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OAK RIDGE TNS PROGRAM: A STATUS REPORT*

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The Oak Ridge TNS activities have been directed at characterizing the design space between TFTR and EPR with a fundamental emphasis on higher beta plasma systems than previously projected, i.e., $\bar{\beta} \sim 5$–10% as compared to 1–3%. Based on the results of the FY 1977 System Studies, our activities this year are directed toward preconceptual design with particular emphasis placed on reducing the technological requirements through innovations in plasma engineering. Examples of the new innovations include microwave assisted start up to reduce power requirements and a reduced TF ripple constraint by more refined ripple loss calculations, to increase engineering feasibility through simpler, more maintainable designs.

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INTRODUCTION

TNS, The Next Step after the Tokamak Fusion Test Reactor (TFTR), is intended to be a reactor core experiment forcing fusion technology. In order to place our TNS program in perspective, it is useful to consider the evolution of our advanced systems studies. Prior advanced systems studies started with point designs (ORMAK F/BX I and II),[1] explored the design issues of the tokamak Experimental Power Reactor (EPR),[2] and culminated in an evaluated EPR reference design.[3] With this basis, the TNS activities were directed at characterizing the design space between TFTR and EPR with a fundamental emphasis on higher beta plasma systems than previously projected, i.e., $\bar{\beta} \sim 5$–10% as compared to 1–3%. The orientation toward smaller sized, higher beta systems rather than larger systems are both mechanically and economically impractical. This judgment was quantified in our Fusion Power Demonstration Study.[4] The characterization of this TFTR-EPR design space has proceeded by plasma engineering investigations of the dynamics of the higher beta plasmas and the requirements on technology of heating and fueling,[5] by developing consistent, feasible engineering models of systems of different size and magnetic field strength,[6] and by program planning studies of the steps required to implement the designs.[7]

In the first area, plasma engineering, early indications were that very stringent requirements would be placed on physics achievements ($\bar{\beta} \sim 10$–15%), on beam technology (~500 keV), on fueling technology (~10,000 m/s pellet velocities to reach the plasma center), and on a large system size. Rather than pursue these difficult requirements with even more difficult technology development programs, high risk physics, or high cost solutions, we re-examined the basis for the requirements. We found that as more realistic models of the higher beta plasma are used, specifically going from 0-D to 1-D models with spatial profiles, the lower the requirements on achievable beta, neutral beam energy, and fueling technology became. Under the constraint

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