Fission Induced by High Energy Particles and Energy Release in Massive Fissionable Targets Applied for ADS

Petar Zhivkov

Institute of Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences, Sofia, Bulgaria

External driven systems (EDS) use accelerators for the generation of a high energy neutrons flux. These neutrons irradiate the nuclear fuel and the long lived high radiotoxic nuclear waste and deposit their energy by interacting with the fissionable nuclei. The neutron flux and plutonium production are calculated by using nuclear models and cross sections. The MCNP transport code is the most widely applicable software for this purpose. Most of the available cross sections data are defined up to 20 MeV, but some are up to 200 MeV (TENDL 2015 [1], JEDNL40he [2,3] and JENDL5 [4]) and 1000 MeV (ADS-II IAEA [5]). The extended cross sections data contain inaccuracies. When used for EDS calculation additional estimations of the energy deposition and high energy neutron interactions have to be done. Some of the inaccuracies are in the primary ENDF files. There are no spallation cross sections for all of the nuclides and the (n,f) reaction for Pb, Bi isotopes is nor present and the (n,xn) reactions are defined up to 30 MeV and for the energies above that the cross sections are zero. There are other inaccuracies in the ACE files. Some versions of the NJOY and FRENDY software do not process correctly the cross sections data above 20 MeV [6]. The article presents the differences in the total neutron production, fission, ^{239}Pu production and fission energy deposition in a cylindrical target made of depleted uranium irradiated by 1 GeV proton beam calculated by MCNP6 with above cross section data.

Keywords: Transmutation, ADS, MCNP6

REFERENCES

1. https://tendl.web.psi.ch/tendl_2015/tendl2015.html
2. https://www-nds.iaea.org/exfor/endf.htm
3. https://rpg.jaea.go.jp/main/en/ACE-J40HE/
4. https://rpg.jaea.go.jp/main/en/ACE-J50/
5. https://www-nds.iaea.org/ads/adshe.html
6. P. Zhivkov, Importance of high energy neutron cross sections for neutron induced reactions for infinite fissionable targets, "*in AccApp2021*", Washington DC, doi.org/10.13182/T125-37232 2021, pp. 88–92.