Nuclear Spent Fuel Management

Tom Isaacs
Lawrence Livermore National Lab

March 7, 2013
PWR is one version of a Light Water Reactor (LWR). It uses regular (light) water as moderator and coolant.
Why nuclear?

- Proven
- Significant, stable, and independent domestic and international resource
- Safe and environmentally sound (What does Fukushima say about this?)
- High-tech export to balance trade and lift standard of living
- Technical leadership and influence in international policy such as non-proliferation, safety, waste
- A proven significant option providing flexibility and energy security in an uncertain future
- Short-term largely a market issue
Civilian nuclear power plants

- Primarily used for electricity generation ~ 16% of world electricity (minor use for heat and desalination)

- Convert heat from controlled nuclear fission into mechanical energy and, in turn, to electrical energy

- Key issues:
  - Economic
  - Safety and security
  - Potential for nuclear weapons proliferation
  - Nuclear waste disposition
Palo Verde Nuclear Generating Station, Arizona

- Largest in U.S.
- 3 units (last completed 1988)
- Cost $ 5.9 billion
- In 2006, generated 24 Million MW-hr power
- In 2000, 4 million people in CA, AZ, NM & Texas received power
Nuclear share of electricity (2004)

- France 78%
- Sweden 52%
- Rep. Korea 38%
- Germany 32%
- Japan 29%
- USA 20%
- Russia 16%
- China 2%

Percentage of electricity from nuclear power
NUCLEAR POWER REACTORS
(July 2006)

443 Reactors in 31 countries 3,695,552 MWe - 16% global electricity

27 Reactors under construction - 21,811 MWe
For nuclear energy to be sustainable as a global source of emission – free energy, the reactor fuel cycle must also remain sustainable (DG-IAEA Scientific Forum 2004)
The Situation Today

• No operating HLW/SNF repositories
• Growth of SNF
  – >230,000 MT worldwide, inventory grows at ~ 10,000 MT/yr
  – >45,000 MT in the U.S., inventory grows at ~ 2,000 MT/yr
• Spread of nuclear power
• Spread of enrichment/reprocessing
• Excess materials/wastes from defense programs
• Research reactor fuel
• Many countries planning on SNF disposal

What are the concerns?
What are the opportunities?
Waste management

• Nuclear power is the only energy-producing technology which takes full responsibility for all its wastes and fully costs this into the product.

• The amount of wastes is very small relative to those produced by fossil fuel electricity generation.

• Two different strategies are utilized for managing high-level wastes.
Storage of Spent Fuel
Yucca Mountain

- **Geology:** Composed of ash tuff deposited 10 million years ago
- **Elevation:** 4950 ft. at crest
- **Climate:** receives less than 7.5 inches rain annually
- **Resources:** none of commercial value
Yucca Mountain Repository

63,000 MTHM for CSNF
7,000 MTHM for Defense wastes
4,500 MTHM equivalent HLW
2,500 MTHM SNF (15 categories)
The Presidential Election

• Senator Barack Obama
  – “We will protect Nevada and its communities from the high-level nuclear waste dump at Yucca Mountain, which has not been proven to be safe by sound science.”
  – “The basic theory was, we won’t solve the problem, we’ll just dump it all in Nevada.”
  – “Among the possible alternatives…are finding another state willing to serve as a permanent national repository or creating regional storage repositories.”

  – Yucca, I think, was a misconceived project.”
BRC Recommendations

• A new consent-based approach to siting
• A new implementing organization
• Access to nuclear waste fees for intended purpose
• Prompt efforts to develop geologic disposal
• Prompt efforts to develop one or more consolidated storage facilities
• Early preparation for eventual transport
• Support advances in nuclear energy technology and workforce development
• Active U.S. leadership in international efforts