Meet Kenneth D. Nichols, the Father of Oak Ridge - Production Facilities, Part 4 (1942-1945): S-50

(As published in The Oak Ridger's Historically Speaking column the week of March 31, 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 fifteenth installment of several articles covering the life and accomplishments of Kenneth D. Nichols, "Multitasker Extraordinaire" is added to his CV during the summer and autumn of 1944.

Vannevar Bush suggested to General Wilhelm D. Styer to look into the Navy's atomic research. Already scheduled to visit the Navy Research Laboratory in Anacostia, Colonel Kenneth D. Nichols was told by Styer to, "Take Groves along." Colonel Groves and Nichols met with Admiral H.D. Bowen, the director, and Dr. Ross Gunn, on September 21, 1942.

Nichols recalls, "Both Bowen and Gunn indicated they would like to cooperate and coordinate their efforts with the Army and were quite open in disclosing the results of their tests and the procedures they were using. However, we did not volunteer any information about our work except that we were connected with the S-1 project as Army representatives."

The meeting would prove crucial to the success of the Manhattan Project, especially in light of Clinton Engineer Works (CEW) and Hanford Engineer Works (HEW) production facility delays. Nichols said, "From the spring of 1943 to the end of 1944, a tremendous construction effort ensued at all the Manhattan Project sites. … I remember the period most for the major crises that arose one after another in all phases of the project, with the exception of the production of feed material."

Construction of K-25 went forward despite no suitable barrier yet created (see 13th article). If the U-235 program was delayed, a weapon would not be ready for the August 1945 target date.

With success hanging in the balance, Brig General Groves received a letter from Dr. Oppenheimer concerning the Navy's liquid thermal diffusion method. Groves reviewed the Navy's plant at the Philadelphia Navy Yard and decided to build an identical plant at Oak Ridge but twenty-one times larger. Nichols, administrator of the construction and operation, assigned Major Mark Fox as his project engineer.

Groves told Fox of the almost impossible deadline: September 16, 1944 (to meet their August 1, 1945, deadline). Fox complained to Nichols who responded that it had to be done. After 21 other firms turned down the project, H.K Ferguson Company of Cleveland agreed on June 27, 1944, to design, construct and operate the liquid thermal diffusion plant (code name "S-50").

Nichols described S-50 containing, "2,172 identical 48' columns consisting of an inner nickel tube, an outer copper tube, a water-cooled jacket, the necessary valves, and interconnecting pipes. Nearly perfect roundness of the columns with a tolerance of only 0.002 inches was key – most experts said it could not

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be done. The tremendous amount of high-pressure steam required for the columns was provided by the electric power plant at CEW not yet in use due to K-25 delays."

Nichols further explained the uranium separation process: "High-pressure steam in the nickel pipe heats the inside wall of the annular space. The out wall of the annular space is cooled by circulation of water within the water jacket about the copper pipe. The U-235 tends to concentrate near the hot wall and the U-238 near the cold wall. Normal thermal convection moves the enriched uranium to the top of the column and the depleted to the bottom. The longer the column, the greater the enrichment."

Ground broke on July 12th. Abelson, Fox, the H.K. Ferguson Company and the US Navy's personnel worked as a team, with the plant going online September 15th. Nichols was drenched with steam during the initial test phase but pleased with such rapid success. Production began October 30th and completion reached just after December 1944. What a remarkable achievement when compared to the German and Japanese atomic research programs attempting but failing to develop the same process during the same war-time period.

With S-50 in operation, a correlated, serial (three-way cycle) approach to the uranium production was analyzed. Nichols explains, "In the autumn of 1944, I realized that coordinating production of the three U-235 plants at the CEW would be a much more difficult task than anyone had anticipated. The liquid thermal diffusion plant (S-50) could raise the enrichment of the U-235 from .7 to .9%; the electromagnetic plant (Y-12), which had two different alpha stages, one more advanced than the other, could raise the enrichment from .7% to 15-20% in the alpha stages, while the beta stage could raise the enrichment from 20-36% to an enrichment useful for weapons.

"The gaseous diffusion plant was designed to raise the enrichment from .7 to 36%. … For each increment, time was required to reach equilibrium. Also, the higher the enrichment withdrawn, the lower the production rate. … In the meantime, we needed to operate the three plants to give us maximum effective production units (epu) for weapons."

Nichols immediately established a production control committee to study the situation headed by Lt Col A.V. Peterson and Dobie Keith. The study resulted in recommending more base units to the gaseous diffusion plant ("K-27") and balancing them with more Y-12 beta units.

Contractors estimated a cost of $100M (~$1.8B in 2025) and completion date of February 1946. K-25, approved as just a pilot plant, was now being considered for expansion to a full-size production plant. Groves did not immediately approve the recommendation as Nichols expected.

Nichols recalled, "Groves said [to the contractors], 'Nichols will tell you my decision tomorrow.' We then went to dinner at the Commodore Hotel [NYC]. Before dinner, he ordered a second drink. I was surprised; this was unusual for Groves. It wasn't until after dinner while we were walking to Pennsylvania Station, that he mentioned the subject of the expansion.

"He asked me, 'What would you do, Nichols?' Without hesitation, I replied, 'I believe it absolutely essential to build the expansion if we want an adequate production rate for U-235. Our actual expenditures are now well over a billion dollars and increasing every day. Personally, I would just as soon be hanged for exceeding two billion dollars as spending one and half billion without planning for an adequate U-235 production rate.' Groves' eyes twinkled as he said, 'I am glad you think that way. I agree. Tell them I approve it.'

"But I knew the reason why he was hesitating, because he had to approve it before he had approval of the President of the United States. We took care of that the next time a letter went to the President. The expanded program was included."

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With the uncertainty of the Manhattan Project's success, Nichols recalled this difficult period: "The summer and fall of 1944 marked the low point in our expectations. I have often reflected that had the Manhattan Project not been protected by super secrecy, it might well have been annihilated by a host of critics proclaiming it an impossibility. It would have been a plausible claim and hard to disprove as our troubles continued during the third quarter of 1944."

Last year (2024) as we commemorated the 80th anniversary of the June 6th 1944, Normandy Invasion, we knew the landing was successful. But to those who lived during the war, over 230,000 Allied casualties were horrific to comprehend. The Battle of the Bulge at year-end 1944, launched by a surprise German attack, was the largest battle ever fought by the US Army in its history with 600,000 American troops suffering over 80,000 casualties. The war was far from over.

Jackie Nichols and June Adamson, lifelong friends and former neighbors on Olney Lane in Oak Ridge, wrote, "One young man whose mother had worked as a chemist in Oak Ridge during the war, … asked Adamson, 'Surely no one in Oak Ridge seriously thought the United States could possibly lose World War II?'

"She stared at him in disbelief, recalling those anxious years when yes, Oak Ridgers in the 1940s along with most Americans, were convinced that chances were high that the war might be lost to Fascist Germany or Imperialist Japan if the U.S., Britain and other Allies couldn't stop them. Did he know nothing of the devastating surprise attack on Pearl Harbor by the Japanese on Sunday, December 7, 1941, that triggered U.S. involvement in the conflict?

"Had he never heard of the Battle of the Bulge where so many Allied lives were lost in December 1944? Or Nazi Germany's evil work toward the 'final solution'? Or Corregidor? Or the Bataan death march? Or how many lives were lost in the battle for Iwo Jima? She told him, 'Oh yes we did. We were terrified that World War II could be lost unless we continued to sacrifice tens of thousands of more Allied lives. Everyone here was intensely worried.'"

Colonel Nichols' Christmas 1944 message to Oak Ridgers invoked encouragement to "continue your efforts to accomplish our objective. Only by bending every ounce of effort toward production can we shorten this accursed war and end the sacrifice of the lives of our men and women on the fighting fronts abroad."

S-50 cost $10.6M for construction and $5.1M for operation (~$281M in 2025). Nichols reflected on this cost: "After the war, we calculated that the thermal diffusion plant had saved nine days in providing sufficient material for the uranium bomb dropped on Hiroshima. [An AEC estimate was seven days.] …Considering the daily cost of the war and the saving in lives of even a few days, I believe it turned out to be a good investment."

Saving lives - Thank you to all working on the S-50 rush project and their families.

Next up: Los Alamos Laboratory & Dr. Oppenheimer

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; Michael Stallo and the staff at the Oak Ridge Public Library; Diane Gulley; Gerald A. Potts; and Bruce W. Scollin for their assistance with this article.

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Thanks for this Historically Speaking column and series goes to Barbara Rogers Scollin, grandniece of General Kenneth D. Nichols.

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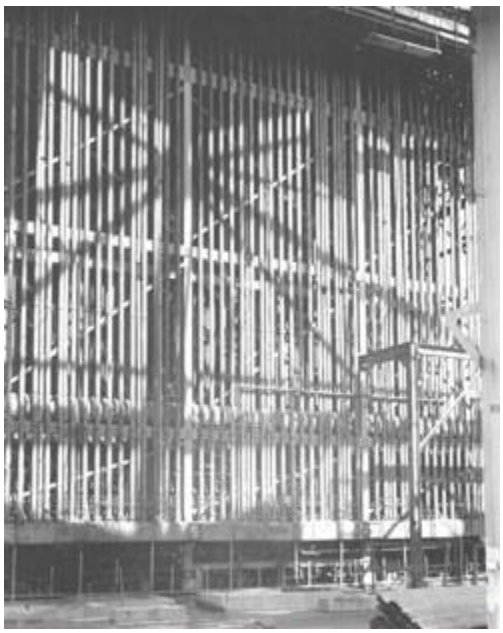
Special Engineer Detachment Citation Award Ceremony. Col. Kenneth D. Nichols and Mrs. A. Carter with six SED officers. Blankenship Field, Oak Ridge TN, 1945. Photo by Ed Westcott. (Courtesy Emily [Westcott] and Don Hunnicutt)



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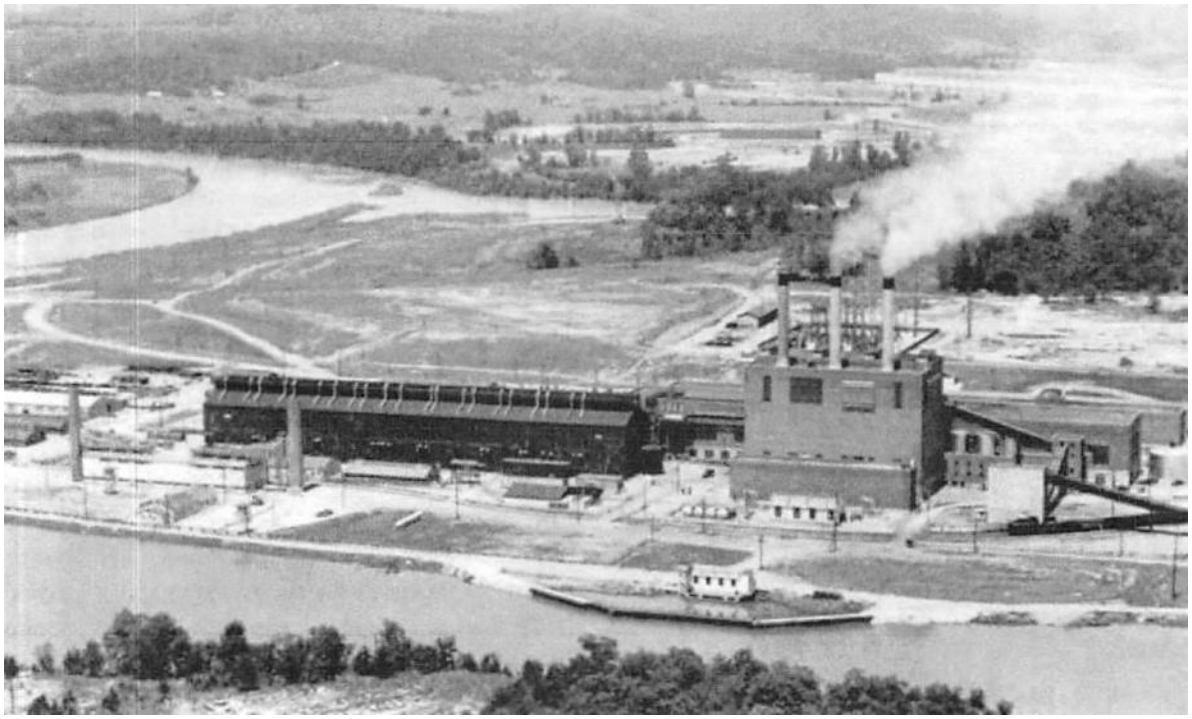
Diffusion columns, S-50 Thermal Diffusion Plant, Clinton Engineer Works, 1945. Public domain. (Courtesy of Barbara Scollin)



S-50 Liquid Thermal Diffusion Plant (long, dark building) The adjacent K-25 power plant shown with 3 smokestacks drew water from the Clinch River Clinton Engineer Works, 1945. Public domain (Courtesy of Barbara Scollin)

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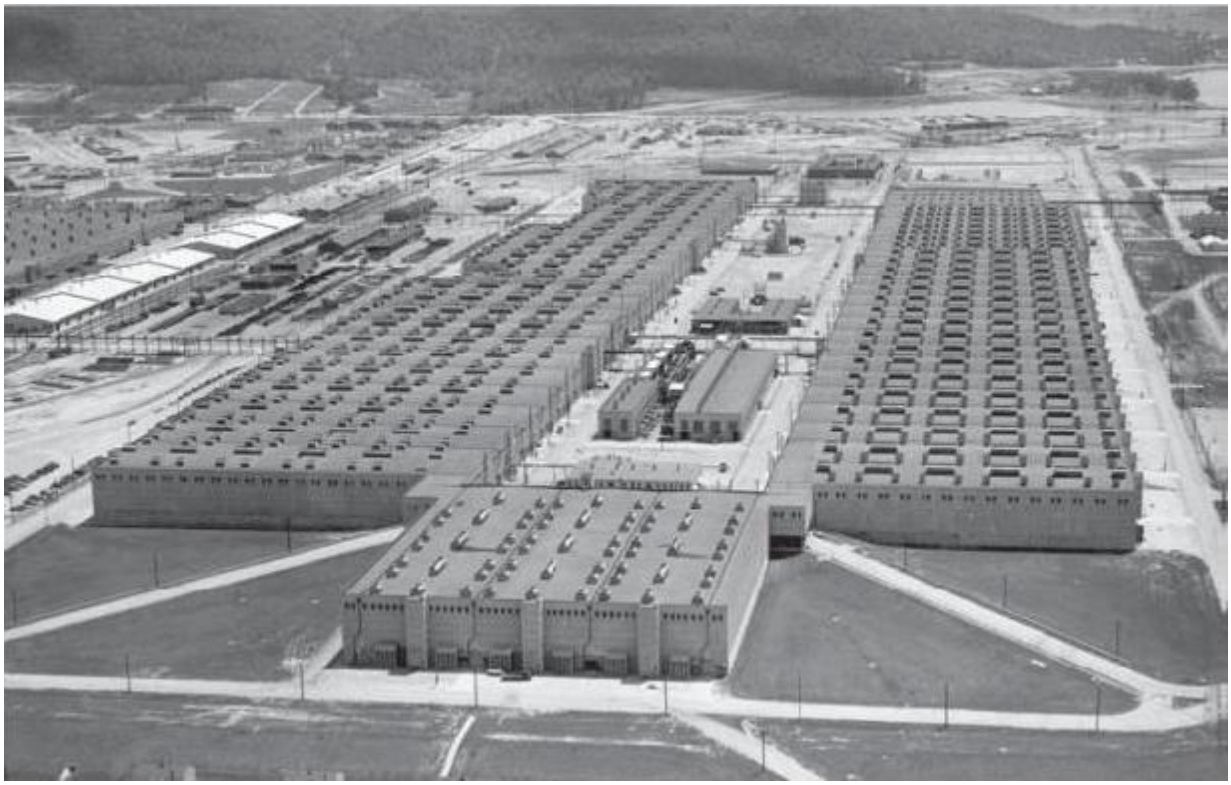

K-25 Gaseous Diffusion Plant, foreground, the largest building in the world at that time. K-27 extension unit subsequently erected adjacent to Poplar Creek, at the upper right. Clinton Engineer Works, 1945. Public domain. (Courtesy of Barbara Scollin)

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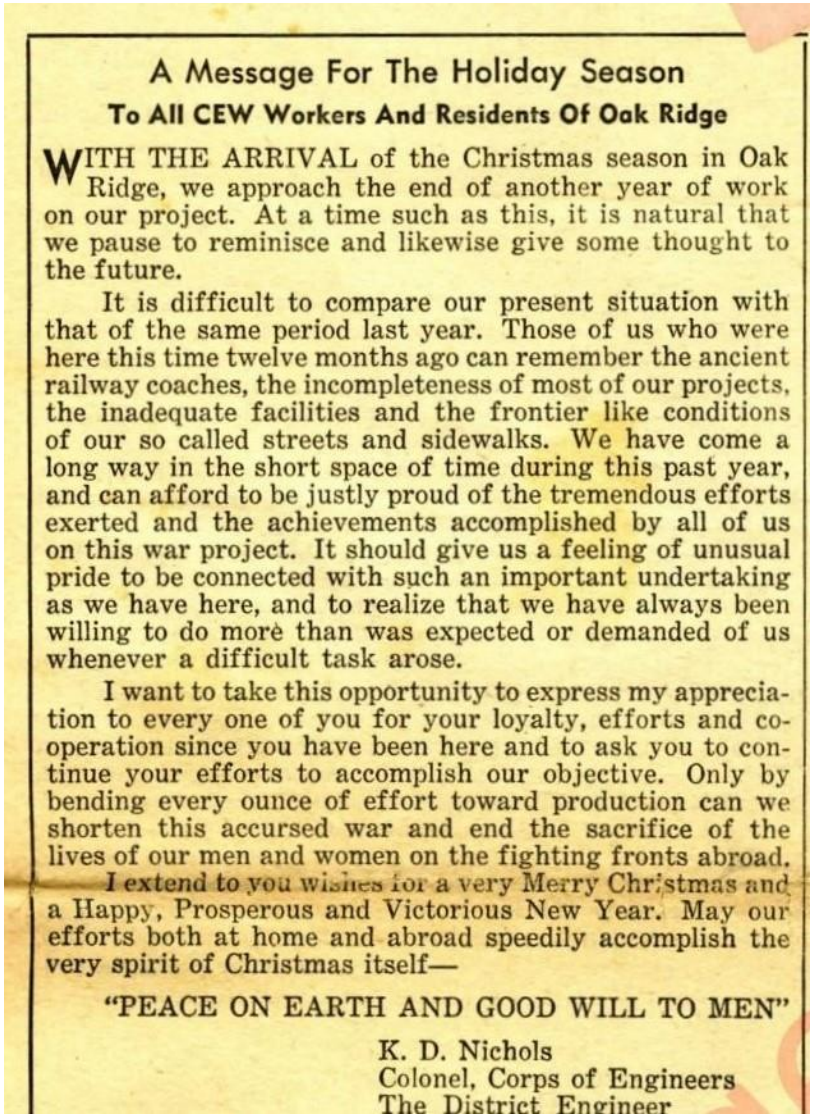

A Message For The Holiday Season

To All CEW Workers And Residents Of Oak Ridge

WITH THE ARRIVAL of the Christmas season in Oak Ridge, we approach the end of another year of work on our project. At a time such as this, it is natural that we pause to reminisce and likewise give some thought to the future.

It is difficult to compare our present situation with that of the same period last year. Those of us who were here this time twelve months ago can remember the ancient railway coaches, the incompleteness of most of our projects, the inadequate facilities and the frontier like conditions of our so called streets and sidewalks. We have come a long way in the short space of time during this past year, and can afford to be justly proud of the tremendous efforts exerted and the achievements accomplished by all of us on this war project. It should give us a feeling of unusual pride to be connected with such an important undertaking as we have here, and to realize that we have always been willing to do more than was expected or demanded of us whenever a difficult task arose.

I want to take this opportunity to express my appreciation to every one of you for your loyalty, efforts and cooperation since you have been here and to ask you to continue your efforts to accomplish our objective. Only by bending every ounce of effort toward production can we shorten this accursed war and end the sacrifice of the lives of our men and women on the fighting fronts abroad.

I extend to you wishes for a very Merry Christmas and a Happy, Prosperous and Victorious New Year. May our efforts both at home and abroad speedily accomplish the very spirit of Christmas itself—

"PEACE ON EARTH AND GOOD WILL TO MEN"

K. D. Nichols
Colonel, Corps of Engineers
The District Engineer

A Message For The Holiday Season, K.D. Nichols, Colonel, District Engineer. Oak Ridge Journal, December 21, 1944. (Courtesy of the Oak Ridge Public Library)