Igniting India's fusion future

D. Raju[*], *I. Bandyopadhyay and D. K. Aswal*

Nuclear fusion, the process powering stars, holds immense potential as a sustainable energy source with minimal radioactive waste. India, with its strong foundation in nuclear fission, is strategically advancing fusion research through tokamak experiments (ADITYA-U, SST-1) and major contributions to the international experimental thermonuclear reactor (ITER). The present article outlines India's fusion roadmap, emphasising key challenges in plasma confinement, tritium breeding and reactor materials. In a phased approach, we propose to build and operate a steady-state deuterium-tritium fusion reactor called SST-Bharat as an intermediate fusion device, whose primary objective would be to demonstrate fusion power production with a net energy gain in steady-state power plant-like scenarios, as well as test tritium breeding and fissile blankets. Thereafter, we shall launch the project to construct an indigenous DEMOnstration reactor (fusion power plant), also known as DEMO, reactor to be commissioned by 2060 for net energy supply to the grid. DEMO may be chosen either as a fusion-fission hybrid reactor or a pure fusion reactor, depending on the success of the R&D in SST-Bharat. The integration of digital twins, advanced superconducting magnets and strategic industry partnerships will be crucial. By prioritising innovation, policy support and international collaboration, India can transition from experimental fusion research to scalable power generation, aligning with its Net Zero 2070 commitment. The time to ignite India's fusion energy future is now.

Keywords: Digital twin, fusion energy, ITER, national fusion mission, tokamak.

INDIA's nuclear energy narrative has long been dominated by its robust three-stage fission program, which has

developed Western nations due to our huge