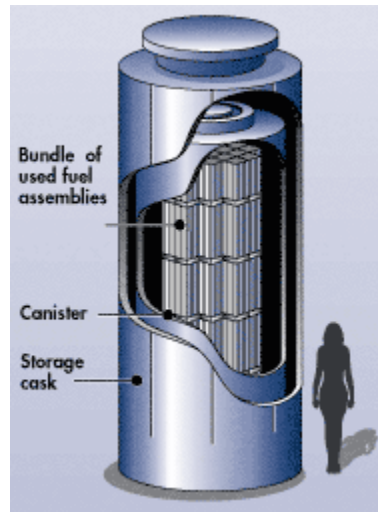
**Figure 2.** A pond for used nuclear fuel at the Sellafield waste processing center, sourced from the World Nuclear Association ([Radioactive Waste Management - World Nuclear Association \(world-nuclear.org\)](http://www.world-nuclear.org))

## 3. Temporarily Housing LLWs in Dry Casks

LLWs must be deposited into dry casks before they can be finally disposed of. This is necessary both so the waste can be transported to the final disposal site and that, in the event of a groundwater intrusion, contamination is negligible. It may also be the case

that a disposal site does not yet exist, and so the waste must be held in these casks at the site of the nuclear plant until one is built.

Dry casks have multiple feet-thick walls made of steel and reinforced concrete to contain the radiation from the waste inside. The casks are weatherproof, meaning that keeping these dry casks above ground is not a public health risk.



**Figure 3.** Diagram of a steel dry cask holding wastes, sourced from the Nuclear Regulatory Commission ([Typical Dry Cask Storage System | NRC.gov](http://www.nrc.gov))

#### 4. Building the Disposal Site

The disposal site has three critical components:

- i. First, the hole in which the disposal site is built. A hole must first be excavated so that the disposal building can be constructed within it.
- ii. Second, this concrete disposal building is created within the excavated hole to prevent direct contact between the dry casks and the outside world.
- iii. Third, the concrete disposal building has a drainage system. The drainage from the disposal building is monitored to check that no water has infiltrated the disposal site.

After the site is built, a backfill of impermeable material is built over its top. The building is then finally covered in topsoil.

## **Conclusion**

Surface-level disposal aims to protect people and the environment from harmful radiation while limiting the extent and depth of construction of the final disposal site, reducing costs. This second aspect of surface-level disposal is not in conflict with its first aspect (protecting people), since only LLWs, wastes with relatively low levels of radiation, are disposed close to the surface—the low radiation level of these wastes does not necessitate further precautions (in terms of depth).

Wastes are first classified by their radiation level. If a waste is not already an LLW, it may be stored in a radiation-absorbing moderator until it becomes an LLW. It is then temporarily disposed of in a tightly sealed, weather-proof dry cask until there is an underground disposal site to hold it. The disposal site is designed to prevent any contact between the radiation in the casks and groundwater. As such, the underground building is made of impermeable concrete.