Nuclear Waste Reprocessing Initiatives

CONSOLIDATED FUEL TREATMENT CENTER AND ADVANCED BURNER REACTOR

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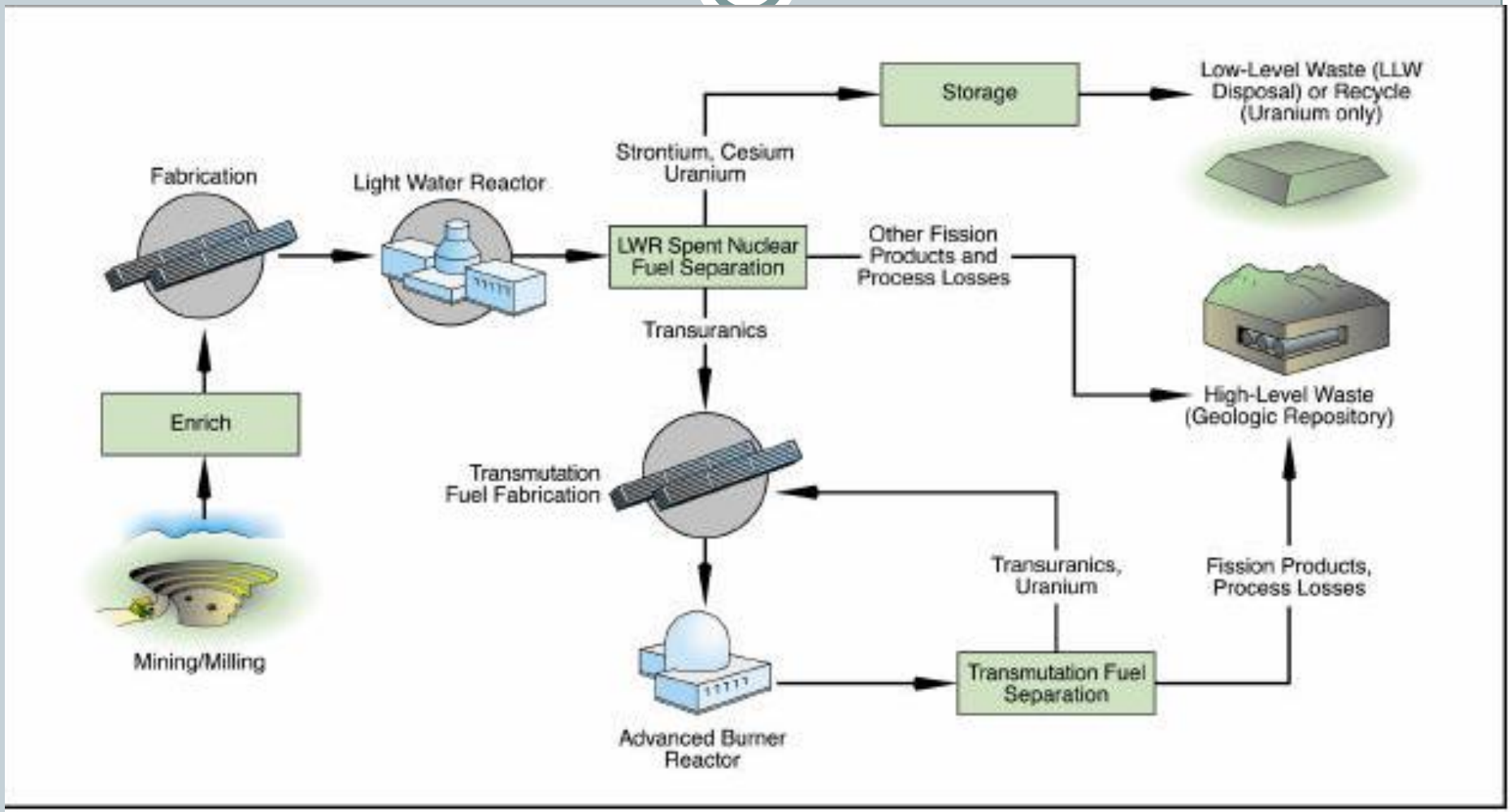
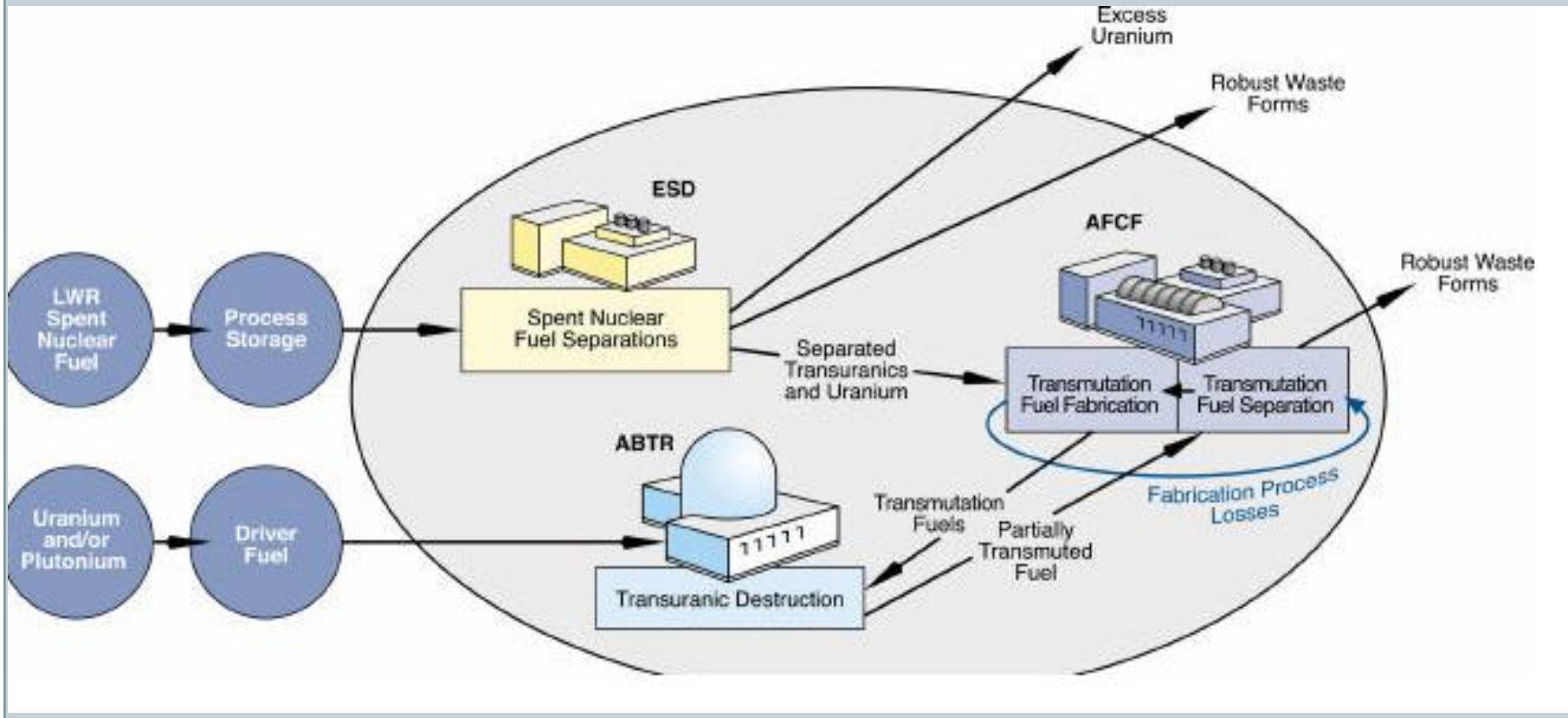
Nuclear Waste and Storage/Reprocessing Alternatives

Consolidated Fuel Treatment Center: Nuclear Fuel Cycle



CFTC


Excess Uranium
Robust Waste Forms
ESD
AFCF
Robust Waste Forms
LWR Spent Nuclear Fuel
Process Storage
Spent Nuclear Fuel Separations
Separated Transuranics and Uranium
Transmutation Fuel Fabrication
Transmutation Fuel Separation
ABTR
Uranium and/or Plutonium
Driver Fuel
Transmutation Fuels
Partially Transmuted Fuel
Fabrication Process Losses
Transuranic Destruction

Nuclear Waste

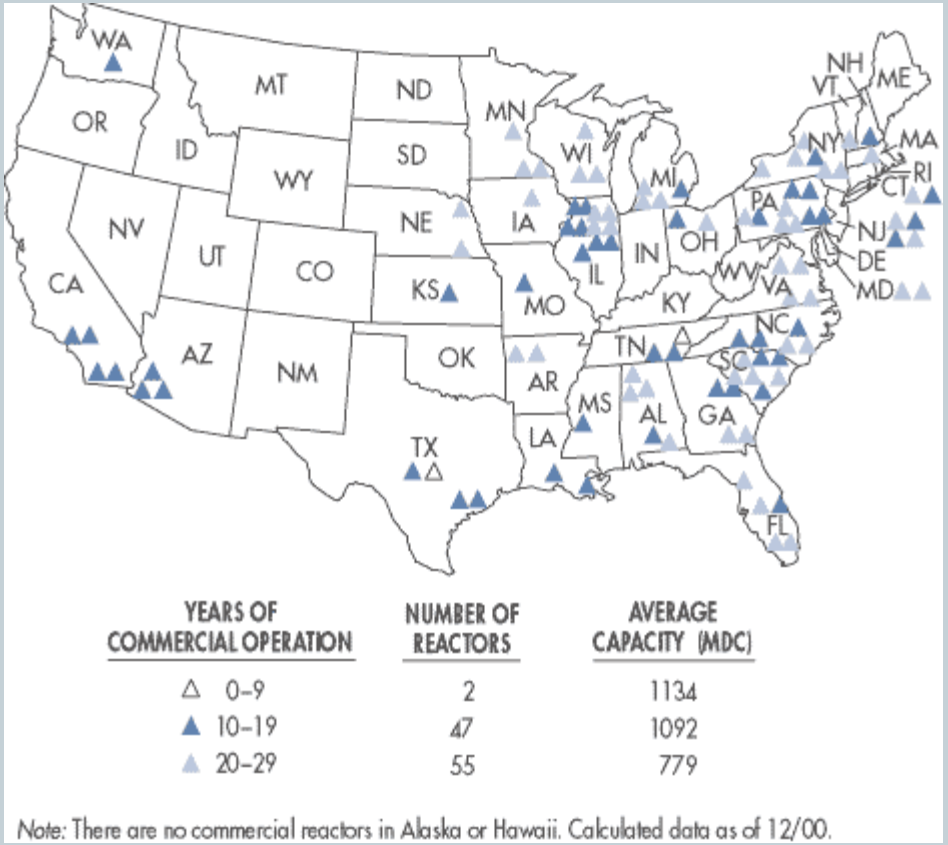
- Nuclear waste fits loosely in 3 categories, by levels of radioactivity/mass or volume:
- Low Level Waste (LLW): contaminated soil, clothing, debris
- Intermediate Level Waste (ILW): chemical sludge, reactor shielding, de-commissioning materials
- High Level Waste (HLW): fission products and transuranic elements from reactors=Spent Nuclear Fuel (SNF)
- 95% of waste from nuclear power is LLW+ILW

Reactors and Nuclear Waste in the World

- 442 operating nuclear reactors
- 400,000 t of waste produced annually
- 3% of waste (12,000 t) is high-level waste (HLW):
  - 96% of this is U
  - 1% of this are actinides (TRU transuranics)
  - 3% other fission products

Reactors in the US

- Nuclear reactors generate 20% of US electric power
- As energy needs are projected to double in 25 years, number of nuclear reactors to increase
- 103 reactors
- 2100 t of SNF produced/year
- 53,000 t SNF in storage today
- 119,000 t SNF by 2035

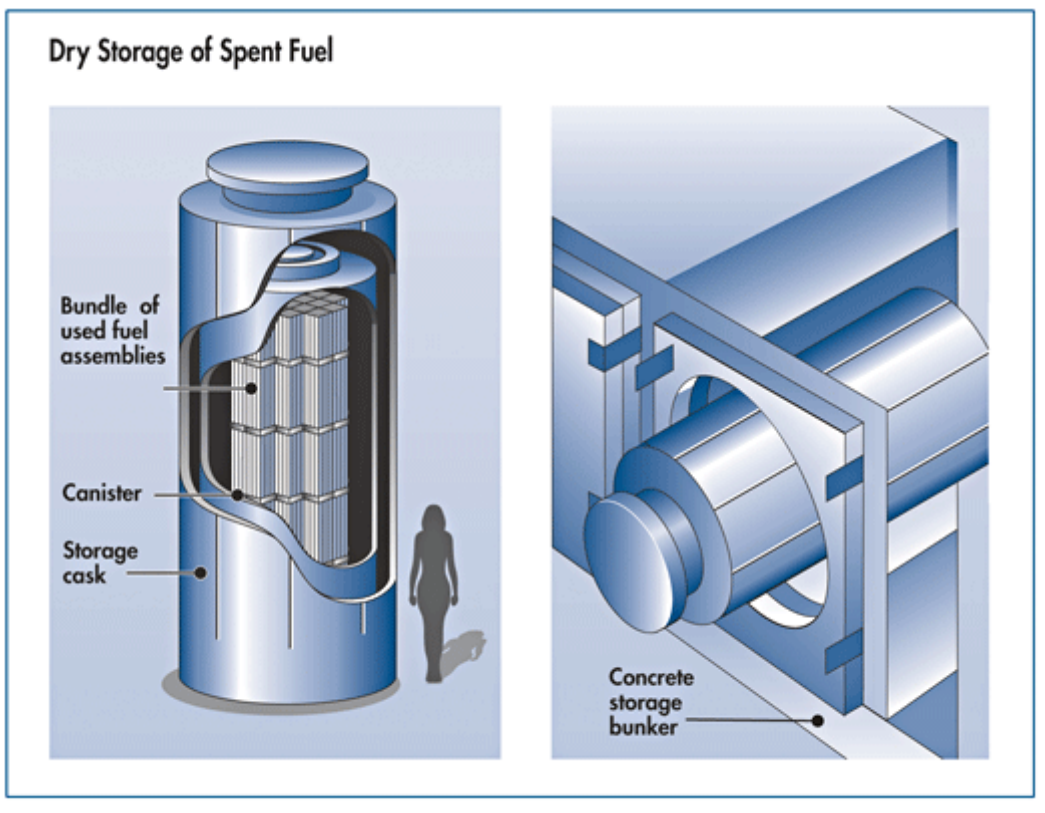


YEARS OF COMMERCIAL OPERATION	NUMBER OF REACTORS	AVERAGE CAPACITY (MDC)
△ 0–9	2	1134
▲ 10–19	47	1092
▲ 20–29	55	779

Note: There are no commercial reactors in Alaska or Hawaii. Calculated data as of 12/00.

Dry Casks Storage

•SNF, cooled for at least 1 year in SNF pools at power plants
•SNF surrounded by inert gas inside large steel containers
• Theoretically, containers are leak-tight
•Disadvantage: de-centralized , **temporary** storage system



Questions to Consider when comparing CFTC to Yucca Mountain

- How much can Yucca be expected to keep without CFTC?

  Planned to store 70,000 t of waste--- already in temporary storage

- How much can the CFTC be predicted to recycle?
- Separation of Uranium, transuranics, fission products with 99% efficiency. ~2000 t/yr.
- How much can Yucca be expected to keep with CFTC?

Assuming 99% recycling of current yearly quantity of SNF, the projected capacity will fill up in 3000 years! Since LLW and ILW may also be deposited there, it will reach capacity faster.

- What will the results be of the CFTC recycling?
- How much high level waste? 0.1% of SNF
- How much low level? 0.9 % of SNF
- How much recovered energy?

CTFC Research Effort

- How much R&D will this take?

20 years until deployment of recycling system

- How much has already been done?

Siting studies, 11 sites

- Near-term goals:

2011- Engineering Scale Demonstration plant for removal of transuranics (TRU)

2014-2019: Advanced Burner Test Reactor to turn TRU into shorter-lived isotopes, while making power

2016-2019: Complete Advanced Fuel Cycle Facility

Transportation

- Rail and truck transport
- Exemplary safety record of 3,000 SNF shipments in the last 40 years
- DOE plans to build a special railroad through Nevada, to Yucca Mountain
- Same transportation arrangements can be used to carry fission products from the 11 proposed CFTC sites

Economics of CTFC

Economic Considerations

- CFTC has be opened up to Expressions of Interest (EOI) from the private sector
  - Cost dependent on the final design chosen by the DOE
  - Thus, cost cannot be easily estimated for the final form of the CFTC
- Specific goals have been set for industry
  - Benefits of meeting these goals can be estimated for use in comparison with costs when released

Inputs and Outputs

- Spent nuclear fuel (SNF) from light water reactors (LWRs)

- High purity uranium (reusable by LWRs)
- Transuranic fuel feed (for use by fast reactors)
- Fission products (with lower heat and radioactivity)

Other Goals

- Research and Development
  - Making fuel recycling cost effective compared to the once-through fuel cycle
  - Improvements in fuel processing to reduce proliferation risks

Potential Benefits

- CFTC as a source of fuel
  - Produces both uranium for reuse in LWRs and transmutation fuel for fast reactors from SNF
- CFTC as a way of handling waste
  - Augments the current waste repository plans (Yucca Mountain)
- CFTC as a way of enabling increased nuclear energy use
  - As a means of increasing waste handling capacity

Estimating Benefits

- CFTC as a source of fuel
  - Assumptions used:
    - Fuel for LWRs valued at least as much as cost of mining and processing today
    - Transmutation fuel is valued at a premium above LWR fuel
    - Benefits from using the CFTC as a fuel source will be realized over the lifetime of its operation as long as inputs are available

Estimating Benefits

- CFTC as a way of handling waste
  - Assumptions used:
    - Benefit of handling waste at least equivalent to cost of doing so under Yucca Mountain plan
    - Yucca Mountain will be able to handle fission products from the CFTC (after minor modifications)
    - The CFTC will decrease the volume of SNF that requires storage from LWR, thus increasing capacity of the Yucca Mountain site
    - Benefits from increasing waste handling capacity will be realized over time as waste is produced

Estimating Benefits

- CFTC as a way of enabling increased nuclear energy use
  - Assumptions used:
    - Yucca Mountain capacity unable to support expansion of nuclear industry without the CFTC
    - Nuclear energy represents an overall cost saving when carbon emissions costs are taken into account
    - Benefit will be realized over time based on additional energy produced by reactions supported by the CFTC

Total Benefits

- Benefits from all three sources can be summed:
  - CFTC with a given capacity will give a stream of benefits from the three sources
  - Benefits to be discounted over time and summed for a few hypothetical capacities
  - Sum of benefits at a given capacity can be compare to cost of construction and operation to be proposed by industry

The Politics of Nuclear Waste

Congressional (in)action on waste

- 819 Congressional bills proposed addressing nuclear waste in the last 15 years
- 532 that actually were voted on
- 62 passed and sent to President
  - Incorporating provisions of many of above bills
- 54 in 110th Congress alone

Jurisdiction

- Mostly Federal
  - Waste crosses state boundaries (either to be store or reprocessed)
- Some State
  - Internal storage and transport

Yucca Mountain

- Nevada delegation opposed
- Democrats more vocal
- Less to say about reprocessing
  - Jon Porter ♥ reprocessing

Reprocessing

- Mostly internationally-focused

CFTC

- Barely mentioned in Congress
- Not included in any current bills
- Just a few hearings in Senate Environment and Public Works Committee
- Mild support from Reps on shortlist for facility locations – but mainly as source of construction jobs

Presidential Candidates

Clinton

- While supporting nuclear waste in theory, prefers efficiency and renewables for sources of new energy, due in part to proliferation and disposal concerns
- Opposes Yucca Mountain
  - Instead would convene scientific panel to develop alternative disposal solution
- Campaign brief on energy and climate change doesn't even mention nuclear
  - Only mentioned in longer fact sheet

Obama

- Nuclear is likely contributor to global warming solution, but only if cost, proliferation, public information, and disposal concerns are improved
- Opposes Yucca Mountain
- Nuclear not even mentioned on campaign energy and environment site
- Fact sheet: Supports dry cask storage using most modern technologies possible until a more permanent solution is found

McCain

- Strongly supports nuclear power on climate change and energy independence grounds
- Wants to see 20 new plants under construction by end of first term
- Nuclear features prominently on energy and environment portions of website
- Supports Yucca as storage site for waste
- Also “not opposed” to reprocessing
- Doesn’t address what to do if new plants overflow Yucca