percent could be achieved, if and when applications demanded it.

Today, the center for rare earth chemistry and related technology is located at Ames Laboratory, Iowa State University, just north of Des Moines, where these discoveries were first made. Since then, refinements continue to be made to both these processes and others.

The Laboratory provides a full array of technical services to research laboratories and commercial and industrial firms throughout the United States. Within this technically supportive environment, applications for rare earth products continue to expand, finding uses important to commerce, industry, science, medicine, and the national defense.

Besides color televisions, rare earth phosphors are used in high-efficiency fluorescent lights, achieving not only a 30 percent reduction in energy consumption, but also yielding a more appealing and natural spectrum of light. These lights are popular in Europe and are becoming more so in the United States. Recently, rare earth phosphors were also heralded as a boon for medical science, because they amplify x-ray signals, cutting patient exposures by 97 percent.

The rare earth neodymium made possible some of the world's most powerful and versatile lasers. The neodymium laser's pure and coherent light beams serve countless purposes in manufacturing and research. One of the most versatile research lasers is the so-called neodymium-YAG laser (yttrium aluminum garnet), employing two rare earth elements, the former in extremely high purities.

The high magnetic strength of the rare earth magnets enabled motors to have higher efficiency and lower weight than more conventional motors. In a unique and highly visible extension of this application, General Motors used them in an experimental solar-powered racing car, called Sunraycer. Sunraycer propelled itself by electric motors employing these magnets, winning a 2,000-mile endurance race across Australia's sun-baked interior.

Finally, rare earths have also found many other useful, albeit less glamorous, applications. These include polishing compounds, petroleum refining catalysts, and alloying materials for the iron and steel industry.

These examples underscore a common theme relevant to the support of basic research. Basic Energy Sciences researchers did not invent, nor even foresee, all of these applications of rare earth technology. Yet, their fundamental work on separating rare earth elements in highly purified form, combined with their continued theoretical work on rare earth properties and their interactions with other elements, provided the essential foundation upon which all of these applications were built.

HAFNIUM-FREE ZIRCONIUM

In December 1957, a nuclear reactor at Shippingport, Pennsylvania, first began to produce electricity for public use. Ever since, nuclear power has contributed to growing portions of the world's electric energy supply. Today, about one-fifth of the electricity used in the United States is generated by splitting the atom, and this fraction is even larger for Japan, South Korea, the Soviet Union, and several European countries.

Bringing this achievement to reality involved scientific and technological accomplishments on a grand scale. Basic Energy Sciences research made numerous contributions to this effort, particularly in the development of special materials used in the internal construction of nuclear reactors.

These special materials had to endure prolonged exposure to adverse conditions of a unique operational environment. Most importantly, they also had to be physically compatible with the nuclear activities required for efficient and controlled nuclear fission.

In the process of nuclear fission, a large atom, usually uranium, is split into two smaller ones by a relatively slow moving "collision" with one of the basic constituents of matter, the subatomic particle called the neutron. As the atom splits, a large release of nuclear energy is carried off by the two fission products. It is this energy that ultimately turns water to steam, drives the generating turbines, and produces electricity.

Usually two or three fast moving neutrons are also produced when each atom splits. The fate of these neutrons is important to the design of a reactor because if not lost by escape or otherwise