



# **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

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

وَقُلْ رَبِّ 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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## **Abstract**

Name: Amr Ibrahim Abd El-Azeam

Title: Neutronic Characteristics Analysis of a Fast Breeder  
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The Gas Cooled Fast Reactor (GCFR) is one of the six advanced systems that have been chosen by Generation IV initiative for research and development of a reliable, 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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