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NEUTRONIC PARAMETERS AND CPS (CONTROL AND PROTECTION SYSTEM) WORTH CALCULATION OF THERMAL RESEARCH REACTOR USING MCNPX CODE

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One of the main attributes of reactor core design is finding the best distribution of the core controls and protection systems. Nuclear reactors have several distinctive types of control and protection elements, such as control rods, shimming rods and emergency rods. Each of these elements performs a separate task in a control procedure. The distribution of these elements in the core contributes to their worth and expense, therefore finding the best location and distribution of the control protection system (CPS) elements is very important from the viewpoint of nuclear reactor design and safety. The scope of this paper is to present the neutronic parameters such as effective multiplication factor (Keff), Neutron Spectrum and CPS worth calculation of research heavy water reactor using MCNPX code. In order to reduce the possible systematic errors due to inexact geometry, a very exact three-dimensional model of Reactor was developed. The MCNPX2.6 input file was prepared in such a way that a very quick setup of any desired core configuration with an adequate position of all Control and Protection Systems (CPS) is possible. Utilizing the appropriate material cross-sections in an MCNP calculation is essential to obtain reliable results. The MCNP neutron interaction tables used in this study are processed from ENDF/B-VII evaluated data file at room temperature. The thermal scattering treatment was used for light and heavy water, and polyethylene.
The obtained computational data showed that when all the emergency rods are fully inserted in the core, or when all the emergency channels are filled by light water, the negative imposed reactivity is more than the clean core excess reactivity (5% ΔK/K) plus 1%. Therefore, the emergency system satisfies the nuclear safety regulations.

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