A design of DT fusion reactor in the field-reversed configuration by using normal conductive coils.

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Being stimulated by the recent amazing results in C-2 and C-2U, we study a feasible design of DT fusion reactor in field-reversed configuration (FRC) which uses normal conductive copper magnetic field coils at room temperature. We assume continued stability, favorable energy confinement time scaling and an effective current drive and maintenance methods. The reactor has 3GW fusion power, 1.5MW/m^2 neutron wall loading at the first wall and thermal loading less than 1MW/m^2 at diverter plates. Plasma has 40m in length and 8.6m in diameter. We assume β value of 0.7 in average, then the magnetic field strength (B_0) of reactor will become 1.215T, which can be produced by normal conductive coils having 70m in length, 17.6m in diameter and 1.5m in thickness with 0.6 effective conductive area ratio. Its Ohmic power loss will be ~74MW, which is less than 10% of the expected electric output power. The scenario to reach the ignition from the initial formation is also considered. Initially two FRCs are formed at both ends of reactor by the theta-pinch, which has 6m in length and 0.5m in diameter. They are accelerated and merging at the center of burning region to form a single large FRC, which has 10m in length and 1.8m in diameter. This FRC plasma is grown up to the ignition by the intensive neutral beam injection (NBI) heating and particle supply. Taking 200s of heating up duration, necessary values of the maximum NBI powers in different energy confinement scaling laws are estimated. When we used a scaling of confinement time ~ $r_s^2B_0$, this value will be ~250MW before alpha particle heating becomes significant (r_s is the separatrix radius). This value is large but may not be impossible.

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