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Review the Behavior of Thorium Based Fuel (U,Th) and (Pu,Th)

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Abstract: Study on the behavior of thorium based fuel in a fuel bundle is the aim of this Simulation. check the spectrum flux in theoretical sample Shown that (Th, U) and (Th, Pu) cycle can work in one fuel bundle.

Keywords: Thorium nuclear fuel, MCNP and MCNPX code, (U-Th) and (Pu-Th).

1. Introduction

The Thorium fuel cycle has some advantages in compare with uranium fuel cycle: 1) a small initial inventory, 2) reduced radioactive inventory 3-a none proliferating fuel 4-large reserves of Thorium. Thorium is not itself fissile and so is not directly useable in a thermal neutron reactor. Howe ever it is fertile and upon absorbing a neutron will transmute to uranium-233 (U-233) which is an excellent fissile fuel material. In this regard it is similar to Uranium-238 (which transmutes to Pulotonium-239). All thorium fuel concepts therefore require that (Th-232) is first irradiated in a reactor to provide the necessary neutron dosing to produce Protactiume-233. The Pa-233 that is produced can either be chemically separated from the parent thorium fuel and the decay produce U-233 then recycled into new fuel, or the U-233 may be useable in-situ in the same fuel form especially in molten salt reactors (MSRs) The management use of nuclear fuel with use less uranium fuel and produced less nuclear poison nuclear waste are considerable points and more attention on (Thorium mixed fuel). Thorium based fuel applicable in new generation reactors and in reactor park Reactors concepts (namely hybrids of accelerator driven with molten salt blanket systems, hybrids of fission and fusion reactor have been envisaged as potentially making use of thorium [2]. Thoria bundles have been used for power-flattering in the initial core of the standardized Indian PHWR and the RAPS type of PHWR [5]. (PuO_2+Tho_2) feasibility study of Thorium-Plutonium mixed assembly.

2. Experimental Setup

In this basic study fuel bundle simulated by mcnpx and mcnp nuclear code in experimental scale, the main purpose of this work is study on mixed thorium based fuel, the management use of nuclear fuel by use mixed fuel and use less uranium, the considering point produced less poisonous nuclear waste and more attention on Thorium based mixed fuel in this simulated fuel bundle loaded three different fuel. the main politic is useless uranium and considering on mixed material contain thorium, a basic study just on the behavior of MOX (U,Th), (Pu,Th) in real condition inpresense of coolant , clad, and other reactor materials and real condition the results would be change. No attention on heattransfer concepts and coolant fluid and other fluid behavior in real reactor in this study. A basic idea of fuel bundle contains 3 diffrent fuel materials concentrate on thorium mixed fuel. Fig. 1 shown the simulated fuel bundle.

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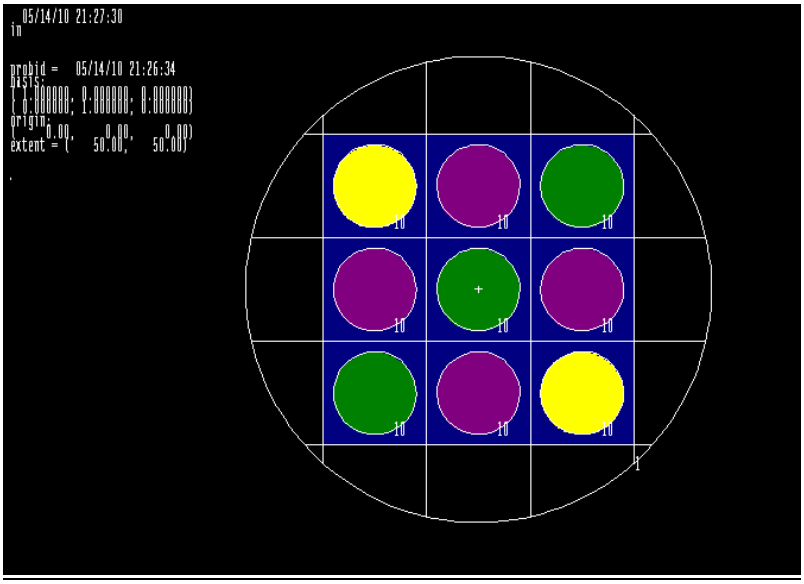

Fig. 1 A mixed fuel bundle simulated by mcnx : green (U-Th) purple (Pu-Th) yellow (U-Pu).

Also Use of mixed (Pu-Th) in this imaginary bundle shown. Atomic reactors would convert Uranium-238 which is not a reactor fuel to Plotonium-239 which is breeder reactors would make more fuel consumed it would be magical [4].

Fuel mixed used in this bundle:

^{238}U	^{232}Th	^{238}Pu

$^{238}\mathrm{U} + \mathrm{n} \rightarrow {}^{239}\mathrm{U} \rightarrow {}^{239}\mathrm{Np} + \mathrm{e}^{-} \rightarrow {}^{239}\mathrm{Pu} + 2\,\mathrm{e}^{-}$

$^{232}\mathrm{Th} + \mathrm{n} \rightarrow {}^{233}\mathrm{Th} \rightarrow {}^{233}\mathrm{Pa} + \mathrm{e}^{-} \rightarrow {}^{233}\mathrm{U} + 2\,\mathrm{e}^{-}$

$^{239}\mathrm{Pu} + \mathrm{n} \rightarrow {}^{240}\mathrm{Pu} \rightarrow {}^{134}\mathrm{Xe} + {}^{103}\mathrm{Zr} + 3\,\mathrm{n}$

also attention choose these bundles in reactor than can use thorium fuel suggested.

3. Experimental Results

In traditional bundle usually used just one fuel rod. Here study on rainbow of different material fuel and check the ability of it.

In Fig. 2 shown the spectrum flux of mox(U,Th) and in Fig. 3 the surface spectrum of (U-Pu) cell. In this study no attention on thermodynamic and heattrabsfer aspects, and cocentrate on managing irradiated fuel, Reprocessing, Waste management and designe descripthion thoria bundle. For next step, study on fraction of fuel material and change rod array designes suggested.

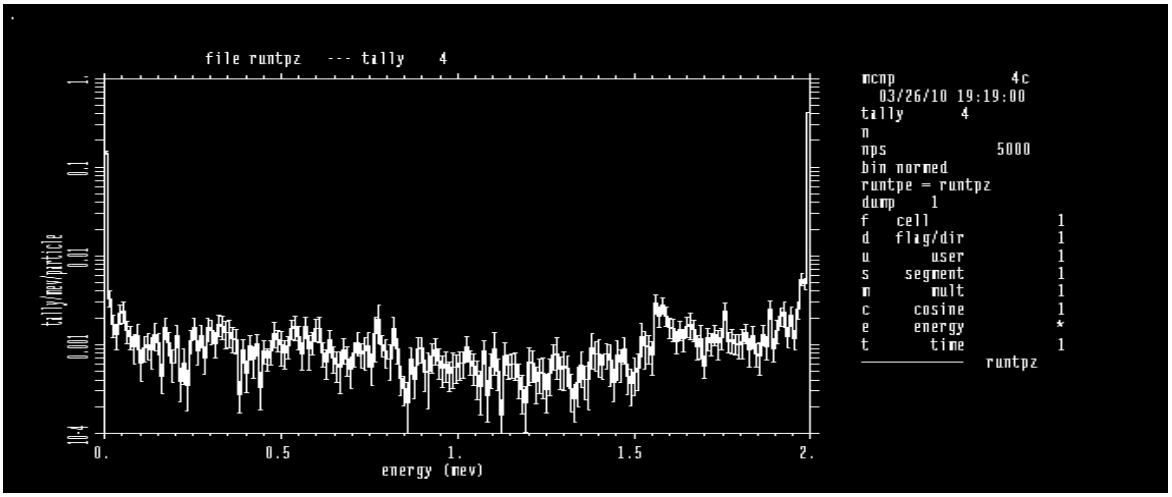

Fig. 2 Spectrum of MOX (U-Th) cell flux.

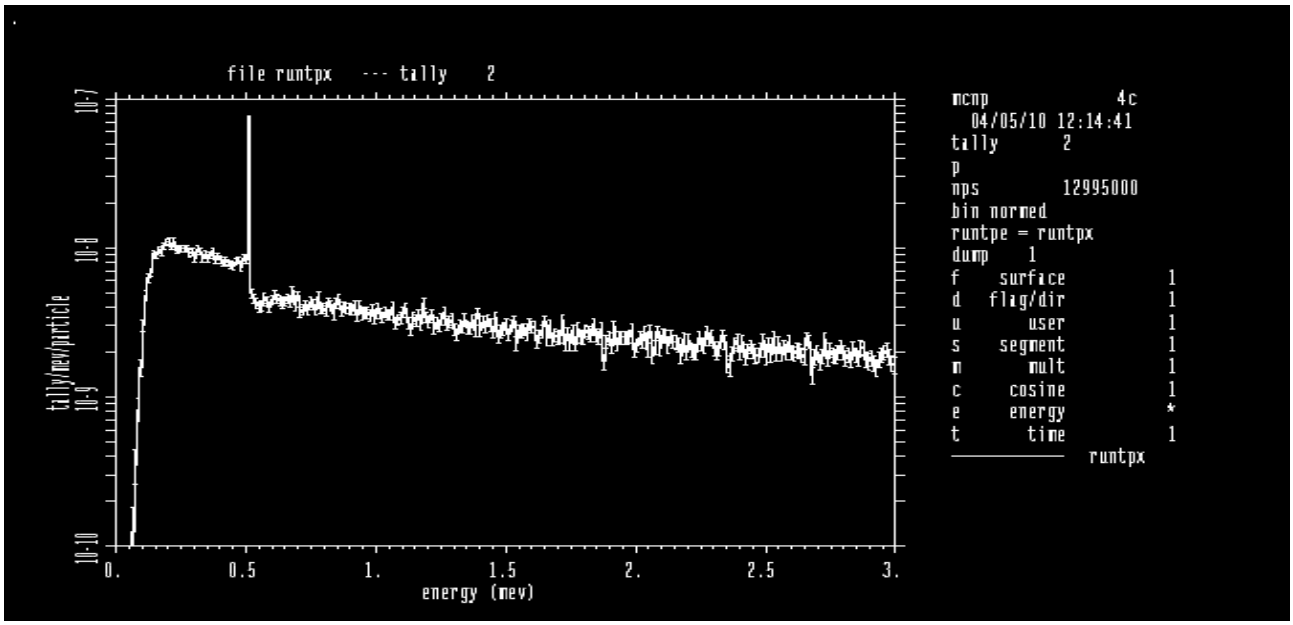

Fig. 3 Spectrum of surface flux (Pu-Th) cell.

4. Conclusion

The results of this simulation demonstrate new designe fuel bundle with different fuel and use less uranium and reviwe the behavior of mixed fuel caused to change the tip of fuel bundle. It shown that (U-Th) and (U-Pu) and (Pu-Th) could be work parallel in one fuel bundle.

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