Neutronic Characteristics Analysis of a Fast Breeder Reactor (FBR) Using MCNPX Code

A Thesis
Submitted for the degree of Ph.D in physics as a partial fulfillment for requirements of the doctor of Science

By
Amr Ibrahim Abd El-Azeam
M.Sc. (Physics), 2014, Ain Shams University

Supervised By

Prof. Dr. Soad Abd El-Monem El-Fiki
Professor of Nuclear Physics, Faculty of Science, Ain Shams University

Prof. Dr. Samir Yousha El-Khamisy
Professor of Nuclear Physics, Faculty of Science, Ain Shams University

Prof. Dr. Moustafa Aziz Abdelwahab
Professor of Nuclear Engineering at Nuclear and Radiological Regulatory Authority

Dr. Ahmed Abdelghafar Galahom
Lecturer of Nuclear Physics at Higher Technological Institute 10th of Ramadan

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Ain Shams University
Faculty of Science
Physics Department

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Name: Amr Ibrahim Abd El-Azeam

Thesis Advisors	**Approved**
Prof. Dr. Soad Abd El-Monem El-Fiki Physics Department, Faculty of Science, Ain Shams University	……..
Prof. Dr. Samir Yousha El-Khamisy Physics Department, Faculty of Science, Ain Shams University	…….
Prof. Dr. Moustafa Aziz Abdelwahab Nuclear and Radiological Regulatory Authority	…….
Dr. Ahmed Abdelghafar Galahom Higher Technological Institute 10th of Ramadan	…….

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

وَقُل رَّبِّ زِدْنِي عِلْمًا

In the Name of Allah, the Most Gracious, the Most Merciful

“..**And Say: My Lord! Increase me in Knowledge”**

“TAHA/114, the Glorious QurAn”

To

Mother,
Father,
Brother,
Sisters,
And
Dear Wife.

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Abstract

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Name: Amr Ibrahim Abd El-Azeam

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The Gas Cooled Fast Reacor (GCFR) is one of the six advanced systems that have been chosen by Generation IV iniatiative for research and developement of a relaible, economic, safe and proliferation-resistant nuclear system. This study presents a comprehensive overview of the neutronic performance of the large scale Gas Cooled Fast reactor GFR2400. This reactor is a highly innovative system with advanced geometrical design and fuel materials. The active fuel region of this reactor is divided radial into two core zones namely, inner core fuel assemblies (IC), and outer core fuel assemblies (OC). MCNPX code is used to study the neutronic behavior and fuel isotopic transmutations of the GFR2400 and to investigate the effect of fuel homogenization on the neutronic parameters and fuel transmutations both at assembly and core levels. An analysis of the core neutronic and safety related parameters have shown favorable neutronic characteristics. Moreover, the results of isotopic transmutation and burn-up within the reactor core demonstrated the capability of GFR2400 concept to achieve fuel sustainability even without the use of fertile blankets.

Keywords: Fast reactors- GFR2400- MCNPX- Fuel homogenization.

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