TERRAPOWER LLC

Advanced Traveling-Wave Reactors

One Path to a New Generation of Clean, Safe Nuclear Energy

EnergyBiz Leadership Forum

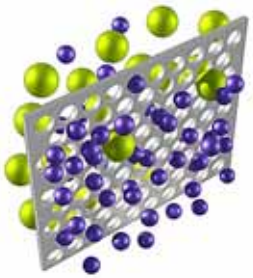
1 March 2010

Nuclear Faces Deployment Challenges

Nuclear Infrastructure Today is Complex and Expensive

Uranium mining and milling

Conversion to uranium hexafluoride

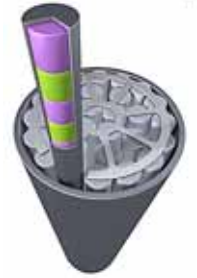


Uranium enrichment

Fuel fabrication

Depleted uranium storage

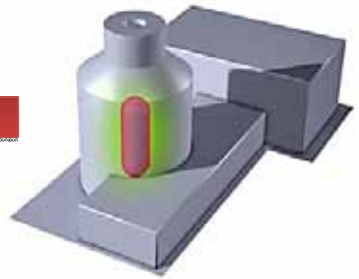
Long-term geologic repository



Actinide fuel fabrication

Reprocessing

Spent fuel storage



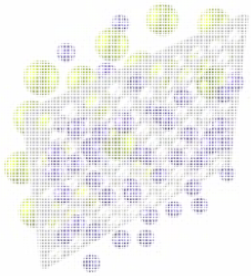
Nuclear power generation

Use Unenriched Uranium as Fuel

Many Steps Then Become Unnecessary

Uranium mining and milling

Conversion to uranium hexafluoride



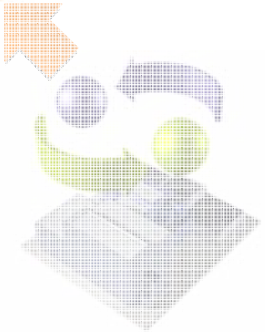
Uranium enrichment

Fuel fabrication

Depleted uranium storage

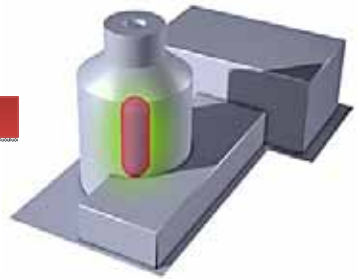
Long-term geologic repository

Actinide fuel fabrication



Reprocessing

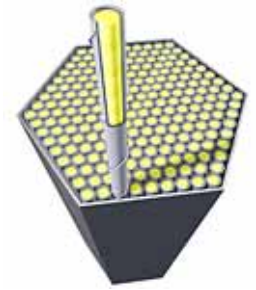
Spent fuel storage



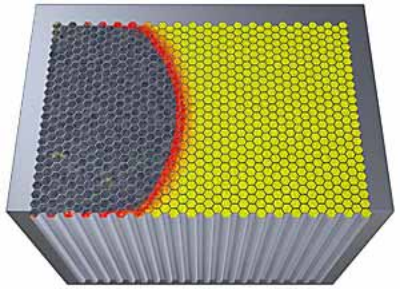
Nuclear power generation

A Simpler, More Secure and Economical Nuclear Energy System

Depleted uranium storage



Fuel fabrication

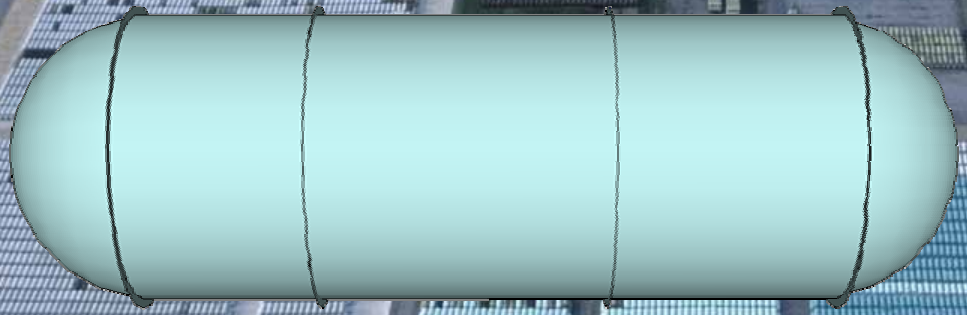


Nuclear power generation
(with half-century refueling)

Spent fuel storage
(with greatly reduced
waste volumes)

Long-term geologic repository
(with greatly reduced
waste volumes)

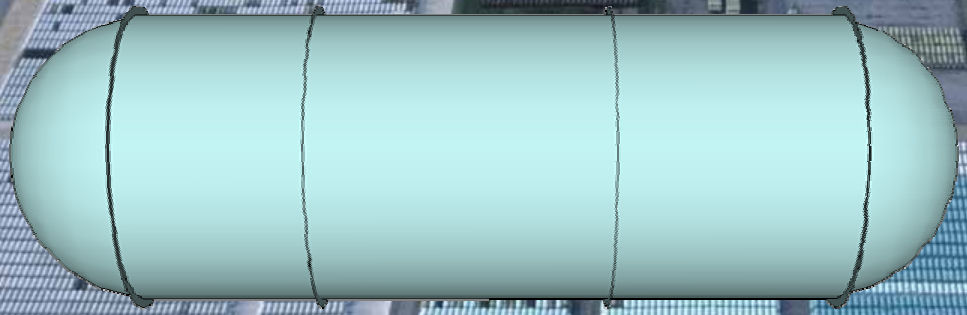
A More Sustainable and Secure Fuel Supply



Each 14-ton canister of depleted uranium can generate 60 million megawatt-hours of electricity…

…enough to power six million households at current U.S. rates of consumption for a year.

A More Sustainable and Secure Fuel Supply



The existing U.S. stockpile of 700,000 metric tons represents a national energy reserve that could last for many centuries.

TWRs can convert these 38,000 cylinders of "waste" to about $100 trillion worth of electricity.

The First TerraPower Reactors

- Fueled mainly by depleted uranium, a byproduct of uranium enrichment
- Small amount of enriched uranium is used to start the reaction
- Just one fuel load lasts for decades
- No reprocessing
- Reactor is sealed and below grade
- Near zero proliferation risk

Advanced Traveling-Wave Reactors

Making Fuel and Burning It
in One Pass, in One Place

The Traveling-Wave Reactor (TWR)

- Waves make, and then burn, fissionable material as they travel across the core.
- Waves are launched with a kernel of enriched uranium, but sustained solely by fuel made from depleted uranium or natural uranium
- Operates with well-developed technologies

TERRAPOWER

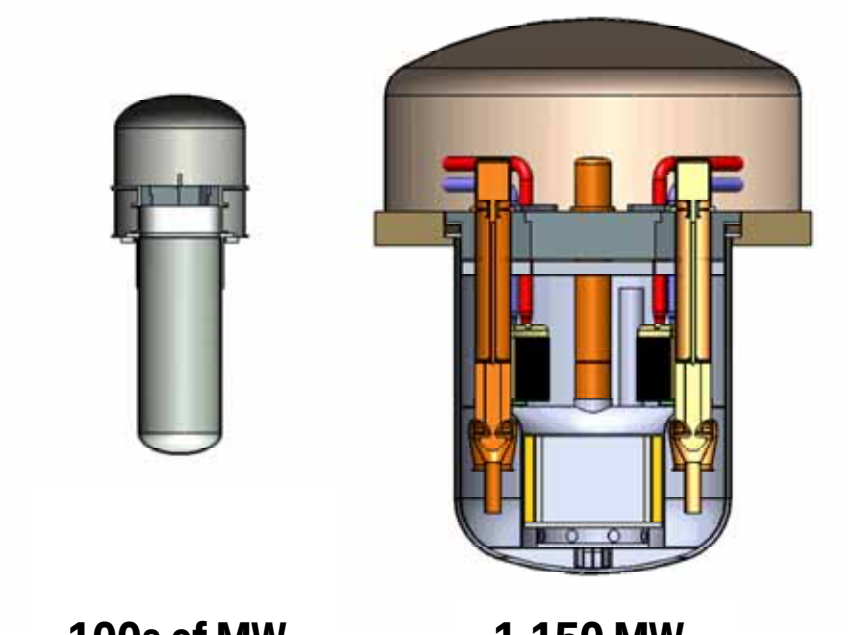
TWRs can also run on Spent Fuel from Light Water Reactors

- Existing nuclear plants in the U.S. are now storing about 60,000 metric tons of “spent” fuel
- Enough fuel to power 100 TWRs—each generating 1.2 GW_e—for a century
- No separation of uranium or plutonium required
- China plans to have ~100 GW_e of nuclear power by 2020
- These new reactors will expel similar amounts of “spent” fuel by mid-century

TWRs Large and Small

Different designs for different markets:

- Small, modular reactors for factory production, flexible for applications and markets
- Gigawatt-scale TWR that fits well within existing plant designs



100s of MW_e Modular TWR

1,150 MW_e CTWR

TerraPower

The First TWR: TP-1

- To begin operations in 2020, producing electricity for the grid
- 350–500 MW_e capacity (900–1,250 MW_t)
- No refueling needed for 40 years
- Mainly fueled with depleted uranium, with U^{235} as starter fuel
- Designed to accommodate advances in fuels or materials
- Also could be operated as a “standard” fast reactor
- TP-1 core may be compatible with existing or planned sodium-cooled fast reactors
- International cooperation will be needed to construct and operate TP-1

TerraPower Reactors Embrace Public Ideals, Market Realities

- Sustainable
  - Minimizes its environmental footprint
  - Burns waste
  - Meets global energy needs indefinitely
- Safe
  - Meets the highest safety standards
- Affordable
  - Competes with—or beats—existing nuclear systems

- Sustainable
  - ✓ Phases out mining
  - ✓ Burns existing and future DU and other waste as fuel
  - ✓ Known fuel supplies are sufficient for many centuries
- Safe
  - ✓ Uses latest safety features
- Affordable
  - ✓ Needs no reprocessing, and eventually no enrichment

The design provides "the simplest possible fuel cycle," says Charles W. Forsberg, executive director of the Nuclear Fuel Cycle Project at MIT, "and it requires only one uranium enrichment plant per planet."

TECHNOLOGY REVIEW, MARCH/APRIL 2009