International Conference on Management of Spent Fuel from Nuclear Power Reactors: An Integrated Approach to the Back End of the Fuel Cycle

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# THORIUM FUEL CYCLES IN A VERY HIGH TEMPERATURE HYBRID SYSTEM

The current growth of the energy demand, the perspective of a pronounced increment for the next future, added to the near depletion of the fossil fuels has made finding sustainable alternatives of energy supply, a challenge to the international scientific community. Nuclear Energy is presented as a prominent energy source because nuclear energy is a clean, safe, and cost-effective energy supply. However, nuclear energy faces substantial challenges to be successful as a sustainable energy source: manageable nuclear waste, effective fuel utilization, and increased environmental benefits, competitive economics, recognized safety performance and secure nuclear energy systems and nuclear materials. Nowadays an innovative generation of nuclear energy systems and fuel cycles are investigated in order to solve these challenges. The Generation IV of nuclear reactors is expected to solve the problems of the nuclear energy. Pebble Bed Very High Temperature advanced systems together with fuel cycles based in Thorium has significant perspectives to take on the future nuclear energy development challenges and to increase the development possibilities. In this paper the main advantages of the use a Very High Temperature hybrid system using a variety of fuel cycles based on Thorium (Th-U233, Th-Pu239 and Th-U) under a deep burn scheme are studied. The conceptual design of the Very High Temperature hybrid system composed of a Very High Temperature Pebble Bed Reactor (VHTR) and two Pebble Bed Accelerator Driven Systems (ADSs) is analyzed. The VHTR and the ADSs are designed to work in a thermal neutron spectrum, moderated by graphite and cooled by Helium. The fuel elements are TRISO coated particles confined in graphite pebbles. Parameters related to the neutronic behavior like nuclear fuel breeding, Minor Actinide stockpile, the energetic contribution of each fissile isotope and the radiotoxicity of the long lived wastes are used to study Th+U233, Th+Pu239 and Th+U fuel mixtures based on Thorium in the hybrid system, using the MCNPX ver. 2.6e computational code.

## Country/ int. organization

Cuba/The Higher Institute of Technologies and Applied Sciences

**Primary author:** Prof. RODRIGUEZ GARCIA, Lorena Pilar (The Higher Institute of Technologies and Applied Sciences, Faculty of Nuclear Sciences and Technologies)

**Co-authors:** Dr BRAYNER DE OLIVEIRA LIRA, Carlos Alberto (Departamento de Energia Nuclear—UFPE); Dr GARCÍA HERNÁNDEZ, Carlos Rafael (The Higher Institute of Technologies and Applied Sciences , Faculty of Nuclear Sciences and Technologies); Dr MILIAN LORENZO, Daniel Evelio (The Higher Institute of Technologies and Applied Sciences, Faculty of Nuclear Sciences and Technologies); Prof. MILIAN PEREZ, Daniel (The Higher Institute of Technologies and Applied Sciences , Faculty of Nuclear Sciences and Technologies)

**Presenter:** Prof. RODRIGUEZ GARCIA, Lorena Pilar (The Higher Institute of Technologies and Applied Sciences, Faculty of Nuclear Sciences and Technologies)