PERSPECTIVES AND PROBLEMS OF ACCELERATORS FOR PRODUCTION OF FISSILE FUEL

R. Čaplar* and V. Knapp+
*"Rudjer Bošković" Institute, Zagreb, Yugoslavia
+Faculty of Electrical Engineering, Zagreb, Yugoslavia

The use of accelerators for breeding ^{233}U or ^{239}Pu is becoming increasingly interesting due to a number of limitations which characterize the present-day thermal reactors and problems encountered in the development of fast breeders. (See V. Knapp and R. Čaplar, this supplement) At the same time, the intensive development has occurred in accelerator technology from the early fifties when first ideas for breeding fissile material by the use of accelerators appeared.

Physically, the possibility of using high-energy accelerators for efficient breeding is based on the fact that high-energy particles (protons, deuterons,..., of energies about 1 GeV) directed at appropriate targets produce many secondary particles in cascade with the ultimate production of 40-60 neutrons. The neutron production rate increases with energy. Thus, for the same number of neutrons required the choice is possible between the types of particles (protons or deuterons) and in beam energy and current. In this sense, for example, the following accelerators are equivalent: 1 GeV, 300 mA; 800 MeV, 400 mA; 2 GeV, 140 mA proton accelerators and 1 GeV, 230 mA; 1.5 GeV, 160 mA deuteron accelerators. However, target and efficiency considerations are very important in further choice of accelerator parameters. Radiation damage of materials and thermal effects are the principal problems in target design and are also likely to determine beam characteristics. The overall efficiency of the accelerator (ratio of beam power to AC line power) has to be very high, at least 50%, because the cost of fissile fuel produced is very sensitive to it.

Taking into account all factors that determine the characteristics of an accelerator for breeding fissile fuel, it appears that the design and construction of such a facility is within the reach of the present-day accelerator technology.