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Impact of new results of the neutron capture cross section measurements for odd gadolinium isotopes on thermal-spectrum systems

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157Gd and 155Gd play a crucial role in the neutronics of thermal spectrum systems; this is due to their extremely high capture cross section at low neutron energies, so high that they can compete very efficiently with 235U and 239Pu in neutron absorption, even at very low atomic concentrations. Thanks to this characteristic, Gd odd isotopes can play either the role of parasitic neutron absorbers or that of desired neutron poisons, according to specific needs. In current Light Water Reactors (LWRs), Gd isotopes are used as neutron poisons to compensate Beginning-of-Life excess reactivity of nuclear fuels, necessary to increase the economic performances of these reactors; for Boiling Water Reactors, where Gadolinium poisoning is extensively used, a correct estimation of the depletion of odd isotopes is fundamental to ensure the desired safety margins for the storage of spent nuclear fuel in the reactor Spent Fuel Pools. Also in new, emerging LWR technologies, like the s.c. boron-free Pressurized Water Reactor cores, reactivity compensation relies heavily on Gd odd isotopes. In CANDU heavy water reactors, Gd liquid solutions are used as part of an emergency shutdown system to cut the chain reaction. Despite this very important physical role, it appears that the neutron capture cross sections of these isotopes at thermal energies is not known with the accuracy one would expect; many important experimental benchmarks containing Gd are not well reproduced by the currently available cross section evaluations. While for practical purposes the present knowledge might be felt adequate enough, the ever
demanding need for a very precise evaluation of safety margins in neutronics calculations suggests to improve as much as possible these cross sections, as well as their associated uncertainty. To this aim, a series of experimental campaigns at the n_TOF facility has been recently performed. This paper will show the impact of the new measurements on
neutronics calculations and, albeit preliminarily, will try to address qualitatively the issue if the new thermal values go in the desired direction of improving the reliability of the Gd evaluated cross sections.

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