level began falling after three hours. It fell continuously until the pile ceased operating entirely on the evening of the 28th. By the next morning the reaction began again, reached the previous day's level, then dropped.

Xenon Poisoning

Hanford scientists were at a loss to explain the pile's failure to maintain a chain reaction. Only the foresight of DuPont's engineers made it possible to resolve the crisis. The cause of the strange phenomenon proved to be xenon poisoning. Xenon, a fission product isotope with a mass of 135, was produced as the pile operated. It captured neutrons faster than the pile could produce them, causing a gradual shutdown. With shutdown, the xenon decayed, neutron flow began, and the pile started up again. Fortuitously, despite the objections of some scientists who complained of DuPont's excessive caution, the company had installed a large number of extra tubes. This design feature meant that pile 100-B could be expanded to reach a power level sufficient to overwhelm the xenon poisoning. Success was achieved when the first irradiated slugs were discharged from pile 100-B on Christmas Day, 1944. The irradiated slugs, after several weeks of storage, went to the chemical separation and concentration facilities. By the end of January 1945, the highly purified plutonium underwent further concentration in the completed chemical isolation building, where remaining impurities were removed successfully. Los Alamos received its first plutonium on February 2.[44]

Reorganizing for the Final Push

Oppenheimer acted quickly to maximize the laboratory's efforts to master implosion. Only if the implosion method could be perfected would the plutonium produced at Hanford come into play. Without either a plutonium gun bomb or implosion weapon, the burden would fall entirely on uranium and the less efficient gun method. Oppenheimer directed a major reorganization of Los Alamos in July 1944 that prepared the way for the final development of an implosion bomb. Robert Bacher took over G Division (for gadget) to experiment with implosion and design a bomb; George Kistiakowsky led X Division (for explosives) in work on the explosive components; Hans Bethe continued to head up theoretical studies; and "Deke" Parsons now focused on overall bomb construction and delivery.

Field tests performed with uranium-235 prototypes in late 1944 eased doubts about the artillery method to be employed in the uranium bomb. It was clear that the uranium-235 from Oak Ridge would be used in a gun-type nuclear device to meet the August 1 deadline Groves had given General Marshall and the Joint Chiefs of Staff. The plutonium produced at such expense and effort at Hanford would not fit into wartime planning unless a breakthrough in implosion technology occurred.

At the same time, Los Alamos shifted from research to development and production. Time was of the essence, though laboratory research had not yet charted a clear path to the final product. Army Air Force training could wait no longer, and in September at Wendover Field in western Utah, Colonel Paul Tibbets began drilling the 393rd Bombardment Squadron, the heart of the 509th Composite Wing, in test drops with 5,500-pound orange dummy bombs, nicknamed pumpkins. In June 1945, Tibbets and his command moved to Tinian Island in the Marianas, where the Navy SeaBees had built the world's largest airport to accommodate Boeing's new B-29 Superfortresses.

Taking Care of Business

Personnel shortages, particularly of physicists, and supply problems complicated Oppenheimer's task. The procurement system, designed to protect the secrecy of the Los Alamos project, led to frustrating delays and, when combined with persistent late war shortages, proved a constant headache. The lack of contact between the remote laboratory and its supply sources exacerbated the problem, as did the relative lack of experience the academic scientists had with logistical matters.

Groves and Conant were determined not to let mundane problems compromise the bomb effort, and in fall 1944 they made several changes to prevent this possibility. Conant shipped as many scientists as could be spared from Chicago and Oak Ridge to Los Alamos, hired every civilian machinist he could lay his hands on, and arranged for Army enlisted men to supplement the work force (these GIs were known as SEDs, for Special Engineering Detachment). Hartley Rowe, an experienced industrial engineer, provided help in easing the transition from research to production. Los Alamos also arranged for a rocket research team at the California Institute of Technology to aid in procurement,