5 - 23 Reactor Neutronic Core Design of CIADS

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The accelerator driven subcritical system (ADS) is a new type of nuclear energy system. A standard ADS is composed by three elementary components, namely, a high energy and intensity proton beam, a spallation target and a subcritical core. It is regarded as one of the promising technique means to reduce the long-lived radioactive waste inventory. Meanwhile, it shows the potential for fuel breeding and power generation. China has been committed to the ADS research for a long time, making some dramatic breakthroughs in some key technologies. China Initiative Accelerator Driven System (CIADS) led by the Chinese Academy of Sciences is one of the Major National Science and Technology Infrastructures during "the 12th five-year plan" supported by National Development and Reform Commission of China and expected to be the first ADS verification facility in the world.

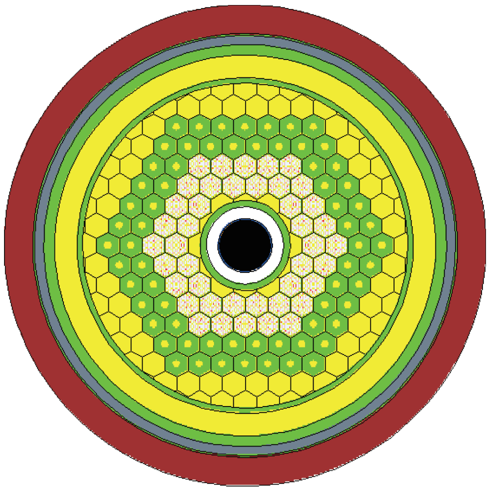

Fig. 1 (color online) CIADS core configuration.

Nuclear design is an important part of CIADS design, this article will make a brief introduction to the reactor neutronic core design of CIADS.

CIADS neutronic core design

The CIADS reactor core is made of 42 fuel assemblies and 66 dummy assemblies (Fig.1). The active zone of fuel assembly is 100 cm and each hexagonal FA contains 60 fuel pins and 1 stainless steel pin. The CIADS fuel rod consists of ceramic 19.75% UO_2 fuel pellets stacked inside a cladding.

The neutronics calculations are performed with the advanced Monte Carlo radiation transport code MCNPX 2.7.0 running in a parallel computer environment with MPI-multiprocessing. Table 1 gives an overview of the main parameters obtained for the beginning of the CIADS core.

Table 1 Overview of the CIADS core main parameters (BOL).

Parameter	Value
Core thermal power/MW	7.86
Spallation thermal power/MW	2.14
k_{eff}	0.850 63
k_{s}	0.879 05
β_{eff}	0.007 59
Spallation neutron yield/(n/p)	1.76
Accelerator current/mA	8.55
Proton beam energy/MeV	250
Proton source intensity/(p/s)	5.34×10^{16}
Max$\phi_{>0.1\text{ Mev}}$ inside core/(n/ (cm^2·s))	1.22×10^{14}
Max$\phi_{>1.0\text{ Mev}}$ inside core/(n/ (cm^2·s))	2.63×10^{13}