FACTS

energy SCIENCES & TECHNOLOGY DEPARTMENT

BROOKHAVEN NATIONAL LABORATORY

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Thorium-Based Proliferation Resistant Reactors

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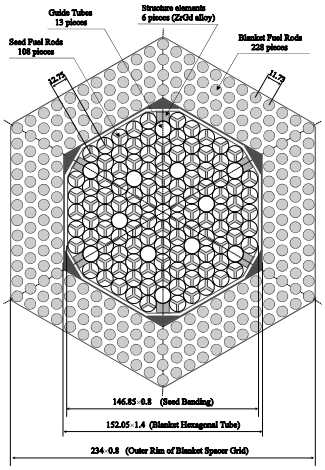
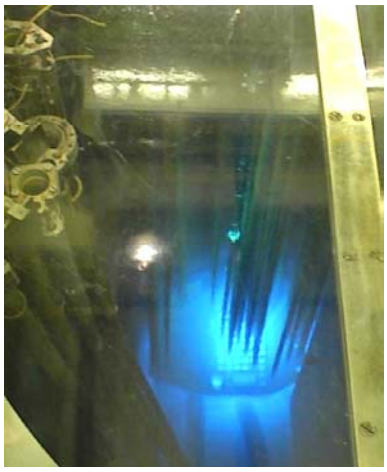


Thorium-based fuels have been receiving renewed attention as a way to address the proliferation and waste concerns associated with commercial nuclear power. Thorium Power Fuel was initially proposed in the mid-1990s to address these concerns. The concept is based on a seed-blanket approach originally pioneered at the Light Water Breeder Reactor (LWBR) at Shippingport, Pa. Whereas the LWBR was designed to breed and recycle U-233 in analog to the conventional uranium-plutonium cycle, the current approach operates "once-through", and denatures the U-233, and burns most of it *in situ*, thereby making its potential extraction/use very unattractive/unlikely. The approach is based on the use of a seed-blanket unit (SBU) which is a one-for-one replacement of a conventional PWR or VVER fuel assembly, and can be implemented in existing reactors with minimal or no modification. In addition to significantly reducing the quantity of plutonium generated, and its attractiveness for potential use in a weapon, initial evaluations of both the VVER and PWR variants of the SBU approach have shown advantages with respect to the quantity and toxicity of the waste generated, as well as being competitive economically, and falling within the existing safety envelope of operating reactors. Variants for the burning of both reactor-grade and weapons-grade plutonium have also received limited examination with encouraging results.



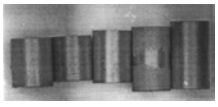
The objective of the Thorium Power Fuels Project is to perform Research Development and Demonstration (RD&D) for thorium-based fuels aimed at qualifying seed and blanket fuels, and the SBU approach for use in existing VVERs and PWRs. Plans are to perform testing of full-scale samples of seed and blanket fuels, and full SBUs in an operating VVER in ~2005-2006.

The work is being performed by a world-class technical team with recognized expertise in reactor analyses: Brookhaven National Laboratory (BNL), the Massachusetts Institute of Technology (MIT), the Russian Research Center-Kurchatov Institute (which heads a team in Russia that includes Bochvar, LUCH, MSZ Electrostal, and others), and the Ben Gurion University of the Negev in Israel. BNL is responsible for the technical program direction, planning and integration, technical assessment and validation, and program management.

Related work is being performed under the U.S. DOE Nuclear Energy Research Initiative (NERI) for a project on "Optimization of Heterogeneous Utilization of Thorium in PWRs to Enhance Proliferation Resistance And Reduce Waste". Participants include BNL and MIT, with collaborators from: the Russian Research Center - Kurchatov Institute; Ben-Gurion University of the Negev, Israel; the Commissariat a l'Energie Atomique, France (inactive); and several Korean nuclear organizations (KAERI, KAIST, Kyung-Hee University).

Another BNL project under the NERI program is examining "A Proliferation Resistant Hexagonal Tight Lattice BWR Thorium Fueled Core for Increased Burnup and Reduced Fuel Storage Requirements"

Finally, work under the LWR-Transmutation task of the Advanced Accelerator Applications (AAA) program is evaluating the potential of thorium-based fuels for burning the transuranics (TRU) from spent commercial reactor fuel. This activity complements earier work as part of an International Atomic Energy (IAEA) Coordinated Research Programme which examined "The Potential of Thorium-based Fuel Cycles to Constrain Pu and to Reduce Long-term Waste Toxicities"



Prototype Seed & Blanket Fuel