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P3.225 RFP based Fusion-Fission Hybrid reactor model for nuclear applications.

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A hybrid fusion-fission (HFF) reactor based on a Reversed Field Pinch (RFP) configuration looks as an attractive option from both a technical (simple design, easy machine assembly and maintenance) as well as economic perspective (low investment costs due the absence of large Heating and Current Drive systems and superconductive toroidal field coils).
The hybrid reactor studied here has a RFP fusion core generating 40MWth fusion power via D-T reactions. The reactor size (R=6 m, a =1), its components design and plasma performances have been extrapolated from the results of RFX-mod, the largest RFP experiment built so far. With a plasma temperature of 9.6 keV and an ohmically driven plasma current of 20 MA, the fusion reactions produce 2.2E+19 n/s which are used to both breed tritium and induce fission reactions.
A breeding blanket is located between the superconductive central solenoid and the torus. Being composed of a lithium-lead eutectic mixture, it also acts as neutron shield.
Instead, in the configuration studied here, the circular area around the torus (16 cm width) is half dedicated to further breed tritium while the rest is occupied by the fission blanket. The three sectors (~3.5 m radial extension) containing Pu+MA (60%)-Zr (40%) rods embedded in solid lead for nuclear transmutation (keff~0.94, P~200 MWth) are spaced out by two intermediate regions (~1.75 m radial extension) that can be used for inducing fast and slow transmutations.
The results corroborate the interest for the RFP as a HFF reactor due to the simple design of the fusion reactor, the high accessibility to the blankets for maintenance and the multiple applications of the neutron flux (transmutation of plutonium, minor actinides and nuclear fission products, radiopharmaceuticals production) favoured by the blanket modularity.

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