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Editorial

The seven papers comprising two consecutive, special issues of the *Journal of Fusion Energy* (Vol. 5, No. 4, December 1986; Vol. 6, No. 1, March 1987) describe studies carried out from 1980 to 1982 on magnetic fusion production reactors (MFPRs), which are designed to produce tritium and plutonium for nuclear weapons. These papers were recently made available to the National Research Council for their study of fusion as a breeder reactor and are being published here in their entirety at the request of this journal's editor with only minor editorial changes.

The first paper, entitled "Feasibility Study of a Magnetic Fusion Production Reactor," serves as an executive summary of the others. The need for tritium and plutonium for nuclear weapons can be met with existing fission production reactors, but aging reactors will eventually need replacing, and fusion may be able to fill this need and do so with cost and safety advantages. A fusion production reactor of the same nuclear power as a fission production reactor can produce six times more material, hence there is the possibility of lower product cost. In addition, the fusion reactor consumes no fissile material as does the fission reactor. The safety advantages come from no possibility of criticality power excursions and greatly reduced meltdown hazard because of the greatly reduced radioactive afterheat.

The second paper discusses the "Mechanical Design of a Magnetic Fusion Production Reactor," comparing the tandem mirror concept with the tokamak one and examining the breeding blanket configuration for each. The breeding blanket is based on the well-known technologies of water cooling at less than 100°C, aluminum structural material, Li–Al breeding material, and beryllium as a neutron multiplier; all of these technologies have multiple decades of successful operating experience at Savannah River, Idaho National Engineering Laboratory, and elsewhere. There would be less than 10% difference in the overall costs between the tandem mirror and tokamak production reactors.

The tandem mirror and tokamak are studied as candidate fusion drivers in "Fusion Technology for a Magnetic Fusion Production Reactor." Although the authors find that the plasma parameters achieved for a tokamak are closer to those required for the MFPR, they add that the higher blanket coverage factor in the tandem mirror, coupled with the reduced difficulty in maintaining the blanket, suggests the continued study of the tandem mirror fusion driver.

Tritium breeding ratios (the amount of tritium generated divided by the amount burned in a reactor) are calculated to be 1.67 and 1.56 for the tandem mirror and tokamak concepts, respectively, in "Nuclear Design and Analysis of a Magnetic Fusion Production Reactor." The two reactor concepts yield the same blanket energy multiplications. Further consideration is given to the net plutonium-plus-tritium breeding ratio and the blanket energy multiplication for the tandem mirror operating in the plutonium production mode.

The tritium breeding blanket surrounding the fusion chamber is a water-cooled configuration of beryllium and a lithium-aluminum alloy. In "Radiation Effects in Be and Al for a Magnetic Fusion Production Reactor," the expected behavior and performance is assessed for the blanket materials when subjected to a fusion neutron flux. In "Economic Analysis of a Magnetic Fusion Production Reactor," the costs are calculated for producing tritium and plutonium.

In the final paper of the series, "Selection of a Toroidal Fusion Reactor Concept for a Magnetic Fusion Production Reactor," the focus is on the basic fusion driver requirements of a toroidal material production reactor. Of the candidate fusion drivers, the tokamak is determined to be the most viable for a near-term production reactor.

Fusion feasibility including tritium burning may be proven in the presently operating tokamak experimental machines. Because of the factor of six more output per unit of power, one fusion production reactor might be built at lower cost than the three or so fission production plants it replaces. Furthermore, a facility could be built in phases with the early operation dedicated to plasma physics test, later operation dedicated to nuclear engineering tests, and the final stage to nuclear material production. If new tritium and plutonium production facilities are needed after the year 2000, fusion may be well-suited to fill that need, and this application might thereby become the first implementation of this new fusion technology.

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