Indian ADS Programme

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Accelerator Driven Systems have evoked considerable interest in the nuclear community the world over because of their capability to incinerate the minor actinides (MA) and LLFP (long-lived fission products) radiotoxic waste and utilization of Thorium as an alternative nuclear fuel. In the Indian context, due to our vast thorium resources, ADS is particularly important as one of the potential routes for accelerated thorium utilization and the closure of the fuel cycle. The Department of Atomic Energy, India has envisaged development of an Accelerator Driven subcritical reactor System (ADS) in connection with its Thorium utilization programme. An ADS consists of a high current proton accelerator, a spallation target and a sub-critical reactor. R&D is in progress for all the three systems.

Efforts are on in India to develop such a system, one of the main components of which is a 1 GeV, high intensity CW proton accelerator. The development is being done in phased manner and experimental facilities are set up to make ADS related studies. Initially, we have developed a 400 keV DC accelerator based neutron source (10^8-10^9 n/sec) for carrying out experiments on physics of ADS and for testing the simulations. A facility, BRAHMMA (**Be**ryllium **O**xide **R**eflected **A**nd **H**igh Density Polythene Moderated **M**ultiplying **A**ssembly), has been set up to measure flux distribution, flux spectra, total fission power, source multiplication and degree of sub-criticality. It uses 14 MeV neutrons produced through D+T reaction. It is a sub-critical assembly (k_{eff}=0.87) of natural uranium. In order to increase the neutron yield to about 10^{11} n/sec, a 400 keV, 1 mA RFQ for D^+ ions has been built for replacing DC accelerator presently used for neutron generation. To perform these studies at higher energies, a Low Energy High Intensity (20 MeV, 30 mA) Proton Accelerator (LEHIPA) is also under development at BARC. This will also enable us to understand accelerator physics issues (space charge and beam halo) associated with high intensity beams. LEHIPA will be an intense neutron source and presently is under commissioning.

An important component of ADS is a 1 GeV proton accelerator. It is planned to build it using superconducting technology from 3 MeV onwards and it is being done in collaboration with Fermilab. Resonators/Cavities designed and built in India and processed at Fermilab, have met the specifications. R&D related to spallation target and materials is also pursued at BARC. LBE will be used for spallation target. Computational codes have been developed for thermal hydraulics for LBE target simulations. Experimental loops for validation of thermal hydraulics codes and corrosion studies on window materials have been built.

BARC has also studied details of a one way coupled reactor system which allows considerable reduction in the beam current. In this system, two sub-critical cores are used. The inner core is subcritical fast reactor with thermal neutron absorber liner surrounded by a gap and outer core is subcritical thermal reactor. The neutrons leaking from inner core can go to thermal core and get multiplied. However, neutron from thermal reactor cannot go to inner core due to absorber liner, that is why it is called one way coupled system.

In this talk, salient features of the Indian ADS programme and its present status will be presented.