= Big Inch =

The Big Inch and Little Big Inch , collectively known as the Inch pipelines , are petroleum pipelines extending from Texas to New Jersey , built between 1942 and 1944 as emergency war measures in the U.S. Before World War II , petroleum products were transported from the oil fields of Texas to the north @-@ eastern states by oil tanker . After the United States entered the war on 1 January 1942 , this vital link was attacked by German submarines in the Operation Paukenschlag , threatening both the oil supplies to the north @-@ east and its onward transshipment to Great Britain . The Secretary of the Interior , Harold Ickes , championed the pipeline project as a way of transporting petroleum by the more @-@ secure , interior route .

The pipelines were government financed and owned , but were built and operated by the War Emergency Pipelines company , a non @-@ profit corporation backed by a consortium of the largest American oil companies . It was the longest , biggest and heaviest project of its type then undertaken ; the Big and Little Big Inch pipelines were 1 @,@ 254 and 1 @,@ 475 miles long (2 @,@ 018 km and 2 @,@ 374 km) respectively , with 35 pumping stations along their routes . The project required 16 @,@ 000 people and 725 @,@ 000 short tons (658 @,@ 000 t) of materials . It was praised as an example of private @-@ public sector cooperation and featured extensively in US government propaganda .

After the end of the war there were extended arguments over how the pipelines should be used . In 1947 , the Texas East Transmission Corporation purchased the pipelines for $ 143 @,@ 127 @,@ 000 , the largest post @-@ war disposal of war @-@ surplus property . The corporation converted them to transport natural gas , transforming the energy market in the north @-@ east . The Little Big Inch was returned to carry oil in 1957 . The pipelines are owned by Spectra Energy Partners and Enterprise Products and remain in use .

= = Background = =

By the time that the United States entered World War II in 1941 , oil was a vital part of military operations around the world . The United States produced 60 percent of the world 's crude oil , with the state of Texas in the south @-@ west leading this production , producing more than twice as much crude as any other state . The industry comprised a handful of very large producers and more than 3 @,@ 500 smaller operators .

The north @-@ east coast of the United States depended on these supplies of oil , importing both crude and refined products . Across most of Texas , there had been little interest in building pipelines to transport oil , and petroleum was typically moved from the south @-@ west to the north @-@ east coast using a mixture of sea freight and railroad transport . In early 1941 , 70 @,@ 000 barrels of oil were moved on the railroads each day , but this method was expensive , and the bulk of the oil was moved using barges , some with a capacity of up to 15 @,@ 000 barrels , operating up and down the rivers and the Atlantic Coast .

With the outbreak of war , the eastern sea routes of the country were attacked by German U @-@ boat submarines . United States naval defence was very limited and largely obsolete ; between January and April 1942 , among other naval losses , 46 oil tankers were sunk and 16 damaged . The problem was made worse as 50 tankers had been sent to help the UK earlier in 1941 . Insurers began to refuse to underwrite the remaining vessels and the volume of crude oil reaching the north @-@ east from the Texas Gulf dropped .

In response , steps were taken to better protect the tankers from attack , but losses continued to mount until , in April 1942 , they were banned by the Navy from operating the north @-@ east sea routes . The government and industry took steps to maximise the use of the railroads , increasing the amount of oil carried on them more than ten @-@ fold , but there were shortages of rail tank cars , and the existing fleet of cars was in poor condition . Instead , the United States government began to examine options for the use of pipelines to fulfil the demand for petroleum in the north @-@ east .

= = Concept = =

Transporting petroleum by pipeline from the south @-@ west to the north @-@ east was a potentially attractive option for the government as it would be safe from submarine attack and could operate efficiently regardless of the weather . Pipelines had been in use in the industry since 1862 , but by the 1930s they were usually only 8 inches (200 mm) wide , able to deliver 20 @,@ 000 barrels of oil a day ; larger pipes could be built , but due to structural weaknesses they could not operate at the regular pressures . Technologies to build high @-@ pressure pipes at sizes larger than 12 inches (300 mm) began to emerge during the decade before the war , but their adoption was not commercially viable .

The concept of constructing such a pipeline was first proposed in 1940 by the Secretary of the Interior , Harold Ickes , who argued 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 " . A consortium led by Standard Oil put forward a bid to build one in spring 1941 , but the plan failed , due to concerns over the amount of steel that would be required for such a project . In May 1941 , Ickes was appointed as the Petroleum Coordinator for National Defense , and in December 1942 became the administrator of the Petroleum Administration for War . New laws were passed to enable the building of pipelines necessary for the war effort , including the compulsory purchasing of land under the right of eminent domain .

Initial planning for the Inch pipelines began on May 15 , 1941 , when a meeting of Ickes and the oil industry commissioned an aerial survey of the possible route . A preliminary design was ready that September , and a consortium of major oil companies formed a new company , National Defense Pipelines , to build a pipeline along the route . The government Supply Priorities and Allocation Board , however , refused to approve the necessary steel , and the consortium 's plan was dissolved shortly before the outbreak of war . After the outbreak of fighting , and the consequent deterioration of the sea routes for transporting oil , industry representatives met in March 1942 to produce a new pipeline strategy , called the Tulsa Plan . This included the construction of the Inch pipelines , backed by the slogan " longlines are lifelines " , for which the steel was finally approved by the War Production Board on June 10 .

Once steel supplies had been agreed , an initial tranche of $ 35 million in funding was provided by the government Reconstruction Finance Corporation , which owned and manage the operation of the pipelines through its subsidiary organizations , the Defense Plants and the Defense Supplies corporations . In turn , the actual construction and operation of the pipelines would be carried out by the War Emergency Pipelines company (WEP) , a non @-@ profit corporation backed by a consortium of the largest oil companies in the United States : Atlantic Refining , Cities Service Oil , Consolidated Oil , Gulf Oil , Pan American Petroleum and Transportation , Standard Oil , Tidewater Associated Oil , Shell Oil , Socony @-@ Vacuum Oil , Sun Oil and the Texas Pipe Line Company . The WEP was led by W. Alton Jones and Burt Hull , both with extensive backgrounds in the industry , with Oscar Wolfe as its chief engineer . The company established its offices in Little Rock , Arkansas .

= = Construction = =

= = = Design and management = = =

The Inch pipelines comprised two systems , the Big Inch pipeline and the Little Big Inch pipeline . The Big Inch was a 24 @-@ inch (610 mm) pipeline for crude oil ; it ran from the East Texas Oil Field at Longview , Texas , to Norris City , Illinois , and onto Phoenixville , Pennsylvania , from where it branched into 20 @-@ inch @-@ diameter (510 mm) segments . One served New York and terminated at Linden , New Jersey , and the other served Philadelphia and terminated at Chester Junction , Pennsylvania . The Little Big Inch , a largely parallel 20 @-@ inch @-@ diameter (510 mm) line intended for refined products , ran from Beaumont , Texas , to Little Rock , Arkansas

, where it joined the path of the Big Inch , making use of the same pumping stations . From there it ran along the same right @-@ of @-@ way as the Big Inch to New Jersey and Pennsylvania .

The pipeline project was the longest , biggest and heaviest of its kind in the world . In total , the Big Inch pipeline was 1 @,@ 254 miles (2 @,@ 018 km) long , with 222 miles (357 km) of secondary distribution and feeder lines , and had 28 pumping stations along the route , approximately every 50 miles (80 km) . The Little Big Inch was 1 @,@ 475 miles (2 @,@ 374 km) long , with 239 miles (385 km) of secondary lines , and had seven unique pumping stations along its southern leg .

Charles Cathers of the DPC directed the engineering project , with much of the work undertaken by Oscar Wolfe and , on the Little Inch pipeline , F. E. Richardson and L. F. Scherer . A meeting of all of the contractors for the build was held at the start of the July to kickstart the project ; overall , 82 different companies would take on the pipeline work on a " cost @-@ plus " basis , employing over 16 @,@ 000 staff . The construction required the government to acquire permission to build the pipeline across 7 @,@ 500 parcels of land ; of these , the right of eminent domain had to be exercised in 300 cases . Major Jubel Parten , a director in the Petroleum Administration for War , considered the Inch pipelines to be part of ? the most amazing Government @-@ industry cooperation ever achieved ? .

The pipelines were soon given the names " Big Inch " and " Little Big Inch " by the construction teams , on account of their unprecedented diameters . The construction project was extensively advertised , as part of the US government 's war @-@ time propaganda effort . Newsreels ran clips such as Pipeline Goes Through ! and Pipe Dream Comes True @-@ Oil ! , and short @-@ films were made about the construction work , including Pipeline . The pipelines also appeared in the RKO Pathé film Oil is Blood .

= = = Process = = =

The Big Inch pipeline was made from sections of seamless steel pipe up to 44 feet (13 m) long , 3 ? 8 inch (9 @.@ 5 mm) thick and 4 @,@ 200 pounds (1 @,@ 900 kg) in weight . The Little Big Inch used both 5 ? 16 inch (7 @.@ 9 mm) thick seamless steel and electric weld pipe , and a small amount of 1 ? 2 inch (13 mm) thick seamless pipe . In total , 21 @,@ 185 railcar loads of steel piping were laid during the project , the Big Inch alone requiring 360 @,@ 700 short tons (327 @,@ 200 t) of steel .

The pipe was laid in trenches 4 feet (1 @.@ 2 m) deep and 3 feet (0 @.@ 91 m) wide , dug out by a combination of ditching machines and manual labor . The pipes were then cleaned by pulling a workman through the inside of them with cloths , and welded together , using both the " stovepiping " method and the roll @-@ weld , or " firing line " , methods . Stovepiping was an older method , in which the welder worked his way around two pipes , which remained stationary ; the newer roll @-@ weld approach instead rotated the pipes , allowing the welder to remain in one position as he worked , with up to seven pipes being welded together at the same time .

Where it was necessary for the pipeline to curve to fit the route , the steel pipes were bent , using either a cold @-@ bending approach , in which tractors would pull and push the pipelines into position , or a hot @-@ bending method , with the pipe heated up by blow @-@ torches and pulled into place using a jig . A new , specialized piece of equipment for bending pipes , the Cummings bending jig , was invented during the Big Inch build , and used on the construction of the Little Big Inch pipeline . To protect the pipeline from corrosion , its outside was then cleaned by machine , and painted in first a layer of coal tar enamel , and then hot coal tar coating , before being wrapped in asbestos felt . Finally the pipeline was lowered into position , taking care not to damage the ends of the pipes ; the larger pipes were so heavy that they required a D @-@ 8 caterpillar tractor equipped with counter @-@ weights to lift them . The trench was then back @-@ filled , completing the process .

The Big Inch pipeline had to pass under 33 rivers and 200 creeks and lakes , as well as under 289 railroad and 626 highway intersections . Specially lined tunnels were bored to lay the pipe under the roads and railroad lines , and specialist trenches dug to lay the pipelines across on the riverbeds and lakes , weighing down the pipeline to stop it floating to the surface . Around 4 miles (6 @.@ 4

km) of underwater piping was laid in total . In marshy areas , the soft ground was filled in to provide firm foundations for the pipeline to rest on .

The pumping stations for the pipelines were built on parcels of land between 11 acres (4 @.@ 5 ha) and 44 acres (18 ha) in size ; those with storage tanks were between 90 acres (36 ha) and 131 acres (53 ha) big . The plain , utilitarian buildings were initially prefabricated steel constructs , but as supplies grew scarce , wood was used instead . As much as 725 @,@ 000 short tons (658 @,@ 000 t) of materials was needed for the total project .

= = = Completion = = =

Work on the Inch pipelines began immediately after the establishment of the WEP on June 26 , 1942 . They were built in three phases . The first part to be constructed was the Big Inch , its initial leg running to an interim terminal at Norris City , where oil was to be off @-@ loaded to the railroad network . Once this leg was complete , it was extended to its terminus at Phoenixville . When the Big Inch was complete , work began on the third phase of the project , the Little Big Inch .

The first purchase order , for 137 @,@ 500 short tons (124 @,@ 700 t) of 24 @-@ inch @-@ diameter pipe , was placed on July 2 , 1942 . To meet a construction deadline of January 1 , 1943 , 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 . The schedule called for 5 miles (8 @.@ 0 km) of the Big Inch pipeline to be laid each day . But soon men were laying as much as 9 miles (14 km) a day . In all , roughly 7 @,@ 000 @,@ 000 cubic yards (5 @,@ 400 @,@ 000 m3) of material were excavated . Oil began flowing through the Big Inch Line between Texas and Illinois on New Year 's Eve 1942 . Work on the Little Big Inch then began in 1943 .

The first crude oil arrived at Phoenixville via the Big Inch on August 14 , 1943 , and the first refined product in the Little Big Inch arrived on March 2 , 1944 . The Big Inch carried up to 334 @,@ 456 barrels of crude oil a day , the Little Big Inch 239 @,@ 844 barrels of gasoline ; the lines were among the largest industrial consumers of electricity in the US , requiring 3 @.@ 89 million kilowatt hours a day to pump the oil along the pipes .

= = = Construction process , recorded by John Vachon = = =

= = Post @-@ war sale = =

By the end of the war , there was considerable debate over the future of the pipelines . The major oil companies , such as Standard Oil , campaigned for the conversion of the pipelines for the transfer of natural gas . Demand for natural gas was rising rapidly , and it was produced in large quantities in the Texas oilfields , but could not be got to market in the north @-@ east and was otherwise burnt off uselessly into the atmosphere . The railroad and coal companies , who saw this as likely to introduce additional competition for coal and coal gas , and therefore lower demand for their goods and services , argued against this move . The smaller oil companies proposed continuing to use the pipelines for oil in order to undermine the transport monopolies of the larger corporations .

A government inquiry was undertaken to determine the future use of the pipelines , and took evidence from the various stakeholders , most of whom presented the case that favored their companies or industry . The inquiry concluded that the pipelines should be sold for continued use in transporting petroleum . An auction for the pipelines was announced in 1946 , which was designed to give preference to bidders who intended to use them for moving petroleum . 16 bids were received , with the highest cash bidders being companies hoping to use the pipelines for natural gas . Assessing the different bids proved difficult and the discussions became enmeshed in national politics , with companies seeking support from various Washington politicians . Meanwhile , a

threatened national coal strike raised concerns over the availability of natural gas , strengthening the arguments of the natural gas lobby .

A fresh inquiry was declared in November , voiding the previous competition and the Inch Lines were transferred to the War Assets Administration on December 2 , 1946 , for disposal . Pending any final decision on their sale , the lines were leased to the Tennessee Gas Company for use in shipping natural gas as far as Ohio and the Appalachians , but no further east , and only for 12 months . Tennessee Gas did not convert the pipelines in any way for their new role , and simply pumped the gas through the system under its own pressure , moving 138 @,@ 000 @,@ 000 cubic feet (3 @,@ 900 @,@ 000 m3) of gas a day in this way .

A second auction was held , with bids for natural gas given equal weight to those wishing to transfer crude oil , although any natural gas bidder would be obliged to maintain the oil pumping stations for use in a national emergency . Ten bids were received and on February 8 , 1947 , the Texas East Transmission Corporation (TETCO) was declared successful . Its bid of $ 143 @,@ 127 @,@ 000 would make the disposal the largest sale of war @-@ surplus property to the private sector following World War II .

= = Conversion by TETCO = =

TETCO was the brainchild of corporate lawyers Charles Francis and James Elkins , who convinced the construction specialists George and Herman Brown , and the fuel engineer E. Holley Poe , that buying the Big and Little Inch pipelines could be a lucrative opportunity . The corporation was established specifically for the purposes of the bid , and came to their bidding figure by estimating that the likely competition would bid at $ 130 million ; their own figure exceeded this by 10 percent , and added on $ 127 @,@ 000 to avoid a suspiciously round number . TETCO believed it could afford to make this offer because it intended to reuse the electric motors in the oil pumping mechanisms for moving the natural gas ; it also believed that the price of gas would rise considerably in the post @-@ war markets .

After winning the bidding , TETCO raised the money to pay the government through a combination of bonds and share issues . A further government enquiry was required before the sale was allowed to go through , which was complicated by the reluctance of the state of Pennsylvania to allow the pipelines to be used to pump gas east through its territory . The government of Pennsylvania was influenced by the coal industry , who feared they would lose sales , but it eventually relented and the sale of the pipelines to TETCO was finally completed on November 1 . The value of the company soared , and the original investors saw the value of their holdings increase 63 @-@ fold .

TETCO immediately began to convert the pipelines for permanent use as natural gas transmission lines , under the direction of Baxter Goodrich , their chief engineer . 24 compressor stations were constructed along the pipeline with centrifugal compressors , increasing the capacity of the system to 433 @,@ 000 @,@ 000 cubic feet (12 @,@ 300 @,@ 000 m3) of gas a day , and the old oil pumps were retained for reuse in a future crisis . Steel valves replaced the older , less reliable cast iron designs . Demand continued to increase , requiring additional compressor capability , and by January 1949 the pipelines were moving 508 @,@ 000 @,@ 000 cubic feet (14 @,@ 400 @,@ 000 m3) a day .

The supply route undermined the local markets for manufactured gas , and the major cities of the north @-@ east rapidly converted to the use of natural gas ; historian David Waples describes how the pipelines contributed to " an extraordinary expansion of natural gas customers and gas company employees after World War II " . The Inch pipelines encouraged the development of further long distance pipelines in the US through the 1960s and 1970s .

= = Later use = =

In 1957 , the operation of the Little Big Inch , and its ownership south of Ohio , was transferred from TETCO to the subsidiary Texas Eastern Petroleum Products Corporation (TEPPCO) , and converted back to use for petroleum products . TEPPCO was purchased by Enterprise Products in

2010 . Around 1961 , there was discussion of converting the Big Inch pipeline back to petroleum use , but it continued in use as a gas pipeline . In 1989 , TETCO was taken over by the Panhandle Eastern Corporation , and in 1997 this company was merged with Duke Power , to form the Duke Energy Corporation ; in 2007 , the oil pipelines were spun off from Duke Energy , to form part of Spectra Energy Partners .

The Inch pipelines are listed on the National Register of Historic Places . Along the western parts of the pipelines , around 90 percent of the pipes are the original installation , although in the east large parts have since been replaced , largely due to the absence of anti @-@ corrosion protective coatings on the original piping . 62 of the original buildings from 1942 and 1943 remain , including pump @-@ houses , offices , employee houses and garages . The best surviving examples of the original buildings are in Pennsylvania . A " Big Inch pipeline " construction playset was produced as a children 's toy in 1962 by the Marx company .

= = List of pumping stations = =

= = = Big Inch and northern Little Big Inch = = =

Station No. 1 : Longview , Texas
Station No. 2 : Atlanta , Texas
Station No. 3 : Hope , Arkansas
Station No. 4 : Donaldson , Arkansas
Station No. 5 : Little Rock , Arkansas
Station No. 6 : Bald Knob , Arkansas
Station No. 7 : Egypt , Arkansas
Station No. 8 : Fagus , Missouri
Station No. 9 @-@ a : Oran , Missouri
Station No. 9 @-@ b : Gale , Illinois
Station No. 10 : Lick Creek , Illinois
Station No. 11 : Norris City , Illinois
Station No. 12 : Princeton , Indiana
Station No. 13 : French Lick , Indiana
Station No. 14 : Seymour , Indiana
Station No. 15 : Oldenburg , Indiana
Station No. 16 : Lebanon , Ohio
Station No. 17 : Circleville , Ohio
Station No. 18 : Crooksville , Ohio
Station No. 19 : Sarahsville , Ohio
Station No. 20 : Wind Ridge , Pennsylvania
Station No. 21 : Connellsville , Pennsylvania
Station No. 22 : Rockwood , Pennsylvania
Station No. 23 : Chambersburg , Pennsylvania
Station No. 24 : Marietta , Pennsylvania
Station No. 25 : Phoenixville , Pennsylvania
Station No. 26 : Lambertville , New Jersey
Station No. 27 : Linden , New Jersey

= = = Southern part of the Little Big Inch = = =

Station A : Baytown , Texas
Station B : Beaumont , Texas
Station C : Newton , Texas
Station D : Many , Louisiana

Station E : Castor , Texas
Station F : El Dorado , Arkansas
Station G : Fordyce , Arkansas