Measurement of the Neutron-Spectrum in the IEA-R1 Research Reactor

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The neutron energy spectrum in fuel element of the IEA-R1 research reactor were obtained through the unfolding multi-foil activation method.

The foils selected covered the neutron energy range from 0,008 eV to 13,3 MeV for 90% saturation activity. The nuclear reactions used are: $^{197}Au(n,\gamma)\ ^{198}Au$, $^{232}Th(n,\gamma)\ ^{233}Th$, $^{59}Co(n,\gamma)\ ^{60}Co$, $^{58}Fe(n,\gamma)\ ^{59}Fe$, $^{115}In(n,n')\ ^{115m}In$, $^{47}Ti(n,p)\ ^{47}Sc$, $^{54}Fe(n,p)\ ^{54}Mn$, $^{24}Mg(n,p)\ ^{24}Na$, $^{48}Ti(n,p)\ ^{48}Sc$.

The foils were irradiated in the Fuel Element 94 from the core configuration number 155 with the reactor power at 4,5 KW. After irradiation, the foil activities were measured using a High Purity Germanium Detector (HPGe). The saturation activity per target nucleus was unfolded in energy spectrum through the SAND-II code. The initial guess spectrum required by SAND-II code was estimated with the HAMMER-TECHNION code, which solves the integral transport equation in a representative cell of the reactor.

The main characteristics of the obtained spectrum, are: i) Neutron Effective Temperature is 328 K; ii) Energy junction between thermal and epithermal spectrum is 0,3 eV; iii) The most probable thermal energy is 0,028 eV and iv) The most probable fast energy is 0,69 MeV. Finally, the obtained spectrum can be used in radiation damage analysis and other applications.