expand as more reactors nearing completion come on-line and begin to add to the Nation's power production.

ENRICHED STABLE ISOTOPES

During the height of World War II, the United States' fervent effort to develop the atomic bomb employed 25,000 people in Oak Ridge, Tennessee, to build and operate more than 1,100 huge, strange-looking machines, each weighing 8 tons or more. Code-named after a progenitor, the California University Cyclotron, these machines were known as "calutrons."

Their purpose was to enrich the concentration in uranium of one particular atomic species of the uranium family, namely the isotope ^{235}U. Although the calutrons were successful, other technologies proved to be more efficient for enriching uranium. After the War, all calutrons were scheduled to be dismantled.

In a fortuitous twist of history, however, 76 of these machines, born of a *war* effort, were spared, modified, and adapted over the years, to a point where a portion of these now lie at the heart of some of the United States' most sophisticated *life-saving* technologies. At what is now known as the Oak Ridge National Laboratory, calutrons hold a very special, though unheralded, place of importance for thousands of Americans who suffer from heart, kidney, brain, and bone diseases, and other organ disorders.

Supported for many years by Basic Energy Sciences, calutrons today produce and maintain inventories of approximately 200 enriched *stable* (non-radioactive) isotopes useful to science, industry, commerce, and medicine. Enriched stable isotopes are used as research materials, intermediates in the preparation of radioisotopes and radiopharmaceuticals, and non-radioactive tracers. Inventories are maintained for both sale and loan, and these are periodically replenished in accordance with demands, priorities, and available resources. Statistics on medical applications hint of the growing importance of enriched stable isotopes. Sales of radiopharmaceuticals alone exceed $150 million per year. Products derived from enriched stable isotopes are used in 600,000 medical procedures each year. Every hospital in the United States is required to have nuclear medicine capabilities in order to become an accredited institution.

As a supplier of enriched stable isotopes, the Oak Ridge calutrons constitute the world's premiere source. Although originally designed to separate isotopes of only one element, uranium, by 1960 the calutrons had demonstrated the full range of their versatility by producing enriched quantities of more than 240 stable isotopes.

The value of enriched stable isotopes may be appreciated by understanding a little about their nature and how they are used. An isotope is one type, or species, of atom found among two or more species, all belonging to the same elemental family. Chemically, all isotopes of the same element are virtually identical. They differ only by their atomic weights.

Most elements found in nature appear as mixtures of several isotopes in almost unvarying proportions. The element iron (Fe), for example, appears as a mixture of four stable isotopes. Shown with their atomic weights, these are symbolically identified as ^{55}Fe, ^{56}Fe, ^{57}Fe, ^{58}Fe, with natural abundances of 5.8, 91.8, 2.1, and 0.3 percents, respectively.

Enriched stable isotopes are those whose abundances have been artificially increased above natural levels, say, for example, from 5.8 to 97.2 percent in the case of ^{54}Fe. Extreme levels of enrichment are attainable, if required, having impurities measuring less than one part per billion. The calutrons of Oak Ridge produce enriched isotopes by separating the naturally occurring isotopes atom by atom. Mechanically, this is achieved by applying the principle of centrifugal force. Isotopes of one elemental family are introduced into a vacuum, vaporized, given positive electrical charges (ionized), and accelerated along curved paths in a carefully focused electromagnetic field. The heavier isotopes fly more to the outside, cutting wider arcs. Although separations at the end of the arcs are small, they are sufficient to allow compartmentalized collections.

Early in their post-War history, the calutrons' principal purpose was to provide research materials crucial for fundamental studies in nuclear physics and atomic energy. These activities resulted in many spectacular scientific achievements and are still important. As the technologies of science and medicine advanced, however, other needs for enriched stable isotopes came to the fore.