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1. Welcome Letter from the Under-Secretary General

Valuable Participants and distinguished delegates,

It is my honor to serve you and the perennial tradition of BKVMUN as the Under-Secretary General and the deviser of this unique Committee. My team of diligent Crisis Team Members and Academic Assistants have worked tirelessly under time constraints and within the pages of innumerable academic resources to give you a guide that is both worthy of the most inquisitive delegates and equally worthy of the hectic setting in which you will be released.

In this Committee, my colleagues and I will give each delegate the opportunity to create their own version of the Atomic Age. In order for you to establish your factions and become the undisputed ruler of this race, we have developed a comprehensive simulation of the various forces of World War II.

We pledge to push ourselves to entertain and be entertained all while you turn the wheel of America's fate.

Ceren Güneyman

2. Introduction to the Committee

Victory in an international conflict is far from assured. Japan fights with unrelenting determination across the Pacific. The rule of Hitler has fallen in Europe, but the threat of Soviet invasion still exists. A different type of conflict, however, is being conducted at the labs of Los Alamos, Oak Ridge, and Hanford—one that is being fought with equations, uranium, and the terrible unknown rather than with guns or tanks.

You are placed in the center of the Manhattan Project, the most significant and covert scientific endeavor in human history. Together with political leaders and military strategists, the greatest minds of the 20th century—Oppenheimer, Fermi, and Bohr—are racing against the clock to unleash the devastating power of the atom. Every calculation, directive, and choice will influence how conflict, world dominance, and human existence are shaped in the years to come.

However, the burden of advancement is heavy. According to intelligence sources, the Soviet Union and Nazis were working on creating their own superweapon. Internal conflicts deepen between those who dread the consequences of the bomb's use for the globe and those who view it as a necessary evil. Secrecy tightens like a noose, spies patiently await in the shadows, and the question is no longer just can the bomb be built—but should it?

There is a hum from the reactor. It's countdown time. The future itself is at stake as science and war clash at this precise time. The world will never be the same again—if it survives at all.

3. The Atomic Mission's Foundations
    a. The Army and the Atomic Energy Program
        i. Origins of the Army's Role

On the evening of June 17, 1942, Colonel James C. Marshall received a teletype message instructing him to report to Major General Eugene Reybold, Chief of the Army Corps of Engineers, for temporary duty. The next day, he arrived at Reybold's office, where he was given further orders to meet Brigadier General Wilhelm D. Styer, Chief of Staff for the War Department's Services of Supply. Later that afternoon, Styer informed Marshall of his new assignment: he was to establish a new engineer district responsible for constructing a manufacturing plant as part of an ongoing project to develop atomic energy for military use.

This marked the Army's official entry into a program in which it had played only a minor role since 1939. Until then, the military had shown little enthusiasm for atomic energy.

The Army's first engagement with nuclear research began on October 12, 1939, when President Franklin D. Roosevelt, convinced by financier Alexander Sachs, agreed to investigate the military potential of atomic energy. That same day, Roosevelt's military aide, Major General Edwin M. Watson, summoned officers from the Army and Navy to discuss the matter. The Army sent Lieutenant Colonel Keith F. Adamson, head of the Ammunition Division at the Ordnance Department, along with his civilian assistant, Arthur Adelman. The Navy was represented by Commander Gilbert C. Hoover, an ordnance specialist.

During the meeting at the White House, Sachs repeated his arguments about nuclear energy's potential. However, Army representatives responded with skepticism. Adamson questioned whether nuclear research had advanced far enough to justify government funding. He was also wary of Sachs's financial motives, particularly his push for the United States to purchase uranium from the Belgian Congo.

The Army's Chemical Warfare Service (CWS) also evaluated the proposal. While Lieutenant Colonel Haig Shekerjian reacted favorably, Major Maurice E. Barker, Chief of the CWS Technical Division, was decisively negative. After reviewing Albert Einstein's letter and Leo Szilard's memorandum, Barker concluded that there was "no basis" for believing that bombarding uranium with neutrons would produce an explosion. He acknowledged the scientific interest of the idea but saw the chances of military success as too slim to justify funding.

Unlike the Navy, which had a central research body in the Naval Research Laboratory, the Army lacked an organization dedicated to advanced scientific research. Army officers were trained to focus on immediate military needs, not long-term theoretical projects. Given the tight budgets of the 1930s, military funding was directed toward proven weapons systems rather than speculative research. As a result, Army officers dismissed the idea that nuclear energy could have military value.

ii. Decision To Develop Atomic Weapons

The Army had an opportunity to voice its skepticism through the Uranium Committee, a small advisory group created by Roosevelt on October 21, 1939. Chaired by Lyman J. Briggs, Director of the National Bureau of Standards, the committee included Colonel Adamson and Commander Hoover.

At the committee's first meeting on October 21, 1939, nuclear physicists Szilard, Teller, and Wigner explained the steps needed to achieve a chain reaction in uranium. They requested $6,000 to purchase high-purity graphite, which was necessary for their experiments. The discussion revealed three distinct positions: Adamson and Hoover were skeptical and felt that years of research would be required before nuclear energy had any military use. Sachs and Teller were highly optimistic, while Szilard and Wigner took a cautious approach, emphasizing both the potential and the uncertainties of their work.

Despite Adamson's doubts, the Uranium Committee recommended funding for continued research. Its report to Roosevelt on November 1, 1939, stated that while nuclear fission's military application was still unproven, the subject was important enough to justify government support. The committee advised purchasing four metric tons of graphite and, if experiments were promising, an additional 50 tons of uranium oxide.

The report was passed to General Watson, who requested a specific recommendation from Chairman Briggs before advising the President. Without this, no immediate action was taken. Meanwhile, military officials took no steps to coordinate the various nuclear research efforts at Columbia University, Princeton, and the Naval Research Laboratory. Instead, individual scientists and civilians like Sachs took the lead in pushing the program forward.

In January 1940, Briggs secured $3,000 from the Navy to fund uranium research. He then approached Major General Charles M. Wesson, Chief of Army Ordnance, who agreed to match the Navy's contribution. The Army and Navy funds—totaling $6,000—were allocated to the Bureau of Standards, which transferred the money to Columbia University. Fermi and his team used it to purchase graphite for neutron absorption experiments.

Despite slow progress, research continued. By April 1940, scientists had confirmed that only U-235 was fissionable and that heavy water could be used as a neutron moderator. The German invasion of Norway that month raised concerns that the Nazis would seize control of the Norsk Hydro plant, the world's only large-scale heavy water producer. This, along with new reports of German interest in uranium research, convinced some officials that the U.S. needed to expand its efforts.

At the second Uranium Committee meeting on April 27, 1940, scientists urged greater support for nuclear research. Although no formal recommendations were made, there was growing agreement that the project deserved significant funding, even if it required large sums of money. The committee also endorsed a proposal by Szilard to suppress public discussion of atomic research to prevent information from reaching Germany.

New funding came from several sources. On May 23, 1940, the Carnegie Institution allocated $30,000 for uranium research. The Army contributed $20,000, and additional funds from the Navy and Bureau of Standards brought the total to over $100,000. This was enough to expand projects at Columbia University and the University of Virginia.

A separate concern was securing uranium. Sachs, who had long pushed for U.S. control over Belgian Congo uranium, met with Roosevelt again in May 1940 to discuss the issue. The same month, he and Harold Urey contacted Edgar Sengier, director of Union Minière du Haut Katanga, the Belgian company that controlled the Shinkolobwe mine, the richest uranium source in the world.

Sengier, already aware of uranium's growing importance, had secretly moved 120 grams of radium from Belgium to the U.S. But he refused to agree to Sachs's request that Union Minière ship uranium ore to the United States. This left American researchers reliant on Canadian uranium from Eldorado Gold Mines, which began small-scale shipments in late 1940.

The attack on Pearl Harbor (December 7, 1941) accelerated the atomic program. By early 1942, the research effort had expanded significantly, with projects scattered across multiple universities and laboratories. However, without a central authority, progress was slow.

In March 1942, Roosevelt placed the project under the Office of Scientific Research and Development (OSRD), led by Vannevar Bush. Scientists convinced him that an atomic bomb was possible, but the effort needed massive industrial resources. The Army was the only organization capable of managing such a program.

On June 17, 1942, Roosevelt ordered the Army to take full control. The Manhattan Engineer District was established in August, with Colonel James C. Marshall as its first head. The project was now military-run, with strict secrecy enforced.

iii. Establishment of the NDRC and OSRD

By the summer of 1940, the organizational structure of the American atomic energy program began to take shape. Scientists took the initiative in improving its administration, recognizing the need for better coordination and secrecy.

At the suggestion of Leo Szilard, and with the support of Admiral Harold Bowen and Lyman Briggs, Harold Urey organized a committee of scientists to advise on atomic energy and security concerns. The Advisory Committee on Nuclear Research met for the first time on June 13, 1940, under Urey's chairmanship. One of its earliest actions was to establish a secrecy policy in collaboration with American scientific journals, ultimately halting the publication of atomic energy research in the U.S. This marked the first step in addressing what would become a major challenge—maintaining an unprecedented level of secrecy in such a large-scale project.

At the same time, discussions were underway to improve leadership in coordinating the entire U.S. scientific war effort, including atomic energy. Since the German invasion of Belgium in May 1940, Alexander Sachs had urged President Franklin D. Roosevelt to establish a "Scientific Council of National Defense" to oversee military-related research. A key advocate for this idea was Vannevar Bush, president of the Carnegie Institution of Washington. He had already gained support from leading scientists and key military figures, including Army Chief of Staff General George C. Marshall and Chief of Naval Operations Admiral Harold R. Stark.

On June 15, 1940, Roosevelt established the National Defense Research Committee (NDRC) with Bush as chairman. The NDRC was tasked with directing, coordinating, and conducting military research and development. Its members came from the National Academy of Sciences, while the Army and Navy were represented by Brigadier General George V. Strong (War Plans Division) and Rear Admiral Harold G. Bowen (Naval Research Laboratory).

Roosevelt also ensured that atomic energy research remained a priority. He instructed Bush to reorganize the Uranium Committee, making it a subcommittee of the NDRC with Briggs as chairman. However, unlike the original committee, this new Committee on Uranium lacked military representation. Although Briggs was authorized to maintain direct contact with Army and Navy officers, the only service member to continue participating was Ross Gunn of the Naval Research Laboratory.

On July 1, 1940, Briggs presented a report to Vannevar Bush outlining the previous work of the Uranium Committee. He also requested $140,000 to purchase uranium metal and pure graphite and to conduct further research on fundamental nuclear properties.

At its first formal meeting on July 2, 1940, the NDRC reviewed Briggs's request but faced a dilemma. The committee's primary mission was to develop practical weapons for the war. Many NDRC members, including Bush himself, felt that the chances of an atomic bomb were "very remote." Even the possibility of using nuclear power for battleships or submarines seemed distant. Given the need for funds in other military research areas, some questioned whether it was wise to allocate money to what might be seen as "wild research."

However, the risk of Germany making a breakthrough in nuclear research could not be ignored. The committee ultimately decided that prudence demanded further investigation. They approved Briggs's request in principle and instructed him to develop a careful but cost-effective research program.

Although this decision paved the way for expansion, the atomic program initially relied on earlier Army and Navy funding. Even the first NDRC contract, signed with Columbia University in November 1940, was financed using leftover Army-Navy funds. It was only on October 25, 1940, that the NDRC formally approved Briggs's $140,000 request, opening the door for larger-scale nuclear research.

By spring 1941, the NDRC had committed nearly $500,000 to nuclear research at institutions such as Columbia, Harvard, Princeton, the University of Chicago, the University of California (Berkeley), Johns Hopkins, the Bureau of Standards, and several others. Although modest compared to other wartime research efforts, this funding was a major step forward. As Sachs later observed, nuclear research was now "invested with the importance, the resources, and the secrecy of the United States Government."

While the NDRC successfully mobilized civilian scientists for military research, certain gaps remained in the national scientific mobilization effort. To address this, President Roosevelt expanded the NDRC's role by establishing the Office of Scientific Research and Development (OSRD) on June 28, 1941.

The OSRD absorbed the NDRC as one of its agencies, but with a broader mandate. Bush became OSRD director, while Harvard University President James B. Conant took over as NDRC chairman. This reorganization allowed for more effective management of scientific research and closer collaboration with the military.

Within the new structure, Briggs's Committee on Uranium remained part of the NDRC, but it was renamed the "Section on Uranium" and expanded slightly. However, once again, no Army or Navy representatives were included—not even Ross Gunn, the only military scientist involved in earlier committees.

Although the OSRD strengthened scientific coordination, the lack of military involvement in uranium research meant that, by mid-1941, the atomic program still lacked the full backing of the armed forces. This would change in 1942, when the Army took control and launched the Manhattan Project.

b. Establishing the Manhattan District
    i. Organizing the District

The Army Corps of Engineers stepped into the atomic energy project in June 1942, and with it came an assignment unlike any before. Colonel James C. Marshall, newly tasked with overseeing this secret endeavor, met with General Wilhelm Styer on the evening of June 18. The full scope of what lay ahead wasn’t clear to him, but the next day, at the Office of Scientific Research and Development (OSRD), Vannevar Bush handed him documents that changed everything.

The Army, Marshall learned, was now responsible for all large-scale aspects of atomic energy development—constructing the plants, selecting sites, and overseeing production—while OSRD would focus on scientific research and pilot experiments. By the afternoon, Styer had formalized the orders, directing Marshall to take full control of the Army’s role in the program. It was a massive undertaking, and he knew he needed every resource available to succeed.

Army construction projects typically fell under regional engineer districts, but this was different. This district would have no geographic limits, no standard oversight, and an unprecedented level of authority. Marshall answered to the Chief of Engineers, General Eugene Reybold, but he worked directly with Brigadier General Thomas Robins and, crucially, Colonel Leslie Groves, who reviewed his plans and provided critical support. Even General Brehon Somervell, commander of the Army’s supply division, was initially kept in the dark, the project was that secretive.

Marshall needed a base. He set up a liaison office in Washington, D.C., but his main headquarters landed at 270 Broadway in New York City, just steps from the North Atlantic Division of the Corps of Engineers and Stone & Webster, a company soon to become a key contractor. His next move: assembling a team. He pulled experienced officers from his former Syracuse District staff, including Lieutenant Colonel Kenneth D. Nichols, his new assistant district engineer. As more officers arrived from other Corps districts, the team grew.

But it needed a name. On June 26, Generals Somervell, Styer, and Reybold first considered an elaborate cover name: Laboratory for the Development of Substitute Materials (DSM). But by August 13, that was scrapped. Marshall’s temporary headquarters had inspired something simpler, "Manhattan District." It was official: the Manhattan Project had begun.

The Army’s entry into the program meant it had to work alongside OSRD scientists. The S-1 Executive Committee, newly formed under James B. Conant, now oversaw atomic research, replacing the earlier S-1 Section. This group—Ernest Lawrence, Arthur Compton, Harold Urey, and others—coordinated with the Manhattan District.

Meetings between Marshall’s team and S-1 scientists took place at least once a month. Scientists briefed military officers on research progress, while the Army handled contracts, procurement, and security. But secrecy was paramount. To avoid suspicion, Army officers visiting university labs and industrial sites often wore civilian clothing, and official documents carefully avoided mentioning the project’s true purpose. Even so, loose talk from scientists sometimes risked exposure.

Throughout the summer of 1942, the Army and S-1 Committee operated with unusual autonomy. They made key decisions without interference. Reports went up the chain—to Generals Somervell and Marshall, sometimes to Secretary of War Henry Stimson, and occasionally to President Roosevelt. But for the most part, the Army and scientists worked without high-level intervention.

That wouldn't last. As the project expanded, tensions would rise. The Army's control would tighten. The scientists, once leading the charge, would find themselves operating under strict military oversight. The balance of power was shifting, and by year's end, control of the atomic bomb project would belong to one man: Leslie Groves.

ii. Army-OSRD Planning Meeting, 25 June 1942

The first Army-OSRD planning meeting on June 25, 1942, at the Carnegie Institution in Washington, D.C., marked a turning point in the atomic bomb project. General Wilhelm Styer, Colonel James C. Marshall, Colonel Kenneth D. Nichols, Vannevar Bush, and other key figures made crucial decisions about site selection, contracts, and securing government priorities for materials.

General Styer outlined a fundamental policy: all atomic plants must be built in a secure inland zone, at least 200 miles from U.S. borders and safe from enemy air attacks. He pushed for one large site to house all major production facilities, making construction faster, costs lower, and security tighter. The planners agreed that an atomic production center required:

- 150,000 kilowatts of electricity by late 1943.
- Hundreds of thousands of gallons of water per minute for cooling.
- A mild winter climate to allow year-round construction.
- A strong local labor supply and good transportation access.
- Rugged terrain to contain potential accidents.

An OSRD study in April had already pinpointed the Tennessee Valley, specifically an area near Knoxville, as the best choice. Arthur Compton's team in Chicago had also favored this location for the plutonium production plant. By mid-June, Bush and Marshall had discussed the site with Colonel Groves, who gave it his approval. The Tennessee site was now the Army's top choice for large-scale atomic production.

Not everyone agreed. Ernest Lawrence argued that the electromagnetic separation plant should be built closer to his research in California. To keep the project moving, the group delayed a decision on that plant but confirmed that centrifuge, diffusion, and plutonium production would be based in Tennessee.

The committee also tackled locations for other necessary facilities:

- Argonne Pilot Plant – A small plutonium plant was needed near Chicago, but not inside the city for safety reasons. The team settled on Argonne Forest, about 20 miles southwest of Chicago.

- Heavy Water Production in Canada – British chemist Hugh S. Taylor had developed a method to produce heavy water using hydrogen extraction. The Consolidated Mining and Smelting Company's plant in Trail, British Columbia, was the largest hydrogen producer in North America. The OSRD had started working with them in May 1942, and now the Army would take over construction while OSRD continued research.

To manage site development, construction, and engineering, the committee approved Colonel Marshall's proposal to hire Stone & Webster, a Boston-based firm with experience in OSRD projects. They would oversee:

- Tennessee site development and housing construction.
- Engineering for the centrifuge and electromagnetic plants.
- Construction of the Argonne pilot plant and, later, the full-scale plutonium plant.

The M.W. Kellogg Company of New Jersey, an expert in petroleum and chemical plant design, was assigned the diffusion plant, while E.B. Badger & Sons continued work at Trail, Canada.

Time was short. Only six days remained before the end of the fiscal year, and $15 million was urgently needed to extend OSRD contracts. Marshall promised to secure the funds immediately from Army engineer accounts, a sum that would ultimately cover all remaining OSRD atomic expenses.

Finally, the group tackled the problem of securing scarce materials and equipment. OSRD had struggled to obtain them, and now Marshall agreed to assign a priorities officer to coordinate procurement and eliminate competition for resources.

The June 25 meeting marked the true start of Army-OSRD cooperation in the atomic program. The Army was now fully in control of construction and planning.

For Colonel Marshall, summer 1942 was a whirlwind of organization and problem-solving. The scientific challenges were daunting. The Army had to plan huge construction projects while scientists were still uncertain which method of uranium enrichment would work best. Every approach—centrifuge, diffusion, electromagnetic separation, and plutonium production—needed further research, yet large-scale plants had to be built before the results were in.

The June 17 program approved by Roosevelt had demanded progress on all five methods. Each had ambitious production targets:

- Centrifuge – 100 grams of U-235 per day by January 1944.

- Diffusion – 1 kg per day by late 1944.
- Electromagnetic – 5 grams per day in a pilot plant, scaling to 100 grams per day by late 1943.
- Plutonium reactors – 100 grams per day, with heavy water plants producing 0.5 tons per month by mid-1943.

By mid-1942, the centrifuge and diffusion methods, which had seemed promising the previous year, were running into serious technical problems.

Diffusion Struggles

At Columbia University, John Dunning and Harold Urey led research into gaseous diffusion. But two major issues threatened the method:

- Developing a porous material that could withstand the corrosive uranium hexafluoride gas.
- Designing durable pumps, valves, and seals to move the gas through thousands of stages.

The M.W. Kellogg Company worked on solutions, but Urey admitted that, at best, diffusion might produce enough enriched uranium for a bomb by late 1944.

Centrifuge Stalls

The centrifuge method also hit technical roadblocks. The concept—spinning uranium gas in high-speed rotors to separate isotopes—was sound, but:

- Machines needed hundreds of spinning stages to be effective.
- Vibrations and mechanical failures plagued early designs.

Even so, research at Columbia, the University of Virginia, Westinghouse, and Standard Oil continued. But by July 1942, estimates placed usable output no earlier than late 1944.

Plutonium's Slow Progress

At the University of Chicago's Metallurgical Laboratory, Arthur Compton's team focused on plutonium production. Their goals were:

- Prove that a chain reaction was possible.
- Develop large-scale plutonium production.
- Extract plutonium from uranium.
- Design an atomic bomb.

But progress was slow. Basic materials like uranium, graphite, and heavy water were in short supply, limiting experimental work. Compton estimated plutonium wouldn't be weapon-ready until late 1944.

Electromagnetic Separation

The most promising method in summer 1942 was Ernest Lawrence's electromagnetic process at Berkeley. His massive 184-inch cyclotron magnet had successfully separated milligram quantities of U-235.

On July 30, Colonel Marshall and Stone & Webster engineers visited Berkeley and came away convinced:

> "Lawrence's method is ahead of the others… It should be exploited to the fullest without delay."

Lawrence pushed to build both a pilot plant and a full-scale production facility immediately. The S-1 Committee approved the pilot plant but hesitated on full-scale production. They feared it might signal favoritism toward electromagnetic separation, causing other methods to lose funding.

Instead, on August 26, the group agreed to push all four pilot plants forward. Full-scale plutonium production would wait until the Argonne pilot plant showed results. The electromagnetic production plant decision would come in mid-September, after a Berkeley site visit.

Vannevar Bush warned Secretary Stimson:

> "The time for a major decision on the atomic program is near."

c. First Steps for Weapon Development

    i. Securing an Architect-Engineer-Manager

Following the 25 June 1942 planning meeting, military leaders worked rapidly with scientists and engineers to organize the Army's administration and initiate atomic weapon development. The next day, Maj. Gen. Eugene Reybold, chief of the Corps of Engineers, met with Brig. Gen. Thomas M. Robins, Col. Leslie R. Groves, Col. James C. Marshall, and Lt. Col. Kenneth D. Nichols to address immediate priorities: selecting a site for atomic production in Tennessee and securing an architect-engineer-manager (AEM) contract.

Consistent with Army policy, the industrial operator was given a role in site selection. Stone & Webster Engineering Corporation was designated to oversee construction, procurement, and research within the Army's jurisdiction. On 27 June, Nichols visited John R. Lotz, the company's president, who accepted the role enthusiastically. A meeting followed in Washington, D.C., where Lotz assured Army officials that his firm could meet the strict security requirements. On 29 June, Stone & Webster was officially authorized to begin preliminary work. However, as the scope expanded, additional firms were brought in to share responsibilities.

ii. Obtaining Funds

Stone & Webster's contract required immediate funding. The program had allotted $85 million to $54 million for the Army Corps of Engineers and $31 million for the OSRD, but without specifying the source. Early efforts to secure funds from the President's Emergency Fund failed. By 16 July, Marshall arranged for an allotment from the Chief of Engineers' Office, securing an initial $5 million, with the rest following in stages. He also obtained exemptions from standard financial controls, allowing the project greater autonomy in spending.

iii. Securing a Priority Rating

Despite funding progress, obtaining critical materials posed a challenge. The War Production Board (WPB) controlled industrial priorities, with major programs assigned AA-1 to AA-4 ratings. AAA ratings were reserved for emergencies. When Marshall and Nichols met with General Lucius D. Clay on 30 June, they requested an AA rating without specifying a level. Clay, a former West Point classmate of Marshall's, assured them priority requests would receive the highest attention. However, two weeks passed without a decision.

On 13 July, the Army-Navy Munitions Board (ANMB) granted the project an AA-3 rating—a disappointment but the highest possible under existing policy, which prioritized planes, ships, and tanks. Clay insisted AA-3 would suffice and offered AAA ratings for specific items if needed.

Difficulties soon emerged. Badger and Sons reported conflicts between their heavy water work at Trail, Canada, and commitments to the synthetic rubber program, which held the same AA-3 rating but had priority due to an earlier start. By mid-August, Badger estimated the Trail plant would not be operational until August 1943—a delay of two to three months that an AA-1 rating might have prevented. However, pushing for a higher priority risked political backlash, and Clay had already opposed such a move.

The S-1 Executive Committee, responsible for procurement, struggled to obtain scarce materials. In July, a two-week delay in securing 85 pounds of nickel slowed experimental work. On 30 July, the committee met with Marshall and Nichols and decided to urge Vannevar Bush to request a blanket AA-1 priority from WPB Chairman Donald Nelson for orders under $2,000. Marshall and Nichols met with Clay on 31 July, but he refused to support a blanket upgrade, maintaining that AA-3 was sufficient.

By late August, material shortages worsened. Steel became nearly unattainable without AA-2 priority, jeopardizing plant construction. On 29 August, Nichols again met with Clay and presented the unanimous opinion of Army and OSRD leaders that a higher priority was necessary. Clay opposed the request, stating presidential approval did not imply AA-1 priority and that the project was less urgent than tanks and munitions. In Nichols' presence, he called Brig. Gen. Theron D. Weaver, director of the SOS Resources Division, and ordered that the AA-3 rating remain unchanged.

The next day, Vannevar Bush wrote to Harvey Bundy, Secretary Stimson's aide, emphasizing that ANMB's refusal to upgrade priorities threatened the entire atomic program. Bundy relayed Bush's concerns to Stimson, but no immediate action followed. Meanwhile, steel companies refused orders for the electromagnetic separation plant, and ANMB warned that even AA-3 might not secure the required materials.

By 12 September, Marshall requested an AAA rating for Trail's copper supply. With Groves's backing, he met with General Weaver on 15 September and secured approval—on the condition that the metal be drawn from the Corps of Engineers' quota, delaying other projects but ensuring work at Trail proceeded on schedule.

Despite this small victory, project leaders agreed that an overall priority upgrade was essential. Groves believed a stronger case for AA-1 could be made once site selection and construction were finalized. Conant and Bush also concluded that atomic development had surpassed the importance of synthetic rubber and deserved higher priority.

By mid-September 1942, the situation was clear: if atomic energy was truly the most urgent project, it should have top priority. The solution was imminent, but not before the project underwent major organizational changes.

iv. Procuring Essential Materials

Many materials essential to the atomic project had never been produced in significant quantities. When the Army took control, three were urgently needed: processed uranium, highly purified graphite, and heavy water. The Manhattan District had to develop its own supply chains for these resources.

Uranium

By early 1942, the OSRD S-1 Section had located enough uranium ore in North America to meet short-term needs. However, the infrastructure to refine it into the necessary feed materials was almost nonexistent. Some uranium had been secured, but large-scale production remained the Army's responsibility. The immediate demand was for uranium metal for the Metallurgical Laboratory.

Raw uranium was typically refined into uranium oxide (black oxide) or uranium salts, which could then be converted into metal. In early 1942, only a few grams of high-quality uranium metal had been produced by Westinghouse, and a few pounds of pyrophoric powder by Metal Hydrides, Inc. Both companies sourced black oxide from the Canadian Radium and Uranium Corporation, which obtained its supply from Eldorado Gold Mines, Ltd. in Canada. The Eldorado mine had closed in 1940, but stockpiled ore continued to supply uranium for research.

In 1941, the OSRD placed a large order, prompting efforts to restart Eldorado's operations. By spring 1942, as uranium deliveries increased, project scientists worked on refining methods. The National Bureau of Standards demonstrated that the ether process could purify uranium more efficiently. Arthur Compton enlisted Edward Mallinckrodt of Mallinckrodt Chemical Works in St. Louis to develop large-scale brown oxide production using this method. 350 tons of uranium oxide were ordered from Canadian Radium to ensure a steady supply.

By fall 1942, Mallinckrodt was producing enough brown oxide to meet demand. This was converted into uranium tetrafluoride (green salt), the feed material for metal production. Westinghouse abandoned an inefficient photochemical method in favor of a green salt reduction process, achieving steady output. Metal Hydrides initially struggled to produce pure metal, but research at MIT, Iowa State College, and the Bureau of Standards led to the adoption of the steel-bomb reduction process, using calcium and later magnesium as reducing agents. By early 1943, Iowa State had developed a manufacturing program, and Metal Hydrides significantly increased output.

New contracts with Electro Metallurgical Company (Niagara Falls, NY) and DuPont further expanded production. By 1944, the acute uranium metal shortage was largely resolved. In September 1942, Captain John R. Ruhoff, a chemical engineer at Mallinckrodt, was placed in charge of uranium production. The following month, Colonel James C. Marshall formed a Materials Section in the Manhattan District Office, led by Lt. Col. Thomas T. Crenshaw, with Ruhoff as his assistant.

Despite efforts to restart Eldorado, shipments were delayed, and stockpiles at Port Hope, Ontario, were insufficient. A new source was needed. The solution came from Union Minière executive Edgar Sengier, who had secretly stockpiled 1,200 tons of high-grade uranium ore from Shinkolobwe, Congo, in a Staten Island warehouse in 1940. Initially overlooked, the cache became known to Manhattan officials in September 1942. Through Standard Oil Development Company, negotiations began, and by mid-September, the OSRD S-1 Executive Committee recommended acquiring the entire stockpile. The Congo ore became the primary wartime uranium supply.

Graphite

Graphite, a crucial moderator for plutonium production, was commercially available in the United States, but its purity was inadequate. The primary issue was boron contamination, which absorbed neutrons. Scientists at the National Bureau of Standards traced this to the coke used in production. By substituting petroleum coke and modifying manufacturing techniques, National Carbon Company and Speer Carbon Company produced highly purified graphite that met Metallurgical Laboratory standards. With War Production Board (WPB) assistance, large orders were placed, solving the graphite supply problem.

Heavy Water

Heavy water was another potential moderator, but production was limited. Scientists at the Metallurgical Laboratory prioritized uranium-graphite pile development, treating heavy water as a backup. The OSRD proceeded with plans for a heavy water plant at Trail, Canada, but priority issues delayed construction until June 1943.

At the time, only 400 pounds of heavy water existed outside of German-controlled Norsk Hydro in Norway. This supply had been secured in 1940 by Frédéric Joliot-Curie, Hans von Halban, and Lew Kowarski, who arranged for 160 liters to be shipped from Norsk Hydro to France before the German invasion. Just before Paris fell, von Halban and Kowarski transported it to England, contributing to British atomic research. By late 1942, when the British team relocated to Canada, the heavy water went with them.

Silver

The need for silver arose unexpectedly. At a 9 July 1942 Army-OSRD meeting, Ernest Lawrence of Berkeley requested thousands of tons of copper for magnet coils. As copper was a critical war material, Lawrence suggested using silver, which had similar electrical properties but was not restricted.

Colonel Kenneth Nichols approached Under Secretary of the Treasury Daniel W. Bell about obtaining silver. Unaware of the project's scale, Bell asked, "How much silver do you want?" Nichols replied, "About fifteen thousand tons." A startled Bell responded, "Young man, we speak of silver in ounces."

Despite Bell's reaction, approvals came swiftly. On 29 August, Secretary of War Henry Stimson formally requested 175 million fine troy ounces (6,000 tons) of silver for a "highly secret project." The Treasury Department, ANMB, and WPB quickly approved the transfer, stipulating that the silver:

1. Remain in the U.S.
2. Be returned within five years unless required sooner.
3. Be used in government-owned war plants.
4. Be protected against loss.

Subsequent agreements in 1943 and 1944 increased the total silver allocation to 14,700 tons, valued at $304 million.

Under heavy guard, silver bars were melted, cast into billets, rolled into strips, and fabricated into magnet coils. This development was critical since, by mid-1942, the electromagnetic separation method appeared to be the most promising approach to uranium enrichment.

v. Site Selection

Project leaders in summer 1942 recognized that acquiring suitable sites was as critical as securing materials and priorities. At the 25 June Army-OSRD meeting, they confirmed plans for a heavy water plant at Trail and approved the plutonium pilot plant in the Argonne Forest near Chicago. The Army delayed acquiring Argonne land while awaiting further details on space requirements. In early July, Colonel Nichols clarified these needs with Stone and Webster officials and Arthur Compton, leading to a 1,000-acre lease from Cook County in August. The University of Chicago also provided an additional acre for laboratory expansion. To oversee acquisitions and construction, Colonel Marshall established the Chicago Area Engineers Office, appointing Capt. James F. Grafton as area engineer.

For the main production plants, Marshall, Nichols, Stone and Webster, and the Tennessee Valley Authority (TVA) surveyed sites near Knoxville beginning 1 July. The ideal site required:

- Ample electricity, enough to power a small city.
- Sufficient water supply for cooling, processing, and construction.
- Rail and road access for heavy material transport.
- Topographical security, with ridges to separate facilities and mitigate explosion risks.
- Stable ground, suitable for excavation without excessive rock.
- Space for a town, capable of housing thousands of workers and families.

After three days of surveys, no site was ideal, but one showed promise. TVA officials assured Marshall they could meet the 150,000-kilowatt power requirement if he could expedite delivery of critical equipment. With project priorities still unsettled, Marshall agreed to investigate but kept open the Spokane, Washington area as an alternative.

At the 9 July Army-OSRD meeting, John R. Lotz of Stone and Webster reported that Spokane lacked sufficient transmission lines, reaffirming Tennessee as the preferred location. Officials reduced the required land from 200 to 100 square miles, with most space allocated for the plutonium plant, which had to be 2 to 4 miles from other facilities for safety. However, no final decision was made.

That afternoon, Colonel Groves urged Marshall to establish a clear timeline for all project phases. Marshall and Stone and Webster agreed to finalize a Tennessee site by 10 August so that construction on administrative buildings and housing could begin, even if plant construction was delayed. Stone and Webster prepared a site report on a location 12 miles west of Knoxville, mapping tracts for acquisition. They also examined relocating Tennessee Highway 61, which crossed the northern portion and posed a security risk. The Ohio River Division of the Engineer Department appraised the cost of acquiring 83,000 acres spanning Roane, Loudon, Knox, and Anderson Counties.

At the 30 July Army-OSRD meeting, Marshall reviewed site acquisition progress. While the Tennessee Valley was confirmed as the best location, some scientists suggested a cooler site in the Great Smoky Mountains for a future central laboratory. Just as the acquisition process was cleared, Marshall postponed it, reasoning that without a final plutonium process, a short delay posed little risk. The Real Estate Branch assured him land could be secured within ten days of an order. Meanwhile, Marshall worked to obtain TVA power priorities.

While Ernest Lawrence now supported Tennessee for the electromagnetic separation plant, officials continued evaluating the Shasta Dam area in California, only abandoning it in early September. By 26 August, Marshall was prepared to recommend purchasing part of the Tennessee site, but the S-1 Executive Committee deferred a decision, further delaying acquisition despite Robins and Groves urging immediate action.

vi. Reaching Decisions: The Meeting at Bohemian Grove

On 13-14 September 1942, the S-1 Executive Committee met in Bohemian Grove, northwest of San Francisco, to resolve key project issues. In attendance were Nichols, California Area Engineer Maj. Thomas T. Crenshaw, J. Robert Oppenheimer, and two other scientific consultants. Nichols and Crenshaw wore civilian clothes to conceal Army involvement.

The first major decision was to immediately acquire the Tennessee site. Discussion then turned to which plants could begin construction. The gaseous diffusion and centrifuge methods remained unproven, requiring hundreds to thousands of separation stages to produce U-235. The plutonium process had yet to achieve a self-sustaining chain reaction. Only the electromagnetic method had successfully produced small quantities of U-235.

Since a single unit could separate 10 milligrams of U-235 per day, producing a significant amount would require tens of thousands of units. The method was costly, required further research, and demanded a highly skilled workforce. However, it was the only proven method, justifying immediate construction of a large-scale electromagnetic plant.

After visiting Lawrence's laboratory to observe operational separation units, the group agreed to proceed with a 100-gram-per-day electromagnetic plant in Tennessee, estimated at $30 million. Design and procurement would begin immediately, with a final decision by 1 January 1943, at which point construction would commence unless further developments dictated otherwise. A small electromagnetic pilot plant was also proposed but later abandoned.

Meanwhile, the plutonium pilot plant originally planned for Argonne Forest was moved to Tennessee. Growing concerns about radiation risks, operator training, and large-scale chemical processing necessitated a larger site than Argonne could provide. Stone and Webster was tasked with subcontracting a chemical company to develop plutonium separation technology.

To support the plutonium effort, the heavy water plant at Trail was prioritized for completion by 1 May 1943. The Metallurgical Laboratory's experimental pile, originally in Chicago, was relocated to Argonne for safety reasons.

The decisions made at Bohemian Grove ended much of the uncertainty that had delayed progress through the summer of 1942. As these decisions took effect, changes in project leadership and organization would soon accelerate the atomic bomb program.

d. The Commandment of General Groves

i. Reorganization and the Selection of Groves

The son of an Army chaplain, Leslie R. Groves spent his formative years moving between military posts across the American West. There, listening to veterans' tales of frontier conquests, he developed a longing for his own grand challenge—one that would arrive unexpectedly in September 1942 when, as a 46-year-old career officer, he was selected to lead what would become the Manhattan Project. This scientific frontier would prove far more consequential than any he had imagined as a boy.

The Army's formal involvement in the atomic program began on 17 June 1942 when President Roosevelt approved Vannevar Bush's proposal for military oversight. By early September, with the project expanding rapidly, it became clear that stronger leadership was needed. During a critical meeting on the 16th, Bush, General Styer, and General Somervell agreed to establish a policy committee while selecting an officer to execute its directives.
Styer, unable to leave his post as Somervell's chief of staff, immediately recommended Colonel Groves—a logical choice given Groves' extensive experience overseeing military construction projects, including his recent advisory role on Manhattan District site selection. The recommendation was swiftly approved by both Somervell and General Marshall.

When informed of his new assignment on 17 September, Groves' initial reaction was disappointment at missing combat duty overseas. "I was horrified," he later recalled upon learning the project's unproven foundations. His concerns were somewhat assuaged when Somervell emphasized how success could determine the war's outcome. That same afternoon, Styer issued formal orders: Groves would assume complete control while temporarily maintaining his role in Pentagon construction to avoid suspicion. A pending promotion to brigadier general would, Groves believed, give him needed authority when dealing with academic scientists.

Groves' early days were marked by tension. His first meeting with Bush turned awkward when the OSRD director—uninformed of the appointment and wary of military dominance—proved reluctant to share information. However, by 21 September, after frank discussions, the two established a working relationship that would prove crucial.

On 23 September, hours after receiving his general's star, Groves attended a pivotal War Department meeting where Secretary Stimson formalized the Military Policy Committee. Bush would chair the committee with Conant as alternate, while Groves served as executive officer—effectively making him the project's operational commander.

ii. Securing the Tennessee Site

Even before the committee's first formal meeting, Groves took decisive action. Departing directly from the 23 September conference, he boarded an overnight train to inspect the proposed Tennessee site personally. Accompanied by Colonel Marshall, he spent 24

September surveying the 56,000-acre tract between Roane and Anderson Counties. Satisfied with its isolation and water access from the Clinch River, he immediately authorized acquisition.

By 29 September, Under Secretary Patterson approved the $3.5 million purchase. Condemnation proceedings began on 7 October, with residents starting to vacate within weeks. For security, initial public notices described the area as the "Kingston Demolition Range" before adopting the more innocuous "Clinton Engineer Works" designation. The adjacent settlement that would house workers became known as Oak Ridge—a name that would eventually eclipse the official designation.

Groves recognized uranium procurement as his most pressing challenge. Colonel Nichols had already initiated talks with Edgar Sengier of Union Miniere regarding ore stockpiled on Staten Island. Groves accelerated these efforts, personally directing Nichols to finalize terms. The resulting 19 October contract secured 100 tons of high-grade ore (assayed at 65% uranium oxide), with options for the remaining Staten Island stockpile and Congo reserves. Groves established a rigorous shipping protocol using fast transports to minimize submarine risks, while Captain Phillip Merritt, a trained geologist, coordinated refining operations and global sourcing efforts.

By January 1943, with additional contracts for Canadian ore and Colorado tailings, the Military Policy Committee could confidently report to Roosevelt that uranium supplies were secured for the entire program, a crucial milestone in the race for the bomb.

In June 1942, President Roosevelt approved giving the atomic program top procurement priorities. Yet by September, when Groves took command, the existing AA-3 rating proved inadequate. After consulting General Styer, Groves immediately sought broader authority to issue AAA ratings when needed to break bottlenecks.

On 19 September, Groves confronted War Production Board Chairman Donald Nelson with a draft letter granting this authority. Nelson initially resisted—until Groves threatened to escalate the matter to the President. The signed letter authorized the Manhattan District to assign AAA ratings when absolutely necessary.

The Army-Navy Munitions Board formalized this authority on 26 September, though with strict conditions: AAA use couldn't disrupt other critical programs, and each application required a written justification within 24 hours. Groves assured the S-1 Executive Committee the rating would be used sparingly, reserving AA-3 for routine procurement.

By 1943, however, the AA-3 rating proved too weak for standard needs while AAA remained excessive. Groves successfully pushed for an intermediate AA-2X rating in March, then continued pressing until securing the coveted AA-1 base rating on 1 July 1944. Throughout the project's peak construction phase (1943-1945), Manhattan's Washington Liaison Office strategically deployed AAA ratings for over $77 million in critical orders, at times exceeding all other Army and civilian programs combined. Yet Groves' disciplined use of this power avoided backlash that might have revoked their privileges.

iii. Establishment of Los Alamos

By late 1942, J. Robert Oppenheimer argued that bomb research needed consolidation in a dedicated facility. Groves, meeting the Berkeley physicist in October, immediately recognized the proposal's merit. After briefings with Compton and Bush, Groves approved the lab concept on 19 October, but the location required careful consideration.

Initial suggestions, the Tennessee site or Chicago, lacked sufficient isolation. Groves rejected California sites over security concerns and Nevada due to winter logistics. Oppenheimer's familiarity with New Mexico proved decisive. An initial survey of Jemez Springs (16 November) failed, but the nearby Los Alamos Ranch School—a struggling boys' school atop a remote mesa—offered ideal secrecy and expansion potential.

By 25 November, Groves authorized acquisition despite incomplete land transfers. The Albuquerque District began construction on 30 November, while Oppenheimer launched a nationwide recruitment campaign. Scientists arrived as early as March 1943, hauling irreplaceable equipment like Harvard's cyclotron. The lab officially activated on 1 April under Oppenheimer's scientific leadership and Colonel Harman's military administration, reporting directly to Groves.

Security concerns nearly derailed Oppenheimer's appointment due to his prewar leftist associations. Though lacking a Nobel Prize (unlike lab chiefs Compton, Lawrence, and Urey), his unique grasp of both theoretical and practical challenges made him indispensable. Groves personally intervened to secure his clearance, formalizing the appointment on 25 February 1943—though full authorization wasn't finalized until July.

The "Site Y" designation (alternately called Project Y or Zia) masked its true purpose, while its isolation enforced secrecy. Oppenheimer's recruitment succeeded despite restrictive conditions: scientists worked under military oversight, with initial plans to commission key staff later abandoned as impractical. Los Alamos' hybrid structure—academic talent under Army jurisdiction—became the crucible for the atomic bomb's development.

iv. Manhattan Project Organization and Operation

By April 1943, with Los Alamos established, the Army's organizational framework for the atomic bomb program was largely complete. Subsequent adjustments—such as the Manhattan District's relocation from New York to Oak Ridge in August, and Colonel Nichols replacing Colonel Marshall as district engineer—refined but did not fundamentally alter the structure.

The Manhattan Project's administration fell into two categories: elements integrated into the Manhattan District, and those operating outside it, primarily in high-level policymaking. At the top stood General Groves' personal headquarters, a minimal staff consisting of himself, his secretary Jean O'Leary (who doubled as his administrative assistant), and a few clerical workers. Groves strategically positioned his office near the Manhattan District's Washington Liaison Office in the New War Department Building, ensuring direct access to key government agencies.

Though Groves exercised command authority over the Manhattan District, the district engineer (first Marshall, then Nichols) served as its chief executive. The District mirrored traditional Corps of Engineers structures, with military personnel leading most units and civilian specialists filling technical roles. Its organization comprised:

- Operating Units: Tasked with monitoring major contractor activities, these evolved as the project shifted from construction to operations. By August 1943, five primary units existed: Madison Square Area, Hanford Engineer Works, Clinton Engineer Works, New York Area, and Special Products.
- Staff Divisions: Seven components oversaw specialized functions:
    - Four unit chiefs (Y-12, K-25, X-10, P-9) supervised production processes.
    - The Technical Division managed research programs at universities like Chicago and Berkeley.
    - The Service and Control Division handled security, labor relations, and military personnel.
    - The Administrative Division dealt with procurement, contracts, and civilian personnel, while also supporting Los Alamos with routine services.

Policy guidance came from committees like the Military Policy Committee (reporting to the Top Policy Group) and the OSRD S-1 Executive Committee, the latter fading after mid-1943 as the Army assumed full control. Groves, answering directly to the Army Chief of Staff and Secretary of War, executed their directives through the District's streamlined hierarchy.

This structure, though later adjusted to accommodate operational shifts, proved robust enough to transition the project from research to industrial-scale production. Under Groves' leadership, it overcame relentless challenges to deliver the atomic bomb.

4. Producing Fissionable Materials
    a. Organizing for Production

Army's task of securing both skilled manpower and technical know-how for producing fissionable materials in weapons-grade quantities proved extraordinarily difficult. This challenge was compounded by the absolute necessity for speed, which forced the letting of contracts before customary preliminary plans and technical data were available. The lack of specific information—blueprints, specifications, and similar documentation—created additional obstacles, as many of the required scientific and technical processes were virtually unknown in industrial circles.

Making matters worse, most industrial organizations had already committed their resources to conventional war production. Their managers and engineers showed reluctance to take on additional responsibilities for a project of such unusual and uncertain character. The Army therefore faced the critical problem of convincing these firms that the program's success was so crucial to the war effort that they simply could not refuse participation.

At the Metallurgical Laboratory, controversy had simmered for some time regarding responsibility for carrying the plutonium program to production. Some scientists proposed that they themselves should direct the plant's design, development, engineering, and construction. Arthur Compton, the laboratory director who had early career experience with large electrical companies, recognized this proposal contradicted standard American industrial practice. He understood that separating research, development, and production into distinct departments typically yielded the most efficient results.

Compton suggested time would be saved by securing an experienced industrial firm accustomed to large-scale projects, leaving research to his laboratory staff. The staff's reaction, as Compton later recalled, "was a near rebellion." Younger scientists countered that they had already demonstrated their ability to supervise process development through their successful work increasing production of pure uranium metal and graphite. Having contributed so significantly to the program's initiation and development, they wanted to see the plutonium project through to completion.

The European-born scientists on the staff provided particularly strong backing for this position. Most harbored suspicions about large industrial firms' motives. Additionally, their scientific training typically included more extensive engineering knowledge than their American counterparts possessed. By early summer 1942, research progress forced the need for an imminent decision.

Compton assembled about seventy-five members of his research and administrative staff to reach consensus on an organizational plan. When it became clear no agreement would emerge, Compton announced he would proceed without their approval. At the June 25 OSRD S-1 Executive Committee meeting, he supported assigning architect-engineer-manager responsibility for plutonium and other processes to Stone and Webster.

Though the S-1 Committee had suggested the University of Chicago might operate the Argonne Forest pilot facility, no action had yet been taken. In mid-August, Compton urgently advised Colonel Marshall that an operator must be selected immediately as construction was about to begin. He further noted that the Argonne chemical facility operator would likely also run the main plutonium plant's separation works, meaning the operator's engineering staff needed to observe Argonne plant construction.

As potential operators, Compton recommended approaching E.I. du Pont de Nemours Company, Standard Oil Development Company, or Union Carbide and Carbon Corporation. For security reasons, Marshall wanted to minimize the number of involved firms, proposing instead that Stone and Webster add Argonne separation plant operation to its existing responsibilities. Both Compton and the engineering firm accepted this arrangement, though Stone and Webster stipulated it must be permitted to secure technical assistance from other organizations.

At the early September Bohemian Grove meeting, the S-1 Committee recommended Stone and Webster receive the required technical assistance. Newly appointed Manhattan commander General Groves and Stone and Webster agreed on September 26 to approach Du Pont, with the S-1 Committee accepting their decision. Two weeks later, Du Pont reluctantly agreed to design and procure chemical separation equipment and part of the pile equipment for the plutonium pilot plant.

Du Pont had initially resisted pile responsibility, citing lack of experience and strain from other government projects. However, Groves and Compton ultimately persuaded the company this was the logical solution. Since Du Pont's contract covered only design and procurement, Stone and Webster would operate just the Argonne separation installation, securing an operator for other pilot facilities and the production plant remained unresolved.

Both Groves and Compton were rapidly concluding that the task's size and complexity required selecting a company other than Stone and Webster. During his first October 1942 visit to the Metallurgical Laboratory, Groves reviewed the plutonium program with Compton and senior staff, quickly realizing production would be far more challenging than anticipated. After further consultation, Groves and Compton decided Stone and Webster should be relieved of all plutonium project responsibility—a decision supported by Vannevar Bush and James B. Conant.

As Groves learned more about the plutonium process, he concluded that assigning design, engineering, construction, and operation to a single firm would be preferable. Proper organization selection would improve operational efficiency and simplify his coordination task. One Du Pont policy particularly impressed Groves: unlike most American firms, they maintained a long-established practice of building their own plants. This meant Du Pont possessed the necessary resources and experience to handle all plutonium production plant aspects—advantageous for both security and rapid production startup.

When Groves proposed making Du Pont solely responsible for plutonium production, replacing Stone and Webster, he received generally favorable responses from Compton, Bush, Conant, and other leaders. However, the Manhattan chief remained acutely aware that several key Metallurgical Laboratory members—who would need to work closely with Du Pont engineers—still opposed removing plutonium production from their control. Some particularly objected to Du Pont as the epitome of "big industry." Nevertheless, Groves decided to immediately begin negotiating with Du Pont.

On October 30, Groves invited Du Pont senior vice president Willis Harrington to meet with him and Conant, who had previously consulted for Du Pont. Harrington arrived the next day with chemist and vice president Charles Stine, a Conant acquaintance. Groves and Conant provided data on the pile program and general information about other processes and military objectives, emphasizing the program's urgency while frankly admitting serious feasibility questions.

Harrington and Stine were shocked at the suggestion that their company assume major atomic program responsibility. They saw formidable technical requirements, unorthodox operating conditions, and a scientific field completely outside Du Pont's experience. Faced with Groves's insistence that Du Pont was America's only suitable industrial organization, they reluctantly indicated the company might undertake the job. However, only Du Pont President Walter S. Carpenter, Jr. and the executive committee could make the final decision after company experts investigated.

Accordingly, within days Groves permitted a Du Pont expert team to visit the Metallurgical Laboratory. On November 10, Groves, Colonel Nichols, Compton, and associate director Norman Hilberry traveled to Wilmington, Delaware to further plead for Du Pont's assistance. Groves stressed to Carpenter the project's critical importance to the war effort, noting President Roosevelt, Secretary Stimson, and General Marshall all shared this view. He warned that Axis powers might soon produce fissionable materials, making atomic weapons development essential for deterrence through "fear of their country employment."

Following his Carpenter discussion, Groves joined Nichols, Compton and Hilberry at a Du Pont executive committee meeting chaired by Carpenter. Groves repeated his earlier points, but committee members expressed reservations—particularly after hearing their investigation team's report. The team found that laboratory scientists had neither demonstrated a self-sustaining chain reaction nor solved the critical heat control and removal problems for pile operation. Though working on three pile designs, none appeared practical for large-scale production. Plutonium separation progress seemed equally unpromising, with only microscopic amounts separated from radioactive fission products. Based on these observations, the Du Pont team estimated only minute plutonium quantities could be produced in 1943-1944, possibly reaching weapons-grade production by 1945.

Despite this pessimistic evaluation, the executive committee concluded the pile method was probably feasible—provided Du Pont controlled all project aspects and received government protection against potential hazards. On November 12, Carpenter informed Groves that Du Pont would accept the job, prompting the Manhattan commander to direct Colonel Nichols to draft contract terms. With Du Pont's participation assured, the Military Policy Committee cautiously endorsed building a plutonium plant capable of producing 1.0 kilogram of fissionable material daily. They also directed Du Pont to assume Stone and Webster's Chicago responsibilities, effectively relieving the Boston firm of nearly all plutonium project AEM duties.

b. The Electromagnetic Process

When the Manhattan Project leadership faced the critical challenge of producing sufficient fissionable material for atomic weapons in late 1942, they made the strategic decision to pursue three parallel production methods. While plutonium piles and gaseous diffusion were both promising but still unproven at industrial scale, the electromagnetic separation method developed by Ernest Lawrence's team at Berkeley's Radiation Laboratory offered a more immediate, if less efficient, path forward. The Military Policy Committee approved full-scale development despite significant reservations about its scalability, recognizing that Lawrence's method was likely to be the first to produce usable quantities of enriched uranium, even if not in bomb quantities.

At the heart of the electromagnetic process was Lawrence's calutron, an ingenious adaptation of laboratory equipment that combined principles from mass spectrometry with cyclotron technology. The Berkeley team had made crucial breakthroughs in 1942, modifying the original calutron design to allow continuous operation. This involved completely rethinking the vacuum systems that needed to maintain pressures equivalent to one hundred-millionth of normal atmosphere across hundreds of tanks, developing specialized uranium tetrachloride feed materials, and designing oval "racetrack" configurations to maximize the efficiency of the massive electromagnets. These innovations transformed what had been a laboratory curiosity into a potentially viable production method.

The Army's formal takeover of the program in May 1943 marked a turning point. Where the Office of Scientific Research and Development had previously managed the research through contracts with the University of California, the War Department now assumed direct control while maintaining the university's administrative role. Robert Underhill, the university's secretary, handled the complex financial and security arrangements under the new structure. The scale of investment grew dramatically during this period, with monthly expenditures ballooning from 500,000 to ultimately reach a total wartime cost of approximately 20 million. The Radiation Laboratory expanded its physical footprint across multiple buildings on the Berkeley campus and into nearby hills, while its staff swelled to over 1,200 scientists, engineers, and support personnel organized into specialized physics, chemistry, and biological divisions.

Design and engineering responsibilities fell to the Stone & Webster engineering firm, which established a secret design division in Boston in June 1942. The company faced extraordinary challenges in translating Lawrence's prototypes into an industrial-scale facility. Their team of 750 engineers, spread across four secure buildings, had to balance the need for standardized components where possible with the reality that many calutron parts required custom manufacturing to exacting specifications. Major Benjamin Hough's Boston Area Engineers Office maintained strict security over the design process, compartmentalizing information even within Stone & Webster itself. The modular plant design, with separate Alpha and Beta stages for initial and higher enrichment respectively, allowed for incremental construction and operation - a crucial advantage given the project's urgency.

TABLE 1—STONE AND WEBSTER ENGINEERING AND DESIGN PERSONNEL

Date	At Boston	At Berkeley	In the Field[a]	Total
1 January 1943	239	29	9	277
1 July 1943	738	19	13	770
1 January 1944	743	13	33	789
1 July 1944	685	8	79	772
1 January 1945	463	8	49	520
1 July 1945	338	3	40	381

Construction at the Clinton Engineer Works in Tennessee's Bear Creek Valley began in February 1943, presenting a new set of challenges. The site selection itself reflected careful consideration of both security and safety, with the surrounding ridges providing natural containment in case of accidents. Engineers encountered unexpected difficulties with the unstable subsoil that required pouring massive six-foot-thick concrete foundation mats to support the enormous weight of the calutron magnets. The procurement effort became a logistical marvel, with the project commandeering nearly the entire 1943 U.S. production of certain vacuum tubes (85,000 units) and borrowing 13,300 tons of silver from the U.S. Treasury to fabricate conductive coils when copper proved too scarce for wartime demands.

Tennessee Eastman Corporation took on the daunting task of operating the completed facilities beginning in June 1943. Their training program became legendary, transforming thousands of young women with no technical background - mostly recent high school graduates from the surrounding region - into skilled calutron operators. The workforce eventually peaked at 25,000, supported by hundreds of military personnel from the Special Engineer Detachment and Navy technical units. Early operations in late 1943 and early 1944 revealed serious technical flaws that threatened to derail the entire effort. Magnet coil failures caused by contaminated coolant and insulation moisture required Allis-Chalmers to recall and rebuild all the units, setting back full production until March 1944. Even more troubling, the Beta stage's chemical processing initially recovered only 60% of the enriched uranium from the Alpha stage output, necessitating a complete shutdown and redesign in August 1944.

Through relentless troubleshooting and process optimization, the electromagnetic plant eventually achieved its production goals. The addition of four improved Alpha II racetracks in mid-1944 significantly increased throughput, while the integration of pre-enriched feed material from the gaseous diffusion plant in 1945 allowed the Beta stage to operate independently. Security remained paramount throughout, with operators trained on strictly need-to-know basis and rigorous material accounting procedures tracking every gram of uranium. When production finally ceased in late 1945, the electromagnetic plant had delivered 88 kilograms of 84.5% enriched uranium from its Alpha stage and an additional 953 kilograms at 95% enrichment from Beta - a remarkable achievement given the method's early technical challenges and the unprecedented speed of its deployment.

c. The Gaseous Diffusion Process

By late 1942, as the Manhattan Project accelerated its efforts to produce fissionable material, project leaders faced a critical decision regarding uranium enrichment methods. While the electromagnetic process showed early promise, its limitations necessitated parallel development of alternative techniques. The Military Policy Committee, after careful evaluation, gave its endorsement in December 1942 to full-scale development of the gaseous diffusion process, despite significant unresolved technical challenges. This decision reflected both the process's theoretical advantages and the urgent wartime timetable.

The gaseous diffusion process traced its origins to research initiated in 1940 at Columbia University under the direction of Harold Urey, a Nobel Prize-winning chemist, and John Dunning, a physicist. Their work built upon Karl Cohen's theoretical framework applying Graham's Law to uranium hexafluoride (UF_6), the only known gaseous uranium compound.

The principle was straightforward but extraordinarily difficult to implement: when a mixture of gases passes through a porous barrier, the lighter isotope (U-235) would diffuse slightly faster than the heavier one (U-238). Given the minute natural abundance of U-235 (0.7%), achieving weapons-grade enrichment required thousands of successive diffusion stages.
By December 1942, Columbia's team had constructed Pilot Plant No. 1, a twelve-stage apparatus in Pupin Hall that validated the basic concept. However, enormous hurdles remained, particularly in developing a suitable barrier material—the heart of the diffusion process—that could withstand UF_6's extreme corrosiveness while maintaining precise porosity. Early experiments with various metals and alloys proved disappointing until December 1942, when researchers Edward Norris and Edward Adler developed a promising nickel-based barrier.

To translate laboratory findings into an industrial-scale facility, the Army turned to the M.W. Kellogg Company, which established the Kellex Corporation as a dedicated entity for the project. Under Percival Keith's leadership, Kellex assembled a team of nearly 3,700 engineers and technicians working across multiple sites, including New York's Woolworth Building and Columbia's Nash Building.

Plant design presented staggering complexities:

- Cascade Configuration: Kellex engineers designed a 2,892-stage single cascade, divided into nine sections with progressively smaller equipment to handle the increasingly enriched material. This contrasted with the British "cascade-of-cascades" approach, which American engineers rejected due to its longer equilibrium time.
- Barrier Crisis: The Norris-Adler barrier, while functional in the lab, proved too brittle for mass production. A competing design from Kellex's collaboration with Bell Laboratories and Bakelite Corporation, a powdered nickel barrier, emerged as a more viable alternative after months of testing. Groves' November 1943 decision to pursue both barriers in parallel sparked tensions with Urey, who viewed it as undermining Columbia's role.
- Pump and Seal Challenges: Centrifugal pumps required revolutionary seal designs to prevent UF_6 leaks. Westinghouse and the Elliott Company developed solutions, including hermetically sealed pumps and innovative mechanical seals, after exhaustive testing.

Site preparation began in May 1943 on a 5,000-acre tract in Tennessee's Bear Creek Valley. The J.A. Jones Construction Company led the effort, employing innovative techniques to accelerate progress:

- Foundations: Unstable soil necessitated compacted fill layers tested in an on-site lab, allowing foundations to be poured without reaching bedrock.
- Modular Construction: The U-shaped main process building (over a mile in total length) was erected in segments, with construction and equipment installation overlapping to save time.

- Cleanliness Protocols: Given UF_6's sensitivity to contaminants, crews worked in climate-controlled, dust-free environments. Pipe welders mastered 14 specialized techniques to ensure leak-free joints across 100 miles of piping.

By April 1944, the first six-stage unit was operational for testing, though barrier installation lagged until fall. The plant's startup sequence—divided into "Cases" targeting progressively higher enrichment levels—faced delays due to a nitrogen flood during initial operations in March 1945. However, by August 1945, the full 2,892-stage cascade was online, achieving 23% enrichment.

Union Carbide's Carbide and Carbon Chemicals Corporation assumed operations under George Felbeck's direction. Challenges included:

- Workforce Training: Thousands of operators, many with no technical background, were trained in leak detection and process control using simulated systems.
- Material Handling: UF_6's corrosiveness demanded meticulous conditioning of equipment with fluorine gas, handled by Chrysler and later Hooker Electrochemical.
- Integration with Other Plants: From April 1945, K-25's output (initially 1.1% enriched) fed into the electromagnetic plant, while receiving slightly enriched feed from the thermal diffusion plant—creating an efficient enrichment chain.

Though the war ended before K-25 reached full capacity, its design proved so effective that it became the postwar backbone of U.S. uranium enrichment, outpacing the electromagnetic and thermal diffusion plants, which were promptly shuttered. The $479 million facility (including the later K-27 extension) stood as a testament to the Army's ability to industrialize unproven science under crushing time constraints.

The gaseous diffusion saga underscored a recurring Manhattan Project theme: theoretical elegance meant little without engineering pragmatism. From the barrier wars to the pump seal breakthroughs, success hinged on relentless problem-solving and willingness to bypass academic perfection in favor of "good enough" solutions that worked at scale. This ethos, embodied by Groves' decisive leadership and Keith's industrial acumen, transformed uranium enrichment from a laboratory curiosity into a wartime reality.

d. The Liquid Thermal Diffusion Process

Leaders of the atomic energy program had decided against large-scale development of the liquid thermal diffusion process in early 1943, partly because they judged the process infeasible and partly because transferring a Navy project to the Army-directed Manhattan Project risked administrative and security complications. By spring 1944, however, significant progress in thermal diffusion research—combined with delays in bringing the electromagnetic (Y-12) and gaseous diffusion (K-25) plants to full capacity—prompted reconsideration of the method as a supplementary source of partially enriched uranium for Los Alamos.

The process relied on thermal gradients within concentric vertical tubes. When a liquid containing uranium isotopes filled the space between an inner heated pipe and an outer cooled jacket, lighter isotopes (U-235) concentrated near the hot wall while heavier isotopes (U-238) migrated toward the cold wall. Convection currents then carried enriched material upward for extraction.

German experiments in the 1930s had demonstrated minor separation, but the method remained obscure until 1940, when Philip Abelson (Carnegie Institution) and Ross Gunn (Naval Research Laboratory) independently sought funding. Abelson, who had collaborated with Glenn Seaborg on plutonium chemistry, outlined uranium separation via thermal diffusion to the Uranium Committee's Lyman Briggs. The Navy, interested in nuclear propulsion for submarines, backed Abelson's work.

By June 1941, Abelson moved to NRL, constructing 36-foot columns with concentric pipes: steam-heated inner tubes and water-cooled outer jackets. Initial tests with uranium hexafluoride (a compound Abelson had to synthesize himself) were disappointing, but adjusting the spacing between the pipes boosted separation efficiency to 21%, achieving equilibrium in 48 hours.

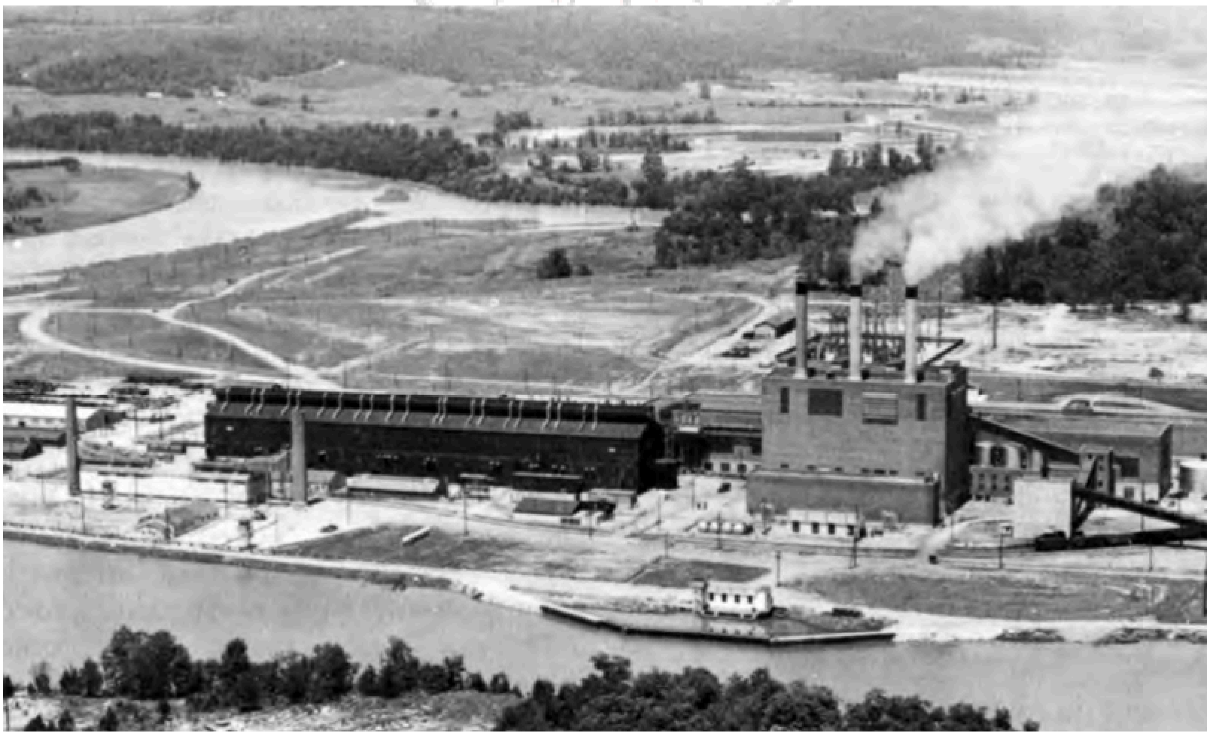
In August 1942, the Navy built a pilot plant at Anacostia Station, featuring five (later expanded) 36-foot columns. Operations began in December 1942, proving remarkably stable. A critical discovery in early 1943 was that higher temperatures (requiring high-pressure steam) drastically reduced equilibrium time.

Despite progress, Manhattan Project leadership initially sidelined thermal diffusion. In September 1942, General Groves and Colonel Nichols visited NRL but deemed the project too small-scale. President Roosevelt's March 1942 directive excluding the Navy from the S-1 program further complicated integration.

Yet by December 1942, the Lewis Committee (reviewing enrichment methods) recommended continued support. To bypass Roosevelt's order, OSRD Director Vannevar Bush liaised via Rear Admiral William Purnell (Military Policy Committee). An S-1 subcommittee (Briggs, Murphree, Urey) acknowledged the Navy's "excellent progress" in January 1943 but hesitated due to sparse production data, proposing only preliminary commercial plant designs.

From September 1942 to April 1943, contact between the Navy and Manhattan Project lapsed. Groves initially denied Abelson's request for additional uranium hexafluoride but relented when reminded that Abelson had developed the process to produce it. The Navy authorized a 300-column pilot plant at the Philadelphia Navy Yard in November 1943, with construction starting in January 1944.

The decisive push came from J. Robert Oppenheimer at Los Alamos. Facing uranium shortfalls in mid-1944, Oppenheimer reviewed Abelson's reports and learned from Captain William Parsons that the Philadelphia plant (100 columns) would yield 5 grams/day of 5% enriched uranium by July 1944. While negligible for bomb needs, Oppenheimer theorized that parallel operation (rather than fractionation) could produce 12 kg/day of 1% enriched material—tripling if all 300 columns were deployed.



On April 28, 1944, Oppenheimer wrote to Groves, arguing thermal diffusion could boost Y-12 output by 30–40% months before K-25 came online. Groves, delayed by security concerns, appointed the Tolman-Lewis-Murphree Committee on May 31. They confirmed Oppenheimer’s calculations (though adjusted output estimates downward) and endorsed a Clinton Engineer Works (CEW) thermal diffusion plant (S-50), using steam from K-25’s powerhouse.

Groves prioritized speed, selecting the H.K. Ferguson Company on June 24, 1944, with a mandate: 75 days to first production, full operation in four months.

Design:

- 2,142 columns (48 feet tall), arranged in 21 racks.
- Each column had:
  - A 1.25-inch nickel inner tube (steam at 545°F, 100 psi).
  - A copper middle tube.
  - A 4-inch iron outer jacket (cooling water at 155°F).
- Freezing coils at column tops replaced mechanical valves for product extraction.

Construction:

- Began July 9, 1944.
- Challenges:
  - Unstable subsoil required 6-foot-thick concrete foundations.
  - Faulty welds caused leaks, delaying startup until January 1945.
  - Steam shortages necessitated a dedicated S-50 steam plant by mid-1945.

Operation and Output

Ferguson’s subsidiary, Fercleve, operated S-50. Training hurdles arose after a September 1944 explosion at the Philadelphia pilot plant. Abelson and 15 Navy personnel relocated to CEW to assist.

Production:

- October 1944: 10.5 lbs (0.852% U-235).
- November: 171.8 lbs, then December: 20 lbs (steam leaks).
- February 1945: 3,158 lbs (despite steam shortages).
- June 1945 (peak): 12,730 lbs.

S-50’s slightly enriched output (0.9–1.1% U-235) was fed into Y-12, then later K-25, ensuring sufficient material for the Little Boy bomb by July 1945.

e. The Pile Process

Of the three fissionable materials production processes endorsed by the Military Policy Committee in 1942, the plutonium pile method represented the greatest gamble due to its unprecedented technical challenges. Research at the University of Chicago's Metallurgical Laboratory revealed that large-scale plutonium production would require handling levels of radioactivity and heat far beyond industrial experience. Similarly, chemical separation of plutonium from irradiated uranium posed unresolved challenges. Despite these uncertainties, the Committee approved full-scale development in December 1942, swayed by the process's military potential—not only for atomic weapons but also for radioactive warfare agents—and its peacetime energy applications.

Under Arthur Compton's direction, the Metallurgical Laboratory consolidated plutonium research in February 1942, organizing into nine divisions spanning physics, chemistry, engineering, and health studies. Key work occurred at multiple sites: uranium metallurgy at Iowa State under Frank Spedding, plutonium chemistry at Berkeley under Glenn Seaborg, and fast neutron research dispersed across institutions.
The Army became deeply involved by fall 1942, establishing the Chicago Area Engineers Office under Captain James Grafton to oversee facility expansion. Stone & Webster initially handled construction contracts, but the Army soon assumed greater control, leasing the 124th Field Artillery Armory for additional space. By 1945, the Chicago program occupied over 500,000 square feet, including new chemistry buildings and the Argonne pilot plant site, at a cost of $2.15 million. The University of Chicago's administration fully supported the effort, prioritizing wartime needs over institutional survival.

Plutonium production hinged on designing a self-sustaining nuclear pile (reactor). Initial plans envisioned three stages:

- A 10,000-kilowatt experimental pile to confirm chain reaction feasibility.
- A 100,000-kilowatt helium-cooled pilot pile to test loading/unloading mechanics.
- A second 100,000-kilowatt helium-cooled pile as the first production unit.

Graphite was chosen as the moderator due to heavy water shortages. However, cooling methods remained contentious. While Compton favored helium, Eugene Wigner and Leo Szilard explored alternatives like diphenyl, bismuth, and even water—despite its corrosiveness and neutron absorption.

Critical uncertainties persisted until Enrico Fermi's Chicago Pile-1 (CP-1) achieved the first sustained chain reaction on December 2, 1942. Fermi's results revealed a higher neutron multiplication factor (k) than expected, broadening coolant options. Yet Du Pont and the Army initially stuck with helium cooling due to its advanced design stage.

By December 1942, the Military Policy Committee relocated plutonium production from Clinton, TN, to the more remote Hanford Site in Washington. Du Pont, concerned about graphite pile scalability, pushed for a heavy water pile as a backup. Groves approved heavy water production at three Du Pont munitions plants.

In early 1943, Fermi's data confirmed that water cooling might work. Wigner's team completed water-cooled pile blueprints by January, while Du Pont engineers struggled with helium designs. By mid-February, Du Pont abandoned helium and pivoted to water cooling. Despite skepticism about corrosion risks, the water-cooled design was finalized by October 1943, aligning with Hanford construction schedules.

Plutonium separation initially appeared simpler than uranium enrichment but proved equally daunting. Early research favored a lanthanum fluoride precipitation method, but by spring 1943, bismuth phosphate emerged as superior due to fewer chemical complications. Du Pont adopted bismuth phosphate for the Clinton semiworks and Hanford, retaining lanthanum fluoride as a backup.

Army-mediated collaboration between the Metallurgical Laboratory and Du Pont was often strained. Scientists like Wigner resented Du Pont's control over engineering details, while Du Pont viewed academic input as theoretical and impractical. Groves intervened repeatedly, including securing a presidential letter affirming Army authority in June 1943.

To placate disgruntled scientists, Compton expanded the heavy water pile program under Princeton's Henry Smyth. Though modest, this project served as a backup and kept researchers engaged.

Du Pont began constructing the Clinton Laboratories in Tennessee in early 1943. The air-cooled graphite pile (later deemed non-representative of Hanford's water-cooled design) and bismuth phosphate separation plant were prioritized. Challenges included:

- Soft clay foundations delaying pile construction.
- Uranium slug canning failures requiring welding fixes.
- Labor shortages exacerbated by poor housing.

The pile reached criticality in November 1943, and by early 1944, the separation plant yielded 500 milligrams of plutonium monthly. Operational tweaks boosted efficiency from 40% to over 90%, proving the bismuth phosphate method.

Hanford's scale dwarfed Clinton's. Three water-cooled production piles (100-B, D, F) and chemical separation areas (200-W, E, N) were laid out across the 400,000-acre site. The 300 Area housed uranium fabrication and testing.

Construction hurdles:

- Stainless steel shortages plagued piping installation.
- Xenon poisoning unexpectedly shut down the 100-B pile in September 1944. Fermi and Met Lab scientists resolved this by fully loading the pile, overcoming neutron absorption.
- Labor shortages persisted despite extended shifts and subcontracting.

The 100-B pile resumed operation in December 1944, reaching full power by March 1945. The 200-W separation plant began processing irradiated slugs in December, with 200-E operational by February 1945.

5. Support Activities
    a. Security
        i. The District's Security System

The leaders of the American atomic energy program, acutely aware of the revolutionary military potential inherent in atomic weapons and alarmed by intelligence reports suggesting parallel German research efforts, recognized from the program's earliest conception the absolute necessity of maintaining impenetrable secrecy. This recognition was not merely precautionary but born of strategic necessity—the very success of the Allied war effort might hinge on preventing Axis powers from discovering the scope and progress of atomic weapons development. When the decision was made in early 1942 to transfer administrative control of the program to the U.S. Army, it was precisely because military leadership possessed both the institutional framework and the disciplined hierarchy required to enforce what General Leslie Groves would later describe as a "foolproof system of security."

The security apparatus implemented by the Manhattan Project served three critical wartime objectives: first, to ensure that Germany and other Axis powers remained completely ignorant of Allied progress toward atomic weapons; second, to minimize the risk that enemy nations might accelerate their own atomic programs or launch espionage operations against American facilities; and third—perhaps most crucially from a tactical standpoint—to guarantee that when atomic weapons were ultimately deployed, they would achieve maximum strategic surprise. These were not abstract concerns. Intelligence intercepts and reports from European scientists indicated that Germany had taken a serious interest in nuclear fission following the pioneering work of Otto Hahn and Fritz Strassmann in 1938. The specter of a Nazi atomic bomb loomed large in the minds of American policymakers and scientists alike.

The first organized efforts to control information about atomic research emerged in 1939, when refugee physicists who had fled Nazi-controlled Europe—including Leo Szilard, Eugene Wigner, and Edward Teller—attempted to establish a voluntary censorship agreement among American scientists regarding publications on uranium fission. Their warnings about the military implications of nuclear chain reactions initially met with skepticism from some quarters of the U.S. scientific community, which traditionally valued open exchange of research findings. However, the outbreak of war in Europe that same year dramatically shifted perspectives. By April 1940, the Division of Physical Sciences of the National Research Council had formed a committee to oversee restrictions on sensitive publications, particularly those related to uranium fission.

When the U.S. government's Advisory Committee on Uranium was absorbed into the newly created National Defense Research Committee (NDRC) in June 1940, it became subject to formal military security protocols for the first time. The NDRC, recognizing that its work would directly support Army and Navy projects, implemented strict compartmentalization policies: research was divided into discrete, need-to-know segments; all documents were classified according to sensitivity; and every individual involved—from senior scientists to laboratory technicians—underwent background investigations. These measures were maintained and expanded when the uranium program was transferred to the Office of Scientific Research and Development (OSRD) in November 1941. Under Vannevar Bush's leadership, the OSRD extended security oversight to industrial contractors, establishing procedures for personnel vetting, document control, and physical plant security that would later form the backbone of Manhattan Project protocols.

The OSRD's security system, while effective for a research-focused program, was soon overwhelmed by the Manhattan Project's explosive growth following the Army's assumption of control in 1942. The transition from laboratory-scale experiments to industrial production created unprecedented security challenges: tens of thousands of workers were being recruited; massive construction projects were underway at isolated sites like Oak Ridge, Tennessee, and Hanford, Washington; and sensitive research was being conducted at dozens of university and corporate facilities across the country.

Colonel Kenneth Nichols, the Manhattan District's chief engineer, moved swiftly to establish a dedicated security apparatus. In June 1942, he created the Protective Security Section to oversee three key areas: personnel security (background checks and clearances), physical security (guarding facilities and materials), and information security (controlling classified documents and communications). Recognizing that counterintelligence operations required specialized expertise, Nichols arranged for direct support from the War Department's Military Intelligence Division (MID). Major John Lansdale Jr., a sharp-minded attorney recruited into military intelligence, was assigned to lead what became a quasi-autonomous security unit operating under the cover of the MID's Investigation Review Branch. Lansdale's group maintained extraordinary secrecy—even within Army channels—reporting exclusively to General Groves while coordinating with the FBI on domestic counterintelligence matters.

By early 1943, the Manhattan Project's expanding geographic footprint—with critical sites spanning from Columbia University in New York to the University of Chicago's Metallurgical Laboratory to the nascent production facilities in Tennessee and Washington—necessitated a more robust intelligence network. Captains Horace Calvert and Robert McLeod were transferred to establish the District's formal Intelligence Section, which implemented a nationwide system of security offices. Eleven branch intelligence units were eventually established, each embedded within major project sites but maintaining direct liaison with both Manhattan headquarters and their local Army service commands. This dual-chain structure allowed for centralized control while ensuring rapid response to security threats at individual facilities.

The summer of 1943 marked a turning point in the Manhattan Project's security evolution. As construction accelerated at production sites and scientific work transitioned from theoretical research to engineering implementation, Groves ordered a consolidation of the Protective Security and Intelligence Sections under Captain Calvert's command. This newly formed Intelligence and Security Section, though still administratively subordinate to the District's Service and Control Division, represented a decisive shift toward centralized authority over all security matters—a principle Groves insisted was vital for maintaining airtight secrecy amid the project's growing complexity.

A major test of this centralized system came in late 1943, when the War Department announced a sweeping reorganization of counterintelligence operations. To streamline resources for overseas operations, responsibility for domestic security investigations was transferred from MID to the Provost Marshal General's office—a move that threatened to fragment the Manhattan Project's carefully constructed security apparatus. Lansdale, now promoted to colonel, fought unsuccessfully for an exemption before Groves intervened with a bold solution: the entire counterintelligence unit would be transferred into the Manhattan District itself. Approved in December 1943, this move preserved the project's autonomy while requiring a complete restructuring of security administration.

In February 1944, the Intelligence and Security Section was elevated to full division status and placed directly under the district engineer's office—a symbolic and functional demonstration of its elevated importance. Lieutenant Colonel William Parsons, a seasoned intelligence officer, took command of what became one of the most sophisticated security organizations in U.S. government history. The division's structure reflected the multifaceted nature of its mission:

- The Clinton Engineer Works Branch managed armed security forces at Oak Ridge, overseeing everything from routine gate checks to emergency response protocols across the massive K-25, Y-12, and X-10 production complexes.
- The Security Branch implemented industrial protection measures, developing specialized procedures for shipping uranium and plutonium—materials so secret that most transporters didn't know what they were moving.
- The Administration Branch processed over 100,000 personnel clearances using investigative techniques that presaged modern vetting systems, while also handling the division's highly classified internal communications.
- The Safeguarding Military Information Branch conducted security education programs and censorship operations so thorough that even many high-level scientists remained unaware of the bomb's actual design until shortly before use.
- The Branch Offices coordinated security across the project's far-flung operations, from the plutonium production reactors at Hanford to the bomb design laboratories at Los Alamos.

- The Evaluation and Review Branch served as the security nerve center, analyzing potential threats and preparing daily briefings for Groves and senior military leadership.

This structure proved extraordinarily effective. Despite the project's enormous scale—employing over 125,000 people at its peak—not a single major security breach occurred. German intelligence never grasped the scope of American atomic efforts, and Japan remained completely unaware of the weapons being prepared against it. When the first atomic bomb detonated over Hiroshima on August 6, 1945, it represented not just a scientific and military triumph, but the ultimate validation of history's most elaborate secrecy apparatus. The Manhattan Project's security legacy endures in modern classification systems, counterintelligence practices, and the fundamental principle that some scientific advancements require unprecedented protections in the interest of national security.

ii. Counterintelligence Activities

Counterintelligence was one of the most critical aspects of the Manhattan Project’s security program. Through rigorous intelligence measures, the project aimed to prevent enemy espionage and sabotage—ensuring that no foreign power gained access to atomic secrets.

But the Manhattan Project’s nature made it vulnerable. With thousands of recruits from across the country, it was impossible to prevent spies and saboteurs from slipping in, no matter how stringent the clearance procedures. Its widely scattered sites made maintaining uniform security a challenge.

Project leaders assumed that sooner or later, Germany, Japan, and the Soviet Union would learn about the atomic program. The real concern was whether they could steal information or sabotage progress before America’s atomic bomb was complete.

The Army's Counter Intelligence Corps (CIC) conducted extensive preventive investigations to reduce the risk. Some focused on unauthorized leaks, often caused by carelessness or ignorance. Others involved follow-up background checks on employees flagged as potential security risks—especially foreign-born scientists and technicians, many of whom had fled Axis-controlled territories.

Security clearances were not always black and white. The project needed skilled personnel and often had to weigh the risks against the need for scientific talent. As General Groves later put it:

> *"All procedures and decisions on security, including the clearance of personnel, had to be based on the overriding consideration—completion of the bomb. Speed of accomplishment was paramount."*

No case embodied this dilemma more than J. Robert Oppenheimer.

In February 1943, Groves chose Oppenheimer to direct the Los Alamos Laboratory—fully aware that he had only an interim security clearance from the Office of Scientific Research and Development (OSRD).

Oppenheimer had been linked to Communist-affiliated organizations in the 1930s. He had never officially joined the party, but he regularly contributed to Communist causes and maintained close ties with party members. His wife, brother, and sister-in-law were former Communists, and his ex-fiancée had been a Communist Party member.

By 1939, the Nazi-Soviet Pact led him to question the Party, but he continued making contributions to Spanish War Relief through Communist channels until 1942.

Groves knew all this but believed Oppenheimer was essential to the project. Since 1941, he had led key theoretical work under Arthur Compton and, by 1942, had become the head of the bomb design team.

Shortly after Oppenheimer took over at Los Alamos, his Communist past resurfaced.

Lt. Col. Boris Pash, head of Western Defense Command Counterintelligence, was already investigating Soviet espionage at Berkeley when Oppenheimer's name surfaced.

On June 29, Pash concluded that Oppenheimer *"may still be connected with the Communist Party."* He recommended three possible courses of action:

1. Replace him immediately.
2. Train a second-in-command as a backup.
3. Confront him directly.

Pash favored the third option—believing that if Oppenheimer understood the Espionage Act and knew the government was aware of his past, he would cooperate fully to protect his career and reputation. He also suggested assigning two undercover bodyguards who would double as spies on Oppenheimer's activities.

Groves ignored the warnings. After a brief visit to Los Alamos, he directed on July 15 that Oppenheimer be fully cleared. In a message to security officials, he made his position clear:

> *"Clearance is to be issued for the employment of Julius Robert Oppenheimer without delay, irrespective of the information you have concerning him. He is absolutely essential to the project."*

Years later, Groves defended his decision, stating:

> *"I knew he would not be cleared by any agency focused solely on military security. But my careful study led me to believe that he was fundamentally a loyal American citizen. His overall value to the project far outweighed the risks."*

Most counterintelligence cases involved classified leaks or allegations of disloyalty. While many seemed like potential espionage, only about 100 cases involved actual spying.

By 1943, espionage concerns were rising, and Groves authorized the deployment of special undercover agents inside project sites. These agents took on cover identities—posing as hotel clerks, contractors, electricians, and even gamblers—to monitor potential threats.

A new surveillance squad was also formed, equipped with concealed cameras, telephoto lenses, and listening devices. Their reports became a key intelligence source for Groves, who briefed the Military Policy Committee and the Top Policy Group on security threats.

But the greatest espionage threat did not come from the Axis powers—it came from America's wartime ally: the Soviet Union.

Soviet intelligence thrived in the U.S. during the war. The Russian diplomatic corps, overseeing Lend-Lease aid, provided ample cover for spies operating within American institutions.

Under the pretense that the U.S. was withholding vital information, Soviet agents recruited American Communists and sympathizers to penetrate the Manhattan Project.

As early as February 1943, the FBI and Western Defense Command detected Soviet efforts to obtain secrets from Berkeley's Radiation Laboratory. Investigators learned that:

- In October 1942, a Communist Party leader instructed a lab employee to stay in his position to gather intelligence.
- Information flowed through local Communist contacts before reaching the Soviet Vice Consul in San Francisco.
- A Soviet embassy official in Washington had recently funneled cash to the West Coast Communist network for espionage.

Western Defense Command swiftly identified the spies at Berkeley. They were fired, and some were inducted into the Army and reassigned to non sensitive posts where they could be monitored.

The case seemed closed, but in August 1943, Oppenheimer personally reported a new espionage attempt at Berkeley.

During a visit to Berkeley, Oppenheimer confided to Pash that an old friend—a professor at the University of California—had acted as a Soviet intermediary, recruiting lab employees to leak atomic research.

At first, Oppenheimer refused to name the friend, insisting that the leaks had stopped. But when Groves personally pressed him, he identified Haakon Chevalier, a romance languages professor with past Communist ties.

Chevalier was soon dismissed from Berkeley, but years later, Oppenheimer admitted that he had fabricated parts of the story.

Despite security efforts, Soviet spies continued to penetrate the project:

- In late 1943, a Chicago-based Soviet agent established contacts at the Metallurgical Laboratory. He managed to obtain technical data, passing it to the Russian consulate in New York before being caught.
- In 1944-1945, Los Alamos became the prime target.

By the summer of 1945, the Soviets had gained enough information to accelerate their own atomic program.

Espionage was one threat—sabotage was another.

Groves ordered every suspicious accident investigated. The CIC reviewed mechanical failures, fires, and equipment malfunctions, searching for sabotage. Regular security audits identified weaknesses before they could be exploited.

The result? Not a single confirmed act of sabotage during the war.

b. Foreign Intelligence Operations

i. Organization of the ALSOS Mission

The Manhattan Project's security system extended beyond domestic counterintelligence to active foreign operations, particularly targeting Germany's atomic program. Intelligence reports on German interest in nuclear research—including their use of French physicist Frédéric Joliot-Curie's cyclotron and heavy water production in Norway—suggested a serious atomic effort. To counter this, Allied military leaders intensified intelligence operations in Europe from 1943 onward, with significant contributions from General Groves, the War Department, and other agencies.

In September 1943, Groves and OSRD Director Vannevar Bush proposed a scientific intelligence mission to investigate German atomic activities in Italy. Approved by General Marshall, the ALSOS Mission was formed under Lt. Col. Boris Pash, an intelligence officer with prior Manhattan Project experience. The initial team included scientists, interpreters, and counterintelligence agents. ALSOS teams in Italy interviewed scientists and examined documents in Naples, Taranto, and Brindisi but found little concrete evidence of German atomic progress. After Rome's liberation in June 1944, a reconstituted ALSOS group questioned physicists at the University of Rome, reinforcing earlier conclusions that Germany's atomic program was limited.

ii. ALSOS Operations in Western Europe, 1944-1945

With the Allied invasion of Western Europe, ALSOS expanded under physicist Samuel Goudsmit, chosen for his European connections and lack of direct Manhattan Project involvement to reduce security risks if captured. The mission's primary focus remained German atomic research, though it also investigated bacteriological warfare and guided missiles. In Paris, ALSOS located Joliot-Curie in August 1944, learning German scientists had used his cyclotron but finding no evidence of large-scale atomic work. Subsequent operations secured 98 tons of uranium ore in Belgium and France, shipped to the U.S. via England.

The Strasbourg operation in November 1944 proved pivotal. Captured documents revealed Germany's atomic program had stalled at the research stage, with no successful chain reaction or uranium enrichment. This was confirmed in April 1945 when ALSOS seized a small underground reactor in Hechingen, along with 1.5 tons of uranium cubes and heavy water. Key scientists like Otto Hahn and Werner Heisenberg were captured, and further interrogations confirmed the program's minimal scale.

Fearing Germany might use radioactive materials as a weapon, Groves briefed Eisenhower and Allied commanders in early 1944. While skeptical, SHAEF developed Operation PEPPERMINT, a contingency plan to detect and respond to radiological attacks. Surveys in England and Normandy found no evidence of German use, and the operation was never activated. By mid-1945, ALSOS confirmed Germany's atomic program had failed due to limited resources, bureaucratic fragmentation, and scientific miscalculations. When German scientists learned of the U.S. atomic bombings of Japan, they admitted their program had focused on reactor development rather than weapons. ALSOS disbanded in November 1945, having verified that Germany posed no atomic threat.

The German failure contrasted sharply with the Manhattan Project's success, underscoring the importance of centralized coordination, ample funding, and clear military objectives in atomic development. The ALSOS mission not only neutralized a potential threat but also provided critical postwar insights into the limits of Nazi science.

c. The Raw Materials Program

i. Geographic Search and Field Exploration

From the very beginning, one of the Manhattan Project's most urgent priorities was securing raw materials—substances that, until then, had never been in great demand. Before the Army took over in mid-1942, the Office of Scientific Research and Development (OSRD) had begun procuring these materials through its S-1 Section and private industry, including the engineering giant Stone and Webster. But when the Manhattan District assumed control, it expanded procurement efforts to a global scale.

Uranium and thorium—essential elements for nuclear fission—were more than just ingredients for a wartime weapon. They were the keys to the future of atomic energy, both as a military asset and as a potential source of power. But there was a strategic concern: What if rival nations secured their own supply? With that in mind, American and British leaders devised a bold plan—to locate, acquire, and control the world's most significant uranium and thorium deposits before anyone else could.

The first major success came in October 1942, when Deputy District Engineer Kenneth Nichols and Union Minière director Edgar Sengier struck a deal. The Manhattan District acquired all of Union Minière's uranium stock, including ore stored in Staten Island and the Congo, ensuring enough supply to meet immediate wartime needs.

But as the project grew in scale, it became clear that short-term supply wouldn't be enough. By 1943, the U.S. and Britain were drafting long-term agreements that would guarantee control of uranium and thorium not just for the war, but for the future.

The challenge was finding more sources—a task that required global exploration, covert operations, and unprecedented coordination between governments, private companies, and military intelligence. General Groves quickly set up an organization to take on the challenge, presenting his vision to the Military Policy Committee in February 1943.

His idea? A dedicated mining task force. He wanted top experts to search for uranium within the United States while exploring potential foreign sources. And rather than relying on the Army or another government agency, he turned to an industry giant: Union Carbide and Carbon Corporation.

Union Carbide was already operating Manhattan's gaseous diffusion plant in Clinton, and Groves saw a strategic advantage in using the company's existing structure to conduct covert mineral explorations. The company had long purchased uranium minerals from abroad, meaning its global operations wouldn't raise suspicions.

In May 1943, Union Carbide formally reactivated its Union Mines Development Corporation as a secret branch dedicated to uranium exploration. The contract terms were unusual: the government would cover all costs, but Union Mines would take no profit. Security was paramount, so its headquarters were hidden in an existing Union Carbide building in New York City.

By mid-1944, Union Mines had built a team of 130 experts—half working in the New York office, analyzing geological data, and the other half in the field, scouring potential sites in the U.S. and beyond. Their research division studied cutting-edge exploration techniques, while field teams conducted surveys in remote areas.

The results were staggering. Over sixty-five thousand documents were examined, leading to fifty-six detailed reports on uranium deposits across fifty countries—from Czechoslovakia to Thailand, Greenland to Madagascar. Field teams, meanwhile, investigated uranium occurrences in thirty-six U.S. states, Alaska, and twenty foreign nations.

By 1945, their data shaped American resource strategy. The Belgian Congo had the best supply. The U.S., Canada, and Sweden were promising. Czechoslovakia, Portugal, and South Africa held moderate potential. But in thorium—India and Brazil were goldmines.

ii. Ore Control Agency: Combined Development Trust

By summer 1943, it was obvious: controlling raw materials was as crucial as developing the bomb itself. The Belgian Congo had the richest uranium deposits in the world, yet they weren't under American control. This, the Military Policy Committee warned, was a major strategic vulnerability.

Colonel Nichols tried persuading Union Minière to reopen its Shinkolobwe mine and sell all future uranium production to the U.S. But Edgar Sengier refused, fearing he'd be unable to justify the sale to the Belgian government-in-exile in London.

By December 1943, the situation became even more precarious. Since British investors controlled nearly a third of Union Minière stock, the U.K. was positioned to take control of the Congo's uranium supply. The best American move, the Military Policy Committee decided, was to secure joint control with Britain.

On February 17, 1944, the Combined Policy Committee approved a new plan—the creation of a joint U.S.-British-Canadian organization to oversee uranium resources. Roosevelt and Churchill endorsed the idea, and negotiations began in London.

The problem? Secrecy.

Even top U.S. diplomats had no idea the Manhattan Project existed. To bypass the State Department, Roosevelt made Ambassador John Winant his personal representative in talks with the British. The War Department—not the State Department—would control the negotiations.

The result was the Combined Development Trust (CDT)—a secret Washington-based organization with six trustees:

- United States: General Leslie Groves, businessman George L. Harrison, and mining engineer Charles K. Leith.
- United Kingdom: British Treasury official Frank G. Lee and raw materials expert Sir Charles J. Hambro.

- Canada: Industrial leader George C. Bateman.

Groves was elected chairman, with Hambro as deputy. Their mission was clear: secure uranium deposits before anyone else could.

But setting up the trust wasn't easy. Legal hurdles emerged—could a secret organization legally acquire resources? Would its transactions be protected under U.S. law? After intense debate, the answer came in the form of a legal loophole: rather than a corporation, the CDT would be a common law trust, avoiding public scrutiny.

By June 1944, Roosevelt and Churchill had signed the trust agreement, making it official. The CDT now had the authority to buy, control, and distribute uranium worldwide, shaping atomic policy for the foreseeable future.

With the Combined Development Trust in place, the United States and Britain secured unprecedented control over the world's uranium supply. The Shinkolobwe mine reopened, and shipments of high-grade uranium ore flowed directly into Manhattan Project plants.

The secret maneuvering of Groves, Nichols, and their British counterparts ensured that, when the war ended, no rival nation—not even the Soviet Union—would have access to the materials needed to build an atomic bomb.

d. Land Acquisition
    i. Clinton Engineer Works

The Manhattan Project was unlike any wartime endeavor the United States had ever undertaken, and its land acquisition efforts reflected that uniqueness. Over the course of the war, the project secured over 500,000 acres of land across Tennessee, New Mexico, and Washington State, carving out vast tracts for top-secret atomic installations.

TABLE 2—LAND ACQUISITION AT CEW, 1942–1944

Date of Directive	Acreage To Be Acquired [a]	Estimated Cost	Type of Control Acquired	Use or Purpose
29 Sep 42	56,200	$3,500,000	Outright purchase	Original site
14 Jun 43	15.1	1,750	Outright purchase	For protection and security
3 Jul 43	70	14,107	Outright purchase	Spur track right of way
15 Jul 43	3.73	400	Outright purchase	Channel diversion of Poplar Creek
25 Sep 43	47.7	3,740	Outright purchase	Borrow pit
5 Feb 44	62	14,600	Perpetual easement	Access road
3 Mar 44	17	5,100	Outright purchase	Access road
19 Apr 44	279		Temporary-use permit from TVA	Expansion of facilities
2 May 44	.89	200	Perpetual easement	Access road
	.3	100	Outright purchase	Access road
4 Aug 44	.32		Temporary-use permit from TVA	Access road
28 Aug 44	425		Temporary-use permit from TVA	Security
	2,375	170,000	Lease or outright purchase	Security

But acquiring this land came with unprecedented challenges. The process had to be swift, absolute, and—above all—secret. Yet secrecy and speed often worked against each other. The faster the government moved, the more public suspicion grew. Newspaper reports, local protests, and political opposition threatened to derail the process before it even began.

Still, Manhattan Project officials pushed forward, determined to complete their mission at any cost—even if that meant uprooting thousands of Americans from their homes.

The first and largest land acquisition for the project was in eastern Tennessee, where the Army planned to build a massive uranium enrichment facility. On September 29, 1942, Under Secretary of War Robert P. Patterson authorized the purchase of 56,200 acres in Roane and Anderson Counties, a remote area just west of Knoxville.

For security reasons, the site was initially called the Kingston Demolition Range—an intentionally misleading name. But by January 1943, it was officially renamed Clinton Engineer Works (CEW).

With approval in hand, the Army moved at breakneck speed. The Ohio River Division (ORD) Real Estate Branch opened an office in Harriman, Tennessee, and within days had recruited fifty appraisers to assess property values across 800–850 separate tracts. The demand for appraisers was so high that the Army had to borrow personnel from the Tennessee Valley Authority (TVA) and Federal Land Banks just to keep up.

By November 1942, the government had secured an order of possession from the U.S. District Court, giving it the legal right to seize the land immediately. Notices went out to property owners: they had between December 1, 1942, and February 15, 1943, to vacate their homes.

And that’s when the real trouble began.

The people of Anderson and Roane Counties were furious. The vast majority of the 1,000 landowners and tenants were farmers, many of whom had already been displaced by TVA dam projects in prior years. Now, just as they had rebuilt their lives, the government was forcing them to move again—and offering lowball prices for their land.

As news of the forced evictions spread, anger turned into organized resistance.

On November 23, 1942, a delegation of property owners stormed the CEW Land Acquisition Office, demanding higher payments for their land. That night, over 200 landowners gathered in protest, forming a landholder’s investigation committee and hiring lawyers and private appraisers to challenge the government's offers.

The local Knoxville newspapers fueled the outrage. One editorial warned:

> *“Since everybody else is getting a fair price for the material and labor going into this Federal project, there is certainly no justification for these farmers being singled out for an economy slaughter.”*

To make matters worse, the government’s appraisal process was deeply flawed. The Army had based its valuations on outdated property records, and when a resurvey was conducted, it revealed that many tracts were smaller than recorded in deeds—meaning owners were being underpaid even more than they had thought.

Rumors ran rampant. Some residents believed the land wasn’t even for a military project but was being handed over to a private corporation in an abuse of eminent domain. But security rules prevented the Army from offering any explanation, leaving fear and suspicion to spread unchecked.

The backlash escalated in February 1943, when local Congressman John Jennings Jr.—a Republican from Knoxville—launched a full-scale political fight against the land seizures.

Jennings took his battle to Washington, accusing the War Department of:

- Using out-of-state appraisers unfamiliar with Tennessee land values
- Coercing landowners into unfair settlements
- Destroying homes before owners had a chance to salvage materials

He introduced a House resolution demanding a Congressional investigation into the land grab, declaring:

> *“A large number of owners assert that the War Department has had the land appraised by nonresidents of Tennessee who are totally unfamiliar with the value of such land.”*

For months, he bombarded War Department officials with letters and complaints, demanding answers. The War Department, in response, doubled down, insisting that:

- Appraisals were fair
- Evictions were necessary for national security
- Construction could not be delayed

Jennings, unsatisfied, kept the pressure on. By July 1943, his efforts paid off. The House Military Affairs Committee authorized a formal Congressional inquiry into the land seizures at Clinton Engineer Works.

On August 11, 1943, a Congressional subcommittee arrived in Clinton, Tennessee. The next day, they moved to Kingston. Over 300 residents packed the hearings, eager to testify.

Jennings did not hold back. He accused the Army of treating the farmers “as cold as ice”, saying their voices had been ignored at every turn. Landowners took the stand, describing:

- How they had been forced to accept unfair offers
- How appraisers never even inspected their properties
- How their homes had been bulldozed before they could recover belongings

Army officials fought back. They insisted that appraisers had done their jobs properly, that all landowners had voluntarily agreed to prices, and that every effort had been made to minimize hardship.

The final report, released in December 1943, was a mixed verdict. While it criticized the Army's lack of transparency and coercive tactics, it ultimately did not overturn the land acquisitions.

Two key recommendations were issued:

- Landowners who were forced into accepting low prices under duress should be given additional compensation.
- Farmers who lost crops due to forced relocation should be repaid for their losses.

Yet neither Congress nor the War Department acted on these recommendations.

Despite the public outrage and political drama, the land seizures continued as planned. By August 1944, the Army had completed the acquisition of 56,700 acres for Clinton Engineer Works.

- 806 tracts were purchased outright
- 38 tracts were held under easements
- 4 tracts were leased from TVA

Later, in March 1945, the Army secured another 2,800 acres to improve security around the gaseous diffusion plant.

In the end, the total cost of the land acquisition program was \$2.6 million—far below the initial estimate of \$3.5 million. The average price paid per acre was just \$47.

For the farmers who lost their homes, justice never came. Many never received additional compensation, and the lands that had once been their livelihoods were sealed off behind barbed wire, never to be returned.

For the Army, however, the mission had been a success. Clinton Engineer Works was built on schedule, and the massive U-235 enrichment plant—later known as Oak Ridge—would soon help produce the world's first atomic bomb.

ii. Los Alamos & Hanford Engineer Works

Los Alamos sat high in the Jemez Mountains of New Mexico, far from major roads or cities. The government needed about 54,000 acres, but most of it was already federal land. That made the process simple.

The War Department transferred control of 45,667 acres from the Santa Fe National Forest. The only major private property was the Los Alamos Ranch School, an elite boarding school. The Army bought it outright for $350,000, taking full control by early 1943.

There were no legal battles, no widespread public opposition. The total cost of the land was $414,971, and by early 1943, work on the laboratory was already underway.

Hanford was different. This wasn't remote forest land—it was a thriving agricultural region in Washington State. The government needed 400,000 acres, making it the largest land acquisition of the Manhattan Project.

On February 9, 1943, the War Department approved the seizure. More than 225,000 acres were privately owned, including farms, orchards, and grazing land. Farmers resisted from the start. They fought for higher compensation, arguing the government's appraisers had undervalued their land.

The biggest battle was over crops. The 1943 season was one of the most bountiful on record. Farmers demanded payment for their cherries, apples, peaches, asparagus, and alfalfa. The government refused. That fueled even more resistance.

By July 1943, some landowners still refused to leave. Army engineers forced out seven families. The backlash spread. Washington's congressmen demanded answers. Legal challenges slowed the process.

Rumors spread that the government was seizing land for DuPont's benefit, since DuPont was running the Hanford site. The situation grew so tense that President Roosevelt got involved.

Worried about food shortages, Roosevelt asked if the government could delay the takeover. The Military Policy Committee considered moving the entire plutonium project elsewhere. But General Leslie Groves pushed back. On June 17, 1943, Secretary of War Henry Stimson personally reassured Roosevelt that Hanford was the only viable site. The President dropped his concerns.

By August 1943, the Army had secured most of the land. The farms were gone. The towns of Hanford, White Bluffs, and Richland were emptied. Farmers got compensation, but not what they believed was fair.

Hanford became a massive nuclear production site. It remained closed to the public for decades. The farmlands never returned. The Columbia River, once a lifeline for irrigation, now cooled nuclear reactors.

Los Alamos, in contrast, became a permanent scientific hub. Today, it still leads America's nuclear weapons research.

The battle over Hanford's land didn't end with the initial seizures. Resistance escalated, and the legal fight dragged on for years. In early June 1943, the Truman Committee—tasked with overseeing wartime spending—began questioning whether the government really needed such a vast tract of farmland. They wanted details on costs, site selection, and construction progress. General Leslie Groves and War Department officials knew that if Hanford became a focus of investigation, security would be compromised. Secretary of War Henry Stimson personally asked Senator Harry Truman to drop it. Truman agreed, but that didn't stop the legal battles.

By fall, lawsuits over land valuation flooded the courts. Juries sided overwhelmingly with landowners, awarding compensation far beyond government appraisals. The Army feared these trials would unravel secrecy. Every jury visit to the site risked exposure. Groves pressured the Justice Department to speed up the process, demanding extra judges and an end to jury inspections. But landowners kept winning. Verdicts in September 1944 granted payouts higher than the owners had even requested.

Tensions boiled over in October 1944. Assistant Attorney General Norman Littell—already at odds with the War Department—showed up in Yakima, Washington, without warning. He stood before the court, publicly attacking the Army's land seizures. His remarks ignited headlines, fueling speculation that the government was mishandling Hanford's land grab. Furious, Groves saw it as a direct security threat. Stimson's office demanded that Attorney General Francis Biddle rein him in.

Littell refused. He pushed for mass reappraisals, claiming the Army's land valuations were deliberately low. He even brought in a high-profile trial lawyer to fight for higher payouts. By late October, he had gone rogue, taking his complaints to Congress. Groves scrambled to control the damage, sending military investigators to Hanford and suppressing news leaks.

But then, in a sudden twist, Littell was fired. His feud with Attorney General Biddle came to a head in November 1944, and President Roosevelt approved his dismissal. Without Littell, the Justice Department and War Department repaired their working relationship, and the legal battles lost momentum.

By March 1945, a new court ruling banned jury inspections, citing "hazards" at the site—a convenient way to shut down unwanted scrutiny. The Army accelerated settlements, closing over 100 cases a month. By December 1946, when control of the site transferred to the Atomic Energy Commission, the government had spent over $5 million securing Hanford's land.

The farms, homes, and towns were gone. What remained was a top-secret plutonium factory, fueling a new era of atomic warfare.

e. Manpower Procurement

i. Personnel Organization

The Manhattan Project was unlike any other wartime program, not only in scale and secrecy but also in the diversity of its workforce. It brought together everyone from unskilled laborers to the world's most brilliant scientists. While most workers were civilians, military personnel from all branches of the armed forces were assigned to the project, working alongside scientists from the United States, Canada, Great Britain, and other Allied nations.

By June 1944, at the peak of construction on the fissionable material production plants, Manhattan employed nearly 129,000 people—a workforce larger than some entire military divisions. This included 84,500 construction workers, 40,500 operating personnel, and nearly 1,800 military personnel, plus an equal number of civil service employees. Though construction slowed after the summer of 1944, employment remained above 100,000 well into 1945, with military personnel peaking at 5,600 in the fall.

Recruiting and retaining such a massive workforce during wartime was no small feat. Competition for manpower was fierce, especially as the war effort demanded labor for shipyards, aircraft factories, and munitions plants. Many of the highly specialized skills required for the atomic project were already in short supply, and the remote locations of the major facilities—Oak Ridge, Hanford, and Los Alamos—only made matters worse. Housing was scarce, transportation was limited, and trained workers were being pulled away by the Selective Service draft. Even after the Manhattan Project was granted top priority for recruiting scarce labor, manpower shortages remained a constant challenge.

Despite these difficulties, the project operated within the framework of existing labor laws, including the Davis-Bacon Act, the Fair Labor Standards Act, and the National Labor Relations Act. However, security concerns meant that some policies had to be modified. Unions, for example, were heavily restricted, grievance procedures were handled internally rather than through the National Labor Relations Board, and wage policies had to be managed within the constraints of wartime stabilization measures. The project had to balance secrecy, efficiency, and compliance—a challenge unlike anything the Army had faced before.

In the early days, Manhattan's primary manpower focus was on securing scientists and technical experts. The National Research Council, under contract with the National Defense Research Committee (NDRC), had created the Office of Scientific Personnel in 1941 to help wartime programs find qualified specialists. As demand soared, Vannevar Bush, head of the Office of Scientific Research and Development (OSRD), formed a Committee on Scientific Personnel, which not only recruited scientists but also secured military deferments for key personnel.

However, by mid-1942, with the decision to build full-scale production plants, the Manhattan Project's needs expanded dramatically. It wasn't just about scientists anymore—the project needed engineers, machinists, electricians, and thousands of skilled and unskilled laborers. Finding and retaining these workers became a logistical challenge of its own.

The Army followed the OSRD's approach by delegating recruitment to project contractors, while Manhattan District headquarters focused on wage adjustments, workplace conditions, and liaising with unions and government agencies. Military personnel were also integrated into the effort, with the Selective Service Section working to secure draft deferments for essential scientific and technical workers.

By August 1943, when the Manhattan District headquarters moved from New York to Oak Ridge, the project's personnel operations were reorganized. A new Personnel Division was created, consolidating manpower-related functions into a single office. Field offices were established in New York, Chicago, Oak Ridge, and Pasco, Washington, near Hanford, to manage local hiring efforts. Each site developed its own personnel structure, tailored to its specific needs.

At Hanford, where tens of thousands of construction and production workers were needed, a large labor relations section worked closely with DuPont and local labor officials to keep operations running. At Los Alamos, the workforce was mostly scientists and technicians, with far fewer industrial workers, meaning labor relations were less of a concern. Here, a small civilian personnel office assisted J. Robert Oppenheimer in recruiting the experts needed to design and build the bomb.

Despite these efforts, many manpower challenges couldn't be solved at the local level. Finding highly skilled personnel, securing scientific talent, and navigating draft exemptions required intervention from the highest levels of government. General Groves kept his Washington headquarters as a central liaison point, personally ensuring that manpower requests reached the right people in the War Department. His ability to cut through bureaucratic red tape was one of the reasons the project stayed on schedule.

ii. Scientific and Technical Personnel

Even as construction moved forward, the Manhattan Project never stopped recruiting scientists and technicians. The highly experimental nature of the work meant that industrial contractors building the plants had to constantly rely on research scientists for guidance. The researchers not only developed new processes but also supervised plant operations, ensuring that the complex chain of uranium enrichment and plutonium production actually worked.

In 1943, the need for scientific personnel became even more urgent with the establishment of Los Alamos Laboratory. By 1945, the lab required over 700 scientists—a staggering number given that most trained physicists were already employed in other critical war projects. To meet these demands, the Manhattan Project turned to graduate students, many of whom were promptly drafted into the Army and reassigned to the Special Engineer Detachment (SED) at Los Alamos.

Securing the best minds for the project often required high-level intervention. General Groves personally wrote to university administrators, corporate executives, and government officials, stressing the vital nature of the work and requesting the release of scientists from other assignments. When necessary, he enlisted the help of OSRD Director Vannevar Bush, Secretary of War Henry Stimson, and top military officials like General Wilhelm Styer and Admiral William Purnell.

One of the most effective recruitment strategies involved direct appeals to leading scientists. James Conant, for example, played a key role in persuading George Kistiakowsky, an expert in high explosives, to leave his position with the NDRC and join the Los Alamos implosion research team. Meanwhile, physicist Richard Tolman compiled a comprehensive list of atomic scientists, ranking them by ability, experience, and availability—a critical tool in ensuring the right people were placed in the right roles.

By late 1944, however, nearly every available scientist in the country was already employed by the project. The only way to meet new staffing demands was through internal transfers. When Oppenheimer requested 50 additional physicists for a new division at Los Alamos, he suggested they could be pulled from the Metallurgical Laboratory, where they were serving as standby crews for the Hanford reactors. After discussions with Arthur Compton, Groves approved the transfer—but it came at a cost. Research at Oak Ridge, Argonne, and the Met Lab was effectively put on hold as personnel were redirected to bomb development.

With each phase of the Manhattan Project, the manpower crisis evolved. Early on, it was a challenge of recruiting scientists. Then, it became about finding engineers and construction workers. By the end of the war, the difficulty was keeping enough talent at key locations while shifting resources to where they were needed most.

Through it all, the project's success depended on constant improvisation, government intervention, and Groves's ability to break bureaucratic barriers. Without the right people in the right places, the atomic bomb would never have been built in time.

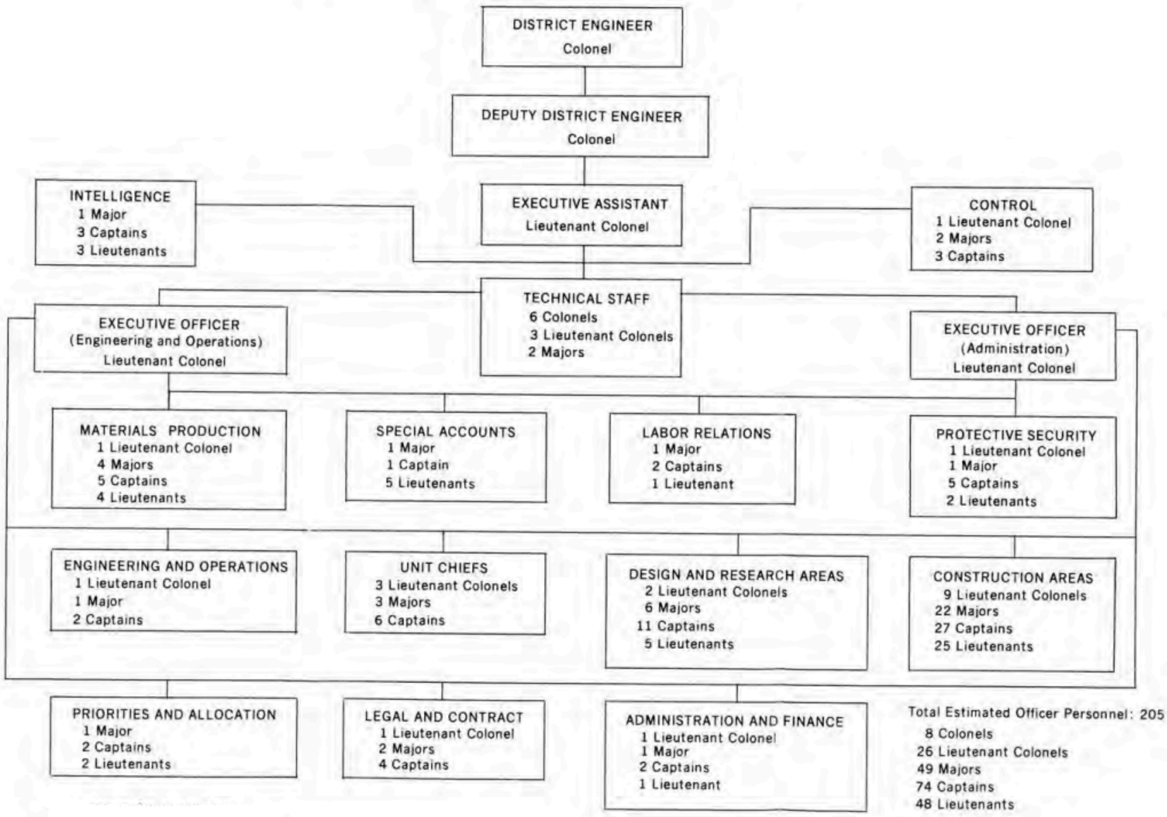
iii. Civilian and Military Personnel

Recruiting thousands of workers for the Manhattan Project was no simple task. Like the search for top scientific minds, the effort to secure skilled and unskilled labor required a blend of strategy, partnerships, and adaptability. For skilled tradesmen—carpenters, electricians, bricklayers, pipefitters, and machinists—Manhattan relied heavily on labor unions, particularly those under the Building and Construction Trades Department of the American Federation of Labor. For unskilled laborers and semi-skilled workers, the project turned to recruiters employed by contractors or the Army, who followed established War Manpower Commission routes to find available personnel. The U.S. Employment Service also assisted, though with limited success.

Yet for all these efforts, it was the major contractors who supplied much of the supervisory and operational workforce, handling everything from plant construction to facility management. The sheer scale of the project, spread across Oak Ridge, Hanford, and Los Alamos, meant that recruitment had to be aggressive, strategic, and persistent.

Although the bulk of Manhattan's workforce came from private contractors, two smaller but critical groups—civilian government employees and military personnel—held key administrative and operational roles. Together, they never accounted for more than 10% of the workforce, but their influence far outweighed their numbers.

CHART 5—ESTIMATED OFFICER PERSONNEL REQUIREMENTS FOR THE MANHATTAN DISTRICT, JANUARY 1943



From the outset, the Army relied on civilians to fill administrative and technical positions at both the District headquarters and project sites. Many were drawn from the Corps of Engineers, government agencies, or transferred from other military services. When Colonel James C. Marshall first assembled the Manhattan District's headquarters staff, he recruited many of his former Syracuse District employees, experienced administrators who helped build the bureaucratic structure of the project.

While placing these civilian employees on standard Army payrolls helped streamline administration, it also subjected the project to wartime labor regulations. President Roosevelt's December 1942 proclamation suspended the eight-hour workday, and a February 1943 directive established a mandatory 48-hour workweek in high-priority labor zones. The War Department allowed six-day, 48-hour schedules, with overtime for Sundays and extra weekday hours, but in practice, only lower-paid employees benefited. Section chiefs and division heads worked overtime without compensation, driven by duty rather than pay.

There were downsides to this arrangement. The Army's Office of the Chief of Engineers (OCE) imposed personnel ceilings, meaning that just as the project was on the verge of rapid expansion in 1943, General Groves was told he had to cut staff by 13%. Furious, he pushed back hard, enlisting General Wilhelm Styer to intervene. In the end, the reductions were absorbed elsewhere, and Manhattan's staff continued to grow. By 1944, as construction gave way to operations, administrative positions shifted from site development to production oversight, keeping personnel levels on an upward trajectory until late 1945.

Though the Manhattan Project began as a civilian-run effort, by mid-1942, the Army had begun integrating military personnel into its structure. The first group of officers arrived as part of an OCE authorization for 62 positions, primarily supervisory and administrative roles at headquarters and field offices. By December 1943, however, uniformed personnel still numbered fewer than 400.

That changed as additional military authorizations came from the Army Service Forces (ASF) and, in some cases, directly from the Secretary of War. The Army filled roles not only through standard officer allotments but also by commissioning key specialists—patent attorneys, engineers, chemists, and physicists—and even bringing in naval officers for certain technical roles. By mid-1945, more than 600 officers and warrant officers were serving at project sites across the United States and beyond.

Beyond administration, the Army took on a more active role in security and site management. In early 1943, as secrecy concerns mounted, Groves requested the Army Service Forces to supply military police, medical staff, and veterinarians for security operations at Los Alamos, Oak Ridge, and Hanford. Special provisional military police and engineer detachments soon followed.

Classified records and mail posed another security risk. With a constant flow of sensitive documents moving between sites, Groves sought personnel who could be strictly controlled. In April 1943, the 1st Provisional Women's Army Auxiliary Corps (WAAC) Detachment was activated at Fort Sill, Oklahoma, with an officer and six auxiliaries deployed to Los Alamos. By June, Manhattan had three WAAC officers and 75 enlisted women, handling classified materials, technical tasks, and administrative work. As their role expanded, additional Women's Army Corps (WAC) detachments were assigned to Clinton, Hanford, and other key locations.

By spring 1943, Groves and his staff faced a new challenge—how to retain younger scientists and technicians who were eligible for the draft. The solution was simple but effective: create a military unit within the Manhattan Project.

In May 1943, the Special Engineer Detachment (SED) was established with an initial allotment of 675 men. Recruiting began almost immediately, with candidates drawn from the Army Specialized Training Program, the National Roster of Scientific and Specialized Personnel, and technical universities. Many enlisted personnel were identified from Army camps, screened for scientific and engineering expertise, and reassigned to Oak Ridge, Hanford, or Los Alamos.

To keep a low profile, some enlisted scientists were placed in the Enlisted Reserve Corps, allowing them to work in civilian roles while remaining under military control. This arrangement also reduced administrative costs for small, scattered groups stationed in remote locations.

As the war progressed, the SED's numbers swelled. From a few hundred men in early 1944, the unit grew to 2,600 by year's end and 5,000 by mid-1945. Unlike regular military personnel, these soldiers were deeply embedded in scientific and technical work, from plant operations and research to laboratory testing and bomb assembly.

Administering such a vast, highly specialized workforce—civilian and military, skilled and unskilled, scientific and industrial—was an unprecedented challenge. The Army's meticulous planning, combined with Groves's ability to navigate bureaucratic roadblocks, allowed the Manhattan Project to recruit and retain the workers it needed on schedule.

By late 1944, with most manpower needs met, the focus shifted from recruitment to retention. The project now faced new threats—from Selective Service pulling workers away to union activity disrupting operations. But by that point, the momentum was unstoppable. The atomic bomb was within reach, and the workforce that had built it was ready to see the project through to its historic conclusion.

f. Electric Power

    i. Power Requirements and Sources

Reasonable access to electric power, water, communications, and transportation was as critical as geographic isolation in selecting sites for the Manhattan Project. Finding locations that balanced both requirements was no easy task. The Army resolved the challenge by choosing comparatively remote areas in Tennessee, Washington, and New Mexico, while securing process support resources from nearby regions. Overseeing the development of these resources, especially in a wartime economy strained by shortages of electric generators, copper wire, water pipes, and boilers—became one of the Army's most demanding responsibilities.

Army personnel at every level were involved. General Groves and the Washington Liaison Office worked to secure procurement priorities. District and area engineers supervised site-specific power development. The Army Engineers, Signal Corps, and Transportation Corps provided critical technical support. Although these challenges were most pressing in the early months of construction, Army involvement in power logistics continued throughout the war.

Electricity was essential to nearly every aspect of the project. From the earliest planning stages, the Army faced three major challenges in securing it. The first was sheer quantity. Initial estimates projected a need for 150,000 kilowatts, but the decision to relocate plutonium production to a separate site increased this to over a quarter-million kilowatts—enough to power a city of half a million people. Later, even this figure would prove too low.

The second challenge was uninterrupted power supply. The production plants relied on continuous operation of pumps, refrigeration systems, and fans to prevent overheating and to remove radioactive gases. Even the briefest outage could throw entire processes into disarray. The electromagnetic and diffusion methods were particularly sensitive, as any disruption in progressive purification stages could compromise the entire production schedule.

The third concern was security. Because the production sites lacked the capacity to generate all their own power, most electricity had to be transmitted over long distances from external sources—an arrangement vulnerable to sabotage. Project engineers had to develop methods to prevent disruptions while maintaining secrecy about the project's massive power consumption.

Early negotiations with the Tennessee Valley Authority (TVA) and the Bonneville Power Administration (BPA) secured initial commitments, but neither agency had significant surplus power. Most of their electricity was already allocated to war industries, particularly aluminum production. Recognizing power procurement as a top priority, the Army turned to the War Department, leveraging its expertise in electrical resource planning. Groves enlisted power specialist Carl H. Giroux and assigned Captain Allan C. Johnson to navigate the War Production Board's (WPB) power allocation system.

By October 1942, power requirements for the Clinton site had already been revised upward. What was originally estimated at 60,000 kilowatts had increased to 125,000 kilowatts and was projected to reach 150,000 by 1944. But just as these figures were being finalized, a new obstacle emerged. On October 20, WPB Chairman Donald Nelson issued a directive halting nonmilitary government construction that was not deemed essential to the war effort. The order threatened to halt TVA expansion projects, potentially leaving the Clinton site without enough power.

Before the Army could intervene, TVA Chairman David Lilienthal approached Under Secretary of War Robert P. Patterson, urging him to secure an exemption. Patterson succeeded, winning WPB approval to complete Fontana Dam, a major power project on the Little Tennessee River. With this assurance, TVA could now meet Clinton's growing energy demands by early 1945.

The decision in December 1942 to relocate plutonium production from Tennessee to a new site in Washington State created another major power challenge. Engineers estimated that the Hanford facilities would require 140,000 kilowatts by early 1944. Unlike Clinton, however, Hanford had no existing power commitments.

General Groves, confident that the Grand Coulee Dam (set to generate 800,000 kilowatts) would be operational in time, moved forward with site selection without securing a formal power agreement. The Bonneville Power Administration's Midway Substation, located on the western edge of the Hanford area, provided a direct access point for transmission lines. A smaller local utility, the Pacific Power and Light Company, also operated lines that crisscrossed the Hanford reservation, ensuring at least some power for early construction efforts.

By January 1943, WPB officials had learned that the Army would soon request a large power allocation for an unspecified Pacific Northwest project. On February 7, Groves formally submitted Hanford's staged power request:

- 10,000 kilowatts by April for initial construction.
- 40,000 kilowatts by December as work ramped up.
- 140,000 kilowatts by 1944 for full-scale production.

Within weeks, BPA confirmed availability, and power planning for Hanford moved into high gear.

At Clinton, the design of the gaseous diffusion plant (K-25) presented an unexpected power dilemma. The process required a vast system of motor-driven pumps and blowers, all of which had to operate continuously. Engineers soon realized that even the briefest outage could cripple production for weeks.

The obvious solution was to build an on-site power plant. Beyond ensuring reliability, this approach offered two advantages. First, it eliminated the need for costly and hard-to-procure frequency converters, as K-25 required variable-frequency current that TVA could not provide. Second, a dedicated power plant would be far less vulnerable to sabotage than long transmission lines.

By April 1943, the Army had approved construction of a steam-electric plant adjacent to K-25. The J.A. Jones Construction Company was awarded the contract, and work began in early summer. The facility's nine turbogenerators, powered by three massive boilers, would produce 238,000 kilowatts—nearly enough to power the entire gaseous diffusion process.

Despite wartime shortages, Army procurement officials worked through WPB's Office of War Utilities to secure critical materials. A Chicago firm was persuaded to cancel an order for two 750,000-pound boilers, allowing Manhattan to acquire them. WPB also reassigned priorities from other war projects, ensuring Manhattan obtained eight 25,000-kilowatt turbogenerators, later increased to fourteen.

ii. Implementation of the Power Program

Beyond Clinton and Hanford, smaller research sites also required reliable electricity.

- Chicago's Metallurgical and Argonne Laboratories relied on local power grids, with allocations secured through WPB.
- Los Alamos, isolated in the mountains of New Mexico, had no external power sources. The Army post commander arranged for small diesel generators, which were adequate for the lab's early experiments.

Through careful planning and aggressive negotiations, the Army ensured all sites had the power they needed, despite the wartime energy crisis. The success of the Manhattan Project depended not only on scientific breakthroughs, but on the Army's ability to secure and deliver power on an unprecedented scale.

By mid-1943, Manhattan had largely secured its power resources. The next step was to put them to use, negotiating purchase contracts and operating agreements with TVA, BPA, and other suppliers, designing distribution systems, and procuring materials and equipment.

The Clinton power contract was built on an agreement TVA Chairman David Lilienthal and Under Secretary of War Robert Patterson had drafted in late 1942. Under this arrangement, TVA would supply all War Department projects at its lowest primary rate, normally reserved for long-term purchases. The War Department, in turn, could cancel service with thirty days' notice without penalty. TVA would handle transmission lines, while the Army built substations and connecting lines.

By April 1944, however, Clinton's power needs had grown far beyond what was originally anticipated. Concerned about the long-term impact on TVA's economy, Lilienthal warned Patterson that if Manhattan suddenly withdrew from the TVA grid, the agency would suffer heavy financial losses. In normal commercial agreements, TVA protected itself with higher rates and long-term contracts. Now, under the 1942 terms, it had no such safeguards.

Patterson acknowledged the risk. If TVA couldn't immediately find new buyers for the power allocated to Clinton, he assured Lilienthal that the War Department would support TVA in seeking financial compensation. With this understanding, the Clinton power contract was finalized on April 25, 1944, retroactive to October 1, 1943. TVA viewed all Clinton operations as a single consumer, billing Manhattan just as it did its largest commercial users.

The situation at Hanford was more complex. The Bonneville Power Administration (BPA) agreed to a general purchase contract in February 1944, but final terms weren't settled until November, delayed largely by General Groves' insistence on stronger reliability guarantees.

Patterson intervened again, pressing the Office of War Utilities to grant Hanford first claim on Bonneville's power resources. A directive was drafted, prioritizing Hanford over all other BPA customers once the plutonium plants became operational.

Securing an operating agreement proved equally difficult. The BPA administrator objected to key provisions that guaranteed uninterrupted service, arguing they placed unreasonable restrictions on BPA's grid, threatened financial stability, and could limit service to existing and future customers.

Faced with another stalemate, Groves turned again to Patterson, who had Assistant Secretary of War John J. McCloy step in. On August 11, 1944, McCloy assured BPA that any financial losses resulting from Hanford's power demands would be covered as a wartime cost.

This resolved the issue. The final agreement guaranteed Hanford 150,000 kilowatts and put BPA in charge of upgrading and maintaining transmission systems to ensure continuous power under all foreseeable conditions. With BPA now on board, the War Utilities Office issued the long-delayed directive, removing the last hurdle to Hanford's power security.

At K-25, a July 1, 1945, contract supplement permitted limited resale of surplus power to onsite concessionaires. It also stated that any excess electricity from the K-25 power plant could, if needed, be supplied to TVA's grid.

Powering Manhattan's smaller installations presented fewer challenges. Facilities at Chicago, Berkeley, and Columbia simply tapped into existing local grids. The heavy water plants at Trail, British Columbia, and three U.S. munitions sites also used available power.

Los Alamos, however, was a different story. The nearest high-power transmission line was 25 miles away, leaving the lab dependent on small diesel generators for over a year. By August 1944, power demand had exceeded safe limits, forcing engineers to build a new transmission line to connect with the New Mexico Power Company's grid.

Even this wasn't enough. Projected 1945 needs surpassed available supply, so two additional diesel generators were procured and became operational in 1946—providing Los Alamos with the power it needed for the next phase of the bomb program.

g. Communication

Electric power wasn't the only essential process support for Manhattan's laboratories, production plants, and atomic communities. With sites spread across the country, the project depended on efficient communication to coordinate efforts and on reliable transport to move materials quickly and securely.

Early surveys showed local infrastructure was inadequate. The Army had to build from scratch, upgrading telecommunications networks and securing rail and highway links—all while maintaining strict security measures.

During the construction phase, linemen were a common sight at Clinton, Hanford, and Los Alamos, stringing miles of wire across remote landscapes. While much of this work supported power transmission, a significant portion was dedicated to creating complex, integrated communication systems.

Before the war, these sites had minimal communication infrastructure:

- Hanford had the best existing network, with service from five independent telephone companies and a Pacific Telephone and Telegraph line. The Bonneville Power Administration also maintained a two-way radio system.
- Clinton had only one six-mile telephone line, serving local farmers.
- Los Alamos had a single Forest Service line, operated by Mountain States Telephone and Telegraph.

To support operations, the War Department acquired and integrated private communications facilities wherever possible.

At each major site, the Army worked closely with the Signal Corps, local phone companies, and prime contractors to install the most advanced wartime systems available. Given the safety and security concerns, these systems included:

- Alarm devices to warn of fire or hazardous conditions.
- Two-way radio networks for rapid response.
- Radio monitoring for security surveillance.
- Codified teletype circuits linking sites to General Groves' Washington headquarters.

The DuPont Corporation, for example, installed a private teletype service connecting its Hanford, Richland, and Wilmington offices. Other contractors had similar direct lines to their home offices.

The Army took an unusually active role in communications development. Its Signal Corps had the expertise to rapidly build secure networks, and Army Command teletype circuits ensured fast, encrypted communication. The degree of involvement varied by site:

- At Clinton, the 4th Service Command signal officer advised the district engineer, later handing over operations to a dedicated Clinton communications unit.

- At Los Alamos, the Signal Corps' role was limited to technical support and equipment supply.
- At Hanford, however, building the telephone system became one of the largest Signal Corps projects in the U.S. during the war.

In early 1943, Hanford's communication system became a source of conflict between DuPont and the Signal Corps, both of whom wanted control. Groves personally intervened, negotiating an arrangement where DuPont would design the system to Army standards, while the Signal Corps and Pacific Telephone and Telegraph handled construction and maintenance.

A similar division of responsibility was applied at Clinton and Los Alamos.

- Stone & Webster designed Clinton's network; Southern Bell handled construction.
- Mountain States Telephone built and maintained Los Alamos' system.

As Manhattan's production plants moved into operation, the Army tightened security. At Clinton, for example, the communications unit evolved into a full branch of the Operations Division by early 1945. At Hanford, Women's Army Corps (WAC) personnel were recruited for communications roles, as they were easier to security-clear than civilians.

Despite this tight control, the Army did not directly operate communications networks—except at Los Alamos, which remained a military post. At Hanford, DuPont ran the system, hiring staff to operate switchboards, maintain lines, and handle repairs. At Clinton, Roane-Anderson Company took over Oak Ridge's civilian network, with Western Union providing telegraph service.

6. The Bomb
    a. The Los Alamos Weapon Program
        i. Planning Phase

The Los Alamos Laboratory served as the focal point of the Manhattan Project, integrating research, material production, procurement, and logistics into the development of an atomic weapon. By early 1943, efforts were underway to establish a fully functional scientific and engineering facility in New Mexico. General Leslie Groves outlined the laboratory's primary objectives: refining fissionable materials, fabricating weapon components, assembling a viable design, and completing the process in time for deployment once sufficient material was available.

Building an advanced research facility in an isolated location presented unique challenges. The technical problems associated with bomb development had few precedents, leaving military and civilian leaders to adopt a pragmatic approach in structuring the laboratory. With security concerns dictating an unusual administrative model, Groves took a direct role in overseeing operations, coordinating closely with J. Robert Oppenheimer, the laboratory's scientific director.

Given the sensitive nature of the project, a conventional Army Corps of Engineers management structure was deemed impractical. Instead, Groves maintained direct control over key policies while working closely with Oppenheimer and select Army and Navy liaison officers. Administrative functions were divided, with the University of California handling business operations and procurement.

Groves' leadership extended to staffing decisions, selecting Lt. Col. John M. Harman as the first commanding officer of the Los Alamos post. He also worked with the War Department to ensure military personnel—including engineers, security forces, and medical staff—were in place by April 1943. Additionally, he established a procurement office in Los Angeles to manage supply chains while coordinating operational details with University of California officials.

At the same time, Oppenheimer was actively recruiting scientists from institutions involved in nuclear research. Despite initial skepticism over military oversight, he reassured potential recruits that the laboratory would remain civilian-operated during the early phases of the program. His efforts drew physicists and chemists from major universities, including Berkeley, Chicago, and Princeton, as well as research organizations such as MIT's Radiation Laboratory and the Ballistic Research Laboratory at Aberdeen.

By mid-March, Oppenheimer and a small team arrived at Los Alamos, where they began laying the groundwork for research and development despite the unfinished state of the facilities. Over the following months, staffing expanded rapidly, and by June, the laboratory housed over 300 military personnel and nearly 460 civilians. With a growing workforce, leadership focused on refining operational structures and ensuring effective coordination between scientific research and military administration.

In late March, Oppenheimer assembled a formal steering board to define the research priorities of the weapon program. A series of conferences held in April brought together laboratory staff, external consultants, and a special reviewing committee to assess the feasibility of different weapon designs.

Initial discussions highlighted the theoretical nature of most nuclear research at that time. While significant progress had been made in understanding uranium and plutonium chemistry, critical uncertainties remained in experimental physics, bomb assembly, and detonation mechanisms. Theoretical models indicated that a single kilogram of U-235 could release energy equivalent to 17,000 tons of TNT, but practical implementation required designing a mechanism capable of achieving a fast-neutron chain reaction without premature detonation.

Scientists reviewed several weapon assembly methods, discarding designs that required excessive material or impractical fusion triggers. The gun-type method, which used an explosive charge to propel one piece of fissile material into another, was considered viable for U-235 but raised concerns regarding Pu-239. Given that plutonium production at Hanford was expected to outpace uranium availability, researchers explored alternative designs. The implosion method, which used high-explosive lenses to compress plutonium into a supercritical state, emerged as the most promising solution. Further studies confirmed that this approach not only worked effectively but also required less fissile material than the gun method.

Beyond technical development, the April conferences underscored the need to assess the weapon's physical, psychological, and structural effects. The board recommended systematic studies on the destructive impact of an atomic explosion, recognizing that certain data would only be obtainable through full-scale testing. Research objectives were outlined to refine critical mass calculations, improve detonation mechanisms, and ensure production capabilities aligned with projected material availability.

To evaluate the laboratory's progress, Groves convened a special reviewing committee in March. Comprised of experienced scientists and engineers, the committee reviewed the findings of the April conferences and provided recommendations to streamline development. Their report, issued on May 10, emphasized the need for expanded engineering efforts, additional personnel, and closer collaboration with the Army Air Forces for bomb delivery testing.

The committee also recommended transferring Pu-239 purification responsibilities to Los Alamos, allowing for direct oversight of material quality. This shift required increased staffing and infrastructure but ensured that experimental data could be directly integrated into weapon design.

On the administrative side, the committee praised Oppenheimer's leadership but suggested appointing an associate director to manage operations in his absence. It also called for improvements to procurement efficiency, citing delays at the Los Angeles office as a risk to project timelines. To mitigate these issues, the committee proposed establishing a New York procurement office to expedite supply chains from the eastern United States.

With these recommendations in place, Los Alamos entered a more structured phase of development, setting the stage for the final push toward a functional atomic weapon.

ii. Administration

Los Alamos retained the administrative structure it had at its inception in 1943, though it expanded significantly as the project grew. Oppenheimer encountered considerable difficulties in assembling an administration that could function effectively under the constraints of the laboratory's security system, coordinate with outside agencies, and keep pace with the scientific and technical demands of bomb development. The security structure restricted communication both within the laboratory and with the outside world. At the same time, there was a shortage of experienced scientific administrators, and efforts to recruit trained personnel met with little success. As a result, Oppenheimer was forced to rely on scientists with no administrative background and administrators with no experience in the scientific work of the laboratory.

Attempts to strengthen the administrative staff proved largely unsuccessful. Edward U. Condon, an early recruit, resigned after only a month due to security concerns. Oppenheimer struggled to fill key positions, appointing Dana P. Mitchell to handle procurement and Arthur L. Hughes to manage personnel. But staffing difficulties persisted, and by mid-1944, Groves intervened, replacing Hughes with Charles D. Shane. Only in early 1945 was a complete administrative team finally in place.

Technically, the laboratory was organized into divisions for theoretical physics, experimental physics, chemistry and metallurgy, and ordnance, with smaller groups responsible for specialized research. Initially, a governing board helped coordinate the laboratory's work, though over time it evolved into a decision-making body. A coordinating council, made up of the scientific group leaders, facilitated communication and the exchange of ideas. Oppenheimer sought to boost morale and ensure that scientists understood the necessity of security restrictions by introducing weekly colloquia, a move that met with some resistance from Groves. The problem of balancing security with morale was significant enough that President Roosevelt personally addressed the laboratory's scientists, urging them to uphold secrecy while recognizing their contribution to the war effort.

In its early months, Los Alamos functioned in near-total isolation, with all external communication requiring special permission. By mid-1943, limited exceptions to this rule had been made, allowing scientists to visit other Manhattan Project sites. As the work at Los Alamos shifted from theoretical research to engineering and ordnance in 1944, increased contact with outside agencies became necessary, and various arrangements were made to circumvent the strict security regulations.

Recognizing the need for greater efficiency, Oppenheimer reorganized the laboratory in mid-1944. He replaced the governing board with separate administrative and technical boards, aligning the laboratory's structure more closely with the demands of bomb development. Specialized committees were created to address specific challenges, including implosion research and bomb testing. At the same time, Groves brought in Hartley Rowe, an industrial engineer, to streamline production processes.

As a result of these changes, Los Alamos evolved from a research laboratory into an engineering and manufacturing center. The decision that plutonium could not be used in a gun-type bomb led to a shift in emphasis toward implosion. The theoretical and research divisions were reduced in size, while new divisions were formed for ordnance, weapon physics, explosives, and chemistry. By the spring of 1945, Project Alberta had been established to oversee the combat use of the bomb, while Project Trinity was formed to manage the first test of an implosion bomb.

The wartime administration of Los Alamos reflected the bomb development program. In early 1943, Colonel Harman organized the post based on plans for a small technical laboratory with a few hundred civilian and military personnel, requiring strict security and self-sufficiency. The administration had three major divisions: Administrative, handling personnel, communications, records, and auditing; Protective Security, overseeing security and military units, including MPs and Provisional Engineer Detachments (PED); and Operations, managing housing, utilities, commissary, and community services. A procurement group handled supplies, contracts, and the Santa Fe receiving facility.

Personnel arrived in April 1943, and by June, the post commander, Colonel Ashbridge, had 18 officers and over 450 personnel. The military included 200 MPs, 85 PED members, 7 WAACs, and nearly 160 civil service employees. As demands increased, additional personnel were secured through the 8th Service Command and the Army Specialized Training Program (ASTP), which provided scientifically trained enlisted men. The Special Engineer Detachment (SED) was created to retain technical employees subject to the draft, beginning in August 1943. By year's end, total personnel reached 1,100, with civil service employees growing from 160 to nearly 450. MPs increased to 300, PEDs to 200, and WACs to 90. SED strength rose to 475 with ASTP graduates.

Despite expansion, the post structure remained stable, with Operations reorganized in 1944 to manage community construction separately from technical projects. Increased technical construction demands led to hiring contractor Robert E. McKee. In 1945, Col. Tyler unified the division under separate sections for construction, maintenance, and engineering services.

The Army's role at Los Alamos was to ensure administration and efficiency. The post commander arranged military deferments for technical staff, oversaw fissionable material shipments, and managed procurement and construction. Collaboration with Oppenheimer and Capt. William Parsons intensified as the project shifted from theoretical research to engineering. Challenges included remote location, strict security, and complex procurement needs. The University of California insisted on handling purchasing but was barred from stationing employees at Los Alamos, leading to a main procurement office in Los Angeles and branches in New York and Chicago.

Despite logistical challenges, Groves and procurement officers worked with the university to improve efficiency. A Detroit-based officer sourced bomb components, while Caltech's Project Camel provided skilled workers and facilities. Emergency procurement meetings in 1945 addressed delays before the implosion test.

As bomb development progressed, military personnel took on technical roles. Some WACs moved from clerical to laboratory work, and officers contributed to scientific efforts. Maj. Wilber Stevens oversaw outlying test sites, while Capt. Davalos helped plan and maintain technical facilities. Initially excluded from technical matters, post commanders gained more involvement through increased liaison with Oppenheimer and laboratory staff. Groves maintained close contact via calls, teletype messages, and periodic visits, ensuring coordination between laboratory and post administration.

Groves also pushed for skilled labor recruitment, negotiating physicist transfers and advocating for more junior scientists. He secured additional workers through Caltech's Navy rocket program under Project Camel. By mid-1945, Los Alamos housed 4,900 post personnel, 1,300 scientists and technicians, and 500 construction workers, totaling a workforce of 6,700. As the project neared its climactic test, all efforts focused on final technical preparations.

b. Weapon Development and Testing

i. Building the Bomb

A watershed in the development of nuclear science was the Army's building and testing of the atomic bomb. In early 1943, with America engaged in what was believed to be a desperate race with Germany, American and foreign-born physicists, chemists, metallurgists, engineers, and military technical experts came together at Los Alamos to devise a weapon with unprecedented power. This practical objective merged with the broader scientific challenge of transforming atomic theory into reality, creating a unity of purpose that sustained the scientists. Organized by Oppenheimer into specialized research and technical groups, the Los Alamos team focused on two fundamental tasks: solving the theoretical and experimental problems of a fission bomb and working out the complex ordnance and engineering issues of weapon design and fabrication. Their concentrated efforts over two years transformed the laboratory into a weapon assembly and testing facility. The climax of this work was Project Trinity, the first test of an atomic bomb.

By the fall of 1943, with the laboratory's administrative structure in place, Oppenheimer, Groves, Conant, and other project leaders turned their attention to determining the best design for an atomic device. By late September, Oppenheimer and his staff had committed the laboratory's major resources to developing a fission bomb, relegating research on the "super" or fusion bomb to theoretical investigations under Edward Teller and later Enrico Fermi. Groves and Richard C. Tolman, Groves's chief adviser on weapon development, endorsed this decision, believing it necessary to maintain some research on the super bomb due to German interest in heavy water. During inspections of Los Alamos, Groves found that some of the scientific staff, including Captain Parsons, favored the gun assembly method over implosion. They argued that the well-established mechanical techniques of a gun-type weapon made success almost certain if properly designed. The design and engineering of the gun's outer configuration and mechanics were already well advanced. Once the physicists, chemists, and metallurgists determined the precise nuclear specifications for the active material—whether U-235, Pu-239, or U-233—a workable gun-type weapon would only be a matter of time.

Determining the exact nuclear specifications was the responsibility of the laboratory's experimental physics division. Through intensive research, physicists gathered data on cosmic rays, nuclear cross sections, and scattering phenomena, all of which contributed to bomb efficiency. By the summer of 1944, calculations confirmed that either a gun or implosion-type bomb would produce sufficient destructive force to justify their fabrication. The key question remained how much fissionable material would be required for an effective weapon. The answer would determine whether atomic bombs would be available before the war ended.

One way to increase efficiency was to maximize the purity of the active materials. The chemistry and metallurgy divisions focused on refining U-235 and Pu-239. Since purity requirements for uranium were less stringent than for plutonium, and because little Pu-239 was available before early 1944, chemists first experimented with uranium purification, developing techniques later applied to plutonium. When sufficient Pu-239 arrived from the Clinton pile, chemists developed both wet and dry purification methods, ultimately favoring the wet process for final purification. Before either material could be used in a bomb, they had to be converted into metal of the required purity and configuration. Metallurgists faced challenges in forming uranium and plutonium metals, including uranium's tendency to ignite during processing and plutonium's extreme reactivity and toxicity. They experimented with various methods before settling on a modification of the stationary bomb reduction technique developed at Iowa State. The recovery of these rare materials was also a priority, requiring extensive refinement of processing techniques to minimize losses.

While awaiting nuclear specifications, the laboratory's ordnance division worked on the development of mechanical components for the first experimental guns. The primary focus was on designing and fabricating a plutonium gun. This weapon posed greater challenges than a uranium gun due to Pu-239's tendency toward predetonation. The division reasoned that a gun with high muzzle velocity would prevent premature detonation, making it suitable for U-235 as well. Using ordnance and ballistics data from the National Defense Research Committee, engineers completed designs for a high-velocity gun, which was approved by the Navy's Bureau of Ordnance. The Naval Gun Factory in Washington, D.C., was ordered to forge two prototypes. In September 1943, testing began at the Anchor Ranch Proving Ground, eight miles east of the central laboratory. By early 1944, research progressed steadily despite personnel shortages and procurement difficulties. The engineers determined that a low-velocity gun would be adequate for U-235, allowing them to reduce muzzle velocity requirements. This led to an earlier-than-expected order for three uranium guns from the Naval Gun Factory, just days after the first plutonium prototypes were delivered to Los Alamos.

Implosion research initially received less attention due to technical uncertainties. Since April 1943, physicist Seth Neddermeyer had conducted high-explosive experiments to test the implosion concept. However, a shortage of experienced personnel and general skepticism hindered progress. The situation changed in mid-1943 with the arrival of John von Neumann, a mathematician and explosives expert. Applying his knowledge of shock waves, he theorized that increasing the velocity of an imploding core could achieve criticality with less active material and at lower purity levels than previously believed. If successful, implosion could shorten the timeline for weapon development.

By the fall of 1943, Oppenheimer, Groves, Conant, and other leaders reconsidered implosion. Groves consulted George B. Kistiakowsky, a Harvard chemist specializing in explosives, and Oppenheimer expanded the implosion program. A facility for casting explosive charges was built, and new testing sites were constructed. By early 1944, implosion research had gained priority.

With the focus shifting from theory to engineering, construction crews under Maj. Wilber Stevens built over thirty test sites. The Anchor Ranch Proving Ground was expanded, and the larger Sawmill Site was developed with laboratories, workshops, and storage facilities. Special Engineer Detachment troops helped operate these test sites. Los Alamos teams also conducted ordnance tests at Wendover Field in Utah, Inyokern in California, and Alamogordo Army Air Field in New Mexico. Weapon components were sourced from multiple suppliers, including the Naval Gun Factory in Washington, D.C., and private companies like Monsanto and Hercules Powder. However, for specialized parts, the laboratory functioned as its own ordnance manufacturing facility.

By early 1944, procurement of specialized implosion equipment intensified. IBM machines were brought in to accelerate data analysis. In July, the Military Policy Committee approved the construction of a massive steel containment vessel, nicknamed "Jumbo," to recover plutonium in case of a failed implosion test. While implosion research advanced, uncertainties remained regarding its efficiency and the production rate of fissionable materials at Clinton and Hanford.

By mid-1944, two bomb models were finalized. The gun-type model, Thin Man, measured ten feet in length and weighed five tons when loaded. The implosion-type model, Fat Man, was nine feet long, weighed six tons, and had a wider, more spherical design. Captain Parsons oversaw the fabrication of prototype models, which were tested at the Naval Proving Ground in Dahlgren, Virginia, and later in airborne drops at Muroc Army Air Field. The gun-type bomb displayed satisfactory ballistic characteristics, but Fat Man had stability issues, which were resolved with a tail modification.

Despite progress, new data from Los Alamos scientists raised concerns. Tests on plutonium from the Clinton pile confirmed the presence of Pu-240, a contaminant that significantly increased neutron emissions. Plutonium from the larger Hanford piles was expected to contain even more Pu-240, making gun-type bombs impractical due to predetonation risks. In July 1944, Oppenheimer alerted Conant to the problem. Conant quickly convened a meeting with project leaders, including Groves, Compton, and Fermi. They concluded that plutonium could not be used in a gun-type bomb, forcing an immediate shift to implosion as the only viable method.

With the fate of the project now dependent on implosion, engineering efforts intensified. The laboratory accelerated explosive lens development to ensure a symmetrical imploding shockwave. By early 1945, all resources were devoted to completing a functional implosion bomb. The final test of this design would be Project Trinity, the first detonation of an atomic bomb.

Abandonment of the plutonium gun forced General Groves to revise his predictions for when an atomic weapon would be ready for use. In a progress report to General Marshall in early August, he presented a new production timeline: between five and eleven implosion bombs from March to June 1945, with an additional twenty to forty by year's end. However, he cautioned that if implosion tests failed and the project had to rely solely on the gun-type bomb, the first weapon would not be ready until 1 August 1945, with only one or two more by the end of the year. In Groves's view, any delay would likely prevent the bomb's use against Germany, which by late summer 1944 appeared close to defeat. Many also doubted whether it would be used against Japan.

Through the final months of 1944 and the first half of 1945, the laboratory focused its resources on refining the uranium gun and the implosion design. Development of the gun proceeded smoothly, as expected. Experiments confirmed earlier estimates of the critical mass of U-235, and successful firing tests were conducted with a full-sized gun tube, substituting U-238 for U-235. Implosion, by contrast, remained plagued by uncertainties. Progress in achieving sufficient symmetry was slow. Of the various designs considered, explosive lenses appeared to be the most promising.

Initial tests, however, produced disappointing results. In December 1944, Groves and Conant concluded that U-235 should not be used in an implosion bomb and should be conserved for the gun-type weapon, which was certain to work. As the new year began, unexpected breakthroughs lifted the prevailing sense of doubt. In February, when Groves, Tolman, and Conant visited Los Alamos, they found new reasons for optimism. Just days before their arrival on 27 February, the gun group had finalized the U-235 weapon's design, ensuring a usable model would be ready by July. Implosion had also made notable progress. In a conference attended by Groves, laboratory leaders decided to proceed with manufacturing the implosion model favored by Oppenheimer.

To guarantee at least one implosion bomb test with active material by 4 July, Oppenheimer also directed the California Institute of Technology's Project Camel to construct a second model with alternate design features. By this time, data from Hanford indicated that large shipments of plutonium would begin arriving at Los Alamos in May. Experiments at the Metallurgical Laboratory were refining the critical measurements for Pu-239, and construction of a larger plant for final plutonium purification at Los Alamos was well underway. With these developments, the Trinity test date now appeared feasible.

ii. Project Trinity: The Test of the Bomb

Project Trinity was the final step in the Los Alamos weapon program, marking the laboratory's transition from research to engineering, fabrication, and testing of an atomic device. Without Trinity, the feasibility of employing the bomb remained uncertain. "If we do not have accurate test data from Trinity," Oppenheimer and Kistiakowsky warned, "the planning of the use of the gadget over enemy territory will have to be done substantially blindly." By 1945, Trinity had become the primary focus of the scientists at Los Alamos. As preparations intensified, both the bomb builders and Army leaders concentrated their efforts on making the device work. While scientists perfected implosion assembly and field teams prepared the remote test site at Alamogordo, General Groves and his deputy, Brig. Gen. Thomas F. Farrell, oversaw preparations. Groves, preoccupied with planning for the bomb's use against Japan and postwar atomic policy, made only three brief visits to Los Alamos between April and July but remained in constant contact through Farrell's reports.

Groves instructed Colonel Tyler, the Los Alamos post commander, to carefully coordinate Trinity's development with the laboratory staff and Farrell to ensure every aspect fit the schedule. Procurement delays in April and May required Groves's personal intervention to expedite requisition of implosion lenses and globe-shaped test containers known as "pumpkins." In May, after reviewing a special report from Farrell on procurement issues at the New Mexico installation, Groves helped finalize an agreement with the University of California to hire additional personnel. As the test approached, Groves and Farrell also closely monitored shipments of active materials from Hanford and Clinton.

On 7 May, General Farrell represented the Army at Trinity's first major event—a rehearsal explosion of 100 tons of high explosives with a small amount of radioactive material atop a 20-foot platform. Observers, including Tolman and Oppenheimer, deemed it a successful trial run. The test allowed Trinity teams to rehearse their assignments, highlighted weaknesses in transportation and communications, helped calibrate instruments, and provided a preliminary indication of the radioactive material required for the final test.

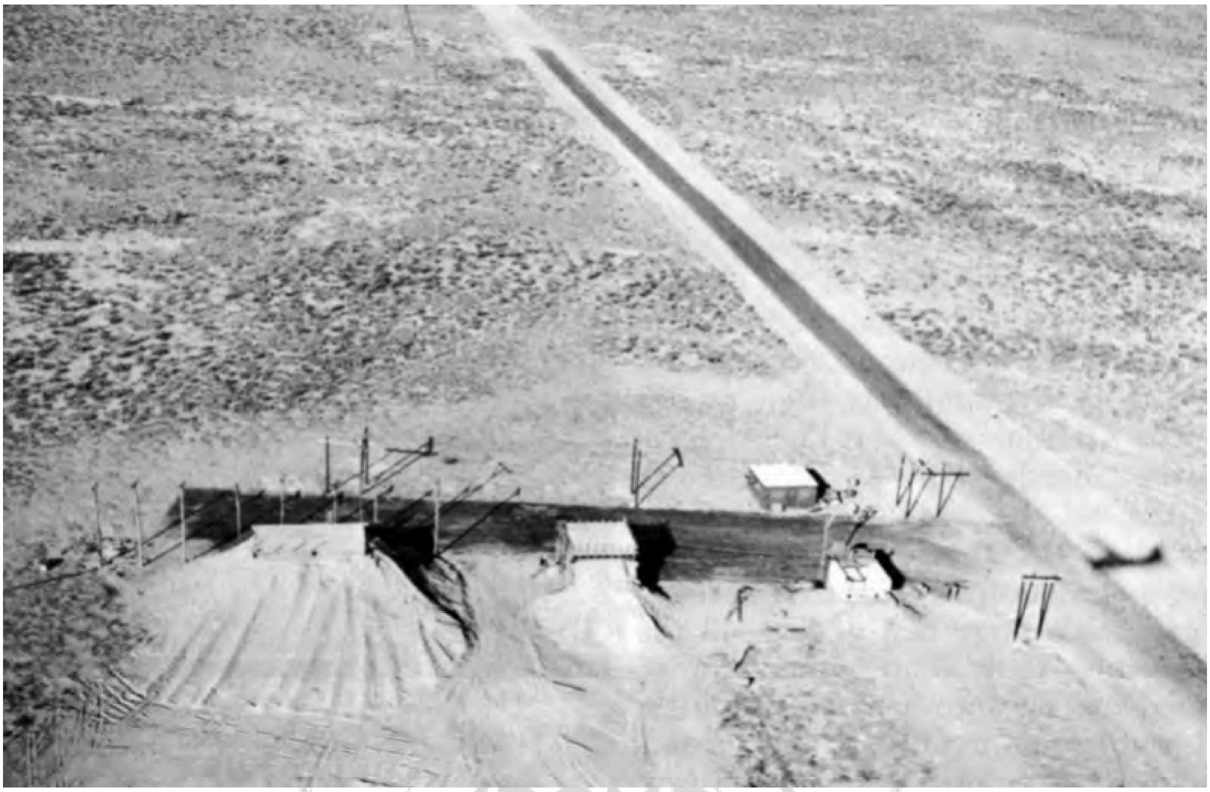
In early June, "Jumbo," the massive steel container intended to contain the first atomic explosion, arrived at Trinity. Groves had taken a personal interest in its design and transport. It had been moved in April on a special railroad car from Barberton, Ohio, via a carefully planned route to Pope, New Mexico. There, workers loaded it onto a massive trailer pulled by two tractors for the 25-mile journey to the test site. Once placed 800 yards from the test tower, it was never used. By the time of its arrival, Los Alamos scientists had concluded that Jumbo would interfere with obtaining critical data on the explosion and abandoned the plan to use it.

Although 4 July had been set as the target date, few at Los Alamos believed it could be met. The test depended on multiple factors, including weather, procurement of key components, shipment of active material, experimental preparations, and security arrangements. In mid-June, Oppenheimer announced to laboratory leaders that 13 July was the earliest possible date, with a delay of up to ten days considered reasonable. The cowpuncher committee, responsible for Trinity's scheduling, reviewed progress on 30 June and set the test date for 16 July to accommodate additional experiments. Oppenheimer initially informed Groves that the test would take place on the 17th, but Groves objected. With the war in Europe over, Secretary Stimson was scheduled to leave for the Potsdam Conference beginning on the 16th, and Groves wanted the test completed beforehand. Discussions with Conant, Tolman, and Stimson's aides, George L. Harrison and Harvey Bundy, resulted in pressure to move the test to 14 July. After further review, Oppenheimer reaffirmed the 17th as the test date, citing continued issues with the implosion device and active material shipments. However, progress accelerated, and on 7 July, Oppenheimer informed Groves that the test could proceed as early as the 16th.

In the days before the test, the Army handled security and safety measures. A detachment of 160 enlisted men with vehicles was stationed at Socorro, New Mexico, and along key highways near the site in case civilian evacuations were required. To further enhance security, 25 Counterintelligence Corps (CIC) agents were assigned to towns within 100 miles of Trinity to manage potential evacuations and circulate a cover story about an ammunition dump explosion. Groves had already coordinated with the Office of Censorship in Washington, D.C. to prevent news of the test from reaching national media. The Alamogordo Army Air Base commander reluctantly agreed to suspend all flights during the test.

On 12 July, two Los Alamos scientists transported the Pu-239 core for the bomb to Trinity in an Army sedan. The next day, a convoy arrived with nonnuclear components, including high explosives. Before the test team moved the plutonium core to the base of the 100-foot steel shot tower, General Farrell signed a receipt for the active material, formally transferring

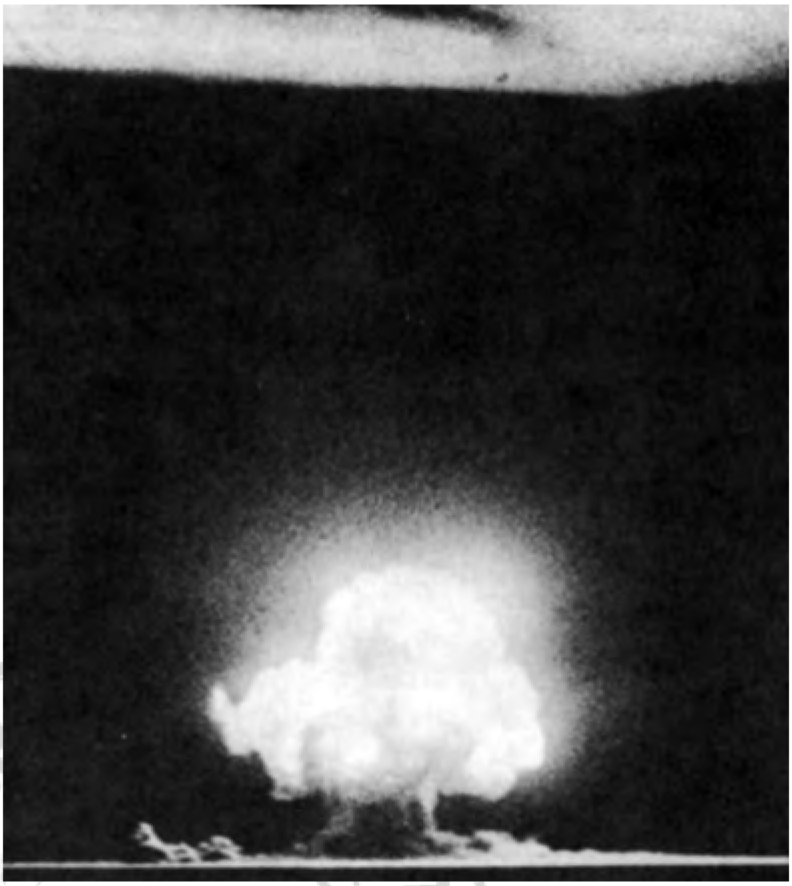
Pu-239 from the scientists to the Army. Workers removed the tent covering the device, hoisted it to a platform at the top of the tower, and technicians completed final connections. By the afternoon of 14 July, the bomb was ready.



On 15 July, Trinity crews conducted last-minute inspections. Observers, including Vannevar Bush, Conant, Groves, and British scientist Sir James Chadwick, arrived. A large group from Los Alamos reached the site just before 3:00 A.M. on 16 July, stepping into stormy weather. Rain and lightning raised concerns about fallout, electrical failures, and poor visibility. Groves and Oppenheimer met at midnight and, weighing the risks, delayed the test by 90 minutes. By 5:00 A.M., the rain had stopped, the wind was favorable, and the test was cleared to proceed.

As the final countdown began, Groves returned to the base camp, leaving Oppenheimer and Farrell in the control dugout 10,000 yards from the tower. At precisely 5:30 A.M., an automatic firing mechanism detonated the bomb. The explosion illuminated the entire region, its light visible as far as Albuquerque and Los Alamos to the north, Silver City to the west, and El Paso to the south. A massive fireball rose like a sun, shifting from yellow to orange to deep red before forming a towering white mushroom cloud surrounded by a blue glow. The shockwave arrived moments later, followed by a rumble that echoed for five minutes.

Eyewitness reactions varied. General Farrell described it as "unprecedented, magnificent, beautiful, stupendous and terrifying." He recalled a "searing light many times that of the midday sun," which revealed "every peak, crevasse, and ridge of the nearby mountains with a beauty the great poets dream about." Thirty seconds later, the explosion’s "strong, sustained, awesome roar warned of doomsday." Groves reflected that the success justified the faith of those who had undertaken the Herculean project. To him, the endeavor was like Blondin crossing Niagara Falls on a tightrope—only this tightrope had lasted three years.



Less than 30 minutes after the test, Groves called his secretary in Washington, D.C., to inform George Harrison, who relayed the news to Stimson in Potsdam. Groves reported that the explosion strength was “satisfactory plus” and possibly even greater than expected. Concerned about public reaction, he authorized the release of the pre-prepared cover story to the Associated Press:

> "A remotely located ammunition magazine containing a considerable amount of high explosives and pyrotechnics exploded. There was no loss of life or injury to anyone, and property damage outside of the magazine itself was negligible."

Later that day, Stimson received confirmation from Potsdam:

> "Operated on this morning. Diagnosis not yet complete but results seem satisfactory and already exceed expectations."

A second cable followed:

> "Doctor has just returned most enthusiastic and confident that the little boy is as husky as his big brother."

With Trinity’s success, the Manhattan Project had changed the course of history. The world had entered the atomic age.

c. The Atomic Bombing of Japan
    i. Preparations for an Atomic Bombing Mission

The 16 July 1945 explosion at Trinity confirmed to U.S. leaders that an atomic bomb could be used in war. Before 1945, the Army's atomic program had played no role in strategic planning for the war in Europe or the Pacific. By summer 1944, Germany's defeat was imminent, making the bomb unnecessary in Europe. With this shift, Manhattan Project leaders focused on its use in the Pacific and intensified planning with the Army Air Forces (AAF) for an atomic bombing mission against Japan.

In March 1944, General Leslie Groves met with AAF Chief Henry H. Arnold to discuss bomb deployment. Arnold, already briefed on the project, reviewed updates on bomb development. Los Alamos data confirmed the gun-type bomb's dimensions were set, but the implosion-type bomb's design remained uncertain. They discussed which aircraft could transport the bomb. Oppenheimer's studies at Los Alamos and Muroc Army Air Field suggested a modified B-29 could handle the load. If not, Groves proposed the British Lancaster, but Arnold insisted an American aircraft be used and promised to secure a B-29 for the mission.

The AAF agreed to:

- Organize and train a tactical bombing unit with full control over bomb delivery.
- Provide ballistic testing assistance and air transport for materials.
- Maintain continuous coordination with Manhattan through Maj. John A. Derry (Manhattan) and Maj. Gen. Oliver P. Echols (AAF), later replaced by Col. Roscoe C. Wilson.

As soon as bomb production schedules were available, Groves gave Wilson updated estimates. He projected an implosion bomb by January 1945 and a gun-type bomb by June, slightly ahead of official timelines to avoid delays. For ballistic testing, Manhattan supplied several hundred high-explosive bombs mimicking the implosion bomb's aerodynamics.

With this data, Wilson drafted a tactical plan, committing the AAF to:

- Form a heavy bomb squadron with special support units.
- Establish a training base in the U.S. Southwest.
- Modify and deliver 14 B-29s by 1 January 1945.
  Continue flight testing of implosion-type bombs and support Manhattan in ballistics research.
- Inspect an overseas base site in the Marianas.

To command the bombing unit, Arnold selected Col. Paul W. Tibbets, Jr., a seasoned bomber pilot with combat experience in Europe and North Africa and expertise in B-29 test flights. Because of the mission's secrecy, Arnold gave Tibbets full authority to choose his team.

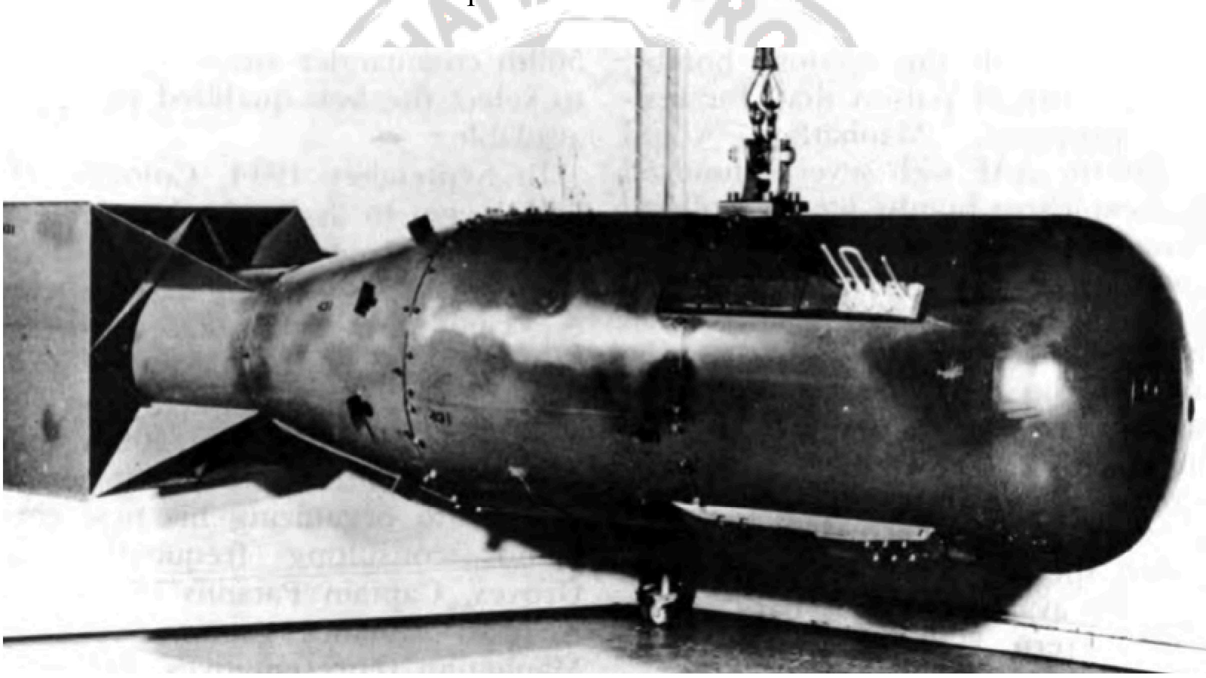
In September 1944, Tibbets began assembling the 509th Composite Group at Wendover Field, Utah, an isolated base with strong security and proximity to Los Alamos and Salton

Sea Naval Air Station. Over the next months, he structured the 509th for self-sufficiency, incorporating:

- The 393d Bombardment Squadron (VH) for bomb delivery.
- The 390th Air Service Group (603d Air Engineering & 1027th Materiel Squadrons).
- The 320th Troop Carrier Squadron and 1395th Military Police Company (Aviation).
- The 1st Ordnance Squadron, Special (Aviation) and the 1st Technical Detachment, consisting of Manhattan Project scientists and AAF/Navy personnel.

By September, with bomb configurations finalized—Little Boy (U-235 gun-type) and Fat Man (Pu-239 implosion-type)—the AAF initiated flight training. Modifications to the B-29 proceeded with assistance from Los Alamos technicians. The 393d Squadron received its first modified B-29s in October, slightly behind schedule. Testing at Wendover focused on:

- Ballistics and aerodynamics.
- Electrical fusing and detonator function.
- Aircraft release mechanisms.
- Structural vibrations and temperature effects.



Tests exposed modification flaws and performance issues in some B-29s. The AAF, reluctant to allocate more planes, delayed replacements. In December, as the 393d left for Batista Field, Cuba, for navigation training, Groves appealed directly to Arnold, who ordered immediate replacement of all inadequate B-29s. By spring 1945, a second lot of 15 upgraded aircraft arrived, enabling intensified training and testing.

With the 509th's training advancing, project leaders turned to selecting a Pacific base. In December 1944, Manhattan and AAF officials, including Groves and Arnold, met to discuss deployment. The AAF recommended informing Twentieth Air Force leaders in the Marianas, the only viable location. With General Marshall's approval, Groves had Brig. Gen. Lauris

Norstad brief Lt. Gen. Millard Harmon and his staff in January 1945. When Harmon disappeared in May, Groves re-briefed his replacement, Lt. Gen. Barney Giles.

To secure Navy cooperation, Adm. Chester W. Nimitz was briefed by Cmdr. Frederick L. Ashworth, a Los Alamos ordnance officer. Ashworth inspected Guam and Tinian as potential bases. While Guam had superior harbor and maintenance facilities, it was 125 miles farther from Japan, overburdened with port traffic, and lacked construction personnel. Tinian, under Army jurisdiction, had ample space, new facilities under construction, and Navy Seabees available for rapid building. On 22 February, Ashworth reported his findings, and the next day Groves confirmed Tinian as the base. Construction began immediately.

In March, Groves sent Col. Elmer E. Kirkpatrick, Jr. to oversee Tinian operations. Kirkpatrick, a longtime Manhattan associate, had spent months observing bomb prototypes, 509th training, and planning bomb shipments. Upon arrival in Guam, he met with Nimitz, then coordinated with Maj. Gen. Curtis LeMay, head of the XXI Bomber Command, under the cover of a War Department liaison officer.

Kirkpatrick spent April–May expediting construction. When unloading delays slowed 509th supplies, he alerted Groves, who secured an Admiral King directive ensuring priority offloading at Tinian. Kirkpatrick also addressed issues with emergency landing facilities on Iwo Jima.

Returning to the U.S. in May, Kirkpatrick conferred with Groves, Parsons (Los Alamos), and Wendover officials. By late May, he returned to Tinian, where the 509th had begun arriving. The unit brought C-54 transport planes, enabling continuous supply runs to the U.S. mainland. By mid-July, the 509th was fully operational, including the 1st Technical Detachment—scientists from Los Alamos, now temporarily enlisted for bomb assembly and maintenance. Lt. Col. Peter de Silva was dispatched to enforce security on Tinian, while physicist John H. Manley managed classified communications from Washington, D.C.

Meanwhile, the 509th intensified flight training, flying mock missions to Iwo Jima and bombing enemy-held islands with "pumpkin bombs"—high-explosive versions of Fat Man. In late July, combat crews began precision strikes over Japan to familiarize themselves with target areas. The bombing runs focused on cities like Koriyama, Nagaoka, Toyama, Kobe, Yokkaichi, Ube, Wakayama, Maizuru, Fukushima, and Niihama—all near the planned atomic targets.

In the late spring and early summer of 1945, Manhattan and AAF representatives met in Washington and Los Alamos to select targets for the 509th's atomic bombing mission. Normally, such decisions were made at the highest command levels in a theater of war. After briefing President Truman on the atomic program in April, General Marshall determined that Manhattan's security and technical concerns required project leaders to play a direct role in target selection. Instead of assigning the task to the War Department General Staff, he placed it under General Groves.

Groves acted immediately. After consulting General Arnold, he and General Norstad selected a target committee. The group included General Farrell and Major Derry from Groves's staff, Colonel William P. Fisher from the AAF, and John von Neumann, Robert R. Wilson, and William G. Penney from the Manhattan Project. Joyce C. Stearns and David M. Dennison from the AAF served as additional technical advisors.

The committee met for the first time on 27 April. Groves emphasized secrecy and laid out general selection criteria. The second meeting took place on 10 May in Los Alamos, allowing the committee to consult directly with scientists and engineers working on the bomb. A third meeting followed in Washington on 28 May, where Colonel Tibbets and Commander Ashworth, recently returned from Tinian, provided additional input.

The committee considered several key factors, including the operational range of a loaded B-29, the need for clear weather and visual targeting, and the potential for maximum destruction. Project scientists advised that the bomb's impact would be greatest if dropped on a dense urban area of military and industrial significance. They also stressed that targets should remain untouched by previous bombings to allow accurate assessment of the weapon's effects.

At the conclusion of the 28 May meeting, the committee recommended four targets. Kokura Arsenal, one of Japan's largest munitions plants, covered an area of eight million square feet. Hiroshima served as a major military port and convoy hub, with railway yards, storage depots, and industrial plants. Niigata was an important seaport with an aluminum reduction plant, ironworks, oil refinery, and tanker terminal. Kyoto, with a concentrated three-square-mile industrial district and a population of one million, was also selected.

Groves approved all four targets and prepared a plan of operations for General Marshall. On 30 May, while meeting with Secretary of War Stimson on other business, he mentioned Kyoto. Stimson objected immediately. As Japan's ancient capital, Kyoto held immense cultural and religious significance. Groves argued that its large population and military importance made it a suitable target, but Stimson remained firm. Despite this, Kyoto was included in General Arnold's instructions to the Twentieth Air Force and remained on the Manhattan Project's target list.

At the Potsdam Conference on 21 July, Groves attempted once more to persuade Stimson, sending a cable through special assistant George L. Harrison. The message emphasized that all military advisors strongly favored Kyoto. Stimson consulted President Truman, who upheld the decision to remove Kyoto from the list. Nagasaki was selected as a replacement.

ii. The Decision To Use the Bomb

While target selection proceeded, the question of whether to use the bomb against Japan was under discussion. In May, Secretary Stimson appointed the Interim Committee to advise on atomic energy matters. The committee included Stimson as chairman, George L. Harrison as alternate chairman, and James F. Byrnes as the President's representative. Other members included Vannevar Bush, James B. Conant, Karl T. Compton, William L. Clayton from the State Department, and Under Secretary of the Navy Ralph A. Bard.

At the first meeting on 9 May, Stimson outlined the committee's authority, which ranged from wartime controls and publicity to postwar atomic energy policy. Although he did not explicitly assign it responsibility for military use of the bomb, its role naturally expanded to include that decision.

On 14 May, the committee formed a scientific panel. Oppenheimer, Fermi, Arthur Compton, and Ernest Lawrence were tasked with assessing the technical and political aspects of atomic energy. They presented their findings at the 31 May meeting, which Generals Groves and Marshall attended.

Oppenheimer described the bomb's effects in stark terms. A brilliant luminescence would rise to 10,000 or 20,000 feet. The neutron radiation would be lethal within two-thirds of a mile. Stimson concluded that the bomb should be used without warning. While he did not insist on targeting civilians, he believed its use should make the most profound psychological impact.

The committee members generally agreed. Conant suggested a vital war plant surrounded by worker housing. Stimson approved. Oppenheimer proposed simultaneous strikes, but Groves objected. A staggered approach would allow better evaluation of the weapon's impact. Rushed assembly could increase the risk of failure. If too many bombs were dropped at once, their effect might not be distinct from conventional AAF raids.

While the Interim Committee deliberated, some scientists in the Metallurgical Laboratory strongly opposed using the bomb without prior warning. Led by James Franck, they produced the Franck Report, which was delivered to George Harrison on 12 June. The report warned that a surprise attack would damage America's moral standing and complicate postwar atomic negotiations. It proposed a public demonstration in an uninhabited area, leaving open the possibility of later military use.

The scientific panel reviewed the Franck Report but rejected its conclusions. Their 21 June report stated that no technical demonstration was likely to end the war and that there was no alternative to direct military use. The Interim Committee reaffirmed its position. The bomb would be used as soon as possible without warning. The target would be a military installation or war plant adjacent to buildings most susceptible to damage.

On 21 July, Stimson received Groves's official report on the successful Trinity test. That same day, Harrison sent cables confirming that bombs would be ready earlier than expected. Stimson relayed the news to Truman, Churchill, Byrnes, Marshall, and Lord Cherwell at Potsdam. They reacted with elation.

On 24 July, Stimson met with Truman and showed him the final bombing plan prepared by Groves. The President approved it without hesitation. On 25 July, General Marshall submitted the official directive to the United States Army Strategic Air Forces, which Stimson signed.

25 July 1945, Official Bombing Orders

01. The 509th Composite Group, 20th Air Force, will deliver its first atomic bomb as soon as weather permits visual bombing after 3 August 1945. The designated targets are Hiroshima, Kokura, Niigata, and Nagasaki.
02. Observation aircraft will accompany the bombers but remain several miles from impact.
03. Additional bombs will be used as soon as they are ready. Further instructions will follow for additional targets.
04. All information regarding the bomb's use is restricted to the Secretary of War and the President.
05. General MacArthur and Admiral Nimitz will receive personal copies of this directive for their information.

iii. Dropping the Bomb

Manhattan played a crucial supporting role in the AAF's execution of the 25 July directive. General Groves retained influence over the mission through his access to General Arnold's staff, his representatives on Tinian—Colonel Kirkpatrick and, as of 31 July, General Farrell—and Admiral Purnell, who coordinated with Navy commanders in the Pacific.

Farrell arrived in the Central Pacific with direct orders from Groves to oversee preparations for the atomic bombing. After stopping in Guam to meet with General LeMay and Admiral Nimitz, he continued to Tinian, where he conferred with Purnell and Captain Parsons. Parsons detailed the 1st Technical Detachment's efforts throughout July, focusing on the final tests and assembly of both bomb types. He had also formed a project technical committee to coordinate with the AAF.

Little Boy's components and U-235 arrived first. Most of the materials left Los Alamos in mid-July under the escort of Major Robert Furman and Captain James Nolan. They traveled from Santa Fe to Albuquerque, then flew to Hamilton Field near San Francisco, before boarding the cruiser Indianapolis at Hunters Point. The ship made a record-breaking voyage across the Pacific, delivering the components to Tinian on 26 July. The remaining parts arrived via two C-54 cargo planes on 28 and 29 July.

The 509th technical teams swiftly assembled Little Boy, and Parsons requested permission to drop the bomb as early as 1 August. Bad weather delayed the mission. While waiting, the teams continued rehearsals, refining bombing plans and conducting final tests on Fat Man units. Meanwhile, two B-29s carried the remaining Fat Man components to Tinian, with plutonium arriving via C-54.

On the morning of 5 August, meteorologists predicted clear skies over the target cities for the next day. General LeMay ordered the mission for 6 August. Technical teams loaded Little

Boy onto the Enola Gay, a B-29 piloted by Colonel Paul Tibbets, and conducted final checks. To reduce the risk of premature detonation, bomb technicians had devised a delayed arming procedure, which Parsons would perform in-flight.

At midnight, crews gathered for the final briefing. The weather planes took off first. Hiroshima was the primary target, followed by Kokura and Nagasaki. A C-54 transport flew to Iwo Jima, carrying Colonel Kirkpatrick and a bomb-loading team in case a spare B-29 was needed.

At 0245 (Tinian time) on 6 August, the Enola Gay lifted off, followed at two-minute intervals by two observation planes carrying instruments and scientific observers. Tibbets was instructed to choose a target based on weather conditions and return with the bomb if none were viable. Hiroshima was preferred as it had no American POW camps.

The Hiroshima Bombing

Captain Parsons recorded the historic mission in his log:

- 0300 – Final loading of gun.
- 0315 – Loading complete.
- 0605 – Departed Iwo Jima for Japan.
- 0730 – Inserted red plugs, arming the bomb.
- 0741 – Began climbing. Weather reports confirmed Hiroshima and Nagasaki were clear, Kokura was not.
- 0838 – Leveled off at 32,700 feet.
- 0847 – Final fuse test: All systems operational.
- 0909 – Target in sight.
- 0915½ – Bomb dropped. A flash followed by two shock waves struck the aircraft. A massive cloud rose rapidly.
- 1000 – Still visible, the cloud exceeded 40,000 feet.
- 1041 – Lost sight of the cloud 363 miles from Hiroshima.

Fifteen minutes after the explosion, Parsons radioed General Farrell in a special code:
"Results clear cut, successful in all respects. Visible results greater than Trinity. Conditions normal in airplane following delivery. Proceeding to Tinian."

Farrell relayed the message to Groves in Washington, but unexplained delays prevented it from reaching him until 11:30 P.M. (Washington time), 5 August—more than four hours after the bombing. At 4:30 A.M., Groves received a detailed cable from Farrell, forming the basis of his report to General Marshall and Secretary of War Stimson.

Groves waited for confirmation on Hiroshima's destruction before releasing President Truman's prepared statement to the press. General LeMay in Guam confirmed that the bomb had caused massive devastation. At 11:00 A.M., Truman's press secretary announced the atomic bombing and revealed the existence of the Manhattan Project to the world.

The Nagasaki Bombing

On Tinian, the 509th teams rushed to prepare Fat Man for a second strike, initially scheduled for 11 August. Parsons proposed advancing the mission to 10 August, but worsening weather forecasts prompted Tibbets to push for 9 August. Working without pause, the teams completed assembly, loading, and final checks by the evening of the eighth.

The primary target was Kokura, with Nagasaki as the alternate. Niigata was excluded for being too far.

At 0347 on 9 August, the B-29 strike plane Bock's Car, piloted by Major Charles Sweeney, took off, followed by two observer aircraft. The flight plan mirrored Hiroshima's route, allowing an emergency landing at Iwo Jima if needed. Colonel Kirkpatrick waited there with a spare B-29 and bomb team.

Shortly before takeoff, the crew discovered a malfunctioning fuel pump in the reserve gasoline tank. Normally, this would have aborted the mission. But with deteriorating weather and the Allies pressing for Japan's surrender, Farrell ordered the mission to proceed.

The difficulties continued. The aircraft had to circle for 45 minutes over Kokura due to thick haze and smoke, likely caused by conventional bombings the previous day. With fuel running low, Sweeney and Ashworth diverted to Nagasaki, knowing they had enough fuel for only one bombing run.

Ashworth recorded the events in his log:

- 0900 – Reached Yakushima, waiting for the observer planes.
- 0920 – One B-29 arrived, but the second failed to appear.
- 0950 – Departed for Kokura, where weather reports initially predicted clear skies.
- 1044 – Began bombing run but could not see the aiming point due to haze and smoke. Made two more attempts, still with no visibility.
- 1130 – Abandoned Kokura and headed for Nagasaki.
- 1150 – Dropped Fat Man after a 20-second visual bombing run. The bomb detonated as planned.
- 1205 – Departed for Okinawa, circling the mushroom cloud before heading to the emergency landing field.
- 1351 – Landed at Yontan Field, Okinawa.
- 1706 – Departed for Tinian.
- 2245 – Landed on Tinian.

Ashworth radioed Farrell from Okinawa, expressing some uncertainty about the damage. Crews later confirmed that the implosion bomb performed as expected. Compared to Hiroshima, the flash was brighter, shock waves stronger, and the cloud larger. Initial photographs showed little detail due to smoke and dust, but later images revealed complete destruction of Nagasaki's industrial and residential areas.

iv. The Surrender of Japan

When word of the Nagasaki bombing reached General Groves, he was certain Japan's surrender was imminent. He immediately met with General Marshall to discuss future operations. Since Stimson's policy allowed use of the bomb only to end the war, they agreed to delay shipment of materials for a third bomb until 13 August. When Japan had still not surrendered by that date, neither Stimson nor Marshall was available due to ongoing armistice negotiations. Groves then informed General Thomas T. Handy, Acting Chief of Staff, that he would continue holding all fissionable materials in the United States and asked him to relay this decision to Stimson and Marshall.

At Los Alamos and Tinian, project personnel remained on full alert, ready to prepare and deliver additional atomic bombs if needed. Their preparations proved unnecessary. On 14 August, President Truman received Japan's formal acceptance of the Allied surrender terms, as outlined in the Potsdam Declaration. The atomic bombings, Soviet entry into the war on 9 August, and the promise to preserve Emperor Hirohito's position had forced Japan's decision.

Historians later determined that Japan's surrender movement had begun months earlier. By spring 1945, the Japanese military had driven the Empire to the brink of collapse. Public support for the war was fading as people realized the nation's survival was at stake. When Premier Kantaro Suzuki replaced General Hideki Tojo in April, the government began seeking peace on terms acceptable to Japan's ruling elite. By June, they had attempted to open negotiations through the Soviet Union, but Japan's militarists still controlled the government, and the Allies refused to guarantee the Emperor's future status. Only the shock of the atomic bombings and Soviet invasion created conditions where Emperor Hirohito could intervene decisively and push for peace. Despite resistance from hardline militarists, his authority proved strong enough to end the war.

The surrender completed the mission of Project Alberta, the Manhattan Project group assigned to the 1st Technical Detachment on Tinian. Most of the technical personnel had planned to leave on 20 August, with only General Farrell's small team remaining to investigate the bombings. However, delays in surrender procedures led General Groves to order key personnel to stay on Tinian until the occupation of Japan was complete. The Alberta group finally left on 7 September. Colonel Kirkpatrick and Commander Ashworth stayed behind to dispose of project property, ensuring that sensitive materials were either returned to Los Alamos under guard or dumped at sea.

v. Survey of the Bombing Effects

With Japan's surrender, American scientists could now study firsthand the effects of the atomic bombings in Hiroshima and Nagasaki. Military leaders also needed radiation surveys to ensure the safety of occupation forces. While Manhattan scientists were confident that detonating the bombs above ground had prevented lingering radiation, actual inspections were required to confirm this.

A Manhattan Project survey team formed quickly, including scientists and medical personnel from Los Alamos, Clinton Laboratories, the Metallurgical Laboratory, the Monsanto Chemical Company, and the University of Rochester. Specialists in radiation measurement and casualty analysis joined the group. The team assembled at Hamilton Field, California, on 12 September and departed for Tinian the next day.

Arriving on 16 September, they joined General Farrell's survey group, which included Manhattan personnel, AAF representatives, and interpreters. Groves also sent Major Furman, who had conducted scientific intelligence missions in Europe, to investigate Japan's atomic research.

By late August, Farrell had divided the survey group into three teams:

- The Hiroshima team, led by Lt. Col. Hymer L. Friedell, focused on radiation effects.
- The Nagasaki team, commanded by Col. Stafford L. Warren, chief of the Manhattan District's Medical Section, studied casualties and damage.
- A special advance party, including Farrell, Brig. Gen. James B. Newman Jr. (AAF), and medical personnel, conducted preliminary radiation checks.

On 8 September, the special party, accompanied by Japanese officials, flew into Hiroshima. Using Geiger counters, they confirmed no significant residual radiation. A Signal Corps photographer documented the destruction. After a brief stop in Nagasaki, Farrell and Newman returned to Tokyo.

Meanwhile, Warren's team reached Nagasaki on 17 September, spending three weeks investigating damage and injuries. They examined survivors at Omura Naval Hospital, reviewed autopsy records, and studied casualty trends. A new Army Medical Corps team replaced them in early October, and Warren's group returned to the U.S. on 15 October.

Due to typhoons, Friedell's team did not reach Hiroshima until 26 September. Their week-long survey supplemented Farrell's earlier findings before they departed on 3 October to join the Nagasaki team for the return to the U.S..

Other groups also conducted bombing surveys in late 1945 and 1946. SCAP headquarters formed the Joint Commission for the Investigation of the Atomic Bombing of Japan, composed of Army medical personnel and Japanese scientists. This team continued work after the Manhattan Project's departure. The U.S. Strategic Bombing Survey (USSBS), ordered by President Truman, studied the overall impact of air attacks, including the atomic bombings. The Navy's Technical Mission to Japan collaborated with Manhattan teams. The British Mission, arriving later, worked with the USSBS.

The Manhattan District's final report, released on 30 June 1946, provided a detailed assessment of the bombings. The report found that:

- Hiroshima suffered greater destruction than Nagasaki, with over 5 square miles leveled, compared to 3 square miles in Nagasaki.
- Structures within 1 mile of the epicenter were completely destroyed, except for a few reinforced concrete buildings.
- Hiroshima's flat terrain allowed destruction to extend 2 miles, with damage up to 3 miles and broken windows as far as 12 miles.
- Nagasaki's hilly landscape confined the blast, causing severe damage mainly within a 3-mile radius along the valley.

Casualty estimates varied among survey groups. The Manhattan teams had difficulty collecting precise death tolls due to:

- Destroyed records from hospitals, police, and fire departments.
- Uncertain population counts at the time of the bombing.
- Mass evacuations after the attacks.

Despite these challenges, the report confirmed:

- Most injuries resulted from burns, blast pressure, and falling debris.
- Radiation injuries came primarily from gamma rays at detonation, with little impact from lingering radiation.
- Psychological trauma ranked among the bomb's most significant effects, spreading fear and causing mass panic.

The USSBS, unlike the Manhattan survey, focused on Japanese morale and government decision-making. It found that, although the bombs shocked Japan's leaders, their understanding of nuclear power was limited. The Japanese public had little time to grasp the bomb's significance before surrender negotiations began.

While most survey groups concluded that the atomic bomb was a revolutionary weapon, Maj.

TABLE 3—COMPARATIVE ESTIMATES OF ATOMIC BOMBING CASUALTIES IN WORLD WAR II

City	Population 1945	MED June 1946		USSBS March 1947		OSW (Japan) and USNR April 1966	
		Dead	Injured	Dead	Injured	Dead	Injured
Hiroshima	255,000	66,000	69,000	80,000	80,000–100,000	70,000	70,000
Nagasaki	195,000	39,000	25,000	45,000	50,000–60,000	36,000	40,000
Total	450,000	105,000	94,000	125,000	130,000–160,000	106,000	110,000

Alexander de Seversky dissented. After a hurried inspection, he claimed that 200 B-29s with incendiaries could have caused similar destruction. He also argued that modern cities like

New York would suffer no more damage than from a 10-ton blockbuster bomb. His controversial views, published in *Reader's Digest*, led to heated public debate.

The Senate Special Committee on Atomic Energy, drafting postwar atomic energy legislation, called de Seversky and Manhattan representatives to testify on 15 February 1946.

Personnel of the Manhattan Project had participated in almost every aspect of the planning and preparations for employment of atomic bombs against Japan: in the decision to use the bombs against Japanese cities; in the choice of targets; in the development of an overseas base; and, finally, in the assessment of the damage wrought. The destruction of Hiroshima and Nagasaki marked their efforts with complete technical success and contributed significantly to ending World War II. Yet the respite that the project's success had afforded was momentary, for looming on the horizon was another threat to the security of the nations of the world, how to control this revolutionary new force in a peacetime environment. In face of this profound problem, the Manhattan Project would continue to operate in the emerging postwar period and its personnel would assume a role in guiding the domestic and international efforts to ensure that atomic energy would best serve the needs of mankind.

7. Completing the Atomic Mission
    a. The Atomic Bomb and Its Problems
        i. Informing the Public

The atomic bombings of Hiroshima and Nagasaki shattered the secrecy of the Manhattan Project. Overnight, what had been America's most tightly guarded military secret was thrust into the public eye.

The world had just witnessed the dawn of the atomic age. No longer a theoretical concept, atomic energy was now a terrifying reality. But with that realization came a flood of questions—political, social, and moral.

Secretary of War Henry Stimson, addressing reporters in the wake of the bombings, made it clear:

> *"Great events have happened. The world is changed, and it is time for sober thought."*

For Manhattan's leaders, the challenge was twofold. They needed to reveal just enough to explain the bomb's existence while ensuring that the deepest technical secrets remained hidden.

Stimson understood the weight of what had been unleashed.

> *"The result of the bomb is so terrific," he warned, "that the responsibility of its possession and its use must weigh heavily on our minds and on our hearts."*

Even those at Trinity, watching the world's first atomic explosion, had felt it. Within moments of that blinding flash, they knew they had altered history in a way no one could fully comprehend.

The public would demand answers, and the government needed to control the message. Manhattan's leaders had anticipated this moment for over a year. By early 1944, a public relations plan was already in motion, designed to inform the American people while keeping critical details classified.

For the press releases, General Groves initially relied on his Washington staff. But as the need for a more polished approach became clear, he looked for outside help.

He first considered Jack Lockhart, an expert in wartime censorship, but Lockhart was unavailable. Instead, he recommended William Laurence, a respected science reporter from The New York Times.

Groves personally arranged for Laurence to be released from his newspaper assignment. By early 1945, the journalist was traveling between atomic sites, interviewing key figures, and preparing to witness history at Trinity and Hiroshima.

By summer, as the war neared its end, the final wording of public statements was being refined. Laurence wrote the drafts, while Arthur Page, a close aide to Stimson, reviewed them. The Interim Committee provided oversight, ensuring that the statements aligned with broader military and diplomatic goals.

At a meeting on June 21, they made their final revisions. The statements then went to Stimson's personal staff, who worked through the complexities of coordinating them with the British—an effort made even more difficult by Churchill's electoral defeat at the end of July.

Despite the chaos of a shifting political landscape, the message remained intact.

When Hiroshima was bombed, Japan had no idea what had just happened. Reports from the city were confused and fragmented—an enormous explosion, a blinding flash, total devastation. But the nature of the weapon remained a mystery.

Sixteen hours later, the world learned the truth.

> *"It is an atomic bomb,"* President Truman announced. *"It is a harnessing of the basic power of the universe. The force from which the sun draws its power has been loosed against those who brought war to the Far East."*

He framed it as a triumph of science and military ingenuity, crediting American industry and the Army for accomplishing what had once seemed impossible.

Moments later, Stimson's statement followed. He offered carefully selected details about the project, revealing its vast scale while keeping its deepest secrets hidden.

> *"Every effort is being bent toward ensuring that this weapon and the new field of science behind it will be employed wisely, in the interests of the security of peace-loving nations and the well-being of the world."*

Over the next several days, the American public learned what had been hidden for years. The Trinity explosion was finally acknowledged. The basic principles behind atomic energy were outlined in broad strokes. The massive production plants in Tennessee, Washington, and New Mexico were briefly described. The scientists and military leaders behind the bomb were given their due recognition.

It was a carefully orchestrated unveiling. The War Department and Manhattan officials had managed to tell the story in a way that emphasized American achievement while keeping the most sensitive details locked away.

Even as the world digested the news, Groves moved quickly to tighten control over what could and could not be said. He placed Lt. Col. William Consodine, a journalist-turned-security officer, in charge of overseeing public relations from Washington. At each atomic installation, officers were assigned to monitor local press activity.

Nothing was left to chance. Any release of photographs, film footage, or radio broadcasts had to be cleared at the highest levels. Groves himself provided a specific list of off-limits topics, ensuring that reporters would never gain access to the technical details of bomb production.

From a public relations standpoint, the campaign was a success. The atomic bomb had been revealed to the world in a way that maintained American military dominance while reassuring the public that its use had been justified.

But beneath the official statements, deeper questions remained.

The world had changed overnight. The balance of power had shifted. Science had crossed a line that could never be uncrossed.

As Stimson had warned,

> *"The world is changed, and it is time for sober thought."*

The atomic age had begun. There was no turning back.

Even before the first atomic bomb was dropped, some of the scientific leaders of the Manhattan Project—James B. Conant, Vannevar Bush, Arthur Compton, and Henry D. Smyth—had foreseen the need for a detailed public account of what had been achieved. They believed that once the weapon was used, there had to be an official report explaining its development—one that would recognize the scientists and engineers who had worked in secrecy for years.

General Leslie Groves agreed. He saw another advantage: if carefully written, the public release of selected information could help protect more sensitive secrets from being leaked.

In April 1944, Groves met with Conant and Smyth to discuss the idea. A month later, after securing approval from the Military Policy Committee, Groves formally assigned Henry DeWolf Smyth, a Princeton physicist and longtime Manhattan Project consultant, to write the report.

Smyth had been involved in atomic research since 1941, first with the National Defense Research Committee's Uranium Section, later as a division head at the Manhattan District headquarters. He knew the technical aspects of the project, but he also understood the delicate balance between scientific openness and military secrecy.

Groves made sure that Smyth had everything he needed. At Princeton, Smyth's office was given guards and secretarial support, ensuring that his work remained confidential. To gather material, he was granted access to Manhattan's major installations, where he interviewed key scientists and examined classified documents.

In a letter to the project's top leaders, Groves made it clear:

> *"The purpose is to give clearly and promptly recognition to those who have worked so long and necessarily so anonymously. . . . To accomplish this, Dr. Smyth must have rather complete information concerning your phase of the project, including access to necessary documents."*

Whenever Smyth needed help, he went straight to Groves. That fall, Groves approved his request to hire Lincoln G. Smith, a fellow Princeton physicist, as a research assistant. Later, when Smyth needed information about the thermal diffusion process, Groves personally ensured that credit was given to the Navy scientists who had contributed to its success.

By January 1945, Smyth had completed eleven of thirteen chapters. He submitted a near-final draft to Groves in February, only missing a concluding chapter, which he assured would be easy to finish.

Groves and Conant were the first to review the manuscript. Their verdict? The report was too technical, included too many of Smyth's personal opinions, and gave too much detail about Los Alamos. It also didn't give enough credit to the individuals and companies that had contributed.

Determined to refine the report before it was made public, Groves ordered an extensive review process.

Heads of the major project installations, as well as leaders of industrial firms involved in Manhattan's production plants, were asked to comment on the sections relevant to their work. Once their revisions were incorporated, Groves handed the entire manuscript to his most trusted scientific advisor, Richard Tolman, for a final edit.

Tolman, assisted by two scientists from the National Defense Research Committee, spent months refining the report. They weren't just editing for clarity; they were ensuring that the information included wouldn't compromise national security.

To help guide this process, Smyth and Tolman created a set of strict security rules. Nothing about the actual construction of an atomic bomb was to be included. Any other information had to meet at least one of the following criteria:

- It was essential for understanding the Manhattan Project's work or had scientific value.
- It was already known to scientists outside the project or could be guessed based on what was publicly known.
- It had no direct bearing on the production of atomic bombs or could be discovered independently by a small group of scientists within a year.

These strict classification rules led to additional cuts and rewrites.

By early July 1945, the final edits were complete. But Groves still wanted one last confirmation from the scientists involved. To avoid future disputes over credit, he couriered select chapters to key Manhattan Project personnel for a last-minute review.

Most had only a few hours to read their section before signing off. Some barely had time to make comments.

Colonel Kenneth Nichols, however, raised concerns. He believed the report:

- Overemphasized the work of the Metallurgical Laboratory and Smyth's personal role.
- Neglected the contributions of industrial firms like DuPont.
- Gave too little attention to Los Alamos, where the bomb was actually built.

He suggested adding a disclaimer:

> *"Full credit should be given to H.D. Smyth for preparing it, and the Army should clarify that it has no responsibility for the report except for asking him to do it."*

Groves accepted the first suggestion, but not the second.

By the end of July, the final manuscript was complete. Now, all that remained was official approval.

Groves had the Pentagon's classified printing unit prepare 1,000 copies, anticipating a quick approval. But Secretary of War Henry Stimson—who had just returned from the Potsdam Conference—was hesitant.

On August 2, he gathered a high-level meeting to discuss the release. Among those present were General Groves, James Conant, Richard Tolman, Sir James Chadwick and Roger Makins.

Stimson was worried. With tensions rising between the United States and the Soviet Union, was it wise to release so much information? Chadwick shared his doubts. He was not convinced Britain should publish such a report. Makins relayed the concerns of Sir John Anderson, Britain's atomic energy minister, who feared its cumulative impact.

Groves pushed back.

He argued that the report contained only general scientific principles, comparing it to frontier survival guides:

> *"It tells people where to find water, but not how to dig the well."*

Stimson, despite his concerns, trusted Groves's judgment. He approved the release, but only if the President and British leaders agreed.

On August 8, two days after the bombing of Hiroshima, Stimson met with President Truman and his closest advisors. Truman understood the risks, but with support from Bush, Conant, and Groves, he gave the green light.

Three days later, on August 12, the Smyth Report was officially released to the public.

Its full title, *A General Account of the Development of Methods of Using Atomic Energy for Military Purposes Under the Auspices of the United States Government, 1940-1945* was deliberately vague.

With it came a warning statement:

> *"Nothing in this report discloses military secrets. However, all information beyond what is included here must remain classified—now and for all time."*

The Smyth Report was a measured success. It revealed enough to educate the public while keeping critical military secrets intact.

Of course, not everyone was satisfied. Some criticized its distribution of credit. Others worried that even its general information might help foreign powers.

Over time, minor corrections and additions were made, but the original document remained largely unchanged.

Looking back, Groves believed it struck the right balance.

Smyth himself saw the report as something greater. The atomic bomb, he argued, wasn't just a weapon, it was a turning point in human history.

> *"The ultimate responsibility for our nation's policy rests on its citizens. And they can discharge that responsibility wisely only if they are informed."*

With the release of the Smyth Report, the atomic age had been officially introduced to the world.

8. Timeline of the Atomic Mission Process

1939

- August 2: Albert Einstein signs the letter (Einstein–Szilárd letter), authored by physicist Leó Szilárd and addressed to President Franklin D. Roosevelt, advising him to fund research into the possibility of using nuclear fission as a weapon as Nazi Germany may also be conducting such research.
- September 3: Great Britain and France declare war on Nazi Germany in response to its invasion of Poland, beginning World War II.
- October 11: Economist Alexander Sachs meets with President Roosevelt and delivers the Einstein–Szilárd letter. Roosevelt authorizes the creation of the Advisory Committee on Uranium.
- October 21: First meeting of the Advisory Committee on Uranium, headed by Lyman Briggs of the National Bureau of Standards; $6,000 is budgeted for neutron experiments.

1940

- March 2: John R. Dunning's team at Columbia University verifies Niels Bohr's hypothesis that uranium 235 is responsible for fission by slow neutrons.
- March: University of Birmingham-based scientists Otto Frisch and Rudolf Peierls author the Frisch–Peierls memorandum, calculate that an atomic bomb might need as little as 1 pound (0.45 kg) of enriched uranium to work. The memorandum is given to Mark Oliphant, who in turn hands it over to Sir Henry Tizard.
- April 10: MAUD Committee established by Tizard to investigate feasibility of an atomic bomb.
- May 21: George Kistiakowsky suggests using gaseous diffusion as a means of isotope separation.
- June 12: Roosevelt creates the National Defense Research Committee (NDRC) under Vannevar Bush, which absorbs the Uranium Committee.
- September 6: Bush tells Briggs that the NDRC will provide $40,000 for the uranium project.
- September – Belgian mining engineer Edgar Sengier orders that half of the uranium stock available from the Shinkolobwe mine in the Belgian Congo—about 1,050 tons—be secretly dispatched to New York by African Metals Corp., a commercial division of *Union Minière*.

1941

- February 25: Conclusive discovery of plutonium by Glenn Seaborg and Arthur Wahl at the University of California, Berkeley.

- May 17: A report by Arthur Compton and the National Academy of Sciences is issued which finds favorable the prospects of developing nuclear power production for military use.
- June 28: Roosevelt creates the Office of Scientific Research and Development (OSRD) under Vannevar Bush with the signing of Executive Order 8807. OSRD absorbs NDRC and the Uranium Committee. James B. Conant succeeds Bush as the head of NDRC.
- July 2: The MAUD Committee chooses James Chadwick to write the second (and final) draft of its report on the design and costs of developing a bomb.
- July 15: The MAUD Committee issues final detailed technical report on design and costs to develop a bomb. Advance copy sent to Vannevar Bush who decides to wait for official version before taking any action.
- August: Mark Oliphant travels to USA to urge development of a bomb rather than power production.
- 30 August 1941: Winston Churchill becomes the first national leader to approve a nuclear weapons programme: the project was named Tube Alloys
- September 3: British Chiefs of Staff Committee approve Tube Alloys.
- October 3: Official copy of MAUD Report (written by Chadwick) reaches Bush.
- October 9: Bush takes MAUD Report to Roosevelt, who approves Project to confirm MAUD's findings. Roosevelt asks Bush to draft a letter so that the British government could be approached "at the top."
- December 6: Bush holds a meeting to organize an accelerated research project, still managed by Arthur Compton. Harold Urey is assigned to develop research into gaseous diffusion as a uranium enrichment method, while Ernest O. Lawrence is assigned to investigate electromagnetic separation methods which resulted in the invention of Calutron. Compton puts the case for plutonium before Bush and Conant.
- December 7: The Japanese attack Pearl Harbor. The United States and Great Britain issue a formal declaration of war against Japan the next day.
- December 11: The same day after Germany and Italy declare war on the United States, the United States declares war on Germany and Italy.
- December 18: First meeting of the OSRD sponsored S-1 Section, dedicated to developing nuclear weapons.

1942

- January 19: Roosevelt formally authorizes the atomic bomb project.
- January 24: Compton decides to centralize plutonium work at the University of Chicago.
- June 19: S-1 Executive Committee is formed, consisting of Bush, Conant, Compton, Lawrence and Urey.
- June 25: S-1 Executive Committee selects Stone & Webster as primary contractor for construction at the Tennessee site.
- July–September: Physicist Robert Oppenheimer convenes a summer conference at the University of California, Berkeley to discuss the design of a fission bomb.

Edward Teller brings up the possibility of a hydrogen bomb as a major point of discussion.

- July 30: Sir John Anderson urges Prime Minister Winston Churchill to pursue a joint project with the United States.
- August 13: The Manhattan Engineering District with James C. Marshall as District Engineer is established by the Chief of the United States Army Corps of Engineers, Major General Eugene Reybold, effective August 16.
- September 17: Major General Wilhelm D. Styer and Reybold order Colonel Leslie Groves to take over the project.
- September 23: Groves is promoted to brigadier general, and becomes director of the project. The Military Policy Committee, consisting of Bush (with Conant as his alternative), Styer and Rear Admiral William R. Purnell is created to oversee the project.
- September - Lieutenant Colonel Kenneth Nichols meets Edgar Sengier in the New York offices of *Union Minière*. Nichols has been ordered by General Groves to find uranium. Sengier's answer has become history: "You can have the ore now. It is in New York, a thousand tons of it. I was waiting for your visit." Nichols reaches an agreement with Sengier that an average of 400 tons of uranium oxide will begin shipping to the US from Shinkolobwe each month.
- September 26: The Manhattan Project is given permission to use the highest wartime priority rating by the War Production Board.
- September 29: Under Secretary of War Robert P. Patterson authorizes the Corps of Engineers to acquire 56,000 acres (23,000 ha) in Tennessee for Site X, which will become the Oak Ridge, Tennessee, laboratory and production site.
- October - 100 tons of Sengier's uranium ore is sent to Canada for refining by Eldorado Mining and Refining in Port Hope, Ontario.
- October - A special detachment from United States Army Corps of Engineers arrives in the Belgian Congo to reopen the Shinkolobwe mine in the Belgian Congo. Work involves draining water from flooded workings, upgrading the plant machinery and constructing transportation facilities.
- October 15: After a meeting in Chicago on the Manhattan Project General Leslie Groves invited J. Robert Oppenheimer to join himself, James C. Marshall and Kenneth Nichols on their return trip to New York on the 20th Century Limited. After dinner on the train they discussed the project while squeezed into Nichol's one-person roomette (of about 40" by 80" or 1m by 2m). Shortly afterwards Oppenheimer was appointed to head the Los Alamos Laboratory (Site Y).
- October 19: Groves appoints Oppenheimer to coordinate the scientific research of the project at the Site Y laboratory.
- November - The first uranium oxide shipment leaves the Congolese port of Lobito (it will later change to Matadi because of better security). Only two shipments will ever be lost at sea. Aerodromes at Elizabethville and Leopoldville are expanded with US assistance. The OSS is employed to prevent ore smuggling to Nazi Germany.

- November 16: Groves and Oppenheimer visit Los Alamos, New Mexico and designate it as the location for Site Y.
- December 2: Chicago Pile-1, the first nuclear reactor goes critical at the University of Chicago under the leadership and design of Enrico Fermi, achieving a self-sustaining reaction just one month after construction was started.

1943

- January 16: Groves approves development of the Hanford Site.
- February 9: Patterson approves acquisition of 400,000 acres (160,000 ha) at Hanford.
- February 18: Construction begins for Y-12, a massive electromagnetic separation plant for enriching uranium at Oak Ridge.
- April 1: Los Alamos laboratory is established.
- April 5–14: Robert Serber delivers introductory lectures at Los Alamos, later are compiled into *The Los Alamos Primer*.
- April 20: The University of California becomes the formal business manager of the Los Alamos laboratory.
- Mid-1943: The S-1 Committee was *eliminated* by mid-1943, as it had been superseded by the Military Policy Committee.
- June 2: Construction begins of K-25, the gaseous diffusion plant.
- July: The president proclaims Los Alamos, Clinton Engineer Works (CEW) and Hanford Engineer Works (HEW) as military districts. The Governor of Tennessee Prentice Cooper was officially handed the proclamation making Oak Ridge a military district not subject to state control by a junior officer (a lieutenant) he tore it up and refused to see the MED District Engineer Lt-Col James C. Marshall. The new District Engineer Kenneth Nichols had to placate him.
- July 10: First sample of plutonium arrives at Los Alamos.
- August 10: Medical Section of the MED created, on 3 November Colonel Stafford Warren commissioned to head it.
- August 13: First drop test of gun-type fission weapon at Dahlgren Proving Ground under the direction of Norman F. Ramsey.
- August 13: Kenneth Nichols replaces Marshall as head of the Manhattan Engineer District. One of his first tasks as district engineer is to move the district headquarters to Oak Ridge, although its name did not change.
- August 19: Roosevelt and Churchill sign Quebec Agreement. Tube Alloys is merged with the Manhattan project.
- September 8: First meeting of the Combined Policy Committee, established by the Quebec Agreement to coordinate the efforts of the United States, United Kingdom and Canada. United States Secretary of War Henry Stimson, Bush and Conant are the American members; Field Marshal Sir John Dill and Colonel J. J. Llewellin are the British members, and C. D. Howe is the Canadian member.
- October 10: Construction begins for the first reactor at the Hanford Site.
- November 4: X-10 Graphite Reactor goes critical at Oak Ridge.

- December 3: The British Mission, 15 scientists including Rudolf Peierls, Franz Simon and Klaus Fuchs, arrives at Newport News, Virginia.

1944

- January 11: A special group of the Theoretical Division is created at Los Alamos under Edward Teller to study implosion.
- March 11: Beta calutrons commence operation at Oak Ridge.
- April 5: At Los Alamos, Emilio Segrè receives the first sample of reactor-bred plutonium from Oak Ridge, and within ten days discovers that the spontaneous fission rate is too high for use in a gun-type fission weapon (because of Pu-240 isotope present as an impurity in the Pu-239).
- May 9: The world's third reactor, LOPO, the first aqueous homogeneous reactor, and the first fueled by enriched uranium, goes critical at Los Alamos.
- July 4: Oppenheimer reveals Segrè's final measurements to the Los Alamos staff, and the development of the gun-type plutonium weapon
- July 17: "Thin Man" is abandoned. Designing a workable implosion design (Fat Man) becomes the top priority of the laboratory, and design of the uranium gun-type weapon (Little Boy) continued.
- July 20: The Los Alamos organizational structure is completely changed to reflect the new priority.
- September 2: Two chemists are killed, and Arnold Kramish almost killed, after being sprayed with highly corrosive hydrofluoric acid while attempting to unclog a uranium enrichment device which is part of the pilot thermal diffusion plant at the Philadelphia Navy Yard.
- September 22: First RaLa test with a radioactive source performed at Los Alamos.
- September 26: The largest nuclear reactor, the B reactor, goes critical at the Hanford Site.
- Late November: Samuel Goudsmit, scientific head of the Alsos Mission, concludes, based on papers recovered in Strasbourg, that the Germans did not make substantial progress towards an atomic bomb or nuclear reactor, and that the programs were not even considered high priority.
- December 14: Definite evidence of achievable compression obtained in a RaLa test.
- December 17: 509th Composite Group formed under Colonel Paul W. Tibbets to deliver the bomb.

1945

- January: Brigadier General Thomas Farrell is named Groves' deputy.
- January 7: First RaLa test using exploding-bridgewire detonators.
- January 20: First stages of K-25 are charged with uranium hexafluoride gas.
- February 2: First Hanford plutonium arrives at Los Alamos.
- April 22: Alsos Mission captures German experimental nuclear reactor at Haigerloch.
- April 27: First meeting of the Target Committee.

- May 7: Nazi Germany formally surrenders to Allied powers, marking the end of World War II in Europe; 100-ton test explosion at Alamogordo, New Mexico.
- May 10: Second meeting of the Target Committee, at Los Alamos.
- May 28: Third meeting which works to finalize the list of cities on which atomic bombs may be dropped: Kokura, Hiroshima, Niigata and Kyoto.
- May 30: Stimson drops Kyoto from the target list; it is replaced by Nagasaki.
- June 11: Metallurgical Laboratory scientists under James Franck issue the Franck Report arguing for a demonstration of the bomb before using it against civilian targets.
- July 16: the first nuclear explosion, the Trinity nuclear test of an implosion-style plutonium-based nuclear weapon known as the gadget at Alamogordo; USS *Indianapolis* sails for Tinian with Little Boy components on board.
- July 19: Oppenheimer recommends to Groves that gun-type design be abandoned and the uranium-235 used to make composite cores (but Little Boy was not abandoned).
- July 24: President Harry S. Truman discloses to Soviet leader Joseph Stalin that the United States has atomic weapons. Stalin feigns little surprise; he already knows this through espionage.
- July 25: General Carl Spaatz is ordered to bomb one of the targets: Hiroshima, Kokura, Niigata or Nagasaki as soon as weather permitted, some time after August 3.
- July 26: Potsdam Declaration is issued, threatening Japan with "prompt and utter destruction".
- August 6: B-29 *Enola Gay* drops Little Boy, a gun-type uranium-235 weapon, on the city of Hiroshima, the primary target.
- August 9: B-29 *Bockscar* drops a Fat Man implosion-type plutonium weapon on the city of Nagasaki, the secondary target, as the primary, Kokura, is obscured by cloud and smoke.
- August 12: The Smyth Report is released to the public, giving the first technical history of the development of the first atomic bombs.
- August 13: Groves holds shipment of material for a third bomb, on his own authority as he could not reach Marshall or Stimson; as *it would be a terrible mistake for us to send overseas the ingredients of another atomic bomb*. A Fat Man bomb as enough U-235 for a second Little Boy bomb would not be available until December.
- August 14: Surrender of Japan to the Allied powers.
- September 4: Manhattan District orders shutdown of S-50 liquid thermal diffusion plant and the Y-12 Alpha plant.
- September 8: Manhattan Project survey group under Farrell arrives in Nagasaki.
- September 17: Survey group under Colonel Stafford L. Warren arrives in Nagasaki.
- September 22: Last Y-12 alpha track ceases operating.
- October 16: Oppenheimer resigns as director of Los Alamos, and is succeeded by Norris Bradbury the next day.

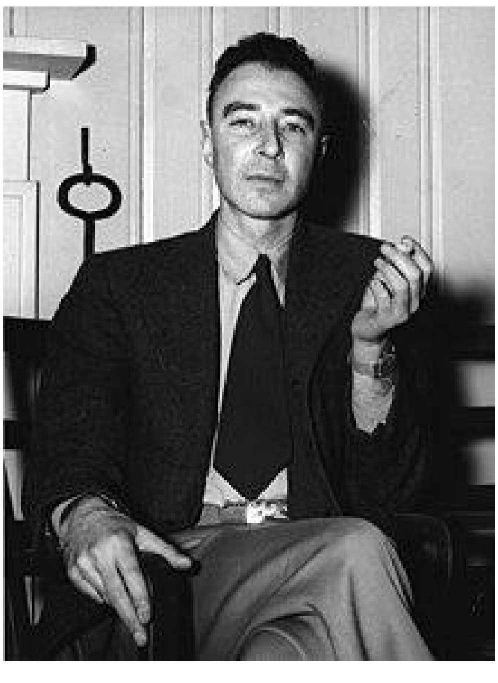
9. More Thorough Examination of Key Figures
    a. Gen. Leslie R. Groves

General Leslie Richard Groves was a U.S. Army Corps of Engineers officer. He was one of the most important characters who played a significant role before and after the Manhattan Project. He was appointed as the head of the Manhattan Project who oversaw the research, construction, production, deployment and many more various important acts. He was basically the key person for the Manhattan Project.

He selected the strategic sites of the Manhattan Project in order to have the maximum efficiency. The sites included the bomb design site Los Alamos, uranium production site Oak Ridge and lastly plutonium production site Hanford.

Also he was responsible for appointing Oppenheimer to be the scientific director of the project. This was a "fate-changing" decision because at the time, Oppenheimer was a target and he was getting investigated by the Federal Bureau of Investigation (FBI) because of his political stance and close relationships with the leftist side. His militarist role and background made him impose strict precaution and security measures and made the confidentiality of the Project secure and prevented the leaks and espionage. He also coordinated with U.S. political and military leaders, securing funding and support from President Franklin D. Roosevelt and later Harry Truman.

    b. Dr. J. Robert Oppenheimer

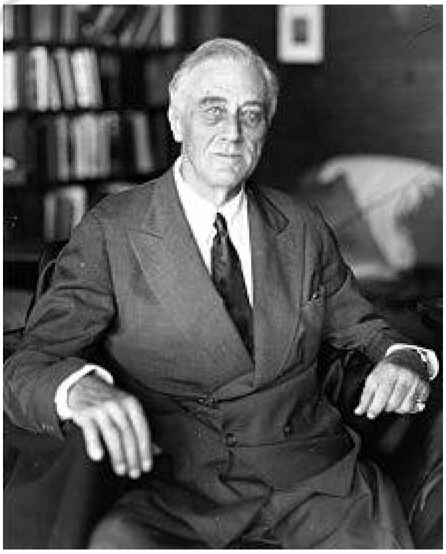


Originally, Julius Robert Oppenheimer was a theoretical physicist; later with the Second World War he became the scientific director of the Manhattan Project. He was one of the children of a Jewish originated family which immigrated to the U.S. He studied at Harvard in the field of chemistry and then in order to acquire more knowledge in quantum mechanics he went to Germany to obtain a doctorate in physics. Another key factor of him going to Germany was to work and study under Max Born who was among the few leaders of quantum mechanics worldwise in that time. This allowed him to expand his skills and knowledge enough to give lectures of quantum mechanics in the U.S. and later become the director of the Institute for Advanced Study in Princeton. Eventually he became the scientific director of the Manhattan Project with the help of Ernest Lawrence and Leslie Groves.

He was maybe the most important and outstanding person in the Manhattan Project, important enough for people to refer to him as "the father of the atomic bomb" Oppenheimer brought important scientists together and created a perfect team for the Manhattan Project. He brought scientists such as Edward Teller, Hans Bethe, Enrico Fermi, Richard Feynman and more who would later become one of the most important people in the history of physics. He oversaw the creation of the two atomic bombs in the Manhattan Project which were "Little Boy" and "Fat Man". He supervised the production of these bombs fastidiously since "Little Boy" was made out of uranium and "Fat Man" was made out of plutonium. This was a great challenge since the bombs were made out of completely different materials and resulting in completely different mechanisms to construct and deploy. However, Oppenheimer managed to work it out with his coordination skills.

Although building the first atomic bombs, Oppenheimer later became an advocate for nuclear bombs and their usage. After the deployment of the Bombs Oppenheimer realized their danger to humanity's future and remained as an advocate for the rest of his life.

c. President Franklin D. Roosevelt



Franklin D. Roosevelt was the 32nd President of the United States. He was the president from 1933 to 1945 and is the only one who was elected four times. He is well-known for his leadership during the Great Depression and World War II.

During his presidency, Albert Einstein and Leonard Szilard (who was a great scientific mind too) sent a letter to him to warn the U.S. about Nazi Germany's possibility of working on nuclear bombs. This was a turning point in history because with two important scientific minds warning him personally, Roosevelt later approved a project to research nuclear bombs with confidentiality. He created the Advisory Committee on Uranium which later became the Manhattan Project.

He brought Leslie Groves as the head of the Project and with his role of president he ensured international cooperations. This resulted in a negotiation with Winston Churchill and later forming the Quebec Agreement which allowed the US and UK to share nuclear research and prevent their secret research on nuclear arms. He also allowed the Project to receive unlimited funding in order to expedite and strengthen the process, later the project got a fund over 2 billion USD with the currency of the time.

Before his death in 1945 he hadn’t made a decision to use the bombs on enemy countries in World War 2. However his successor, Truman made the decision to use both of the bombs on Japan.

d. Gen. Wilhelm D. Styer

General Wilhelm Delp Styer was also a U.S. Army Officer who played another important role in the Manhattan Project. He was a Lieutenant General in the U.S. Army Corps of Engineers and in the project, he served as the Chief of Staff to General Brehon B. Somervell who oversaw the construction and logistics of the Los Alamos Laboratory. The project’s logistic side was mainly responsible to him and since the Laboratory was constructed in the “middle of nowhere” the logistics to support the scientist’s families and ensuring everyone’s vital requirements was a significant challenge. However, thanks to him and more this challenge was overcome and the project continued as expected. He led a critical role in securing and constructing the other two main sites which took part in the Manhattan Project, Oak Ridge, Hanford.

Also due to his military rank, Styer was Groves’ immediate superior and with this role he approved key decisions in Los Alamos and was responsible for Groves’ selection as the project director and provided him and his team with military backing. Lastly he played a negotiator role between the government officials, military engineers and scientists in order to ensure smooth relations among these three main groups in the Project.

e. Vannevar Bush

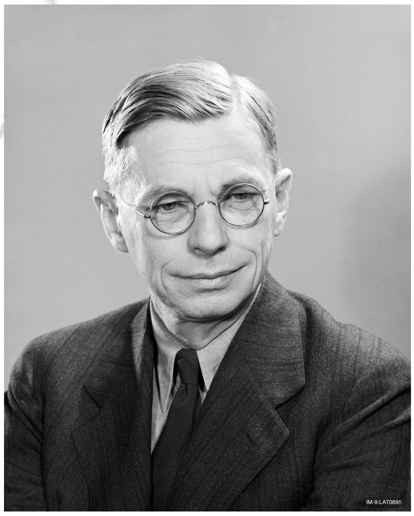
Vannevar Bush was an American engineer, inventor, and science administrator who played a critical role in the Manhattan Project by leading and coordinating U.S. wartime scientific research. He was appointed by Roosevelt to oversee all scientific research for military applications, including radar, weapons, and nuclear energy. He worked with James Bryant

Conant and lobbied Roosevelt to fund atomic research, leading to the formal launch of the Manhattan Project in 1942. He also streamlined the collaboration between universities, private industry, and the military, ensuring scientists had the necessary funding and facilities. He was a part of high-level discussions between the UK and US which as we mentioned eventually turned into the Quebec Agreement.

His efforts were undeniably crucial and we can say that he was the key architect of the Manhattan Project because without his lobbying and administrative oversight, the project may not have received the funding and urgency it needed. This included actions such as transitioning the nuclear research from a theoretical stage to large-scale industrial production of fissionable materials, without Bush most of these wouldn't be able to happen.

f. James B. Conant

James Bryant Conant was an American chemist who also took a significant role in the Manhattan Project. He wasn't actively in the field but supported and ensured smooth interactions between the government and the scientists in Los Alamos being the chairman of the National Defence Research Committee. Also he directly influenced the project working closely with Vannevar Bush, with these he ensured the research efforts were well funded and had the proper communication with the government officials. Since he is a scientist too, his skill to communicate complex scientific ideas to policymakers was the perfect suit for the Project.



With his scientific identity he advised on plutonium and uranium bomb designs and was involved in strategic discussion on the matter of the bomb usage. His leadership made the Manhattan Project possible, as the Office of Scientific Research and development directly supervised nuclear research. After receiving the Einstein-Szilárd letter, that we mentioned earlier, warning about Nazi Germany's atomic research, Bush pushed the U.S. government to accelerate nuclear research. He worked with James Bryant Conant and lobbied Roosevelt to fund atomic research, leading to the formal launch of the Manhattan Project in 1942.

g. Maj. John Lansdale Jr.

Major John Lansdale Jr. was a U.S. Army intelligence officer who played a critical role in security and counterintelligence for the Manhattan Project. As the head of the Army's Counter Intelligence Corps for the project, his main responsibility was to prevent espionage, sabotage, and leaks related to atomic bomb development. He was personally appointed by General Leslie Groves to lead intelligence and security operations for the Manhattan Project. Groves chose him because of his close relationships with the FBI, military police, and British intelligence to safeguard nuclear research.

His team monitored scientists, workers, and engineers involved in the project to ensure loyalty and prevent leaks. However despite his efforts, Soviet spies such as Klaus Fuchs and Theodore Hall managed to pass atomic secrets to the USSR. With his militarist role, he made a significant contribution in the Alsos Mission which was a secret U.S. operation to capture German nuclear scientists and seize uranium supplies before the Nazis or Soviets could. These intelligence work combined, he helped secure uranium shipments for the US from sources in Africa and Europe.

h. Gen. Dwight D. Eisenhower

Dwight D. Eisenhower was the Supreme Commander of the Allied Expeditionary Forces in Europe during World War II and later became the 34th President of the United States. While he was not directly involved in the Manhattan Project's active and daily operations, his role in the broader war effort and nuclear policy was significant. As the Supreme Allied Commander, Eisenhower focused on winning the war in Europe but was kept informed about nuclear developments. He had limited direct influence on the Manhattan Project, as it was under the control of General Leslie Groves and civilian scientists.

Eisenhower later expressed reservations about dropping the atomic bomb on Japan. He believed Japan was close to surrender and that using the bomb was unnecessary from a military standpoint. He reportedly told Secretary of War Henry Stimson that the U.S. should not use the bomb because it would damage the country's moral standing. In the following years as he became the president Eisenhower played a crucial role in Cold War nuclear strategy. He launched the "Atoms for Peace" program, promoting nuclear energy for peaceful purposes. However, under his leadership, the U.S. expanded its nuclear arsenal, escalating the arms race with the Soviet Union.

i. Winston Churchill

Winston Churchill was the Prime Minister of the United Kingdom during World War II and one of the key leaders in the Allied war effort. He played a major role in the early development and strategic direction of the Manhattan Project, particularly in fostering U.S.-British nuclear cooperation. Churchill was one of the first world leaders to recognize the military potential of nuclear fission. In 1941, British scientists, working under the Tube Alloys project which was the UK's nuclear program, made significant progress toward building an atomic bomb. Churchill supported the project and ensured it received high-level government backing.

His contributions to the Manhattan Project started with collaboration with the US. In 1943, He and President Franklin D. Roosevelt signed the Quebec Agreement, this agreement merged Britain's Tube Alloys project with the American Manhattan Project, allowing British scientists to work at Los Alamos and other key sites. Churchill agreed that the U.S. would have primary control over nuclear development, but Britain would receive nuclear technology after the war. Lastly, even though he is not in the American government, he was involved in high-level discussions on the use of the atomic bomb against Japan. Before leaving office in July 1945, he supported using the bomb to quickly end the war and prevent a costly invasion of Japan.