The Big Inch and Little Big Inch Pipelines

The Most Amazing Government-Industry Cooperation Ever Achieved

Front Cover:
Pennsylvania section of the war emergency 24-inch pipeline carrying oil from the Texas fields to eastern refineries, completed in July 1943. Pipe stacked along the railroad tracks. John Vachon. NARA 208-LU-37C-50.

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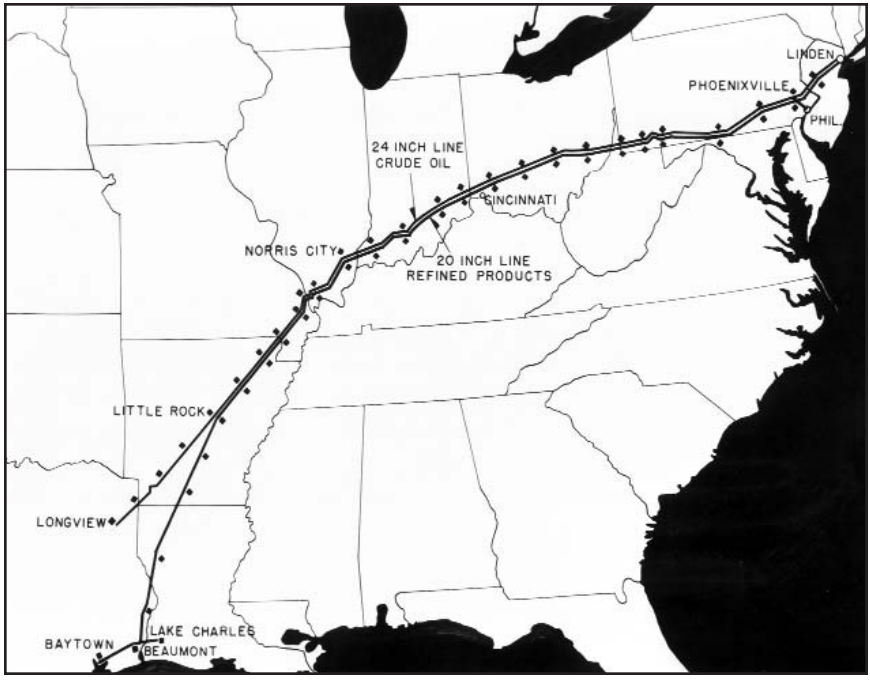
Introduction

The Big Inch and Little Big Inch pipelines (Inch Lines) were constructed in 1942-1943 for the United States government by War Emergency Pipelines, Inc. (WEP). The purpose of these pipelines was to transport crude oil and refined petroleum products from the Gulf Coast region to refining and distribution areas near New York City and Philadelphia. The Inch Lines served as alternatives to tanker deliveries, which had experienced major disruption because of attacks by German submarines. The Inch Lines also supplied large volumes of export petroleum to the East Coast. This allowed the limited number of surviving tankers, spared the longer route across the Atlantic from the Gulf Coast, to meet the demands of the European war fronts by using the shorter route from the East Coast. In the face of a serious oil crisis, both at home and on the war fronts overseas, the Inch Lines represented creative and efficient technology applied on an unprecedented scale.



Petroleum pipelines from Baytown and Beaumont, Texas, to Linden, New Jersey. National Archives and Records Administration (NARA) 208-LU-37C-1.

At the end of the war, the Inch Lines became part of the "war surplus property" that the United States government proposed to sell to private industry. Formal bids for these pipelines were submitted in early 1947, and the Texas Eastern Transmission Corporation (TETCO) submitted the winning bid. According to the terms of the sale and a subsequent agreement, TETCO converted both underground oil/products pipelines to transmission of natural gas, beginning in 1947 and continuing into the early 1950s. In 1957 the Little Big Inch Line was converted back into a common-carrier products pipeline.

Prelude to War

American oil policy during World War II followed the example set during World War I: to maintain and expand Allied petroleum supplies while restricting or cutting off those of the enemy. By 1939 oil had become more important than ever with the increasing mechanization and mobility of military forces. The Allies had an overwhelming advantage over the Axis powers in terms of the world's crude oil resources. In 1939 the United States produced 60 percent of the world's output of crude oil; Russia followed with about 17 percent. British and Dutch companies dominated production in many of the oil-rich regions of the world. The Axis powers of Germany, Italy, and Japan, by contrast, had little or no domestic crude production and relied totally upon imports. Once war broke out, Germany's supply of foreign oil was blockaded by the British Royal Navy. In preparation, Germany had built up a large synthetic fuel industry based on coal, but the synthetic process was more expensive and yielded lower-quality products than those derived from petroleum (Tugendhat 1968:116; Williamson et al. 1963:748-749).

The Karl Alexander Coal Mine in Germany (November 18, 1944). Signal Corps. NARA 111-SCA-4603.

Even with America's clear advantage in having abundant supplies of oil, the war could not be prosecuted successfully without the means to transport and

refine the oil. The Allies had to contend with transporting supplies over thousands of miles of ocean from the centers of production to the fighting fronts. Beginning in the 1920s, practically all the petroleum consumed on the East Coast was transported by tanker and nearly all of it came from Texas. On the eve of World War II the 17 eastern states consumed 1.4 million barrels of oil daily. Pipelines transported only about 50,000 barrels per day. Another 5,000 barrels came eastward by rail and a small amount came by river barge. Gas rationing helped control civilian demand (Williamson et al. 1963:748-749; Wolbert 1979:19).

Refinery in Baytown, Texas. Standard Oil Company. King Features. NARA 208-PRA-3-14-(mounted).

In the spring of 1941 Great Britain urgently requested the loan of 80 American tankers, following the sinking of much of the British tanker fleet by German submarines. The effects of an oil shortage were immediately felt on the East Coast. American oil producers began shipping their supplies eastward by railroad tank car, each carrying about 210 barrels, to make up the difference.

On May 14, 1942, the eve of the sad day when motorists could no longer get gasoline without a rationing card, in eastern states, many car owners dashed to the neighborhood station and ordered "Fill Her Up." As a result, many stations ran out of gas hours before the midnight deadline would prohibit them from selling even a gallon without getting a coupon for it. Many of the stations put up cards like this one, exhibited at a station on the corner of First Avenue and 33rd Street in New York City (May 14, 1942). NARA 208-PP-152-1.

Shipments by rail rose from 5,000 barrels of oil a day in the spring of 1941 to 140,000 barrels a day by that October. Though regarded as a great achievement at the time, this amount was not even half of the 300,000 barrels of oil that eastern refineries had received from the Texas oilfields each day before the war. Rail shipments continued to increase, however, so that by July 1943 one million barrels of oil were being moved eastward by rail each day ("Big Inch" 1943:2-3; Rister 1949:351-352, 355).

Recognizing the vulnerability of America's tanker transportation system to submarine attacks, Secretary of the Interior Harold Ickes wrote President Franklin D. Roosevelt on July 20, 1940, that "the building of a crude oil pipeline from Texas to the East might not be economically sound; but that in the event of an emergency it might be absolutely necessary" (quoted in Castaneda and Pratt 1993:17). These sentiments were repeated by Ickes before a Congressional committee on October 1, 1941 (War Emergency Pipelines, Inc. [WEP] 1943:4).

President Franklin D. Roosevelt. NARA 208-PU-172I-B.

Partly in response to the increasing German threat in the North Atlantic, President Roosevelt declared the existence of an unlimited national emergency on May 27, 1941, and called on both citizens and industry to make an all-out effort for national defense. The following day, May 28, 1941, Roosevelt appointed Harold Ickes to the newly created position of Petroleum Coordinator for National Defense. Ickes

Petroleum Coordinator Harold L. Ickes, as he appeared before the Special Senate War Investigating Committee on February 17, 1943. ACME. NARA 208-PU-98K-23.

performed his duties as the nation's "oil czar" while continuing to administer the Department of the Interior. Ickes's organization developed into the Petroleum Administration for War (PAW), formally designated in December 1942. The mission of the new agency was to meet the petroleum and natural gas requirements of military and civilian customers; basically, it was a cooperative effort between government and business to manage the flow of oil and gas for the war effort. The military, afraid of inadvertently giving away their plans to the enemy, was reticent about divulging its projected requirements to a civilian agency. The PAW was nonetheless able to anticipate the petroleum products required by the armed forces. The PAW was also directly involved in the construction and operation of the Big Inch and Little Big Inch lines, as it was responsible for reviewing all pipeline construction plans and directing the physical operation of all pipelines.

The U-boat Threat

> *Our U-boats are operating close inshore along the coast of the United States of America, so that bathers and sometimes entire coastal cities are witness to the drama of war, whose visual climaxes are constituted by the red glorioles of blazing tankers.*
>
> *—Admiral Karl Dönitz*

On December 11, 1941, four days after the Japanese attack on Pearl Harbor, Adolf Hitler's foreign minister, Joachim von Ribbentrop, announced to the American chargé d'affaires that a state of war now existed between Germany and the United States. Earlier that day, Hitler had signed a revision of the Tripartite Pact (among Germany, Italy, and Japan) that threw Germany into the war on Japan's side and exacted a promise from the Japanese government not to make a separate peace with the Allies. Two days before, on December 9, Hitler had released Admiral Karl Dönitz, Befelshaber der Unterseeboote (BdU) (commander in chief, U-boats), from all previous restrictions on naval

Admiral Karl Dönitz. NARA.

warfare against the United States (Gannon 1990:97-99). In reality, an undeclared war had already begun in the Atlantic between Germany and the United States; Dönitz was now excited by the possibilities of unrestricted U-boat warfare against the United States, which, given Washington's nearly total involvement with Britain's war effort, had already found it necessary to become an armed belligerent in everything but name.

The German admiral did not have a very high opinion of American defensive capabilities and thought that the U.S. Navy's home installations were in such a poor state of readiness that a U-boat could steam into New York Harbor on the surface, at night, without a challenge (Gannon 1990:71). A concerted attack on shipping off the United States coast, when American naval and air forces were weak and inexperienced, could result in heavy damage to the Allied war effort—severing Britain's lifeline and depriving American war industries of fuel and materiel. As events would prove, the U-boat assault on merchant shipping in United States waters during 1942 was a greater strategic setback for the Allies than the surprise attack on Pearl Harbor (Gannon 1990:xviii).

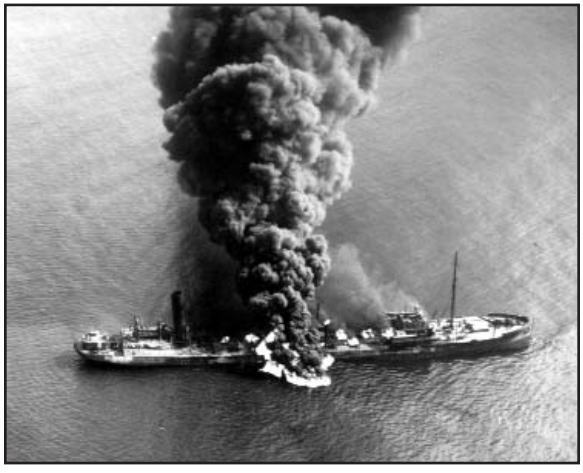
The Brooklyn Bridge, the East River, and the Downtown Skyline. Ewin Galloway. NARA 208-PP-62-22.

That American forces were woefully unprepared for the challenge posed by Dönitz's U-boats was recognized by the commander of the U.S. Navy's North Atlantic Naval Coastal Frontier (later, Eastern Sea Frontier), Rear Admiral Adolphus Andrews, who was responsible for the naval defense of the East Coast from Maine to northern Florida. To defend 1,500 miles of coastline, Andrews had a total of 20 ships available, none of which had a fully trained crew and none of which could be considered the equal of a U-boat in terms of armament or surface speed. Any destroyers still in the Atlantic were dedicated to transatlantic convoy duty, so Andrews had to make do with this makeshift flotilla (Gannon 1990:176-181; Hickam 1989:5-6). Furthermore, the aircraft and crews that were available to Andrews were inadequate for battling Dönitz's

U-boats. Most of the U.S. naval aircraft were obsolete and nearly all were incapable of maintaining long-range maritime patrols. This dismal situation was partly offset by Andrews's relationship with the Army's Northeast Defense Command, which enabled him to turn to the Army Air Forces for long-range antisubmarine patrol duties. Their effectiveness, however, was limited by the Army aircrews' inexperience in ship recognition and over-water navigation; the Army aircrews restricted their flying time to daylight hours, when the U-boats tended to stay submerged and out of sight.

U.S. Convoy in the Caribbean Sea. Photograph taken from the SS WM J. WORTH, U.S. freighter. NARA 80-G-104054.

Before the end of December 1941 five U-boats were at sea, en route to the East Coast of the United States. This was the first sortie of Operation Drumbeat (*Paukenschlag*), Dönitz's offensive against American merchant shipping. Although Dönitz had requested 12 U-boats for his American operation, only five were made available. Despite their small number, these five submarines, and those that relieved them, would wreak havoc along the East Coast shipping lanes. Between January 11 and February 28, 1942, 74 ships were attacked and all but one were sunk or damaged, with no losses to the U-boats. Andrews's inadequate forces were obviously no match for the German submarines. With too few ships, it was



Burning tanker, SS Benson. NARA 80-G-63472.

impossible to institute a convoy system that would have added a measure of protection for merchant vessels, which instead sailed alone in the (false) hope that speed equaled safety. Compounding the problem was the refusal of the civilian and military authorities to order a blackout of coastal towns and resorts. Ships, even as far out to sea as 20 miles or more, were silhouetted against the glow, making them easy targets for torpedoes (Gannon 1990; Hickam 1989).

Aerial view of German submarine U-3008 at sea. NARA 80-G-442933.

The five U-boats in the first wave of Dönitz's offensive were responsible for the sinking of nearly 200,000 tons of shipping. As historian Edwin P. Hoyt (1978:43) has calculated, the German effort made by these five submarines in roughly a month cost the Allies 400 tanks, 60 8-inch howitzers, 880 25-pound guns, 400 two-pound guns, 240 armored cars, 500 Bren carriers, 52,100 tons of ammunition, 6,000 rifles, 4,280 tons of tank supplies, 20,000 tons of stores, and 10,000 tanks of gasoline.

German U-boat (118) under the attack of aircraft from the USS Bogue (CVE-9). The depth charges released by Lt. (JG) Fryatt hit the surface and exploded seconds later. NARA 80-G-68694.

The first month of Operation Drumbeat had been a disaster for the Allies. Worse was to come.

The first tanker sunk as a result of Operation Drumbeat was the *Norness*, a Panamanian ship torpedoed about 60 miles off Montauk Point, Long Island, on January 14, 1942. Over the next three months 46 tankers would go to the bottom and 16 more would be damaged, as the U-boats roamed America's Atlantic and Gulf coasts (Hickam 1989;

Rohwer 1999). Daily crude shipments from the Gulf of Mexico, which had reached a high of 1.4 million barrels in the spring of 1941, would be reduced to 100,000 barrels per day by January 1943. Oil field and refinery production declined as a result of the diminished amount of oil that could be transported.

In response to the sinkings, a meeting was held on March 4, 1942, between service representatives from the Navy and War departments and members of the Tanker Committee of the Petroleum Industry War Council. The industry calculated that if the losses continued at the same rate through the end of 1942, nearly a third of the tankers available on the coast would be destroyed; to make matters worse, insurance companies were already refusing to write policies on merchant vessels (Gannon 1990:342-343). The human cost was even more appalling; at the current rate of loss, 3,000 more seamen would die or be disabled. Already, deteriorating morale was making it difficult to crew the ships, and in some cases merchant crews refused to sail rather than face the U-boats without protection (Hoyt 1978:44).

The oil industry committee made a number of recommendations, including the arming of the tankers (with gun crews provided by the Navy), using the Civil Air Patrol to force down the U-boats (the Shell Oil Company even suggested flying its own planes off of the ships), and suppressing the bright shore lights (Gannon 1990:342; Hoyt 1978:97). Yet despite the efforts of the oil industry and Admiral Andrews, tankers continued to be sunk. Finally, at the end of April 1942, with the situation worsening, Admiral Ernest King, Chief of Naval Operations and Commander in Chief of the United States Fleet, forbade tankers from sailing north of the Florida straits (Hoyt 1978:103).

Despite the sometimes fanciful solutions posed by the oil companies, the real answer to the U-boat threat lay with a combination of escorted convoys, the development of effective submarine-fighting techniques, and the incorporation of recent advances in technology and intelligence. Convoys had proven somewhat effective in protecting merchants' ships, and once a coastal convoy system was established and more escort vessels became available, losses to the German submarines began to decline sharply. By the end of July 1942 Dönitz had withdrawn the U-boats from American waters to concentrate against shipping in the North Atlantic. Yet even before the U-boats were reassigned, other solutions to the growing fuel supply crisis were being applied.

The Development of Petroleum Pipelines in the United States

Oil pipelines date back to the earliest period of oil exploration and production in Pennsylvania. Edwin L. Drake drilled the world's first oil well near Titusville, Pennsylvania, in 1859. Horse and wagon teams provided transportation from the oil fields to the nearby tributaries of the Allegheny River, for eventual shipment down to Pittsburgh. Since the railroads were 20 to 25 miles distant, a search for a more reliable and efficient means of transportation began almost immediately. In 1862 a small-diameter pipeline was successfully installed to carry oil approximately 1,000 feet, from a producing well to a field refinery; however, when two-inch-diameter cast-iron pipe was run over a distance of two miles the following year, it sprang many leaks. Pipeline technology was not the only hurdle: sabotage to the pipelines by teamsters fearful of the threat to their livelihood was another (Wolbert 1979:1-2).

The first successful commercial oil pipeline was completed by Samuel Van Syckel in 1865. It was two inches in diameter, made of wrought iron, and held together with screw-threaded joints. Van Syckel charged one dollar a barrel to run the oil about five miles from Pithole City to the Oil Creek Railroad Station. Entrepreneurs rushed to build pipelines from the oil fields to shipping terminals, either river barge or railroad. Railroads attempted to monopolize oil transportation and dictate prices to producers. Oil producers countered by constructing lines directly from the producing fields to the refineries. By 1874 a four-inch line had been laid from the producing fields to Pittsburgh. Not wanting to be out-maneuvered, railroads formed associations with pipeline transportation companies. The Standard Oil Company, the nation's largest refiner, turned the table on these associations by developing its own system of pipelines and storage facilities.

Standard Oil's chief competition was the Tidewater Pipe Line Company, formed by a group of producers who had built a six-inch line across the Allegheny Mountains, spanning the 115 miles between the producing center of Coryville and the railroad loading facilities at Williamsport, Pennsylvania. Completed in 1879, the Tidewater pipeline represented a major technological advance in pipeline engineering; never before had oil flowed over such a great distance and

at such high altitudes (Wolbert 1979:2-4). The Tidewater pipeline made it possible for independent refiners in the New York area to get Pennsylvania oil at a much lower cost than Standard Oil would have to pay to transport it to its own refineries. Not to be outdone, Standard Oil immediately began building the National Transit Pipe Line system directly from the Pennsylvania oil fields to New York City, thus eliminating any reliance on rail transportation. Upon completion of the pipeline in 1881, Standard Oil controlled the cheapest means of transporting oil to the East Coast.

Demonstrating the size of large-diameter pipe. NARA 208-PRA-3-14-7126-9.

Pipelines had clearly proven their superiority for transporting oil over long distances, and Standard Oil had shown the advantage to refiners of controlling the transportation of oil. Refiners took the lead in financing, building, and operating pipelines, thus assuring themselves of a steady stream of low-cost crude oil of uniform quality, plus an outlet for their products (Burke 1964:788-789; Wolbert 1979:4-5).

Standard Oil continued to invest in large pipeline projects. In the 1880s it built an eight-inch 205-mile pipeline from the newly discovered oil fields of Ohio to Chicago. Unlike the labor-intensive days of pipeline construction during the previous two decades, this pipeline project used a traction engine to string pipe, a steam-powered screw machine to join the threaded pipe joints, and a steam-powered ditching machine to dig the pipe

Oil well derricks and oil tanks in the Moundridge area, near McPherson, Kansas (October 1941). Farm Security Administration, Marie Post Wolcott. NARA 208-PR-26R-4.

trench. Manual labor was used only to remove stumps and boulders and to lower the pipe into the trench (Wolbert 1979:6).

Beginning in the late 1870s most pipelines were five or six inches in diameter because few companies had the production necessary to load larger diameter lines to capacity. A period of intense pipeline construction was ushered in by the discovery of oil in the Mid-Continent field (Oklahoma and Kansas) in the 1890s, the Texas Gulf Coast in 1901, and southeastern Illinois in 1906. Eight inches became the standard pipe size and remained so until the early 1930s, for it was the largest diameter that could function at the normal operating pressures of the times. Ten-inch and 12-inch pipelines required lower operating pressures because of their tendency to split at the seams.

By the end of the 1920s major refineries were capable of processing 80,000 to 125,000 barrels of oil a day, but an eight-inch pipeline could only deliver 20,000 barrels per day. To increase capacity, an additional line usually looped, or was laid alongside of, the existing line. Crude trunk lines radiated from interior points in Texas and the Mid-Continent south to the Gulf and north to major midwestern refineries. Between 1930 and 1945 about 35,000 miles of pipeline were added to the 115,000 miles that had already been built. During the war the oil industry and the government undertook 35 different major pipeline projects, making it the greatest pipeline construction period in the history of the industry. By April 1945 pipeline shipments would soar to 754,000 barrels per day (Burke 1964:784; Castaneda and Pratt 1993:16-17; Frey and Ide 1946:101; *Look* editors 1946:112; Wolbert 1979:6, 10, 15, 22).

The 1930s brought the development of "big inch" steel pipe, referring to pipe larger than 12 inches in diameter. Pipeliners had been aware of the theoretical economies of large-diameter lines for some time, but lacked the impetus to force the technology because the demand for crude oil and products had not been great

Viewed through a section of 24-inch pipe, a worker leans on a section of pipe ready for lowering into the ditch at right. NARA 208-LU-37C-34.

enough. Increased civilian and military demand before and during World War II, together with the shortage of steel, set the stage for the adoption of the "big inch" technology (Wolbert 1979:21).

The "Red Crown," a Standard Oil tanker. Petroleum Administration for War. NARA 253-CD-13-12, Box 2.

On the eve of World War II America's strategists looked back to the lessons learned during the last great war. The importance of petroleum supplies had become abundantly clear as the armies of World War I became increasingly mechanized. American tankers kept the Allies supplied while the Allies cut Germany off from every foreign source of oil. The Germans later admitted that it was chiefly insufficient oil reserves that had forced their capitulation. In the 20 years following World War I, Europe's peacetime consumption of petroleum products more than quadrupled. And to win World War II, America and its Allies would consume almost seven billion barrels of oil, much of it needed to fuel ships, planes, tanks, and trucks, and to manufacture explosives, synthetic rubber, and chemicals (Rister 1949:345; Yergin 1991:378-379).

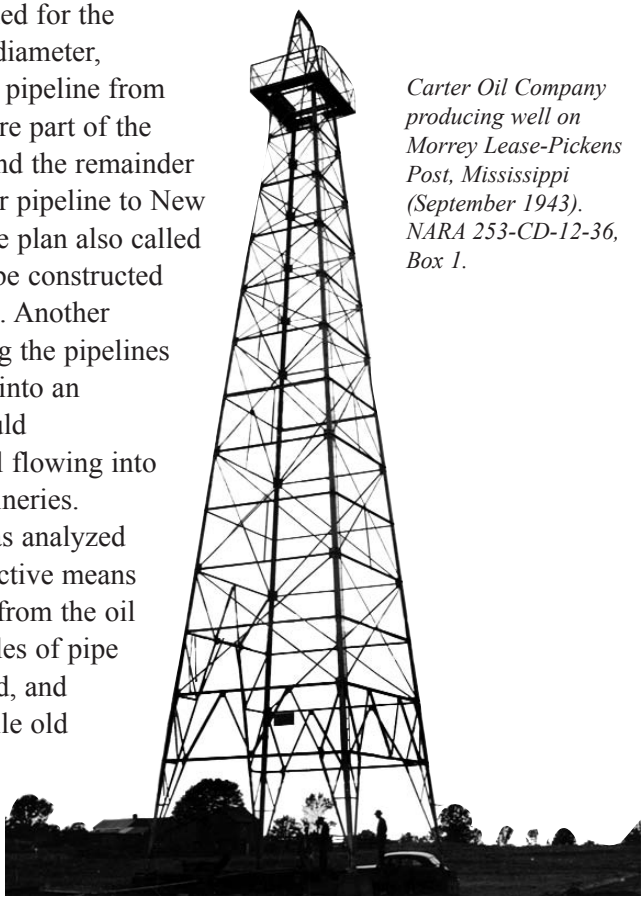
"The Most Amazing Government-Industry Cooperation Ever Achieved"

Oil for the East: Forming the War Emergency Pipeline Corporation

During 1942, as the fuel supply on the East Coast dwindled because of the depredations of the U-boats, a revolution in the transportation and distribution of petroleum began. All existing pipelines, railroad tank cars, and barges were dedicated to transporting oil north and east. Private oil companies began unprecedented practices, such as the pooling, exchanging, or sharing of facilities and equipment with their competitors. Even with these measures, however, tank cars and barges could not replace the capacity of the tankers. So

the United States began a program of tanker building. By the end of 1943 American tankers were being launched more quickly than the Germans could sink them, thanks in large part to better protection from the U. S. Navy. By the end of the war every ton of Allied oil-carrying capacity sunk by the U-boats had been replaced twice over by American shipyards. In fact, America was able to build a fleet of more than 800 tankers, with enough capacity to equal the world's entire prewar petroleum fleet (Frey and Ide 1946:3-4; Rister 1949:355; Tugendhat 1968:117).

Representatives of America's pipeline industry met in Tulsa, Oklahoma, in March 1942 to formulate the basic American wartime pipeline strategy. The resulting "Tulsa Plan," which became the backbone of the PAW pipeline program, focused on developing the nation's petroleum transportation system and reconditioning existing pipelines. One of the plan's components called for the construction of a 24-inch-diameter, 300,000-barrel-per-day oil pipeline from East Texas to Illinois, where part of the supply would be refined and the remainder sent via a 20-inch-diameter pipeline to New York and Philadelphia. The plan also called for a products pipeline to be constructed from East Texas to Illinois. Another project involved converting the pipelines of 12 different companies into an integrated system that would increase the capacity of oil flowing into Illinois and East Coast refineries. Every existing pipeline was analyzed to determine the most effective means of transporting petroleum from the oil fields to the refineries. Miles of pipe were dug up, reconditioned, and relaid in new systems, while old pumps, valves, and meters were salvaged (Castaneda and Pratt 1993:20-21; Frey and Ide 1946:103).



Carter Oil Company producing well on Morrey Lease-Pickens Post, Mississippi (September 1943). NARA 253-CD-12-36, Box 1.

Sections of big inch pipe laid out on the pipeline right-of-way in Pennsylvania. NARA 253-CD-17-10.

This integrated system was largely completed by the end of 1942, making it a watershed year in the history of petroleum transportation. Major Parten, director of the transportation division of the PAW, wrote in September 1942, "the successful completion of any single one of the undertakings [i.e., building the Big Inch from Texas to Illinois, laying 750 miles of new oil lines, digging up and relocating 1,100 miles of second-hand pipe, reversing and converting 2,600 miles of line, and increasing the capacity of several hundred miles of existing pipelines by adding pump and booster stations] in a given year would, normally, be a marvelous accomplishment. That we are doing the entire job at one and the same time, and with practically no new tools, is, to put it mildly, little short of phenomenal." Parten attributed these accomplishments to "the most amazing Government-industry cooperation ever achieved" (Parten 1942a:55).

NARA Poster Collection.

Finally, on June 10, 1942, the War Production Board (WPB) allocated enough steel to build the first section of the proposed 24-inch-diameter pipeline from East Texas to Norris City, Illinois. The chairman of the Reconstruction Finance Corporation (RFC) agreed to finance the $35 million construction project if the oil industry would organize and staff a nonprofit corporation to supervise its construction and operate the completed pipeline. The construction funds would be channeled through the Defense Plants Corporation (DPC), a

subsidiary of the RFC, which would own the pipeline, while another RFC subsidiary, the Defense Supplies Corporation (DSC), would operate the pipeline (Castaneda and Pratt 1993:21-22).

Utility men opening up oil filtering lines at WEP station near Eagle, Pennsylvania (November 1944). Parks-Standard Oil Company, New Jersey. NARA 208-LU-37C-16.

War Emergency Pipelines, Inc. (WEP), was incorporated in Delaware on June 25, 1942, by 11 private oil companies. The WEP had a nominal capitalization and a provision in its charter that prohibited the corporation's stockholders from accruing any profit from the enterprise. Government supervision and restrictions were more stringent for the WEP than for other commercial enterprises. The stockholding companies were the Standard Oil Company of New Jersey, the Texas Pipe Line Company, Cities Service Oil Company, the Socony-Vacuum Oil Company, the Gulf Oil Corporation, the Consolidated Oil Corporation, the Shell Oil Company, the Atlantic Refining Company, the Tidewater Associated Oil Company, the Sun Oil Company, and the Pan American Petroleum and Transportation Company (Burt E. Hull Correspondence Files, June 1, 1943; Castaneda and Pratt 1993:22; WEP 1944:12).

The 11 stockholding companies also pooled their personnel to construct and operate the pipelines. W. Alton Jones, the president of Cities Service Oil Company and the chairman of the Transportation Committee of the Petroleum Industry War Council, assumed the presidency of the WEP. Burt E. Hull, described by W. Alton Jones as "the world's best pipeliner," served as the WEP's vice president and general manager, supervising construction of the pipelines. Before taking on his duties at the WEP, he had headed the Texas Pipe Line Company. Hull put together a staff drawn from the companies he knew best, including Cities Service, Texas Pipe Line, Humble, Standard of Louisiana, and Oklahoma Pipe Line. Burt Hull was succeeded by his assistant, Major A.N. Horne, after the Big Inch was completed. Horne was president of the Empire

Pipe Line Company of Oklahoma and one of the nation's leading pipeline engineers. The WEP's chief engineer was Oscar Wolfe, who had served as chief engineer for the Texas Pipe Line Company. The general superintendent of the WEP was Oscar R. Burden, formerly the general superintendent of the Texas Pipe Line Company (Castaneda and Pratt 1993:22; *Pipe Line News* 1943:9; Reed 1942a:52; *World Petroleum* 1942:39).

The WEP began executing construction agreements with the DPC the day after its incorporation in June 1942. The initial contract was for the construction of the "Big Inch Line" from East Texas to a railroad loading terminal in southern Illinois. A supplemental agreement in November 1942 covered the extension of the 24-inch-diameter pipeline to a junction near Phoenixville, Pennsylvania, with 20-inch-diameter branch pipelines to the New York and Philadelphia refinery areas.

Swooping down the side of an Allegheny Ridge in western Pennsylvania, the "Big Inch" heads toward its other sections already nearing New York and Philadelphia. ACME. NARA 208-LU-37C-54.

The Facilities

The Pipeline and the Pumping Stations. The plan that was developed called for a 24-inch-diameter pipeline to carry crude oil, beginning at Longview, Texas, and running northeast through Arkansas and Missouri to Norris City, Illinois, a distance of 530.36 miles, with a right-of-way width of 75 feet. This leg was to be constructed first to supply a tank-car loading facility at Norris City, from which point the oil would move by rail to the East Coast. A tank farm would be built at Norris City to provide storage, and a 5-mile-long branch pipeline between the facility and Enfield, Illinois, would connect with oil pipelines of the Illinois Pipe Line Company and the Texas Pipe Line Company. This 24-inch-diameter branch pipeline, known as the "Enfield Connection," would

provide an additional delivery capacity of 50,000 barrels per day. Pumping stations would be constructed approximately every 50 miles along the pipeline to supply the necessary power to move the oil at the desired flow rate. Longview was designated Station No. 1, and Norris City was designated Station No. 11 (Cathers 1943:11).

Pennsylvania section of the war emergency 24-inch pipeline carrying oil from the Texas fields to eastern refineries, completed in July 1943. Pipe stacked along the railroad tracks. John Vachon. NARA 208-LU-37C-50.

Once the first leg of the pipeline was constructed and operational, a second leg, known as the eastward extension, was to be constructed. The extension would continue the 24-inch-diameter pipeline 721.76 miles to Phoenixville, Pennsylvania, where the pipeline would split into two 20-inch-diameter pipe laterals to serve refineries in the New York and Philadelphia areas. The New York lateral was 86.25 miles long and terminated in Linden, New Jersey; the Philadelphia lateral was 22.75 miles long and terminated in Chester Junction, Pennsylvania. On October 27, 1942, the RFC approved $60 million for the eastern extension, and on November 12 the contract for its construction was signed between the WEP and the DPC. After the allocation of 219,000 tons of steel for the eastern extension had been approved, Harold Ickes issued a statement saying how essential the pipeline was to the success of the war effort. He cautioned the civilian population not to expect an easing of petroleum restrictions because "[the pipeline's] primary function, first, last, and always, must be to insure adequate petroleum supplies for our armed forces, the United Nations, war production, and the basic needs of civilian transportation and health" (Petroleum Administration for War n.d.).

The Big Inch Line was the biggest and longest petroleum pipeline ever attempted up to that time. No previous pipeline project had ever laid pipe over

such a variety of terrain. Men dug a ditch four feet deep and three feet wide and laid pipe over the Allegheny mountain range, through swamps and forests, under 30 rivers and 200 creeks and lakes, beneath streets, railroad right-of-ways, and through backyards, often during severe weather conditions. Total excavation was more than 3,140,000 cubic yards of earth, and the whole job had to be done faster than anyone had ever laid a pipeline before (*Look* editors 1946:112). The Inch Lines traversed 95 counties in 10 states. Approximately 7,500 individual right-of-way grants and tenants' consent were procured and construction damage claims paid. About 300 parcels required condemnation proceedings ("Big Inch" 1943:16; Pipelines of Energy 1967:9).

Little Rock, Arkansas, to Missouri-Arkansas state line, October 1942. War Emergency Pipeline from Longview, Texas, to Norris City, Illinois. Pipeline cutting through a cotton field. NARA 208-LU-37C-52.

Once the 24-inch-diameter main crude oil pipeline, which became known as the "Big Inch Line," was completed, a second parallel line of 20-inch-diameter pipe was planned to be built alongside it to carry refined petroleum products from the refineries along the Gulf Coast. The products pipeline, or "Little Big Inch Line," was designed to share the same pumping stations as the Big Inch Line (with separate pump houses and associated structures), beginning at Station No. 5 (Little Rock) and running east. From Little Rock, the 20-inch-diameter

pipeline would follow a separate route nearly due south to Beaumont, Texas, to gather petroleum products along the Gulf Coast. Seven additional products-line-only pumping stations would be built along this portion of the route.

Supply System. The 24-inch-diameter main pipeline was supplied by the Longview Feeder System, which consisted of four separate pipelines connecting privately owned carriers and refineries with the tank farm at the Longview Station.

The 20-inch-diameter pipeline was supplied by the Baytown-Beaumont Feeder System, which consisted of two separate systems connected with privately owned refineries in the Gulf area. The system was designed to handle gasoline, diesel oil, heating oil, and kerosene with minimal cross-contamination.

Special Stations. Three "Emergency Stations" were constructed in Pennsylvania and New Jersey. Those located in Montgomery County, Pennsylvania, and Somerset County, New Jersey, consisted of an assembly of piping and valving known as a "manifold bypass." The purpose was to allow future station construction at those sites without interruption of the flow of oil. The Emergency Station located at Chester Junction, Pennsylvania, consisted of a manifold bypass for the purpose of dividing the stream of oil to the different refineries in the Philadelphia area.

Distribution System. The New York delivery system consisted of approximately 15.8 miles of 12-inch-diameter pipeline and approximately one-half mile each of 8-inch- and 10-inch-diameter pipelines, which extended from the Linden Station to seven refineries and outlets in the Bayonne, New Jersey, area. The oil companies served included Socony-Vacuum Oil Company, Sinclair Oil Company, Cities Service Oil Company, Gulf Port Oil Company, Tidewater Associated Oil Company, Hartol, and Richfield.

The Philadelphia delivery system consisted of approximately 11 miles of 16-inch-diameter pipeline, 3.5 miles of 14-inch-diameter pipeline, and 2.9 miles of 12-inch-diameter pipeline connecting the emergency station at Chester Junction with refineries in the Philadelphia area. The oil companies served included Atlantic Refining Company, Gulf Oil Corporation, Socony-Vacuum Oil Company, Sun Oil Company, and Sinclair Oil Company (Cathers 1943:100, 101).

Organizing the Construction

First carload of 24-inch seamless pipe for the Big Inch (July 17, 1942). Petroleum Administration for War. NARA 253-CD-178.

Paul Reed, the primary reporter on the WEP project for the trade publication, *Oil & Gas Journal* concluded that the feat of building the Big Inch within a year's time was made possible by the engineering accomplishments of Oscar Wolfe and his staff and by the initiative displayed by the WEP's management team. This initiative was displayed from the outset when A.N. Horne arrived in Little Rock with only his briefcase on July 1, 1942. Two days later Burt E. Hull joined Horne and the two wrote the specifications, employed a traffic manager, and discussed shipping points with contractors, all from their hotel room. A few days later they purchased office furniture at an auction using their own money. It was several weeks before the United States government provided any funds; the two men operated on a shoestring so as not to delay the project. Without waiting for the usual formalities of signed and approved contracts, both general and pipe stringing contractors went into the field, and the work was well under way by early August (Reed 1943a:88-89).

Workmen at the Lorain, Ohio, works of the National Tube Company send up a cheer as the last carload of 24-inch pipe leaves the plant for the midwest. Petroleum Administration for War. NARA 253-CD-17-7.

On July 11, 1942, Burt Hull summoned to Little Rock every American pipeline contractor who had construction equipment heavy enough to handle big inch

pipe, to help formulate a program that would meet the construction deadline of January 1, 1943. The first leg of the project was divided into eight construction sections. The length of each section was between 50 and 60 miles, depending on the nature of the terrain and therefore the difficulty of construction. Seven contractors were selected to organize eight crews of 350 to 400 men each. To assure completion of all sections by December 1942, river crossings (which required special construction techniques) and the branch pipelines at Longview and Norris City were contracted separately. Eighteen crews were assembled to handle the river crossings alone. In addition, three pipe stringing contractors were needed to supply enough trucks and equipment to haul, unload, and string pipe along the right-of-way ("Big Inch" 1943:10; Reed 1943b:63; Rice 1946:not paginated). The construction agreements between the WEP and the contractors were signed on July 15, 1942, and approved by the DPC the same day. Approximately 35,000 purchase orders would ultimately be issued and over 200 agreements would be negotiated with 82 construction contractors carrying over 16,000 men on their payrolls (Cathers 1943:4, 21).

Williams Brothers, the nation's foremost pipeline builders, were chosen to be the principal contractor on both the Big Inch and Little Big Inch projects. They laid approximately 600 miles of pipeline for the WEP, built 14 pumping stations, and installed all the river crossings on the Big Inch. For them a pipeline project required "the marshaling of talents, equipment, and materials in proper sequence to perform specialized work in any location, at a predictable cost and on a planned time schedule" (Williams Brothers Company 1958:89-90).

Construction of the pipeline consisted of receiving and moving materials to the construction site; clearing and grading the right-of-way and excavating the trench (called ditching); cleaning, welding, bending, and coating the pipe; and setting the pipe in the trench and backfilling. In addition, the pumping stations were constructed at intervals averaging about 50 miles. Station features included pump houses, power supplies, employee housing, storage tanks, and special piping and valves, plus six to 10 other support buildings and structures per location.

Even before the Little Rock office was open, Burt Hull had put 15 surveying parties into the field beginning on June 23, 1942, to stake out the 531-mile right-of-way between Longview, Texas, and Norris City, Illinois. The

contractors' work crews arrived on the heels of the surveyors to clear the 50-foot-wide right-of-way. Pipelaying began on August 3, 1942. The schedule called for five miles of the Big Inch pipeline to be laid each day, but soon men were laying as much as nine miles a day (Rister 1949:358-359).

Constructing the Inch Lines

The Pipe. The first purchase order, for 137,500 tons of 24-inch-diameter pipe, was placed on July 2, 1942. Two weeks later the first trainload of pipe was shipped to Little Rock by the National Tube Company. The entire project would ultimately require 21,185 railcar loads of pipe. Another nearly 4,000 carloads of other materials would be delivered, bringing the total weight of materials for the job to 725,000 tons (Cathers 1943:21).

The pipe used in the construction of the Big Inch Line consisted of 24-inch-diameter seamless steel pipe weighing 94.62 pounds per foot and having a wall thickness of 3/8 inch. A total of 135,700 tons of pipe were required for the first section of the pipeline to Norris City, and 225,000 tons for the second section. The Big Inch Line's distinction as the biggest, heaviest, and longest pipeline built up to that time presented challenges to the builders. The individual pipe sections averaged 38 to 44 feet in length and weighed between 3,800 and 4,200 pounds.

Pipelaying. The laying of pipe began on August 3, 1942, near Little Rock. Other pipeline crews began work immediately on segments elsewhere in Arkansas and Texas. By September 10 all eight pipelaying crews, each consisting of between 300 and 400 men, were in the field working.

Inspecting the pipeline for holes before it is rolled into the trench. NARA 208-PRA-3-14-7128-20.

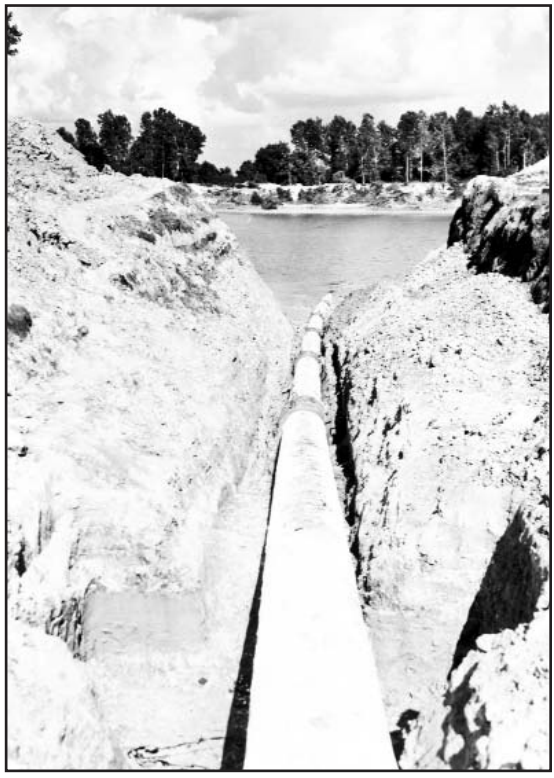
Machine wrapping pipe in felt. NARA 208-PRA-3-14-7126-44.

The pipe was unloaded using a side-boom tractor, which picked the sections off the delivery trailers and placed them on the ground end to end. In contrast to the practice with smaller pipe, which was sometimes simply rolled off, use of the side-boom tractor ensured that the ends of the pipe were not damaged, which could result in faulty welds. The inside of the pipe was swabbed clean by a man who was pulled through the pipe on a cleaning pad and also used hand rags (Cleary 1942:45, 46).

The pipe trench or "ditch" was dug with a rotary-wheel-type ditching machine where soil conditions permitted. In rock and other hard material, backhoes, shovels, and cranes were employed. Occasional hand work was required to clear material that collapsed in the trench before welding or the installation of valves was completed. In all, roughly seven million cubic yards of material were excavated (Cathers 1943:9). The trench was 36 inches wide and excavated to a depth of 4.5 feet, except in solid rock ("Big Inch" 1943:11).

Wherever the pipe crossed under a highway or railroad line, the pipe was "cased" within another pipe of slightly larger diameter. The crude oil pipeline crossed under railroads at 289 points and under highways at 626 points (Cathers 1943:8, 11).

River crossings required different construction techniques and were therefore contracted separately from the main pipeline to companies with the experience and equipment necessary for underwater pipelaying. The crude oil pipeline required 33 river and stream crossings, with another 16 crossings on the feeder and distribution pipelines. Barge-mounted clamshell-bucket dredges, drag-line buckets, and suction dredges were used to excavate the underwater trench for the pipeline. When rock was encountered, underwater blasting with dynamite was employed. Despite its weight, the pipeline floated when empty; this



And so to bed on the bottom of the river in Arkansas goes the big oil pipeline. This was the first river crossing completed on the 530-mile stretch between Texas and Illinois. NARA 208-LU-37C-13.

required the placement of 4,800-pound "river clamps" approximately every 30 feet to anchor the pipe adequately to the bottom.

Perhaps the most challenging of the river crossings was at the Mississippi, where Big Inch engineers had to find a way to lay the heaviest pipe ever laid through a trench along the river bottom. It took nearly 11 weeks to prepare for blasting the trench, to clean it out, and then to lay the pipe. In late December 1942 heavy rains and flooding led to the destruction of the crossing just two days prior to its completion. The replacement crossing was constructed with heavier pipe (Cathers 1943:6; Reed 1943c:41-42).

Conditions in the vicinity of Linden, New Jersey, presented many obstacles to the construction of the New York area branch delivery pipelines. These lines, totaling 16 miles of 12-inch- and 14-inch-diameter pipe, connected the Linden Station with refineries at Bayonne, Bayway, Carteret, Trembley Point, and Perth Amboy. The tidal marshes that had to be crossed could not support heavy equipment, and in most places earthen fill was either dredged or trucked in to create a raised bed for the pipe. In Bayonne, roughly 3,000 feet of horizontal boring were required to install pipe beneath streets and railroad tracks. River and bay crossings required about four miles of submarine pipeline construction. The Army Corps of Engineers required the Newark Bay and Arthur Kill River

crossings to be laid 42 feet below mean low tide, 13 feet deeper than originally planned (Cathers 1943:13-14).

Welding. Depending on the preference and practice of the individual pipeline contractors, the pipe was welded and laid using one of two different methods, known as the stovepiping method and the roll-weld method. Each method had its advantages and disadvantages, which varied depending on equipment and conditions. The primary difference between the two methods was in the manner in which new pipe sections were added to the line and the pipe-bending methods employed. In the stovepipe method, pipe sections were added one at a time, and hot bending was required. In the roll-weld method, three to six sections were first joined together to form a "string" and then welded to the pipeline. Cold bending of the string was accomplished before it was welded to the pipeline. Considerable debate raged among the contractors as to the superior method in terms of quality and efficiency (Cathers 1943:8; Cleary 1942:46).

It's 99 in the shade, not counting the heat from the arc, as the welder joins the ends of two sections of pipe together. Pipeline welders work in pairs. World Wide Photos. NARA 208-LU-37C-36.

Bending the Pipe. To adjust for changes in the vertical and horizontal alignment of the pipe, the pipe was bent to fit in the field using both hot and cold bending methods. On long, straight runs, short horizontal curves or "kinks" were also constructed in the pipeline to absorb the expansion and contraction of the pipeline due to temperature changes (Cleary 1942:45).

In the construction of the 24-inch-diameter pipeline between Longview and Norris City, roughly half of the pipe was constructed with the roll-weld or firing-line method and cold bends, and half with the stovepipe method and hot bends. The standard method of cold bending required three large tractors, one

equipped with a bending shoe and located in the center of the bend and two at each end to push in the opposite direction. A long string of pipe (two or more sections) provided the necessary leverage to make the bend on large-diameter pipe (Reed 1943d:180).

Coating and Wrapping, Placing, and Backfilling. Following welding and bending, the exterior of the pipe was cleaned, and a specially developed three-part coating was applied to prevent corrosion. The substantial expense of the elaborate coating process, which required the use of specialized machines for its application, was justified by the fact that protection against corrosion assured negligible depreciation and a high future value of the pipeline. This forethought greatly served American taxpayers when the pipeline was sold after the war for the full cost of its construction (Cleary 1942:46).

Pumping Station Construction. Construction of the Big Inch Line pumping stations and power transmission lines did not begin until November 1, 1942, because of difficulties in acquiring the land. The stations were of nearly identical design, layout, and equipage, with minor modifications to accommodate site conditions, material availability, or the location of storage tanks and associated equipment. The actual distances between stations varied from 31 to 78 miles, the spacing closer for uphill and wider for downhill terrain ("Big Inch" 1943:6).

Pump Houses. Crude oil pump houses were prefabricated steel-frame buildings measuring 36x60 feet, with concrete-slab foundations, corrugated sheet-metal roofs and walls, steel sash, and steel doors. A sheet-metal firewall, extending from the floor to the peak of the gable roof, ran the length of the building to isolate the motors and pumps in separate rooms. Special facilities for the storage of crude oil and the transfer of the crude oil to railroad tank cars were required at the terminus of the first leg of construction. This dictated a much

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larger pump house to hold the additional pumps required to fill and empty the storage tanks and supply the tank-car loading racks. By the time the design was put on paper in late 1942, the wartime steel shortage had grown more acute, and the materials for the pump house were changed from all steel to wood framing with asbestos roofing and siding.

The products pump houses on the 20-inch-diameter products pipeline were all of wood-frame construction with asbestos roofing and siding, but differed in a number of ways from the crude oil pump houses because of the different nature of the services to be performed and the lessons learned in the operation of the 24-inch-diameter pipeline. The length of the building was increased by 24 feet by the addition of a 24-foot-long control room across one end of the building. This allowed separation of the electrical switchgear and operator controls from the motor room, providing greater safety and comfort for the operators. Other new features on the 20-inch-diameter pipeline included a provision for throttle control, sequence starting and stopping of the units, special control room features, and the addition of filter units known as "hay tanks" to remove suspended particles before they reached the pumps (Reed 1943e:156).

The 20-inch-diameter pipeline was designed to handle as many as four different kinds of products, including gasoline, heating oil, diesel oil, and kerosene. The different materials were kept separate within the line by solid rubber balls, slightly smaller than the inside diameter of the pipe, which moved through the pipe between the different products. The different products were known as batches, blocks, or tenders, three terms used interchangeably in the industry (Reed 1943e:158).

Power Supply. The electrical requirements of the WEP project were very large and required a substantial amount of the project's design and construction dollars. Nineteen utilities in nine states provided the power. Electrical transmission lines were constructed to the stations where electric power was otherwise not available, and two high-voltage substations, one for each pump house, were constructed, because of the difference in their construction time and voltage requirements. For the most part, steel wire was used for transmission lines, because of the shortage of copper during the war (Reconstruction Finance Corporation 1946).

Housing. Since most of the pumping stations were not located near towns, it was necessary to build from one to five cottages at the stations to house the operational crews. Wartime restrictions on automobiles, gasoline, and tires made it impractical to expect employees to commute long distances to work (Cathers 1943:12).

The one-story wood-frame cottages, built according to Federal Housing Administration specifications, were of identical design and typical in their utilitarian character of much of the housing raised under United States government auspices at military installations and war production locations. The cottages were built on concrete foundations measuring 27x33 feet, and included three bedrooms, a kitchen, a living room, and a bath. The buildings had asbestos-shingle siding and roofs, and wooden 6/6 double-hung sash and wooden entrance doors. All rooms had hardwood floors and plaster lath walls, except the baths, which had ceramic tile floors and walls (Cathers 1943:12).

When an oil field is in operation, it requires an army of workers to keep the production machinery going. Many of the workers live close to the fields in attractive homes built in modern community style. This group of houses is near the storage tanks and the treaters of producing wells. King Features. NARA 208-PR-26Q-1.

Storage Tank Facilities. No steel was available for the construction of new oil tanks, so all the storage tanks on the WEP used tanks of riveted construction, which were disassembled at their point of purchase, from as far away as Wyoming, and reassembled at the WEP stations.

Support Buildings and Structures. These included garages and warehouses, well houses, sample and fire houses, crude oil pipeline and products pipeline sump sheds, hay filters, burn areas, and offices.

Communications. The nature of pipeline operations with its sequence of pumping stations made a reliable communications system vital. The WEP had a teletype circuit installed, tying all the stations to a central dispatching office in Cincinnati. Groups of stations were linked together with a loudspeaker that provided two-way conversation between station operators and between the operators and the dispatchers. As a fallback, telephone lines linked each station to the nearest town ("Big Inch" 1943:8-9).

WEP Operations

The year 1942 ended with a better outlook than when it began. The amount of oil carried by railroad tank cars had steadily increased. More oil was obtained from foreign sources, such as Venezuela, and refineries built in the Middle East. Most importantly, oil began flowing through the Big Inch Line between Texas and Illinois on New Year's Eve. Despite the improvements to transportation and distribution, however, the PAW's Weekly Supply Bulletin reported in January 1943 that the "severity of the east coast supply condition remains unrelieved" (quoted in Frey and Ide 1946:4). Although more oil reached the East Coast after the completion of the Big Inch Line in July 1943, petroleum products remained in short supply for the civilian population as ever more was siphoned off for the war effort (Frey and Ide 1946:5).

In February 1943 the construction agreement covering the first section of the Little Big Inch 20-inch-diameter products pipeline was signed. The pipeline extended from the refinery areas near Houston and Beaumont, Texas, to a point near Little Rock, Arkansas, from which point the Little Big Inch Line used the same right-of-way as the Big Inch system (WEP 1943:9).

Progress on the Pipeline

Several crews began work on different sections of the pipeline on August 3, 1942. By the end of September about 160 miles of the 530 miles between Longview, Texas, and Norris City, Illinois, had been completed. Two river

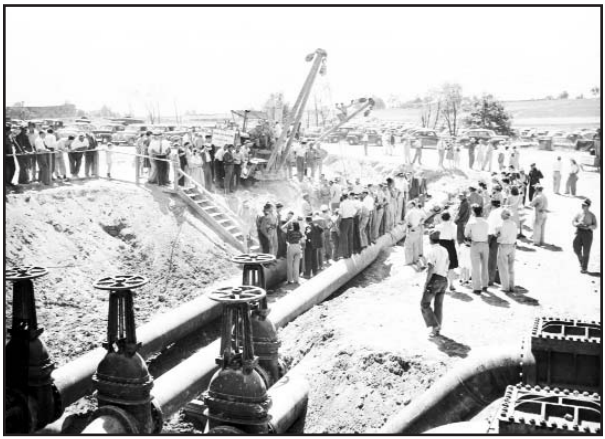
crossings were also finished and another two river crossings were half finished. Problems in the terrain and weather were encountered during the first month of construction in the swampy areas of northeastern Texas and southern Arkansas, where frequent rains made it difficult to lower pipe into the ditch. Even with these delays, pipeline construction continued on schedule (Reed 1942a:52).

When weather conditions were ideal, a construction crew could complete about one to two miles of the Big Inch a day. The Bechtel-Dempsey crew claimed the distinction of having laid the most amount of pipe in a single day, 2.9 miles, while working in Ohio in the spring of 1943. By October 10, 260 miles of pipe had been completed and laid in the ditch. Construction records were being broken and the WEP was confident the pipeline would be completed sometime in December. It was doubtful, however, that pumping stations would be operational before the end of January. During the late fall construction crews experienced intermittent rain and snow that seriously hindered progress ("Big Inch" 1943:12-13; McTee 1943; *Oil & Gas Journal* 1943a:60; Reed 1942b:43).

Weather-related problems also affected progress on the river crossings. The Mississippi River rose quickly on December 29, causing dredges and other floating construction equipment to break their moorings and about 600 feet of pipe to twist off. The construction crew relaid the pipe, and when the last joint was welded at the crossing at 4:00 A.M., January 20, 1943, the Texas-Illinois leg of the Big Inch pipeline was finally completed. The accident at the Mississippi River crossing pointed up the need for a backup, so in February a second 24-inch line was laid across the Mississippi River ("Big Inch" 1943:15; *Oil & Gas Journal* 1943b:100).

The construction of pumping stations, terminal facilities, tanks, and power lines did not keep pace with pipeline construction. This was directly attributable to the need for time to design machinery and valves, as well as the delays caused by inadequate priorities given to their manufacture.

The flow of oil from Longview reached Norris City on February 13, 1943, moving at a rate of 60,000 barrels daily. A few days later, on February 19, 1943, the Texas-Illinois leg of the Big Inch pipeline was dedicated at Norris City. Representatives of government agencies, such as the Reconstruction Finance Corporation, the Defense Plant Corporation, and the Petroleum Administration for War, took part in the ceremonies with War Emergency



The final section of the Big Inch pipeline—the world's biggest and longest—is fitted into place at the eastern terminus at Phoenixville, Pennsylvania, July 19, 1943, just before it was dedicated. The huge valves in the foreground will regulate the flow of oil to eastern refineries. NARA 208-LU-37-C-10.

Pipeline executives and representatives of the pipeline's contractors. Newsreels and newspapers commemorated the event by showing W. Alton Jones, Burt E. Hull, and Ralph K. Davies opening the gate valves and filling the first tank car with oil. Radio carried a coast-to-coast broadcast of the speeches, including remarks from Harold Ickes in Washington, D.C. That same day, the first trainload of oil left the terminal for the East Coast.

Almost immediately, problems arose in getting enough tank cars into Norris City to handle the flow of oil. The tank cars that serviced the WEP line were provided by a pool of cars contributed by oil industry organizations. By the end of March this pool contained only half the number of cars required to meet the monthly schedule of oil shipments. In addition, only three of the six storage tanks at Norris City were completed. A turnaround time of 11 or 12 days occurred between Norris City and the East Coast destinations. Most of the oil was shipped to Standard Oil refineries in New Jersey, Maryland, and Massachusetts. At Norris City, trains of 75 cars were commonly loaded and ready to go within two or three hours after arrival at the loading racks (*Oil & Gas Journal* 1943c:86; Reed 1943e:27).

The completion of all the pumping stations in early April brought the Big Inch up to a steady flow of 200,000 barrels a day. In order for the WEP to meet the schedule of military and civilian petroleum needs, however, the Big Inch had to operate at a capacity of 300,000 barrels a day. Operation at full capacity of the Big Inch had been plagued by floods and the lack of available tank cars. In addition, the lack of completed storage tanks meant that not enough storage was

available at Norris City or Longview to allow the Big Inch to pump at full capacity, and supplies of oil were insufficient, reducing line capacity by 20 to 40 percent (Reed 1943a:88-89).

Several factors contributed to the delays in tank construction at the Longview and Norris City terminals. The purchase of tank farm sites and the contracts to cut down tanks and reassemble them at the WEP tank farms had not been arranged until the late fall or early winter of 1942. There was an acute shortage of skilled labor, as practically all of the labor force had been lured away by cash bonuses to work on the West Coast in the shipbuilding industry. It was so difficult to put together a work crew for this type of work that only one tank construction contractor had bid on the project. Further delays were caused by a reluctance to work overtime, Sundays, or during inclement weather. Executives at the PAW and oil industry stepped in and found additional contractors (Parten 1942b, 1943; Sears 1943).

The problem of the insufficient supply of East Texas crude would need to be addressed by bringing Southwest Texas and West Texas crude through existing lines to Longview. All of the stations were completed in April 1943, but only half were needed to pump the available oil stream ("Big Inch" 1943:12-13; *Oil & Gas Journal* 1943b:50, 100, 1943d:108, 1943e:74; Reed 1943f:34; Rister 1949:360).

Eastern Extension

On October 26, 1942, the allocation of steel was approved for the 721.76-mile eastern extension of the Big Inch. Financing, at an estimated cost of $60 million, was approved the following day. Survey parties were in the field by early November staking out the precise route the eastern extension would follow through Indiana, Ohio, West Virginia, Pennsylvania, and New Jersey. Each survey party was expected to cover one and one-half to two miles a day and complete the survey by the end of the year.

When construction of the eastern extension began in November 1942, 435 miles of the 530-mile distance between Texas and Illinois had been completed, despite two weeks of heavy rain in Arkansas, Missouri, and Illinois. By early December contractors were moving their crews from completed sections along

the Texas-Illinois leg over to the eastern extension, and it was expected that everyone would be at work on the eastern extension by the end of December.

(Left to right) Ralph K. Davis, George Hull, W. Alton Jones, and Burt Hull at the "Big Inch" opening (February 19, 1943). Petroleum Administration for War. NARA 253-CD-17-19.

The expeditious approval of the eastern extension meant that the rolling mills, which had begun rolling out steel pipe on July 10, 1942, would not have to stop and retool. By November 19 the first shipment of pipe from the National Tube Company, a subsidiary of U.S. Steel, was made to points along the eastern extension. By the following February National Tube was turning out a record of 5.8 miles of big inch pipe per day. Another supply of 24-inch pipe was made by the A. O. Smith Corporation, which also furnished factory bends of two, three, four, and five degrees, varying in length from two and one-half to three feet, which were used extensively during construction of the eastern extension. The 20-inch lateral lines were manufactured by Youngstown Sheet & Tube Company and the Republic Steel Corporation ("Big Inch" 1943:13; *Oil & Gas Journal* 1942:163; 1943f:80).

On July 19, 1943, 350 days after construction began, a ceremony was held near Phoenixville, Pennsylvania, to mark the final weld of the Big Inch Line. Oil had already begun flowing into the eastern extension five days earlier. The line was filled at the rate of 100,000 barrels per day, moving eastward at 40 miles per day. It required 2.6 million barrels of oil to fill the eastern extension and a total of five million barrels to fill the entire line between Texas and the East Coast. The flow of oil reached the Philadelphia refinery area on August 15, but problems with the New Jersey lateral delayed delivery to the Linden refineries until October 11. The demand for oil was so acute that rail shipments could not be discontinued during the filling process. As with the southern leg, the pumping stations of the eastern extension were completed after the pipeline

work was finished ("Big Inch" 1943:14; *Oil & Gas Journal* 1943g:90, 1943h:64; Reed 1943g:22).

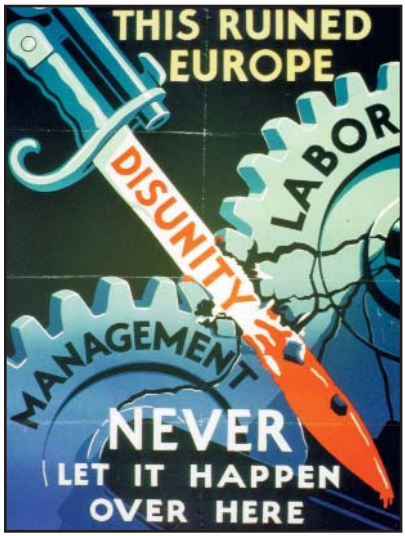
Secretary of the Interior Harold L. Ickes, speaking as the Petroleum Administrator for War, dedicated the $95 million "Big Inch" oil pipeline today with a pledge to fighting forces that they will be provided with all the oil they need for "blasting every enemy." (Left to right) W. Alton Jones, President, War Emergency Pipe Lines, Inc., Secretary Ickes, Mrs. Delores McMurren of Aurora, Illinois, wife of the first welder on the pipeline. She holds her daughter, Patricia (July 19, 1943). ACME. NARA 208-PU-98K-22.

At the national broadcast of the dedication ceremony, it was revealed that the entire Big Inch line was completed for $75 million, $20 million less than the original estimate. Credit for this achievement was given to Burt Hull and his staff at the WEP, as well as all the contractors. Harold L. Ickes again cautioned the people of the East Coast not to expect a greater availability of oil, as the entire capacity of the line would be required to meet military demands. It was estimated that the cost of pumping from Texas to the East Coast would be about 15 cents per barrel. The Big Inch's schedule of 300,000 barrels a day was not expected to be reached until the last pumping stations were completed around November 1 ("Big Inch" 1943:12-13; Reed 1943h:15).

Labor

On a hot day in July 1942 Cliff Baker, a Houston-based pipeline contractor, received word of his involvement with the Big Inch project. Pipeliners were known to be a special breed of men—tough, hard-living, ingenious, and nomadic. He sent telegrams to the places pipeliners could often be found between jobs in the 1940s—lunchrooms, juke joints, and flophouses—from which they were expected to respond on short notice when summoned. Working

in such a specialized field, pipeliners earned top wages but had the reputation for being broke a few days after payday. Pipeliners were also known for their colorful nicknames. Cliff Baker's first wire went to "Wedgehead" Madden, a boss pipeliner in Oklahoma City, who promptly rounded up "Jersey Red," "Sailor" Larson, "Hard-times" Schwartz, and "Stony Pete" (*Look* editors 1946:112).



NARA Poster Collection.

Most pipeliners fell into one of several job categories, "ditchers," "skinners," "welders," "dopers," and the "backfill gang." A cat skinner eased the ends of pipes together in preparation for the weld. A doper moved ahead of the wrapping machine, applying a protective asphalt coating (*Look* editors 1946:112-114, 124-125).

One anecdote of the Big Inch's construction concerned a welder named "Red" McGinnis. Red was flat on his back completing a weld around the Big Inch in southern Pennsylvania when he heard a hissing above the noise of the welding gun. Fourteen inches away a five-foot rattlesnake was poised to strike. Red kept calm, maneuvered his gun into position, and when the snake struck, Red shot. Sometime later, the boss came by to test Red's weld and found it weak. "What happened?" he wanted to know, surprised that one of his best men should do a poor job. "I don't know," Red replied. "Guess my mind wasn't on my work" (Fitzpatrick n.d.).

As construction of the first leg of the Big Inch Line was under way, a serious problem arose among the contractors. Many of their workers were being drafted, and qualified replacements were getting harder to find. One contractor reported losing 20 men called up for military service between September 1 and October 22, 1942. Another 58 of his men were also classified 1-A and would be drafted shortly if deferments were not obtained. Burt E. Hull, the vice president and general manager of the WEP, undertook the investigation of this problem. The Selective Service statute did not allow for blanket deferments, and each request for deferment was treated as an individual case. The solution was to

contact the occupational deferment advisers of each state in which the pipeliners might be registered and convince them to accede to the request for deferments (Burt E. Hull Correspondence Files, October 28, 1942; October 31, 1942). The Navy Department saw the Big Inch Line as an essential war project because of its potential to solve the problem of the tanker shortage, and the Secretary of the Navy therefore made a direct plea to the director of the Selective Service System to defer workers on the pipeline (Burt E. Hull Correspondence Files, November 6, 1942). The Selective Service System had already come to the conclusion that pipeline transportation was an "essential activity," and within the broad category of "Transportation Service" were a number of "essential occupations" applying to the pipeline that were to guide local boards in making determinations regarding occupational deferments (Burt E. Hull Correspondence Files, November 9, 1942).

The draft was not the only reason skilled pipeliners were lost during the Big Inch Line project. Burt Hull noted that as work was nearing completion on the first leg of the Big Inch Line, many of the construction project's key men were seeking employment with other firms (Burt E. Hull Correspondence Files, October 26, 1942). In November 1942 Harold Ickes himself became involved with attempts to alleviate the labor shortage on the Big Inch Line project. He raised the issue with Paul McNutt, Chairman of the War Manpower Commission, who assured Ickes that his agency would "make every effort to supply your four contractors with the needed manpower" (Burt E. Hull Correspondence Files, November 23, 1942).

NARA Poster Collection.

Additional problems arose because of food rationing during the war, which made it difficult to feed the work crews on the pipeline project. Minta Elam of the Home Restaurant in Middletown, Ohio, wrote to Burt E. Hull seeking his help with the Middletown Ration Board. Minta fed breakfast to 90 men, packed more than 40 lunches, and made dinner for 120 men every night. She had

already used up all the ration points for the following month, had a week's supply of food left, and the local ration board had turned a deaf ear to her plight (Burt E. Hull Correspondence Files, May 31, 1943).

Publicizing the Inch Lines

By the 1940s Hollywood had been the dominant force in world film production for two decades. It had an unmatched capacity to produce films that propagandized while they entertained. Approximately 80 million Americans attended films each week, and the moviegoing audience cut across class, regional, and ethnic lines. President Roosevelt declared that motion pictures could be very useful in contributing to the war effort. After Pearl Harbor, newsreel companies devoted roughly three-quarters of their screen time to coverage of the war (Roeder 1993:4, 18).

NARA Poster Collection.

The Office of War Information, formed in June 1942, carefully monitored newsreels and had considerable influence on what stories they featured, although newsreel companies differed significantly in their style of news coverage. An Office of War Information analysis described MGM's News of the Day as "the most politically and socially liberal . . . in promoting Russia, negroes, and war," Fox Movietone as "steady middle-of-the-road," Paramount as "truly outstanding for the caliber and amount of its documentation," RKO Pathe as extreme in its "indifference to government suggested or inspired stories," and Universal as "almost hysterical" in its attempts to get humor into everything (Roeder 1993:18).

Newsreels documented the progress of pipeline construction with such title cards as *Pipe Line Goes Through!* and *Pipe Dream Comes True–Oil!* When the

pipeline reached the Norris City Station, another news clip showed the opening of the gate valves and the loading of oil onto railroad tank cars. In 1943 newsreels showed Harold Ickes and other dignitaries dedicating the Big Inch Line at Phoenixville, Pennsylvania (Paramount News 1942, 1943).

NARA Poster Collection.

The Office of War Information's Bureau of Motion Pictures served as a liaison with the Hollywood film industry. In addition, the bureau distributed films put out by assorted agencies and produced a number of its own for commercial release and for nontheatrical distribution (Winkler 1978:57). Among the short movies produced that emphasized the importance of the Big Inch Line was a 10-minute film titled *Pipeline*, produced by the Overseas Branch of the Office of War Information. It began with shots of prewar methods of oil transportation, such as tankers and railroad tank cars. The film then traced the progress of the pipeline's construction, beginning with the aerial survey. It included shots of the most challenging section of the pipeline through the Appalachian Mountains and finished with the opening of the gate valves (Office of War Information 1943).

NARA 153-CD-17-4.

A more melodramatic depiction of the war's reliance on oil was an eight-minute film produced by RKO Pathe entitled *Oil Is Blood*, in which the narration and music were intended to whip up patriotic fervor. This film devoted a 70-second segment to the story of the Big Inch Line's construction (RKO Pathe 1943).

Putting the Inch Lines in Service

NARA Poster Collection.

Crude oil was first pumped into the Big Inch Line extension from Norris City on July 14, 1943. It arrived in Phoenixville on August 14, the same day as the last weld on this segment was completed, and less than a year after construction had started. That same day oil was delivered to the refineries in the Philadelphia area, and exactly one week later the Linden Station received its first oil (Cathers 1943:24). On October 28, 1943, the process of filling the products pipeline with water for the purpose of hydrostatic testing was begun between Beaumont and Norris City. The final weld was made on December 2 of that year. Gasoline was pumped into the pipeline at Beaumont on January 26, 1944, pushing the water ahead of it into the eastern extension for testing of that section. Defective welds were found in several instances on the eastern extension, and repairs pushed the startup of full operation to March 2, when the head of the gasoline stream arrived at the Linden Station (WEP n.d.).

During the first year that both Inch Lines were in full operation, which ended April 1, 1945, a total of 185,122,264 barrels of oil were pumped through the two pipelines. Of that volume, the crude oil pipeline pumped 112,456,166 barrels for a daily average of 308,099 barrels. This volume greatly exceeded the original design estimates of 290,000 barrels per day. The products pipeline pumped 72,666,098 barrels of the total for a daily average of 199,085 barrels (Cathers 1943:18; King n.d.:66).

The WEP was one of America's largest wartime consumers of industrial power. The Big Inch and Little Big Inch pipeline pumping stations had a total connected load of about 250,000 horsepower, and consumed at peak load over

121.5 million kilowatt hours (kwhr) per month. During the first year that both Inch Lines were in full operation, the WEP consumed a total of over 1.28 billion kwhr. The power was purchased at an average of 0.7 cents per kwhr, resulting in a total annual electricity cost of nearly $9 million (King n.d.:64, 66).

Postwar Disposal And Conversion

Government Disposal of the Inch Lines

In November 1945, after the end of the war, the Big Inch and Little Big Inch pipelines were retired and placed on standby. Operation of the Big Inch ceased on October 13, 1945, and the DSC operations contract was terminated on November 1, 1945. The pipelines remained under the control of the WEP until February 1, 1946, when the Williams Brothers Construction Company was hired to maintain the lines. The War Assets Corporation (later the War Assets Administration), a subsidiary of the RFC, was given the assignment of disposing of all federal war surplus property. The RFC turned over custody of the Big Inch and Little Big Inch pipelines to the War Assets Administration on December 2, 1946. On that same day the pipelines were leased to the Tennessee Gas Transmission Corporation, so that a fuel shortage caused by a coal strike could be alleviated. This use of the Inch Lines for gas transmission involved no physical changes: the gas was moved through the pipelines only by pressure originating at the wellhead.

Harold Ickes, testifying before the House Surplus Property Investigating Committee, urged the government to dispose of the pipelines as quickly as possible. He felt that the combination of depreciation and rising maintenance costs would render the pipelines worthless if inaction prevailed. Ickes testified that natural gas was an energy resource that could not be wasted at a time when many of the natural resources that had been this country's industrial and military foundation were being depleted (Ickes 1946:4-5).

Texas Eastern Transmission Corporation (TETCO) was incorporated in Delaware on January 30, 1947, for the express purpose of bidding for the purchase of the Big Inch and Little Big Inch pipelines. The bid was awarded to TETCO on February 8, 1947, and TETCO was required to take possession on

May 1 by an interim lease and pay $4 million. Title was conveyed in November 1947. It was the largest sale of war surplus made to the private sector (*Times-Herald* 1947).

Conversion of the Inch Lines to Natural Gas Transmission

Baxter D. Goodrich, TETCO's chief engineer and a vice president, was charged with the complex job of converting the WEP system to carry natural gas. His task was to take pipelines, pumping stations, and other facilities that had been designed to carry crude oil or oil products and convert them for use in the transmission of gas in the most efficient and economical way possible, at the same time preserving the ability of the Inch Lines to be immediately reconverted to their original use in the event of a national emergency.

When operation of the Inch Lines by TETCO commenced on May 1, 1947, none of the facilities had been converted for gas operations. The gas moved through the pipeline under its own pressure without any mechanical assistance. Approximately 138 million cubic feet of gas per day were transported through the pipeline in this way. The immediate need for gas was in the Appalachian region, where regional supplies were failing to meet the increasing demands of industry in the area.

By the end of 1953, just six years from the start of its operation in 1947, TETCO had expanded its capacity nearly tenfold, from 138 million to over 1.2 billion cubic feet per day. Its total pipeline mileage increased by 1,318 miles to over 4,500 miles and was operating with one of the highest efficiencies in the industry (Texas Eastern Transmission Corporation 1954:11).

Over the course of operations, the Little Big Inch Line proved unsatisfactory as a transporter of natural gas, and in 1957 TETCO converted it back to a common-carrier products pipeline operated by a different company, the Texas Eastern Products Pipeline Company. At 20 inches, the Little Big Inch Line was too small to transport natural gas economically. In addition, the Little Big Inch Line had been plagued by defective pipe problems from the beginning. Youngstown Sheet & Tube Company, the Little Big Inch Line's pipe supplier, was forced to refund millions of dollars because the pipe was not up to specifications.

Documenting the Inch Lines

The Inch Lines constituted a major part of the United States war effort from 1942 to 1945. They helped to solve the immense problem of delivering oil, both to the increasingly mechanized Allied armed forces overseas and to industrial and domestic consumers within the United States, at a time when all oceangoing shipments were being savaged by German submarines. The Inch Lines were a major achievement in pipeline technology in terms of sheer size and scope, and represented an outstanding accomplishment in efficient and speedy corporate organization and industry-government cooperation. In short, the Inch Lines were not only the country's first truly transcontinental pipelines, but were built very quickly and during a period of extreme national emergency. TETCO acquired the Inch Lines after the war when the government disposed of the lines as war surplus property. Beginning in 1947 TETCO converted the lines to transmission of natural gas; in 1957 the Little Big Inch Line was converted back to a common-carrier products pipeline.

Because of the significance of the Inch Lines, an inventory was conducted to identify original World War II-era features and associated aboveground facilities remaining along the Lines. Today the remaining features and facilities retain sufficient historical integrity to be considered contributing elements of this multistate, linear historical resource, and to serve as a reminder of "the most amazing Government-industry cooperation ever achieved."

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