[illegible] ENGINEERING PROBLEMS IN THE TFTR NEUTRAL BEAM SYSTEM †

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Summary

A conceptual design of a prototype beam line for the TFTR Neutral Beam System has been developed. The basic components have been defined, cost estimates prepared, and the necessary development programs identified. Four major mechanical engineering problems, potential solutions and the required development programs are discussed.

Design of the TFTR Neutral Beam System will require the solution of several mechanical engineering problems related to components which either presently do not exist or are designed to requirements which are less severe in neutral beam systems built to date. These problems result from the combination of increased beam power, multiple sources on each beam line, remote handling requirements and stringent design requirements on the allowable local pressures and leakage of cold gas into the torus.

These problems require the development of beam targets capable of handling up to 10 MW of beam power from a single ion source with peak power densities approaching 30 kW/cm^2. Pumping speeds approaching 3×10^6 ℓ/sec in each beam line coupled with severe space limitations will require the use of cryosorption or cryocondensing pumping. Minimizing cold gas leakage into the torus makes it necessary to use conductance limiting valves with opening and closing times of $\sim$ 50 milliseconds. The radioactive environment requires that a hard seal or welded vacuum system capable of remote assembly and disassembly be developed.

Introduction

The experimental tokamak fusion test reactor which is being planned for construction at Princeton Plasma Physics Laboratory[1] will include a neutral beam injection system. Demonstration of a "reactor grade" plasma in the TFTR depends upon the successful operation of the neutral beam injection system to produce and inject energetic neutral particles into the plasma.

As a part of ERDA's DCTR development and technology effort, ORNL has been engaged in plasma heating development since 1970 when a program for development of neutral injection as a viable supplemental heating technique was initiated.[2] This program developed multiaperture closely coupled modules in 1971 which were incorporated into the ORMAK injection system in 1973 and in two additional higher power ORMAK systems in 1974.

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