ENGINEERING DESIGN STATUS OF THE QUASI-POLOIDAL STELLARATOR (QPS)

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The Quasi-Poloidal Stellarator (QPS), currently in the R&D and prototyping design phase, is a low-aspect-ratio ($R/a \geq 2.3$), compact stellarator experiment with a non-axisymmetric, near-poloidally-symmetric magnetic field. The QPS design parameters are $\langle R \rangle = 0.9$ m, $\langle a \rangle = 0.3$-0.4 m, $B = 1$ T, and a 1.5-s pulse length with 3-5 MW of ECH and ICRF heating power. The stellarator core consists of the modular coil set that provides the primary magnetic field configuration, auxiliary coils including vertical field and toroidal field coils and an ohmic current solenoid, machine structure, and an external vacuum vessel. The modular coils represent the most difficult part of the core design and fabrication. The coil set has two field periods with 10 modular coils per period. Due to symmetry, only five different coil shapes are required. The vacuum vessel is an external "bell jar". The modular coil set is in the same vacuum region as the plasma, so the coils must be canned for compatibility with the vacuum. The absence of an interior vessel provides excellent access for plasma diagnostics and heating. An R&D program is underway that includes extensive conductor characterization and testing, vacuum canning studies, and fabrication of a full scale prototype modular coil. The QPS device will be located at the Oak Ridge National Laboratory, where existing plasma-heating systems (2 MW ECH, 3 MW ICRF), power supplies (>40 MW), de-mineralized water system, and other equipment are available for this experiment. The QPS device is estimated to require four years from start of preliminary design to first plasma, planned for 2010. This paper describes the status of the engineering design and analysis.

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