- Getting Started
- Nuclear Power
  - Japan's Nuclear Program
    - Why Nuclear Power?
    - Government's "Long Term Program"
    - "Long Term Program" Excerpts
    - Nuclear Power and Other Power Sources
    - Location of Nuclear Plants
    - Nuclear Power & CO_2 Mitigation
    - **Nuclear Waste Management**
    - Nuclear Power and Deregulation
  - Japan's Nuclear Fuel Cycle
  - Japan's MOX Program
  - Vitrified Waste
  - Transportation of Nuclear Materials
  - Addressing Nonproliferation Concerns
- About FEPC
- Press Room
- Links & Resources
- Nihon Salon
- Stay In Touch
- Home

Search Go

Managing the Waste Stream from Nuclear Power

Japan's nuclear power industry is responsible for the safe management of all radioactive waste materials. Various types of waste are produced during the production of electricity from nuclear power. Since not all wastes are alike, different methods of treatment and disposal must be used.

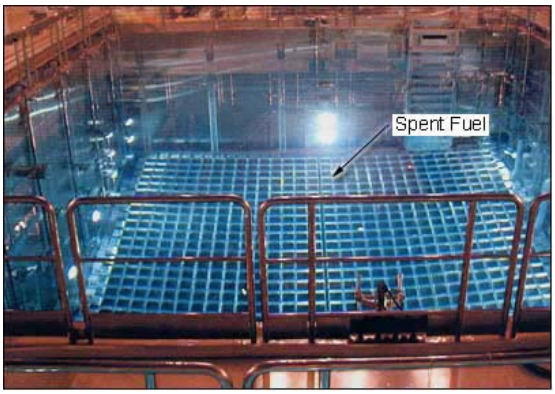
What is Radioactive Waste?

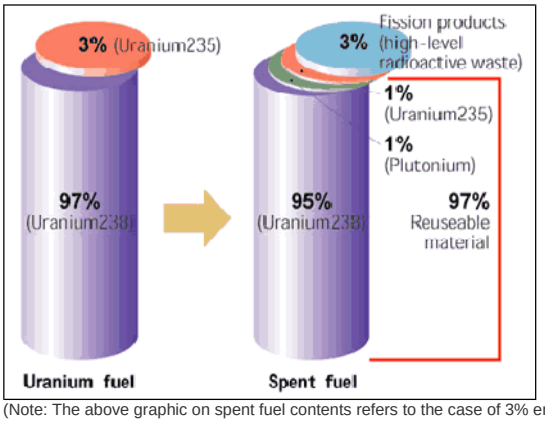
Radioactive waste, which is not the same as spent nuclear fuel, is unusable matter that contains radioactive elements. Radioactive waste is generally classified on the basis of how much radiation and the type of radiation it emits as well as the length of time over which it will continue to emit radiation. The purpose of this classification system is to ensure that radioactive waste is handled, stored, and disposed of in ways that are appropriate to its characteristics. There are generally considered to be two types of radioactive waste: High-Level Waste (HLW) and Low-Level Waste (LLW). Different management processes for these wastes apply.

High Level Waste

As previously discussed, Japan is well on its way to creating a "closed" nuclear fuel cycle. Despite these efforts, HLW accounts for approximately 3% of the composition of spent fuel (depending on the level of initial enrichment). Specifically, when useable elements are recovered from spent fuel during the reprocessing operation, HLW is the liquid by-product. Though the closed fuel cycle minimizes HLW, that HLW must yet be properly disposed of. Below is an explanation of Japan's plans for the disposal of its HLW.

Spent Nuclear Fuel





(Note: The above graphic on spent fuel contents refers to the case of 3% enrichment level.)

HLW Disposal Method

What then is the ideal method of disposing of high-level radioactive waste? Various methods exist, none without drawbacks; the most significant of which are usually related to risk of accidents or the challenge of political complexities. The most agreeable HLW disposal method involves burying waste deep underground, and this is currently a central feature of research and development programs throughout the world.

Underground disposal offers a number of distinct advantages. To begin with, it is relatively unsusceptible to dramatic shifts in climate. The risk of inadvertent excavation is also minimal, since radioactive waste would be buried several hundred meters under the ground. As the remarkable condition of numerous fossils attest, subterranean burial sites are a superior form of preservation over immense time periods.

With underground disposal, vitrified (formed into glass) waste is cooled for 30 to 50 years in above-ground storage facilities. It is then inserted into metal containers (called overpacks), buried deep underground in stable bedrock, and encased in a buffer layer of viscous shock-absorbing material. This manner of burial minimizes the risk of radioactive material leaking into surrounding groundwater and penetrating neighboring strata. The underground burial location is chosen with a view towards creating a natural barrier, so that even if radioactive material were to leak from the site, the rate at which it would spread would be limited by its absorption into the surrounding ground. This combination of artificial and natural barriers is thought to be sufficient to ensure the safety of underground disposal of high-level radioactive waste for many, many years.


(Research into scientific aspects of the earth's stratum)

Japan's HLW Disposal Program

Japan's current high-level radioactive waste disposal program has formed a private consortium to handle the effort. The Nuclear Waste Management Organization of Japan (NUMO) was created in October 2000. Over the ensuing years, NUMO will be responsible for carrying out assessment studies for site selection, developing and demonstrating reliable disposal technologies, reflecting the opinions from local communities, and obtaining confirmation from the government for the selected site. The goal is for a site to be operational sometime between 2030 and the mid-2040s.

Japan is not alone in this endeavor. Similar underground disposal programs are already underway around the world. The United States, Sweden, Switzerland, Germany, and Canada are among those countries currently researching and developing underground facilities. Of all countries, the United States is perhaps furthest along in this process at its site at Yucca Mountain, Nevada.

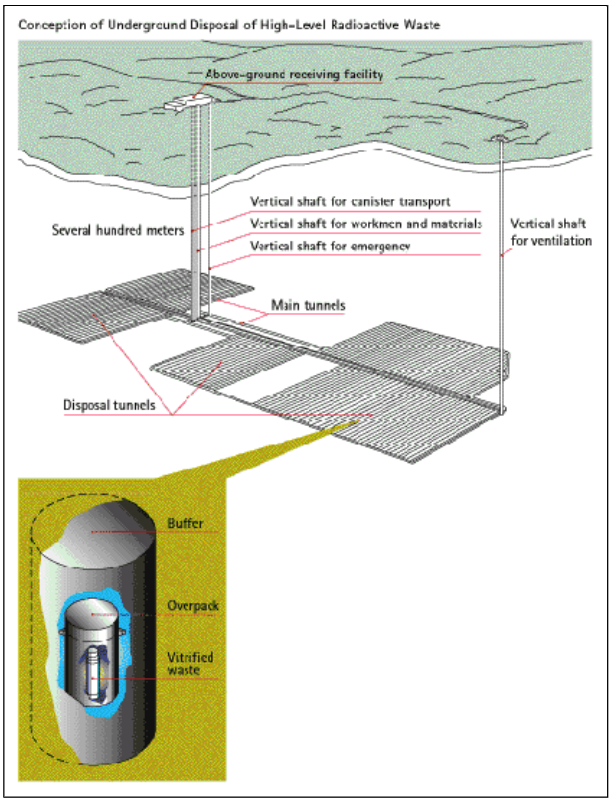
Disposal flow

Vitrification
High-level radioactive waste is mixed with glass and poured into stainless steel canisters where it solidifies.

Primary storage
The vitrified waste is stored for 30 to 50 years above ground to allow it to cool.

Underground disposal
When primary storage is complete, the waste is buried in a deep permanent repository. Once in place below ground, the vitrified waste is enclosed in a thick metal container (overpack) and surrounded by a layer of clayey bentonite (buffer).

Graphical Conception of Underground Disposal of HLW



HLW Disposal Plans in Major Countries

Country	Forms of Waste	Layers of Sites Proposed	Depth of Disposal Sites	Past Events	Future Plans
USA	Spent Fuel Vitrified Waste	Tuff	Approx. 350 meters	1991: Started research of features of Yucca Mt. site 1998: Announced viability assessment of a repository 2002: US Congress approved Yucca Mt. as a final disposal site	2004: DOE applies to NRC for construction permit 2005: DOE starts construction 2010: Start operation of a final disposal site
France	Spent Fuel Vitrified Waste	Granite Clay layer	400 ~ 1,000 meters	1995: 3 sites proposed for underground research facilities were selected 1996: Application for construction permission and public hearing 1999: Allowed to construct underground research facilities on a clay layer 2000: Started site selection for underground research facility on granite, but selection was suspended due to opposition movement	2006: National Evaluation Commission submits an overall evaluation report on waste studies
Germany	Spent Fuel Vitrified Waste	Rock salt layer	660 ~ 900 meters	1977: Gorleben was selected as a site proposed 1984: Safety study report on disposal (PSE) 1988: Characterization evaluation (CEC PAGIS)	2030: Commencement of operation is planned

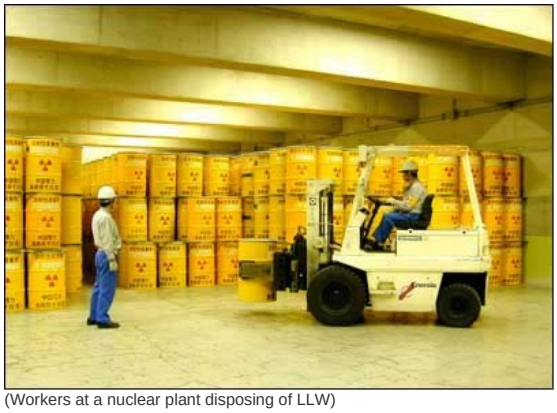
Belgium	Spent Fuel (Returned Waste)	Clay layer	220 meters	1997: Finished digging shafts 1974-89: Disposal safety research at Mol laboratories 1989: Safety evaluation (SAFIR-I) 1994: Started making study programs of deep layer disposal	2000-15: Verification tests on real waste 2025: Receive permission of a disposal site by royal order 2035: Start operation of a disposal site
Finland	Spent Fuel	Granite	Approx. 500 meters	1983: Launched study activities 1987: 5 sites to be surveyed were selected 1995: Submitted an environmental assessment report 2001: A disposal site proposed was decided (Parliament approved)	2003-04: Start constructing underground research facilities 2006: Surveys at the depth of a disposal site 2010: Start to construct a disposal site
Sweden	Spent Fuel	Granite	Approx. 500 meters	1983: Concept design, evaluation report (KBS-3) 1990: Started constructing underground research facilities 1992: Safety evaluation (SKB91), announced SKB research development verification plans 2000: Applied for site surveys at Oskarshamn, Östhammar, and Tierp	2012: Disposal for verification ~2020: Start full operation
Japan	Vitrified Waste	Granite Sedimentary rock	Deeper than 300 meters	1989: Important items and implementation of R&D (AEC) 1992: The first interim report (H3 report) 2000: Governmental evaluation on the second interim report 2000: Law on final disposal of designated radioactive waste was promulgated	2008-12: Selection of areas for detailed observation 2023-37: Selection of a site for repository construction ~2025: Design of the repository; start of construction 2033-37: Start of operation

Low-Level Waste

In Japan, low-level waste (LLW) is considered to be all disposable waste created during the operation of nuclear facilities that is not classified as HLW.

Onsite Disposal

(Contents of an LLW drum)


(Workers at a nuclear plant disposing of LLW)

All commercial nuclear facilities in Japan are required to individually provide storage facilities (see photo above) for their low-level waste. LLW produced at nuclear power plants (such as work clothes, gloves, and cleaning materials) is safely stored on-site in specifically designed, temporary storage facilities. Ultimately LLW can be permenantly and safely disposed of in a landfill.

Landfill Disposal for LLW


(Low-Level Radioactive Waste Center @ JNFL Facilities)

Japan's low-level waste disposal center (pictured above) is located in Rokkasho Village, Aomori Prefecture. This disposal center is part of the JNFL nuclear fuel cycle facilities. Following temporary on-site storage at nuclear plants, LLW is shipped here from individual plants throughout the country.

Metal drums are emplaced in disposal facilities; the spaces between the drums are filled with morter, and the tops are covered with reinforced concrete, forming a solid block. In order to further seal in the radioactive materials, the sides of the metal drums are covered with bentonite (a kind of clay), soil and sand are spread on top of them, and, finally, trees are planted. Each disposal pit (white, square buildings in the above image) contains approximately 5,000 metal drums.

Links & Resources

- More information on Japan's nuclear waste disposal plans (especially for HLW) is available from the Nuclear Waste Management Organization of Japan (NUMO).
- More information on Japan's nuclear waste treatment and research programs is also available from the Radioactive Waste Management Funding and Research Center (RWMC).
- More information on key research into underground repository work being done in the northern island of Hokkaido can be found at this website for the Horonobe Underground Research Laboratory Project.