Meet Kenneth D. Nichols, the Father of Oak Ridge Production Facilities, Part 1 (1942-1945): Y-12

(As published in The Oak Ridger's Historically Speaking column the week of March 24, 2025)

Barbara Scollin, grandniece of Major General Kenneth D. Nichols continues her series on his life.

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Ample reasons, most notably leadership skills, personality traits and qualifications, led to choosing General (then Colonel) Kenneth D. Nichols as Deputy District Engineer and subsequently as District Engineer of the Manhattan Engineer District (MED). In this capacity he had supervision of the research and development connected with, and the design, construction and operation of all plants required to produce plutonium-239 and uranium-235, including the construction of the towns of Oak Ridge, Tennessee, and Richland, Washington.

The responsibility of his position was massive as he oversaw a workforce of both military and civilian personnel of approximately 125,000; his Oak Ridge office became the center of the wartime atomic energy's activities. He also was responsible for internal security operations in the production facilities that helped keep the development of the atomic bomb secret.

In this twelfth installment of several articles covering the life and accomplishments of Kenneth D. Nichols, we learn of the nail-biting effort to build production facility Y-12 at Oak Ridge.

Colonel Kenneth D. Nichols typically spent 3-4 days traveling each week during the Manhattan Project. When in Oak Ridge Nichols recalls, "I deliberately put several layers of organization between me and the residents to cushion myself from involvement in the day-to-day problems of town management. I simply could not spare the time from my primary mission." Early mornings found him in his office at least two hours before 'normal' work hours, his capable staff preparing essential material for him to read followed by various other topics demanding attention.

Earliest facility construction in Oak Ridge began with the Y-12 Electromagnetic Processing Plant. Nichols shared why this plant was first chosen, "I visited Berkeley in August 1942 and was fascinated with Lawrence, his organization, and his process… [With my background in] experimental work… it was relatively easy for Lawrence to convince [me] that his method was nearly ready for engineering design for a pilot plant or even for a full-scale production plant. Once a single unit could be perfected, it need only be reproduced several hundred times to be a useful production plant."

Nichols first met Dr. Ernest O. Lawrence, of the University of California on the S-1 Committee as head of the electromagnetic method of separating U-235, at an S-1 meeting in June 1942. They would closely work together throughout the war at S-1 meetings, at Lawrence's Berkeley laboratory and at the Clinton Engineer Works (CEW). Nichols described Lawrence as, "one of the most brilliant American scientists… that has ever lived. …I would classify him as a type of guy you would want to have as a friend, no matter what business he was in."

As the lead scientist for the Y-12 Plant, Nichols remembered Lawrence, "provided outstanding scientific leadership for the design, construction and operation of the electromagnetics plant (Y-12). In my opinion, Lawrence probably was the most dynamic of all the physicists involved in producing the atomic bomb. A Nobel Prize winner, he had distinguished himself as a great experimenter and leader in the development of the cyclotron. … He was a doer who attracted scientists and engineers to carry out his projects, including the building of a 184-inch giant cyclotron. Its magnet now provided a facility for developing the electromagnetic process.

"Of course, he could be mean as hell when somebody crossed him. But, generally speaking, he was pleasant. Of all the scientific organizations, his was the most cohesive, the most loyal to him, where they worked as a team. Everywhere else, we had dissension among the scientists. …Oh, those guys would just swear by him and would work night and day."

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Lawrence explained to Nichols the theory of the electromagnetic process at their first S-1 committee meeting. Nichols recalls the explanation as follows, "A calutron [CALifornia University cycloTRON built for CEW] consisted of a U-shaped vacuum tank placed within the magnetic field of the huge magnet. At one end of the U, a power source would ionize uranium chloride. The path of the ion beam would, due to the magnetic field, be an arc and end in box collectors at the other end of the calutron. Both U-235 and U-238 ions would be similarly charged and be bent by the magnetic field. The curvature would depend on their masses. The U-238, being heavier than the U-235, would follow a larger arc than the U-235, and the beam would be collected in two separate boxes, with the inner box collecting the more enriched U-235."

Construction on the first production building at Y-12 began February 18, 1943. Stone & Webster tackled the electrical engineering design, addressed procurement issues, and coordinated the development of vacuum pumps and magnets of unprecedented size. Westinghouse designed and produced the calutron tanks, liners, sources and collectors. Allis-Chalmers produced the magnets and General Electric the complicated high-voltage electrical control units. Tennessee Eastman developed the chemical process as well as trained thousands of operators. Nichols worked closely with these contractors as well as the scientists throughout the construction and operations process.

Nichols and Lawrence toured Y-12 in May 1943 and Nichols recalls, "[Lawrence] was amazed at the scope and magnitude of the effort. …he had difficulty comprehending what was involved in building 552 calutrons and accompanying magnets and controls. However, his amazement at the progress increased his enthusiasm and his dedication to final success. Moreover, his enthusiasm permeated the entire project."

Early in the planning stages, Nichols alerted Lawrence that at least 2 stages would be needed. Nichols recalls, "For a while I was in his doghouse because I pointed out on several occasions that his experimental results suggested that at least two stages would be necessary. …I am sure he knew that two stages would be necessary, but he was not about to admit it at that time. …

"By the middle of March 1943, the scope of the Y-12 plant was determined. There would be five racetracks (the magnets were arranged in an oval form like a racetrack) of 96 tanks each for the Alpha stage. Lawrence finally had acknowledged that a second or Beta stage would be needed. The Beta tanks were smaller, arranged in the form of a rectangle [and designed with great precision]."

Unexpected bad news arrived mid-1943 when Dr. Oppenheimer tripled the estimate of the amount of U-235 that would be needed for an effective weapon. This necessitated Nichols to oversee an expansion called Alpha II consisting of two buildings, each containing 2 rectangular tracks of 96 units each. Additional Beta units were also required.

At this point, estimated construction costs for Y-12 were $250M (~$4.6B in 2025). This did not include the 14,700 tons of silver borrowed from the U.S. Treasury (see 6th article). Ultimately, total cost of the plant was $427M (~$7.8B in 2025) covering 500 acres.

Problems were encountered at every stage of construction and production. The huge Allis-Chalmers' magnet coils had to be returned for reconditioning. Most of the cooling system's piping was replaced. Chemical recovery of the enriched uranium was far below estimates. Added to that, there were electrical failures, spare parts problems, cracked insulation and vacuum leaks.

At this time, Lawrence had an apartment in Oak Ridge during the critical period of the Y-12 plant and spent many evenings with the Nichols. He persuaded his wife Molly to visit Oak Ridge joining Nick and Jackie for a much-needed break one weekend visiting Gatlinburg and the Great Smoky Mountains. Nick recalls, "It marked the beginning of a cherished friendship."

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Lawrence brought a team of skilled operators from Berkeley to Oak Ridge that increased U-235 by March,1944. Nichols recalls a critical question at the time: "Would it take hundreds or even thousands of Ph.Ds. to operate the plant?" Tennessee Eastman worked closely with Stone and Webster to develop the chemical process based on UC Berkeley's work, then trained the operators, "the Calutron girls," straight out of high school.

Nichols described the process: "The Tennessee Eastman employees … [in the] electromagnetic plant …[were given a] cover story. … For example, that we were making a catalyst for gasoline to extend the range of bombers. But we had several such stories. …

"At one time, [Lawrence] would break in each new unit. …As we would start up a unit, he would put on [his] operating team until we found out how to operate it. And then he would turn it over to Tennessee Eastman [to] … train these girls to operate it.

"I commented to [Lawrence] one day after we had several units operating, that the girls were outproducing his PhDs. …Of course, he thought I was crazy. We checked and sure enough, they were. And he said, 'Oh that is just because they [the PhDs] do not try.' I said, 'Make them try. I do not think they can out-produce these girls.' …

"The girls won because they were trained like soldiers. …In contrast, the scientists could not refrain from time-consuming investigation of the cause of even minor fluctuations of the dials. This little contest provided a big boost in morale for the Tennessee Eastman workers and supervisors."

By autumn of 1944 with chemical recovery of the enriched uranium still too low, Nichols recalls a major change was needed, "At a conference in New York with [Monsanto and Tennessee Eastman's heads of research and chemical processing], Conant, Groves and I decided to proceed without the concurrence of [Kodak]." It was agreed Nichols would switch leadership in charge of the Madison Square and Y-12 areas. As a result, a new chemical building was designed and constructed by Tennessee Eastman for a new improved process.

By June 1945 all of Y-12 was completed and producing at full capacity. The team of over 22,000 people involved with Y-12 achieved a monumental success.

Thank you to these pioneers and their families for their critical work and sacrifices during the war.

Next up: Production Facilities, Part 2 (1942-1945): K-25

Grateful acknowledgements to K. David Nichols, Jr.; Ray Smith; Sandy Fye; Dr. Bianka J. Adams, Alisa Whitley, Douglas J. Wilson and the U.S. Army Corps of Engineers Office of History; Emily (Westcott) and Don Hunnicutt; Martin McBride; Diane Gulley; Gerald A. Potts; and Bruce W. Scollin for their assistance with this article.

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Thanks for these Historically Speaking columns written by Barbara Rogers Scollin, grandniece of General Kenneth D. Nichols.

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Colonel Kenneth D. Nichols, District Engineer, presents a Letter of Commendation to Mr. Bearl M. Justise, Stone & Webster carpenter employee who only missed one day in 21 months, Clinton Engineer Works, July 15, 1944. Photo by Ed Westcott (Courtesy of Emily [Westcott] and Don Hunnicutt)

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The Y-12 Electromagnetic Processing Plant's 'racetrack'. Clinton Engineer Works, Oak Ridge TN. Photo by Ed Westcott (Public domain Courtesy of Barbara Scollin)

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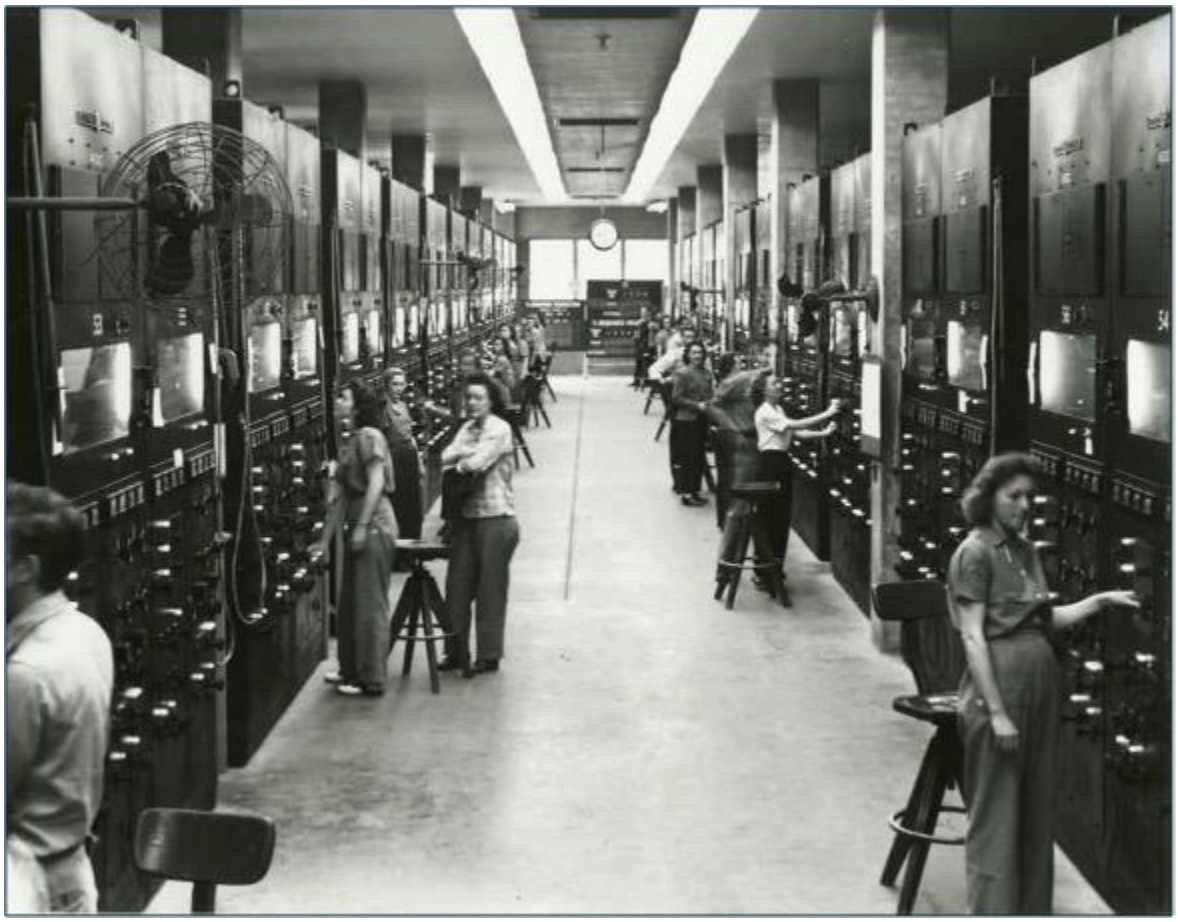

Y-12 Cubicle Operators (aka "The Calutron Girls") Clinton Engineer Works, Oak Ridge, TN Photo by Ed Westcott (Public domain Courtesy of Barbara Scollin)

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Y-12 Processing Equipment Clinton Engineer Works, Oak Ridge, TN Photo by Ed Westcott (Public domain Courtesy of Barbara Scollin)