

Development and Applications of HINEG High Intensity Neutron Sources

Qi Yang, Zhigang Wang, Jing Song, Yongfeng Wang, Quan Gan, Wei Wang, Tongqiang Dang, Wen Wang, Minghuang Wang, Xiang Ji, Canjun Liang, Xueyan Shi, Yingying Zhu, and FDS Team

International Academy of Neutron Science, Qingdao, Shandong, 266041, China

Neutron sources are the important experimental platforms for the R&D of advanced nuclear energy and nuclear technology applications. The High Intensity Neutron Sources (HINEG) have been developed in China with different missions including neutronics design validation, materials & components irradiation test, nuclear waste burning and nuclear technology applications, etc.

According to the characteristics, HINEG can be divided into two series: Miniaturized series and High intensity series. The miniaturized series of HINEG include mini neutron generator with 25mm diameter and intensity of 10^8 - 10^9 n/s, mobile neutron source with intensity of 10^{10} - 10^{11} n/s, etc. These neutron sources are developed for application in neutron logging, security inspection, radiography, etc. The high intensity series of HINEG include HINEG-I, HINEG-II and HINEG-III.

HINEG-I has achieved the fusion neutrons with the yield of 6.4×10^{12} n/s at maximum, and has been coupled with the Lead-based Zero Power Critical/Subcritical Reactor named CLEAR-0, which is actually an accelerator-driven Fusion-Fission Hybrid System. Series of typical experiments have been carried out on HINEG-I, including neutronics and code validation, core physics study of advanced reactors, neutron radiography, neutron detectors calibration, neutron biological effects, neutron radiation hardening, and so on.

HINEG-II is an accelerator-based neutron source with the yield of 10^{14} - 10^{15} n/s. It aims to apply to multi-purposes, e.g. neutron capture therapy, isotope production, etc. The design and R&D for key technologies of HINEG-II are performed on-going.

HINEG-III is initially conceived as a GDT-based or accelerator-based neutron source with the intensity of 10^{17} - 10^{18} n/s. The objectives of HINEG-III are to conduct test of nuclear materials, components test and reliability data collection of nuclear components, nuclear waste burning test, etc. This contribution presents an overview of the series recent activities.