addition, ceramics containing lithium are promising candidates for tritium breeding materials.

When the fusion materials program began, the little information available on radiation effects in ceramic insulators suggested that poor performance could be expected. This meant that reactor designs would have to accommodate the need for frequent replacement of key components. The fusion ceramics testing program has since demonstrated that a number of ceramics offer extended lifetimes in fusion reactor applications. Furthermore, increased understanding of degradation mechanisms has led to effective methods of enhancing radiation resistance.

The importance of ceramics takes on added dimensions in light of promising indications of their usefulness in breeding tritium in the blanket. If the blanket contains lithium, some of the neutrons striking it will interact with the lithium to produce tritium, a constituent of reactor fuel that is not found in nature. Since lithium is difficult to handle in pure forms, a solid lithium compound such as a ceramic containing lithium could offer considerable advantages. Previous doubts that tritium could be successfully extracted from a solid compound have been dispelled following an experiment in which tritium was produced from a lithium ceramic compound while it was being bombarded with neutrons from a fission reactor. It has also been shown that ceramic compounds will hold up adequately under the neutron bombardment of the fusion environment.

Reactor Concepts

For the first time in the history of fusion research, there seems now to be a substantial and reliable experimental basis for the detailed description of the fundamental scientific and technology requirements of a magnetic fusion reactor. The key issues have gradually been revealed by the detailed series of conceptual reactors designed and produced within the MFE Program over the last 15 years. The object of these studies is to describe a plausible fusion reactor based on the underlying physics and reasonable extrapolations of the technology.

Research and design studies on a broad front have made it possible to describe the forms that commercial fusion reactors might take. The required technologies, the plant power balance, the capital and operating costs, and the safety and environmental features of fusion power can all be estimated. A reactor study is performed by a multidisciplinary team of physicists and engineers that must keep one eye on present-day experiments and theory and one eye to the possible future reactor end-product. The feedback from this study then steers it towards the safest and the most environmentally benign application of fusion energy.

These studies allow an early assessment of the potential and impact of fusion reactors in the economy. They project that capital costs could be acceptable, that electricity could be produced at around 50 mills/Kwh, and that the environmental and safety features of fusion could make it more attractive than other long range energy options.

For the past 15 years, these studies and assessments have helped guide the present scientific and technology development programs, determine the directions for an improved fusion product, and provide a technical assessment of the fusion energy option for use in long range energy planning.