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NEUTRAL BEAM INJECTION STATUS AND R&D NEEDS FOR TNS*

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The Next Step (TNS) Program, established by DOE at ORNL in early 1976, has as one of its key objectives to provide a means of focusing the R&D efforts in the National Fusion Program toward the achievement of economically viable tokamak fusion reactors. One part of a draft program plan[1] issued in December, 1977, specifically addressed the R&D needs of each of the major subsystems of a tokamak fusion device that would be extrapolatable to a reactor. Included as a major subsystem was plasma heating.

It is the purpose of the effort reported here to continue the assessment started[1] and to update and expand its findings. The goal continues to be to define, justify and order the required R&D programs that would ensure neutral injection systems for heating tokamak plasmas to be available for a TNS-type machine operation start assumed to be in 1990. Particle injection is covered here. Wave heating is being addressed in a separate, parallel effort.

INTRODUCTION

The usual approach to planning the required R&D for a major project that is to be completed some years hence is to:

1. Characterize the project in detail.
2. Note the technology and physics discrepancies between current capabilities and the project's real needs.
3. Define, cost, and schedule the timely R&D advancements necessary to remove those discrepancies.

This well-understood and often used, straightforward planning approach meets with particular difficulty with a TNS because of the relatively large number of uncertanties in basic physics and technology directions the machine design and operation may take. The task of recommending the appropriate R&D efforts to meet the needs of the TNS Project has, therefore, a number of potential variations in directions and can best be approached by using simple judgements of probabilities to highlight and order the most important advancements.

The steps herein used to arrive at the needed R&D are:

1. Develop the expectation probabilities for various neutral injection uses and characteristics.
2. Define the system and equipment availability and development status to meet the needs.
3. Identify, integrate, and schedule the required R&D to fill the gaps in neutral injection technology.

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