Ministry of education and science of Ukraine

National Aviation University

DISPOSAL OF RADIOACTIVE WASTE

Kalmykov Vadim
IAN – 103-a
Mentor: Yakovleva A. V

Kiev
2016

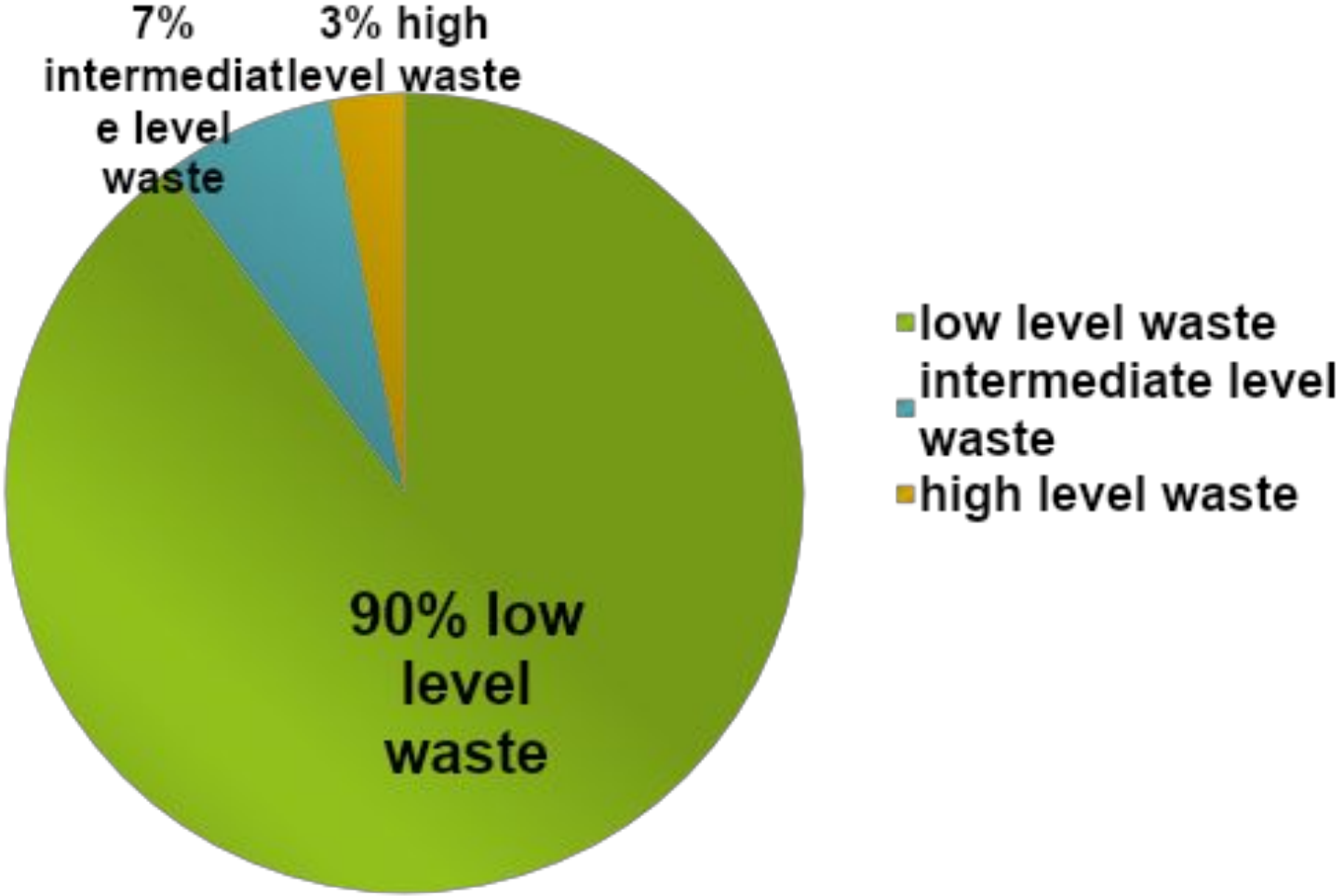
Nuclear Waste

- Composed of radionuclides
- Low, Medium, and High-level waste
- High-level waste produced in nuclear reactors
- Consists of
  - Fission products (short-half lives)
  - Actinides (long-half lives)

Classifications

- Nuclear waste is segregated into several classifications.
- Low level waste is not dangerous but sometimes requires shielding during handling.
- Intermediate level waste typically is chemical sludge and other products from reactors.
- High level waste consists of fissionable elements from reactor cores and transuranic wastes.
- Transuranic waste is any waste with transuranic alpha emitting radionuclides that have half-lives longer than 20 years

Relative waste volume



Low Level Waste LLW

- Contains VERY LOW concentration of radioactivity
- Waste which does not require shielding during normal handling and transportation.
- 90% volume of waste
- Low level nuclear waste usually includes material used to handle the highly radioactive parts of nuclear reactors.

Examples of LLW

Intermediate level waste

- **Intermediate level waste (medium level waste)**
- Waste which requires shielding but needs little or no provision for heat dissipation during its handling and transportation.
- Intermediate level waste typically is chemical sludge, resins, metal fuel cladding and other products from reactors.
- 7% volume of the waste

Examples of ILW

High Level Waste HLW

- High level waste has a large amount of radioactive activity and is thermally hot.
- 3% volume of waste
- 95% of radioactivity
- Current levels of HLW are increasing about 12,000 metric tons per year.
- Most HLW consists of Pu-238, 239, 240, 241, 242, Np-237, U-236
- Spent reactor fuel, if it is declared a waste.

Waste In Hospitals/Nuclear Medical Centers

- The radioactive waste at **hospitals/nuclear medical centers** mainly comprises of low level
- **Solid**
- **Liquid** and
- **Gaseous waste**
- **Solid Waste:** Solid waste mainly consists of used Molybdenum-Technetium generators. empty vessels, swabs, syringes, gloves, laboratory clothing, bench covers, absorbents etc.
- **Liquid Waste:** Liquid waste includes washing from active labs., and excreta of patients injected. Biological waste such as excreta is regarded as liquid waste.
- **Gaseous Waste:** Gaseous waste generally includes working with, tritium and tritiated water, iodine and xenon-133.

Basic Steps and Activities in Radioactive Waste Management

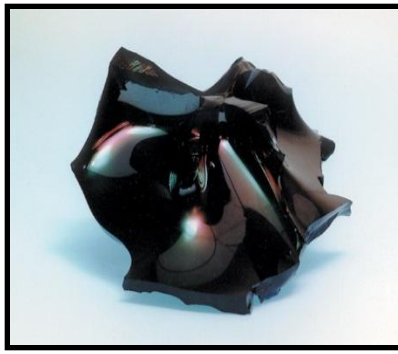
- **Waste Generation** occurs during the operational period. It can be in the form of solid, liquid or gaseous waste.
- **Pretreatment** is the initial step that occurs just after generation. It consists of collection, segregation, chemical adjustment and decontamination.
- **Treatment** involves changing the characteristics of the waste. Basic treatment concepts are volume reduction, radionuclide removal and change of composition.
- **Conditioning** involves those operations that transform radioactive waste into a form suitable for handling, transportation, storage and disposal.
- **Storage** facilities may be co-located with a nuclear power plant or a licensed disposal facility. The intention of storage is to isolate the radioactive waste from environment.
- **Retrieval** involves the recovery of waste packages from storage either for inspection purposes, for subsequent disposal or further storage in new facilities.
- **Disposal** consists of the authorized emplacement of packages of

Treatment

- Purpose
  - Prevent reaction or degradation of waste for extended period of time
- Most common initial treatment of waste is vitrification.
- Mid level active waste is commonly treated with ion exchange
- Process reduces the bulk volume of radioactive material.
- Typically, mixed with concrete for a solid storage form.

Vitrification/Ion Exchange

- **Vitrification**
  - Combine waste with molten glass, harden to form new solid
  - Waste is first mixed with sugar and then passed through a heated tube to de-nitrite the material.
  - This material is then fed into a furnace and mixed with glass.
  - The molten glass mixture is poured into steel cylinders and welded shut.



- **Ion Exchange**
  - Combine with chemical to concentrate waste and encase in cement

Disposal of low level radioactive waste

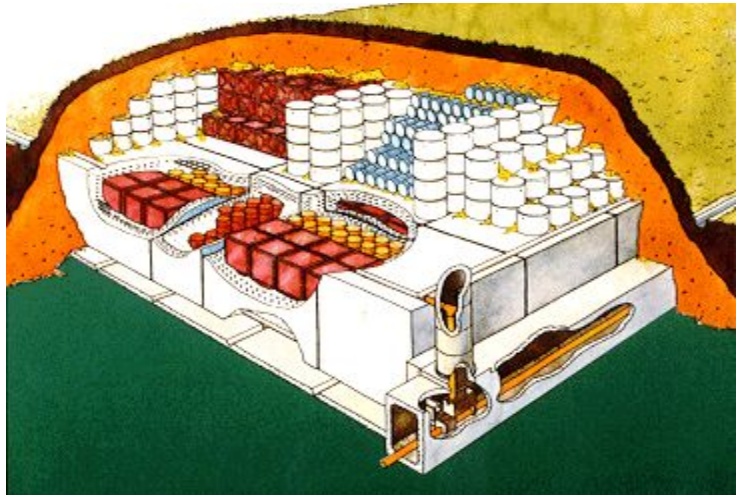
- Disposal facility for low level radioactive waste (LLW).

- **Near surface disposal:** disposal in a facility consisting of engineered channels or vaults constructed on the ground surface or up to a few tens of meters below ground level.

Hanford (Nuclear News, November 2004)

Disposal of intermediate level waste

- **Disposal of intermediate level waste:** Depending on its characteristics, intermediate level radioactive waste (ILW) can be disposed of in facilities of different types.
- Disposal could be by emplacement in a facility constructed in caves, vaults or silos at least a few tens of meters below ground level and up to a few hundred [illegible]evel.

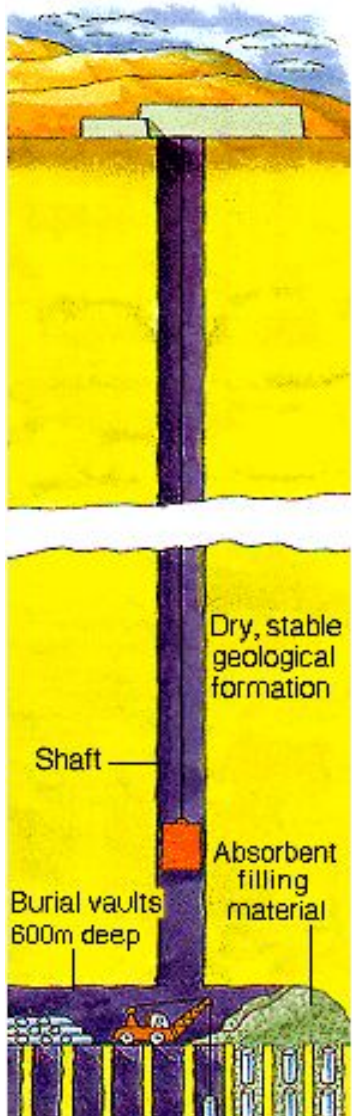


Disposal of high level waste

- **Geological disposal:** disposal in a facility constructed in tunnels, vaults or silos in a particular geological formation at least a few hundred meters below ground level. Such a facility could be designed to accept high level radioactive waste (HLW), including spent fuel if it is to be treated as waste.
- First used in 1999 in the US.

Deep Boreholes

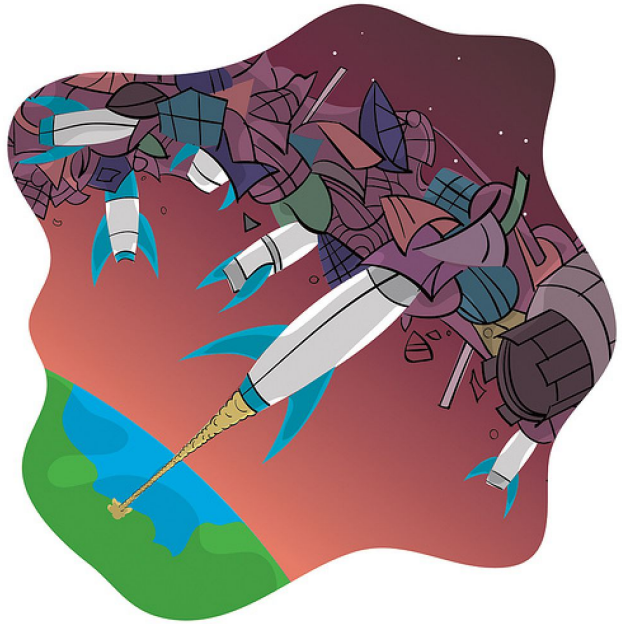
- Similar concept to basic geological repositories
- Kilometers deep rather than hundreds of meters
- Provide Further isolation from ground water
- More potential borehole locations around the globe
- Can be created in many cases close to power plants



Launch it into Space

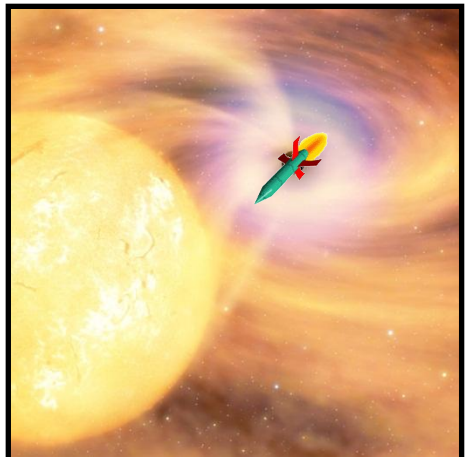
Main peculiarities

- Near infinite storage space
- Completely removes waste from biosphere



Technical risks and problems

- High risk of space vehicle failure
- Relatively limited volume per launch
- High energy cost of space launch
  - The current cost to launch an object into orbit around the earth is about $20,000 per kilogram.



Thank you for watching!