

Y-12 plant prepares to separate lithium isotopes

The Y-12 National Security Complex is one of three major Manhattan Project sites in Oak Ridge. Y-12 is the nation's sole storage location for weapons-grade uranium and is the Department of Energy's National Nuclear Security Administration's production facility for nuclear weapons "secondaries" -- the part of the weapon providing the enormous energy release that can be in excess of tens of megatons of instantaneous energy.

Y-12 also assists with the control and handling of weapons-grade enriched uranium found in other nations that must be protected from terrorists. This ultra-modern and highly sophisticated manufacturing facility is both an economic treasure for Oak Ridge and a tremendous and unique resource for our nation.

The history of Y-12 dates back, of course, to the early 1940s. However, during the years from 1946 through the early '50s, the Oak Ridge plant continued to expand as needed to meet the demand for a growing primary mission of machining uranium.

The Aug. 12, 1953, nuclear explosion by the Soviet Union proved to be even more unsettling than had been the earlier atomic explosion patterned after "Fat Man," because the Soviets were now on equal footing with a thermonuclear weapon capability -- and Y-12 was charged with increasing production and adapting to even more demands for support of the now rapidly expanding nuclear weapons program.

The thermonuclear weapon process required the addition of materials not included in the original atomic bombs, and lithium 6 was one of the new materials that brought both a significant challenge and new work to Y-12. On Aug. 31, 1950, the Oak Ridge National Laboratory successfully enriched lithium 6 on a laboratory scale; and, on April 4, 1951, Dr. Nordhaim of Los Alamos, N.M., indicated the nuclear weapons program would require kilogram quantities of lithium 6 within a year.

By mid-month, the Atomic Energy Commission made that request official, which engaged Y-12 in the experimental lab work to separate lithium 6. Though a successful column-exchange process known as COLEX proved to be the ultimate answer in obtaining appreciable quantities of lithium 6, other processes were tried.

ORNL had begun researching both an electrical exchange process called ELEX and an organic exchange process called OREX. The ELEX's lab process started in Building 9733-2 in 1950 and the pilot plant was installed in Building 9201-2 in '51, where it operated until 1955. This process was promising enough and the pressure on Y-12 was so intense that a full production process was designed and built in Building 9204-4 in 1953, where it operated until 1956.

The OREX's lab process began in Building 9733-1 in '51, and a small pilot plant in Building 9202 ran until '53. Though a larger pilot plant in Building 9201-2 operated from 1953 to 1954, the process was fraught with technical difficulties and failed to progress -- shutting down in March 1954.

The effort to separate lithium 6 from normal lithium was approached in much the same manner as original attempts to separate Uranium 235 from natural uranium in the early days of the Manhattan Project. And in the chronology, "An Overview of the History of Y-12, 1942-1992," Bill Wilcox notes changes taking place at Y-12 almost monthly during the height of the effort to determine the most effective process to use.

In November 1953, a meeting was held at Y-12 with representatives of the Atomic Energy Commission from Washington. The purpose of the meeting was to decide if the latest process being recommended by Y-12 would be considered, and this new and third approach was the column-exchange process. When asked if it had a chance of separating lithium 6 more rapidly than the other two processes, then in the pilot stage, the answer was: "There is a 50-50 chance." The AEC folks response? "Build it."

Although Building 9201-2 was the site of the pilot plants (and thus the hub of much of the activities), two large buildings on the west end of the site were soon to become the focus of the COLEX process. Building 9201-5 was identified as the primary location for the new COLEX process, with Building 9201-4 being chosen as the second location. The buildings were being used to store equipment and miscellaneous calutron-related items, but all excess equipment was removed and the last calutron cubicle left Building 9201-5 on Dec. 9, 1953.

Building 9204-2 was also stripped beginning in January '54 in preparation for the support work needed. This building had also been constructed during the Manhattan Project and had housed "beta" calutrons, the second stage of the calutron process. The calutrons in Beta 2 were used until December 1946, when all beta calutrons

at Y-12 were shut down with the exception of those in Building 9204-3 (Beta 3), which still remain in place today.

These silent sentinels of both the Manhattan Project and the Stable Isotope Program operated until 1998, and they remain in "standby" today. It's significant to note the same science and equipment that separated the Uranium 235 for "Little Boy" also separated the stable isotopes that produced the genesis of the medical isotope program, which continues to this day to save millions of lives each year.