expanded research into the theories describing the behavior of the fusion plasmas which fueled the experimental devices. Fusion fuels are in the form of an ultra-hot gas called a plasma. A plasma differs from an ordinary gas in that magnetic fields can be used to control its movement and position. Researchers focused chiefly on the phenomena of plasma instabilities that had limited the success of early experiments.

Armed with an improved theory base, United States scientists reemphasized efforts to improve experimental devices. Nearly at the same time, the Soviets achieved a major performance improvement in their doughnut shaped "tokamak" device. Russian fusion researchers reported obtaining three times the performance levels that had been achieved on magnetic fusion devices in the United States. These results were verified by British scientists, who were invited to conduct experiments on the Soviet tokamak.

By 1970 the United States adopted the tokamak as its mainline device, and the program mission was significantly broadened. It provided for an orderly series of steps to a final, commercially usable product with a demonstration plant planned for 1995. More attention was given to the development of the components required to design and build a reactor. In support, plasma investigations were focused on the needs of the larger machines that formed the program's backbone: the tokamak on the one hand, and one or two practical and vigorous competitors on the other.

In 1977 research and development of MFE was assigned to DOE. At that time, the leaders of the new Department revised the Nation's energy research and development program, and with it, the MFE Program schedule.

Federal policy changes in the early 1980's produced additional modification in the MFE Program and redefined the program goals. The new National Energy Policy Plan in 1981 stated that the goal of long-term research and development in energy is to carry promising technological innovations to the point where private enterprise can reasonably assess their potential. In keeping with the new directions in policy, plans for Government participation in the commercialization of MFE and Federal support of a demonstration project have been deemphasized. The goal of the program now focuses more narrowly on providing the necessary scientific and technological base for fusion energy.

The Present and Beyond

Today the research and development effort in magnetic fusion seeks to gain a fundamental understanding of the fusion energy processes observed in the sun and stars; to establish the body of theoretical, experimental, and engineering knowledge necessary to apply these processes to generating power on earth; and to do so in a way that will be useful to the Nation's energy producing industries and meet our high National standards for public health and safety.

The Office of Fusion Energy supports advanced research facilities and talented scientific personnel from universities, National Laboratories, and industry that are among the strongest in the world. Participation of the full spectrum of available scientific talent provides innovative ideas, major technical advances, and manpower training to further United States technological growth. At the approximately 26 universities involved in magnetic fusion research, a total of 1,100 Ph.D.'s have been trained in association with fusion research. Many talented scientists and engineers with roots in the magnetic fusion program are making outstanding contributions in other fields, including defense and commercial applications, space and astrophysical plasma physics, computational physics, and materials science. The participation of industry accelerates the transfer of fusion technology to the private sector and attracts industrial investment to fusion related activities.

The MFE Research Program has made remarkable strides toward bringing the Nation closer to a secure and virtually limitless source of energy. Although impressive achievements have been made, the greater goal of fostering commercial development remains to be attained.

Early in the program, the basic laboratory objective appeared deceptively simple: heat a pressurized container of plasma fuel to the point of fusion, and then contain and sustain the reaction. Only after a decade of intense scientific creativity did fusion researchers realize that bringing about a controlled fusion reaction was one of the most complex and challenging feats ever attempted and that it might lie well beyond the theory and experimental capability they could foresee in the 1950's.

Today that situation has changed. The scope and complexity of the problem and the requirements for solving it are much better understood. Fusion technology has advanced immensely; and, based on the foundations of scientific and technical accomplishments described in this document, experiments are well underway to answer the key question: how can we best harness fusion power on earth?