

Potential for Using MOX Fuel Derived from U.S. Nuclear Weapons in TVA's Reactors

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TVA and MOX Fuel

- In the exploratory stage of determining whether to use MOX fuel in reactors
- Decision will not occur until 2012
- Must be safe and advantageous to TVA's customers

What is MOX fuel?

- **Commercial fuel is uranium oxide**
 - Fissionable isotope is uranium-235
 - Plutonium is a byproduct of the uranium fission process in all commercial nuclear power plants.
 - Plutonium remains in fuel pellets producing ~40% of the core's heat energy
 - Over 50% of the energy in individual fuel assemblies in their third cycle
- **Mixed Oxide (MOX) fuel is a mixture of plutonium and uranium**
 - Fissionable isotope is plutonium-239
 - Weapons MOX (WMOX) has a higher concentration of Pu-239 and fewer impurities than commercial MOX

MOX Experience

Isotope	Fresh Uranium Fuel	Irradiated Uranium Fuel	Recycled Fuel MOX	Weapons MOX
U-238	96%	93%	91%	95%
U-235	4%	1%	<1%	<1%
Fission products	0%	5%	0%	0%
Avg assembly Pu	0%	1%	9%	4.3%
Pu-238	0%	1%	1%	0%
Pu-239	0%	57%	57%	94%
Pu-240	0%	27%	27%	5%
Pu-241	0%	8%	8%	<1%
Pu-242	0%	7%	7%	<<1%

PWR Fuel Assembly

The PWR 17x17 assembly is approximately 160 inches long (13.3 feet), 8 inches across, and weighs 1,500 lbs.

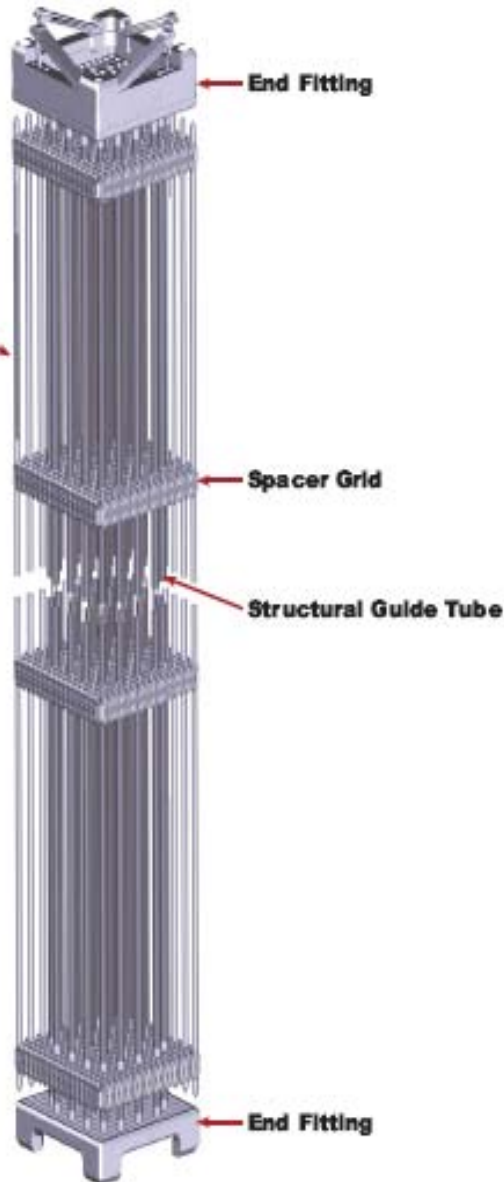


Ceramic Fuel Pellet

MOX fuel pellets and assemblies are physically identical to uranium fuel

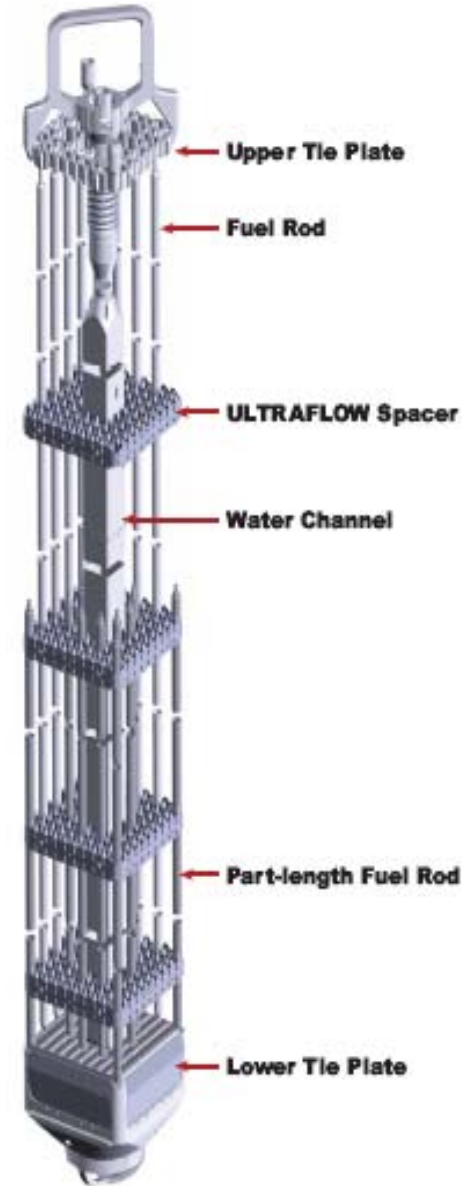


Sealed Fuel Rod



BWR Fuel Assembly

The BWR 10x10 assembly is approximately 174 inches long (14.5 feet), 5 inches across, and weighs about 500 lbs.



Using MOX Fuel

- 40% of the core is replaced every 18 to 24 months
- If using MOX, a maximum of 50% of fuel assemblies in the reactor would be MOX fuel
- Physics differences between plutonium and uranium would be accommodated in the core design
- Analyses run by TVA and its fuel supplier indicate that physics differences can be readily accommodated

WMOX program

- Plutonium from nuclear weapons processed into WMOX fuel
 - ✓ DOE concluded best way to disposition surplus plutonium is in MOX fuel burned in a reactor
 - ✓ DOE building facilities at Savannah River site
- TVA has extensive experience with DOE programs
 - ✓ Blended Low Enriched Uranium (BLEU) program – blends down weapons program uranium into usable reactor fuel
 - Used at Browns Ferry since 2005
 - ✓ Tritium production program in Watts Bar Unit 1 reactor

MOX Experience

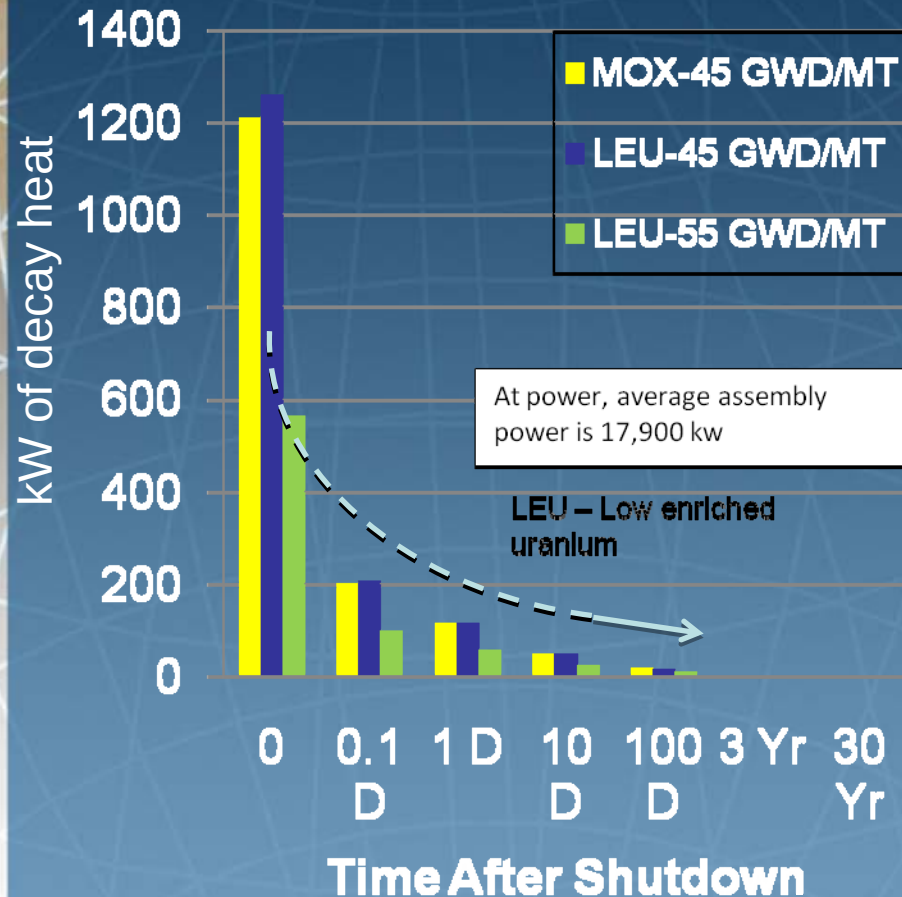
- MOX fuel was first used in a thermal reactor in 1963
- Commercial started in the 1980s
 - Significant operating experience in Belgium, Switzerland, Germany and France
 - About 40 reactors are licensed to use MOX
 - Over 30 actually using MOX
 - Generally use MOX fuel as about one third of their core
 - Some will accept up to 50% MOX assemblies
 - Japan plans to use MOX in one third of its reactors
- US experience
 - MOX fuel was used in testing programs in the United States in the 1970-1980s
 - More than 280 MOX fuel rods were successfully used at Quad Cities, Big Rock Point, San Onofre and Ginna.
 - Programs confirmed that MOX performance comparable to uranium fuel
 - Recent Duke Lead Test Assembly program of WMOX

Is MOX fuel hotter?

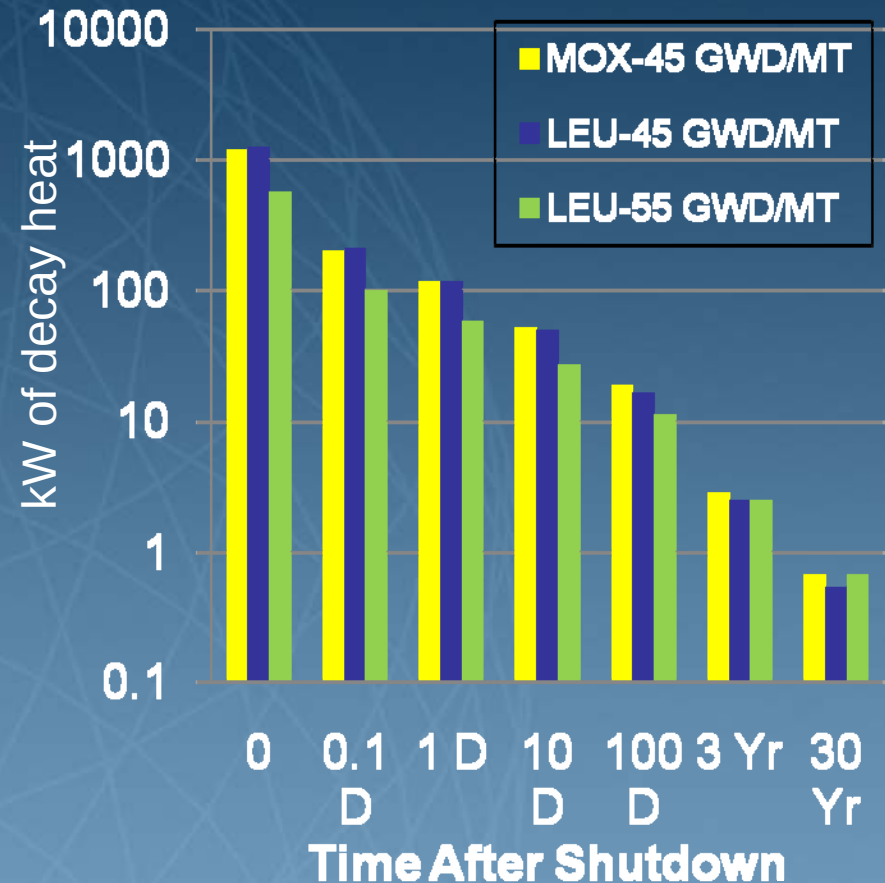
- No, not while in the reactor
 - Reactor will produce the same amount of heat while operating no matter what fuel is used.
 - Licenses from the NRC limit heat output of reactors
- After shutdown
 - MOX fuel is cooler for the first day
 - Slightly hotter years later but able to use existing spent fuel pools or dry casks

Assembly Decay Heat Plots

Decay Heat (kW) vs Time After Shutdown



kW (Log Scale) vs Time After Shutdown



Milestones

- DOE Supplemental Environmental Impact Statement (SEIS) Ongoing
- Fuel cycle and safety analysis studies Ongoing
- DOE complete SEIS 2012
- Determine whether to go forward 2012

If decision is to go forward

- *Develop licensing and implementation plans* 2012
- *Take delivery of first 8 MOX fuel assemblies* 2018

Summary

- TVA is evaluating the potential for using MOX fuel derived from nuclear weapons in its nuclear reactors at Sequoyah and Browns Ferry.
- TVA will go forward with MOX fuel only if it is safe and benefits TVA's customers
- MOX fuel use is one of many nuclear related activities that TVA is evaluating in light of the events in Japan
- A decision is expected in 2012