3ème conférence Internationale des énergies renouvelables CIER-2015

Proceedings of Engineering & Technology (PET)
pp.228-229

The Tunisian Subcritical Assembly Project: Impact of different moderator to neutron parameters of zero power reactor

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The National Center of Nuclear Sciences and Technology of Tunisia has decided to build a subcritical assembly as its first nuclear facility, in order to strengthen its technical capabilities with a facility that is dedicated for education, training, and research in the field of nuclear physics. The subcritical assembly will be extremely useful for carrying out research projects in order to provide scientists with a basic understanding of the main concepts relevant to nuclear reactors. Studies related to site selection and technical characteristics of the facility are currently in progress and almost finalized.

The Tunisian subcritical assembly will be uranium fueled, light water moderated, and reflected. The reactor will be driven by a plutonium-beryllium or americium-beryllium neutron source. The core consists of few hundred of LEU fuel rods, loaded into a water-filled vessel in a square lattice. Fuel rods are based on PWR fuel structural pattern type, made of uranium dioxide (UO2) with less than 4wt% 235U enrichment in zirconium alloy (Zr-4) cladding.

Design and optimization were performed using MCNP transport code. The resulting computed effective multiplication factor (k_{eff}) was around 0.9.

This paper presents a first design proposal, modeling, and core analysis (neutron flux distributions and multiplication factor) of the assembly.

The moderator is a common component to most types of reactors and it is a material in the core which slows down the neutrons released from fission so that they cause more fission. It is usually water, but may be heavy water or graphite. Beryllium has also been used in some experimental types, and polyethylene has been suggested as another possibility.

We also present the effect of the different moderators to the neutron parameters of the subcritical assembly in CNSTN. We will explain our choice of the light water moderator for the future assembly.

ISSN: 2356-5608