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The Dynamak: an Advanced Fusion Reactor Concept with Imposed-Dynamo Current Drive and Next-Generation Nuclear Power Technologies

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A high- β spheromak reactor concept called the dynamak has been designed with an overnight capital cost that is competitive with conventional power sources. This reactor concept utilizes recently discovered imposed-dynamo current drive (IDCD) and a molten salt (FLiBe) blanket system for first wall cooling, neutron moderation and tritium breeding. Currently available materials and ITER developed cryogenic pumping systems were implemented in this design from the basis of technological feasibility. A tritium breeding ratio (TBR) of greater than 1.1 has been calculated using a Monte Carlo N-Particle (MCNP5) neutron transport simulation. High temperature superconducting tapes (YBCO) were used for the equilibrium coil set, substantially reducing the recirculating power fraction when compared to previous spheromak reactor studies. Using zirconium hydride for neutron shielding, a limiting equilibrium coil lifetime of at least thirty full-power years has been achieved. The primary FLiBe loop was coupled to a supercritical carbon dioxide Brayton cycle due to attractive economics and high thermal efficiencies. With these advancements, an electrical output of 1000 MW from a thermal output of 2486 MW was achieved, yielding an overall plant efficiency of approximately 40%.

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