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Configuration Studies for a Sustained-High-Power-Density Next-Step Tokamak[1] JONATHAN MENARD, TOM BROWN, BRIAN GRIERSON, WALTER GUTTENFELDER, PETER TITUS, YUHU ZHAI, Princeton Plasma Physics Laboratory — Recent fusion planning activities recommend that the U.S. should pursue innovative science and technology to enable construction of a pilot plant that produces net electricity from fusion at reduced capital cost. Such a mission requires discovery, development, prototyping, and integration of multiple physics and technology innovations. In this work, tokamak configurations are explored to determine the potential synergies and conflicts between proposed innovations. For example, lower aspect ratio (A=1.8-2.6) tokamaks are potentially advantageous for maximizing self-driven current fraction and plasma performance per unit magnet cost but would have reduced space for a central solenoid for long-pulse partial-inductive operation. Performance characteristics are studied as a function of device size, magnet capability, aspect ratio, and stability and confinement assumptions. Realistic shaping poloidal field coils using free-boundary equilibrium calculations and superconducting magnet layout and stress analysis are also investigated while incorporating long-leg and liquid metal divertors. Initial device configurations, physics scenarios, and engineering studies for a tokamak-based next-step facility dedicated to the exploration and integration of these innovations are described.

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