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MASTER

CONFIGURATION REVIEW OF TFCX DESIGN OPTIONS*

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As part of the preconceptual design effort of the Tokamak Fusion Core Experiment (TFCX), several candidate design options have been explored in order to identify a preferred option that will be developed in further detail during the conceptual design phase of the TFCX program. The development of the TFCX concepts has been a collaborative effort between the Princeton Plasma Physics Laboratory (PPPL) and the Fusion Engineering Design Center (FEDC) with broad community input. The design options being considered include an all-superconducting design, a superconducting/copper toroidal field (TF) hybrid design, and several different all-copper configurations.

The configuration design approach incorporated in the TFCX superconducting studies is based on the design features that have evolved from the Fusion Engineering Device (FED)/International Tokamak Reactor (INTOR) reactor studies.[1,2,3] In this design approach (see Fig. 1), the entire first wall and shield can be removed by individual extraction of each torus sector using simple linear, radial motion. Each torus is designed to be highly modular with plug-in auxiliaries, such as heating, testing, and impurity control. All poloidal field (PF) coils are located exterior to the TF coils and can be removed vertically at the top or from a lower access tunnel at the bottom for repair or replacement.

The design details of the hybrid options have been limited to those areas that are different from the all-superconducting option. The hybrid

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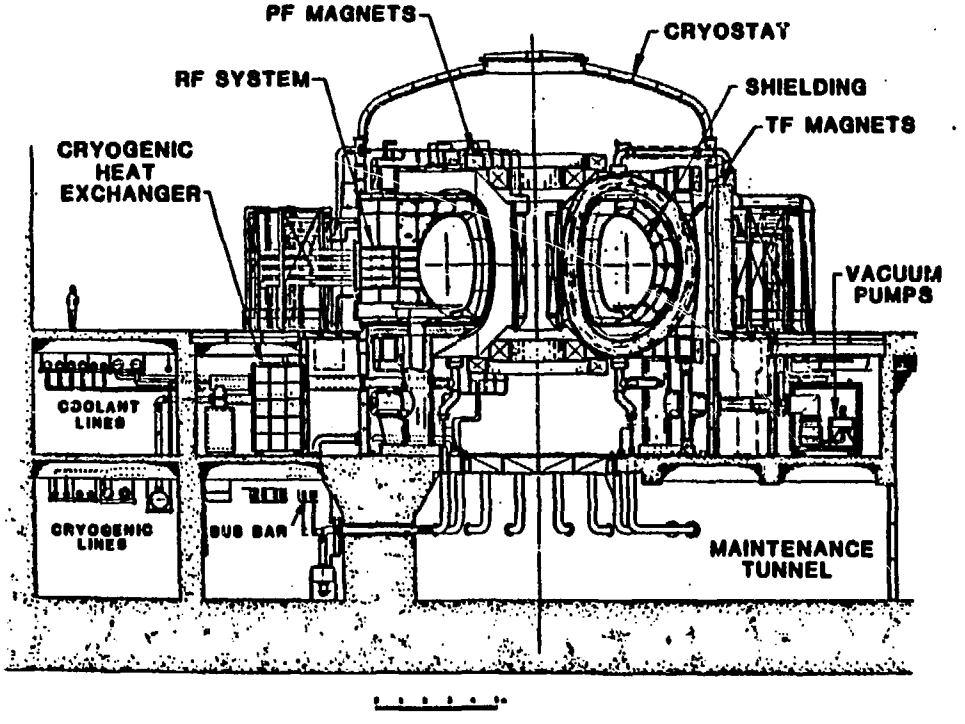

Fig. 1. TFCX – superconducting option.

option achieves ignition by using a combination of superconducting TF coils, complemented by water-cooled copper coil inserts located within the bulk shield region interior to the envelope of the superconducting TF coils. Figure 2 is an elevation view of this concept. The copper insert coils provide shielding for the superconducting coil and, at the same time, enhance the field on-axis. The primary configurational difference between the hybrid and the all-superconducting option focuses on the copper/shield insert.

A number of configuration options are being investigated for the all-copper TF coil design approach, including (1) configurations developed based on discrete copper TF coils that incorporate similar vacuum vessel, TF coil structural support, and maintenance concepts employed in the all-superconducting options, and (2) a configuration developed to support continuous copper TF coils, similar in concept to Massachusetts Institute of Technology (MIT) bitter plates, plus provide the necessary access to the plasma. (Figure 3 illustrates the continuous copper coil concept.)

Configuration design studies and system trade-offs will continue through the preconceptual design phase of the TFCX program. The intent is to select one of these TF coil technology options as the reference concept for the TFCX. The development of the various configurations will be continued until overall feasibility can be determined, which will permit an assessment of assembly/disassembly/maintenance attributes and which will permit the development of comparably based cost estimates. This degree of development should provide a sound basis for making the decision on the concept to be adopted for TFCX.

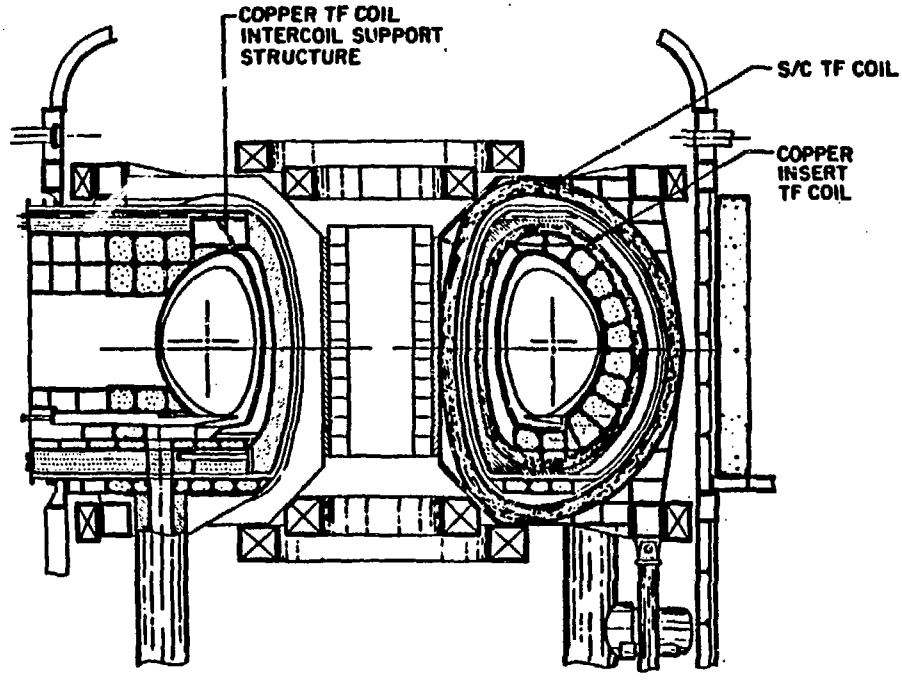

Fig. 2. TFCX — hybrid option.

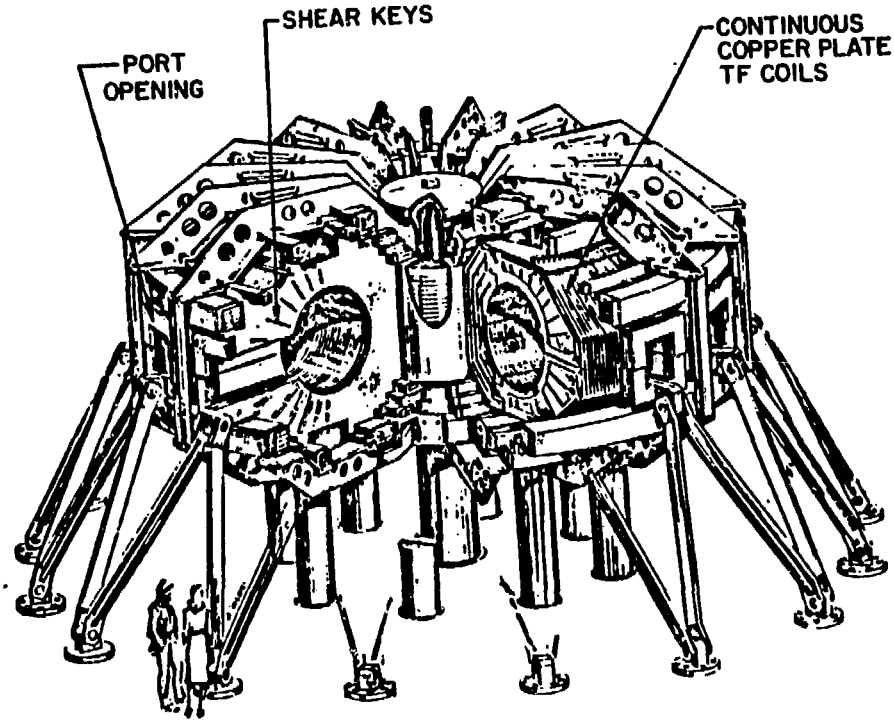

Fig. 3. TFCX — continuous copper TF coil option.

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