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TNS PROGRAM - THE NEXT STEP IN CONFINEMENT FUSION BEYOND TFTR*

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Preparation for the next logical tokamak confinement device beyond TFTR, The Next Step (TNS), is the focus of this program. TNS is intended to lead to an economically viable fusion reactor and is being planned for late-1980's operation. The TNS Program findings directly relate to the basic understanding needed for reactor design and construction. The two principal objectives are (1) demonstration of an ignited and burning reactor core and through the preparation for this demonstration, (2) the provision of a forcing function for the integration of the fusion program elements. The three major components of the activity that constitute the preparation for the TNS are design studies, definition of research, development and demonstration needs, and initiation of project engineering tasks. Closely integrated scientific and engineering design studies have been performed to establish a reference design base from which further planning and design is proceeding. The technical assessments being made in the studies are directed at ensuring that the key ideas conceived on the basis of their theoretical desirability can indeed be made workable in the late 1980's time frame.

The scientific and engineering design studies have resulted in a documented understanding of the appropriate design space for The Next Step after TFTR. Five interrelated tasks have been undertaken in the conduct of these activities.

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1. Plasma Engineering, Neutronics, Divertor Engineering and Magnet Systems are areas in which new technical advances have been made in individual investigations. New insights have come in areas of much uncertainty in plasma engineering, namely effects of profiles on reducing beta requirements, workable poloidal magnetics designs, injection heating scenarios to reduce beam energy requirements and initiation of startup codes. Development in the neutronics area of multidimensional analytical treatments of tokamak shielding will be valuable for machine design optimization. A new compact poloidal divertor design has been generated to fit within modest size TF coils and is being analyzed from a self-consistent engineering point of view. The first phase of study of the possibility of reducing poloidal field system costs using an iron core (as opposed to air core) OH system has been completed.

2. A comprehensive engineering-oriented trade study initiated at the beginning of the year is now being used to determine, in a quantitative fashion, the relative costs of devices differing in plasma size and TF coil technology. Starting from a well-documented set of assumptions and ground rules, the trade study proceeded with the development of a detailed tokamak sizing and costing computer code and is now providing quidance to device characterization and technology developments.

3. A brief but intensive effort was made to assess the R&D needs for TNS. This study provided support for the perception of basic strength in the TNS-related U.S. fusion program and identified physics, technology, engineering and organizational issues that required action judged necessary for the success of the TNS Program.

4. A somewhat more extensive effort was made to develop a schedule for TNS design, construction, operation and, to a lesser degree of detail, eventual upgrading in the context of a

committed site for demonstration of commercial feasibility.

5. A continuing effort provided other members of the fusion community with the information learned from the TNS study for use in improving the focus of both the TNS study itself and the larger number of supporting programs.

The reference design is being used to investigate other design problems. These areas include: cost reductions in the capital intensive neutral beam and poloidal field systems, alternatives in vacuum system topology, reliability of the more complex systems, continuation of the physics investigations into the more uncertain areas of startup, fueling, and, as more information becomes available, particle and gas throughput control.