Federal Helium Program

A Brief History of this Strategic U.S. Resource from 1868 through 2023


U.S. NAVY

Contents

Federal Helium Program: A Brief History of this Strategic U.S. Resource from 1868 through 2023

Helium has been an important strategic asset to the U.S. government since the early 20th century. Research and development during World War I (1914-1918) led the U.S. government to recognize the importance of helium in military applications and establish a Federal Helium Program with funding to construct and operate extraction and production facilities.

The U.S. was the only major producer of helium for most of the 20th century. The Cliffside Gas Field, acquired in 1929, was a key component of the Federal Helium Program as both a large supply of helium-rich natural gas and the location of a geological formation uniquely suited to long-term helium storage, the Bush Dome Reservoir.

During the geopolitical and economic events of the mid-20th century, the demand for helium fluctuated. Yet, World War II (1939-1945) followed by the Korean War (1950–1953), the Vietnam War (1955-1975), and the Cold War (1947-1992) and Space Race (1955-1975) between the U.S. and the Union of Soviet Socialist Republics (USSR) resulted in the expansion of the use of helium with new applications in ballistic missiles, atomic energy, and the U.S. space program.

New private sector medical and industrial applications were also identified. The increased demand and subsequent depletion of the national helium supply led to legislation establishing a Federal Helium Reserve at the Bush Dome Reservoir to secure helium for continued public and private sector use. The federal government also constructed a helium pipeline, connecting the Cliffside Field to public and private helium plants in western Kansas and the panhandle regions of Texas and Oklahoma. Although federal demand waned in the late 20th century, the Cliffside Gas Field and Federal Helium Pipeline remained important components of the Federal Helium Program until 1996, when the federal government ended the program.

Discovery of Helium, 1868-1914

Helium, a chemical element and noble gas, was discovered in the mid-19th century and identified as a natural gas byproduct in 1905. In 1868, French astronomer Pierre-Jules-César Janssen and British astronomer Norman Lockyer working separately both recorded observing the element as a bright yellow line on the sun during a total solar eclipse. Lockyer subsequently named it. The element was not identified on Earth until 1895, when Scottish chemist William Ramsay isolated it in experiments. European scientists continued to identify unique characteristics of the element in the late 19th and early 20th centuries, such as its lifting abilities. Efforts to locate substantial helium sources in Europe, however, were unsuccessful (Seibel 1968, 10-13).

Discovery of Helium, 1868-1914

1868	French and British astronomers Janssen and Lockyer separately identify a line on the sun as a gaseous element using a spectroscope. Lockyer names it helium.
1895	Scottish chemist Ramsay isolates helium as a new element.
1905	American chemists McFarland and Cady identify helium in natural gas.
1910	U.S. establishes Bureau of Mines (USBM) within the Department of the Interior (DOI).
1914-1918	World War I
1914	Germany bombs London with hydrogen-filled Zeppelins.

Development of Uses for Helium, 1914-1925

1915–1917	British scientists undertake research into helium as a lifting source for dirigibles.
1917	USBM and U.S. military officials discuss helium research and development.
1917	Canadian scientists identify a gas field and begin construction of a helium plant in Ontario.
1918	USBM constructs two experimental helium plants at a gas field in Petrolia, Texas.
1921	USBM constructs Production Plant No. 1 in Fort Worth, Texas.
1921	USBM opens the Cryogenic Research Laboratory to extract helium from natural gas in Amarillo, Texas.
1921-1923	U.S. Navy successfully constructs, launches, and tests helium dirigibles.

Establishment of the Amarillo Helium Plant at Cliffside Gas Field, 1925-1930

1925	Congress passes the Helium Act, which creates the Federal Helium Program and authorizes the USBM to build and operate helium extraction and processing plants.
1925	Scientists develop a mixture of helium and oxygen for deep sea diving and asthma treatments.
1927	Congress amends Helium Act to ban its export.
1927	Kentucky Oxygen-Hydrogen Company builds first private helium plant in Dexter, Kansas.
1927	USBM negotiates gas rights at Cliffside Gas Field and Bush Dome in Texas Panhandle.
1929	USBM purchases 50,000-acre Cliffside Gas Field, opens the Amarillo Helium Plant, and constructs a pipeline between the plant and the Bush Dome Reservoir.

Expansion of Helium Processing, 1930–1960

1933–1935	U.S. Navy ends dirigible program, reducing U.S. government demand for helium.
1936	Commercial airships and asthma treatments increase private demand for helium.
1937	Congress amends the Helium Act to open reserves to commercial and scientific use and non-hostile foreign governments after Hindenburg Zeppelin disaster.
1939–1945	World War II
1943	USBM opens Exell Helium Plant in Texas and Otis Helium Plant in Kansas.
1944	USBM opens Navajo Helium Plant in New Mexico and Cunningham Helium Plant in Kansas.
1945	USBM initiates a conservation program by storing helium at the Cliffside Gas Field.
1945	Scientists create a Grade A helium (99.9% pure) for use in welding.

1945	USBM closes Cunningham Helium Plant in Kansas.
1946	U.S. Bureau of Land Management (BLM) is established within the DOI.
1947-1992	U.S. and Union of Soviet Socialist Republics (USSR) Cold War
1949	Grade A helium made available for commercial applications.
1950–1953	Korean War
1955-1975	U.S. and USSR Space Race and the Vietnam War
1958	National Aeronautics and Space Administration (NASA) established.
1959	Surge in military, scientific, and commercial use reduces national helium stockpile to 17 million cubic feet.

The Conservation Period and Construction Boom at Cliffside, 1960–1969

1960	Congress amends Helium Act to establish the Helium Conservation Program and Federal Helium Reserve.
1962	USBM opens the Cliffside Field Terminal office and lab in Texas; Federal Helium Pipeline connecting public and private plants in Oklahoma and Kansas to the Cliffside Gas Field; and a gas metering facility in Satanta, Kansas, to monitor private helium intake.
1962	Helium Conservation Program is officially dedicated, with excess helium stored in the Bush Dome Reservoir at Cliffside Gas Field.
1961–1963	Five privately owned and operated helium plants open in the region around Cliffside.
1968	USBM closes Navajo Helium Plant in New Mexico and Otis Helium Plant in Kansas.

Ebbing Demand for Federal Helium, 1969-1996

1969-1975	Last years of the Space Race and Vietnam War reduce U.S. government demand for helium.
1975	Private helium production continues and is stored at Bush Dome Reservoir.
1978	Private demand for helium skyrockets.
1980s	Federal Helium Program is 1.4 billion in debt.

Privatization and Advances in Helium Refining, 1996-Present

1996	Congress passes Helium Privatization Act, terminating the Federal Helium Program.
1997	USBM transfers Federal Helium System to BLM.
1998	BLM closes Amarillo Helium Plant and partners with the National Park Service to survey historic and archeological properties associated with the Federal Helium System.
2005	Cliffside Helium Enrichment Unit begins operation at the Cliffside Field Terminal and helps enrich crude helium.
2011	U.S. government sells Exell Helium Plant to private entity.
2013	Congress passes Helium Stewardship Act to sunset the Federal Helium System and ensure access to crude helium reserves.
2021	BLM transfers the Federal Helium System to the U.S. General Services Administration (GSA). GSA lists the system for public sale.

Known as "Mr. Helium," Dr. Clifford W. Seibel aided initial efforts to identify military applications of helium. He went on to serve as a USBM employee and helium operations manager at the Amarillo Plant until he retired in 1959.
Source: *Helium, Child of the Sun*, 1968.

In the United States, the rising value of natural gas in the 19th century led to geological exploration and development of natural gas fields. By 1900, geologists had discovered natural gas deposits in 17 continental states and territories. In 1905, Dr. David F. McFarland and Dr. H. P. Cady of the University of Kansas discovered concentrations of helium in natural gas samples from a well in Dexter, Kansas. McFarland and Cady's discovery spurred additional tests, leading Dr. Cady in 1907 to state, "It assures the fact that helium is no longer a rare element, but a very common element, existing in goodly quantity for the uses that are yet to be found for it" (Seibel 1968, 14-17). In a subsequent analysis, geologists identified natural gas fields in Texas, Oklahoma, and Kansas containing the largest percentages of helium in the continental U.S. Despite the abundant supply, a significant use for helium was not identified until 1915. During this period, in 1910, the U.S. established the Bureau of Mines (USBM) within the Department of the Interior (DOI) to monitor health and safety at mines, but it would soon add helium to its responsibilities.

Development of Uses for Helium, 1914-1925

When World War I began in Europe in 1914, Germany deployed hydrogen-filled dirigibles and wreaked havoc on London. In response, the British government and its scientists began conducting research into the potential use of helium as a lifting source for dirigibles as a non-combustible alternative to hydrogen. Lacking local helium sources, British officials turned to the Canadian and U.S. governments for assistance. In 1917, Canadian scientists identified a gas field and began construction of the world's first helium plant in Hamilton, Ontario. The percentage of helium in natural gas fields in Canada, however, was much lower than samples from Dexter, Kansas, and the plant closed a few years later (Seibel 1968, 21-27).

In the U.S., Dr. Clifford Seibel, a chemist at the University of Kansas, presented a paper on the five rare gases contained in natural gas in 1917 in Kansas City at the first national American Chemical Society

Established in 1921, Plant No. 1 Compressor Building Interior at Production, North Fort Worth, Texas. Source: National Archives.

conference. There, he met Dr. Richard B. Moore, the superintendent at a USBM station in Colorado and a former student of William Ramsay, and Dr. Charles L. Parsons, chief bureau chemist. The meeting introduced the notion of using American helium sources for military dirigibles. With America having entered World War I that year, Dr. Parsons met with other USBM officials, who in turn reached out to the War Department about creating a federal helium supply. Encouraged by military leaders, the USBM initiated research and development efforts to create an efficient and sustainable helium program (Seibel 1968, 23-28).

The bureau's natural gas expert, Dr. George A. Burrell, led efforts to develop a helium extraction process. To overcome the considerable hurdles in separating helium from natural gas sources, Burrell and other engineers agreed that a low-temperature process would allow for the easiest and cheapest extraction method. Two New York companies with low-temperature processing experience were enlisted to aid the bureau in developing the Federal Helium Program. By this time, British officials, along with U.S. Army and Navy leaders, fully supported the bureau's efforts and provided funding to produce sizable amounts of helium at low cost. A gas field at Petrolia, Texas, was selected as the primary location for initial helium processing experiments. Two experimental plants were constructed in 1918 near Fort Worth to extract helium from the nearby natural gas supply (Seibel 1968, 24-41). These plants produced 150,000 cubic feet of 90 percent pure helium by war's end, demonstrating that a federal program could be successful. Though the U.S. government shipped small amounts of helium to France and Britain in 1918, most of the supply was placed in cylinders and stored in Fort Worth (Sears 2015, 85-130).

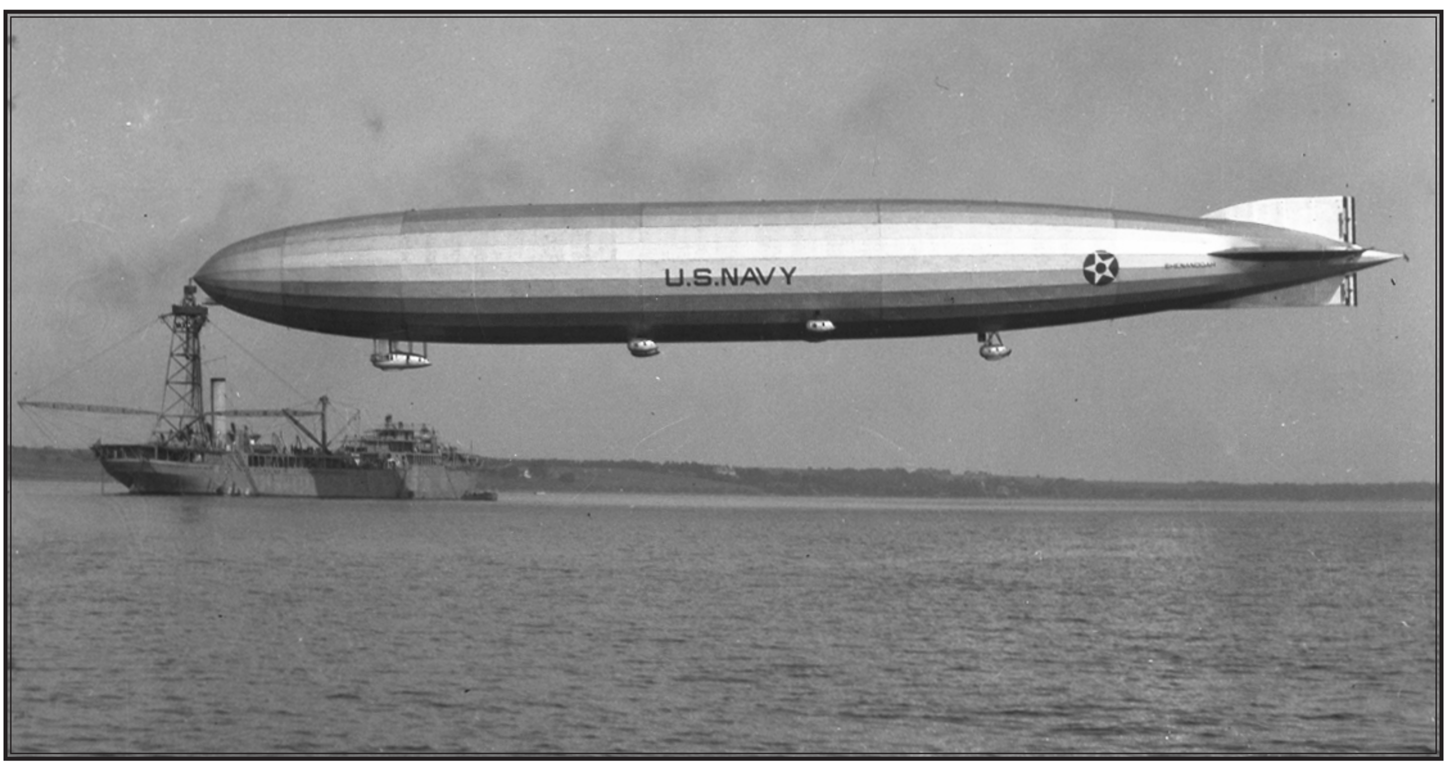
The government's interest in helium production increased in the immediate postwar years, as the U.S. Army Air Service (now the U.S. Air Force) was established in 1918, and the Army and Navy recognized the element's strategic importance. The USBM closed the experimental stations in January 1919 and proceeded with efforts to establish a permanent helium plant. In 1921, Production Plant No. 1 was established in Fort Worth and began efficiently producing helium from the Petrolia gas field. Also in 1921, the USBM opened the Cryogenic Research Laboratory, which researched low-temperature techniques to extract helium from natural gas efficiently. As a result of these efforts, the government significantly reduced helium costs. By 1925, the Fort Worth plant produced 22.4 million cubic feet of helium (Sears 2015, 85-130). The new source of helium convinced the Navy to expand its dirigible program. In December 1921, the Navy launched airship C-7, the world's first helium-filled dirigible, on a flight over Washington, D.C. In 1923, the Navy completed construction of its first rigid dirigible, the USS Shenandoah (Seibel 1968, 66-69). Congress, intent on protecting and conserving the nation's naturally occurring helium resources, passed the Helium Conservation Act of 1925. This act authorized the Federal Helium Program and the USBM to manage it and experiment with, produce, repurify, and research the gas, as well as to build and operate large-scale helium extraction and processing plants (Seibel 1968, 73).

Establishment of the Amarillo Helium Plant at Cliffside Gas Field, 1925-1930

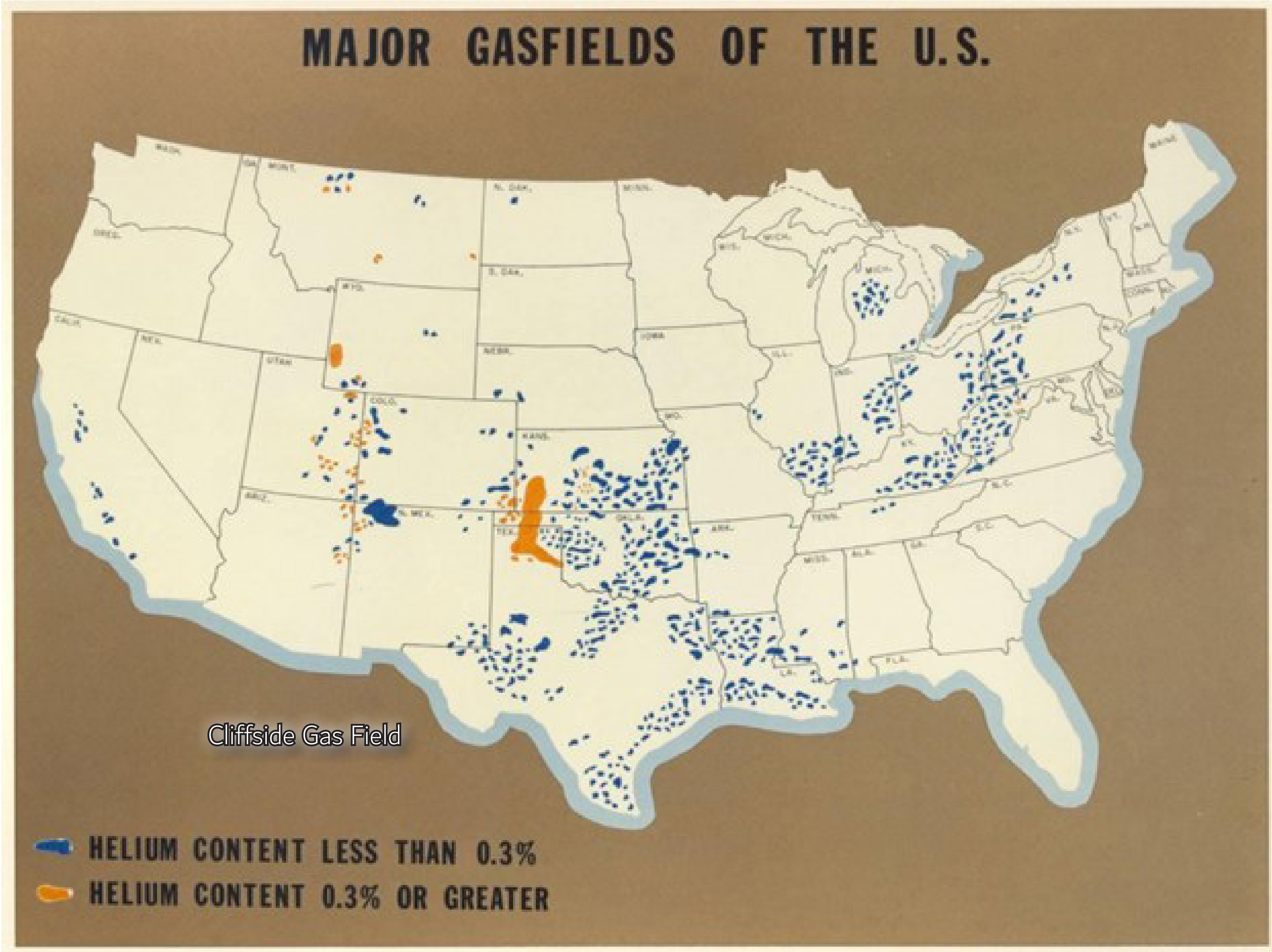
Newly appointed as chief of the USBM in 1925, R. A. Cattell redirected helium production efforts. Shortly after the bureau formally assumed control, new non-military uses of helium emerged. Scientists in 1925 developed an artificial breathing mixture of helium and oxygen, enabling advancements in deep sea diving and asthma treatments (Seibel 1968, 74). The bureau's Fort Worth supply of natural helium, however, had been declining with increased use by the Navy's dirigible efforts. Cattell knew the north Texas gas field could not meet future needs for helium and directed bureau officials to resurvey an area in the Texas Panhandle known as the Cliffside Field (Seibel 1968, 76).

In the early 1920s, the Amarillo Oil Company had discovered and drilled a valuable natural gas deposit in the region that revealed promising quantities of helium. The Cliffside Gas Field, 15 miles

U.S. Navy C-7 dirigible, world's first helium-filled dirigible, December 1921, Washington, D.C.
Source: Library of Congress, National Photo Company Collection.



U.S. Navy USS Shenandoah, its first rigid airship, moored to the USS Patoka, ca. 1924.
Source: National Archives, George A. Horkan Jr. Papers.



Major natural gas fields in the United States.
Source: Bureau of Land Management (BLM), Amarillo Field Office.

northwest of Amarillo, included what became known as the Bush Dome Reservoir. An underground rock formation that naturally stores helium, the reservoir is about 10 percent porous, 3,500 feet below the surface, about 300 feet thick, and covers about 12,000 acres of the 50,000-acre Cliffside Gas Field. Prior to production, the USBM estimated that the formation contained about 295 billion cubic feet of recoverable gas whose helium content ranged from about 1.7 to 1.9 percent (U.S. Court of Claims 1969). Dr. Seibel, longtime USBM employee and helium operations manager from 1930 to 1959, described the reservoir as follows: "dome-shaped, porous, and permeable rock is 120 to 200 feet thick, and the apparently solid rock has a myriad of minute interconnected openings. These openings contain helium-bearing natural gas which will be displaced gradually by stored crude helium" (Seibel 1968, 121).

The Bush Dome Reservoir at Cliffside Field was advantageous because its gas content—pressured at more than 700 pounds per square inch—was much higher than other known deposits. Even more impressive, the

Cliffside Field had nearly twice the helium content as other sources, a near-100-year supply. The reservoir was also enclosed by impermeable rock and a water table, preventing gas from escaping and making its storage capacity over 52 billion standard cubic feet of gas (National Research Council 2000, 20; U.S. Court of Claims 1969). Because of the site's enormous promise, Cattell directed efforts to secure gas rights and land suitable for a processing plant within the 50,000-acre Cliffside Gas Field. William H. Bush, Lee Bivins, and the Fuqua Land & Cattle Company owned various parcels comprising the Bush Dome.

As the Helium Act was amended in 1927 to ban export of the gas to foreign governments, Bush and the USBM reached an agreement, and shortly thereafter, the DOI allocated funds for construction of a helium processing plant on 18-plus acres in Soncy, Texas. The location, just outside of Amarillo, was chosen because of

William H. Bush

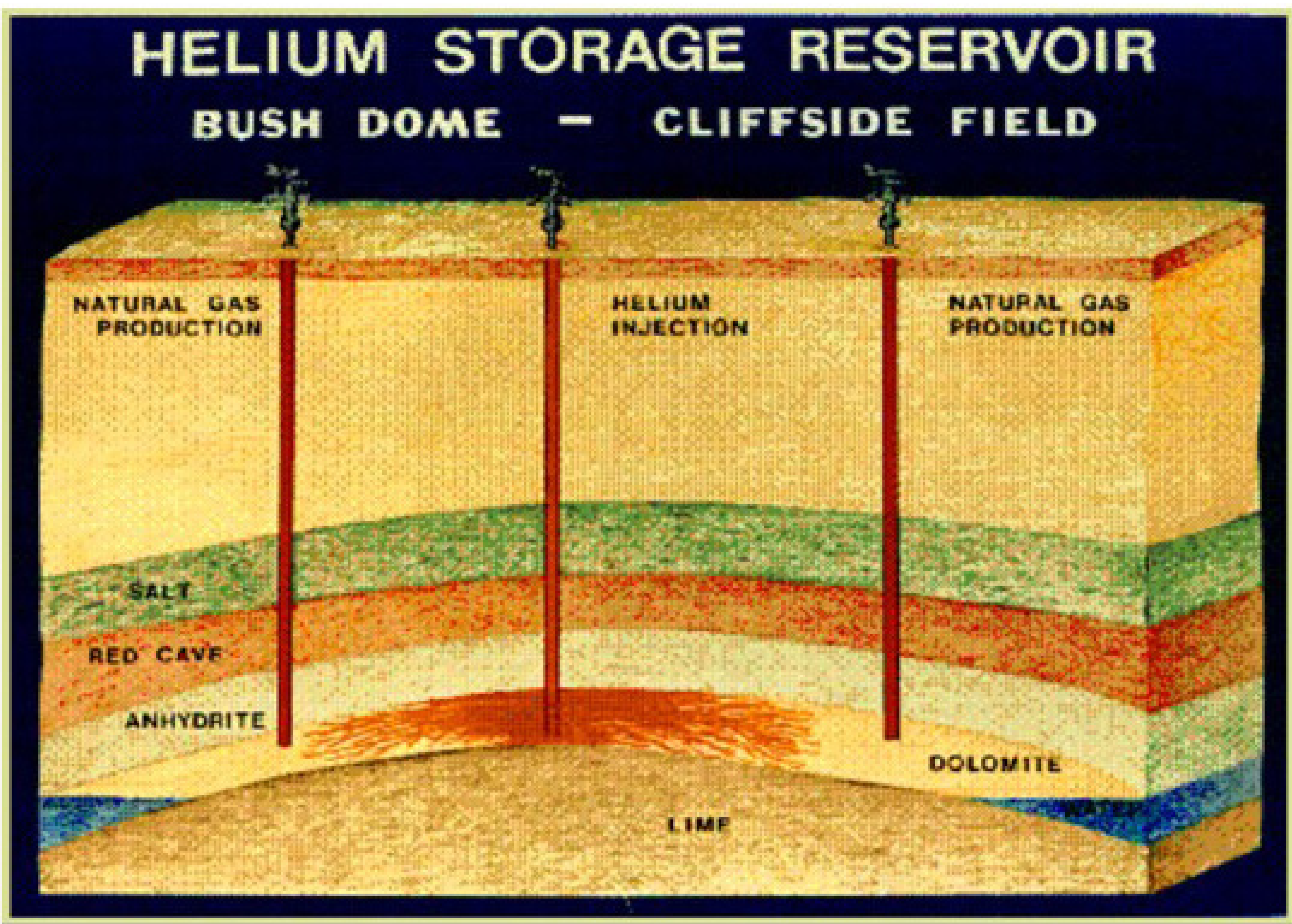
A notable businessman who split his time between Amarillo and Chicago, William H. Bush maintained interests in ranching and manufacturing in the Amarillo area. Bush arrived in the Texas Panhandle in 1879 as a land agent for his father-in-law, Joseph F. Glidden, who manufactured barbed wire. Glidden, who was interested in establishing a Texas ranch as a testbed to showcase his barbed wire, followed Bush's advice and acquired fertile land in the Tecovas Spring area in 1881. This tract, which became known as the Frying Pan Ranch, ultimately consisted of 95 sections of land and covered the entire southwest portion of Potter County up to the Canadian River. This area encompassing the Bush Dome and the Cliffside Field Terminal is located roughly at the ranch's center point. In 1898, Glidden sold his interest in the Frying Pan Ranch to William H. Bush for $68,000. Bush kept homes in both Amarillo and Chicago. The Bush family became major Amarillo benefactors and deeded land for the construction of the Potter County courthouse and jail (Anderson 1952, 1994).

Frying Pan Ranch headquarters near Tecovas Spring, Texas, ca. 1884.
Source: Panhandle Plains Museum.

its proximity to the Bush Dome Reservoir. The semi-arid location had moderate weather conditions, a large supply of available subsurface water needed for helium production processes, and access to the Rock Island Railroad (Feldman and Sallee 1999, 13). Construction on a 12-mile-long pipeline from the Cliffside Gas Field to the newly constructed Amarillo Helium Plant began in 1928. In 1929, the federal government acquired the rights to the entire 50,000 acres (National Park Service 1999, 1, 5). On May 6, 1929, the Amarillo Helium Plant shipped 200,000 cubic feet of helium to Langley, Virginia. The plant quickly became the epicenter of government-supported helium research and production and initiated the United States' role as the only major helium producer for most of the 20th century (Sears 2015, 85-130).

Expansion of Helium Processing, 1930–1960

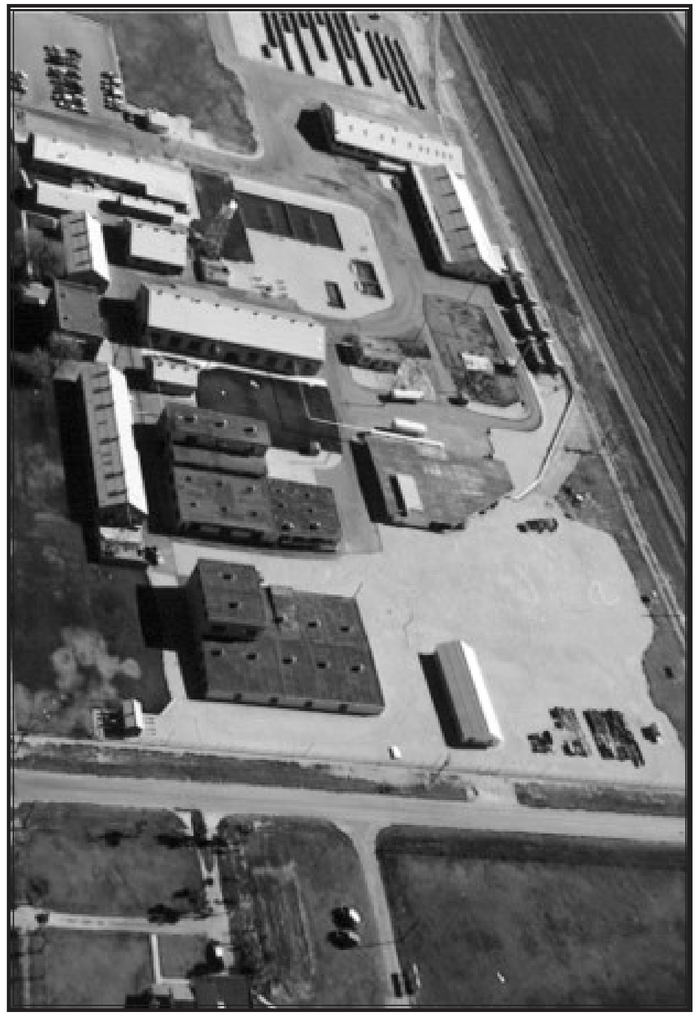
By the early 1930s, the Amarillo Helium Plant far exceeded the government's initial production estimates, supplying over 450,000 cubic feet of helium per day. The largest helium user remained the Navy; however, deadly accidents involving



Encompassing approximately 12,000-acres in Potter County, Texas, the Bush Dome Reservoir at Cliffside Field is a natural geologic formation of porous rock located 3,000 feet below the surface. When discovered, the site included a large deposit of natural gas and helium. The site's unique geologic characteristics, combined with a water table prevented the escape of gaseous elements, made the site an ideal location for federal helium storage. Source: BLM.

dirigibles in 1933 and 1935 resulted in the Navy ending its program. In turn, the government demand for helium dropped, forcing the plant to reduce staff and operations in 1935. Helium demand returned by 1936 because of a government leasing program for commercial airships and the expansion of asthma helium treatments. The shocking 1937 explosion of the hydrogen-fueled airship, the Hindenburg, persuaded Congress to pass the Helium Act of 1937. The act opened the nation's helium reserves to commercial and scientific use, as well as made it available to non-hostile foreign governments. This increased use of helium significantly and allowed the Amarillo Helium Plant to return to full operation (Sears 2015, 85-130).

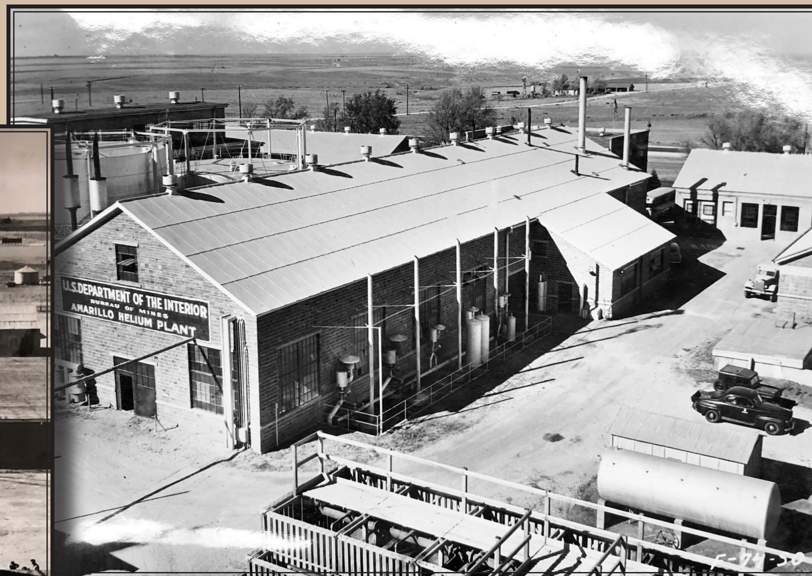
Helium demand further expanded with the outbreak of war in Europe and continued throughout the conflict. The abundance and quality of naturally occurring helium at the Cliffside Gas Field, in conjunction with the efficiency of the Amarillo Helium Plant, allowed the federal government to continue procuring helium without interruption. World War II increased the military's demand, as each branch used the gas. It was essential for blimp reconnaissance of submarines, rocket construction, and the eventual development of the atomic bomb. This militaristic boon for the Federal Helium Program led to construction of four helium processing plants in 1943-1944: the Exell Helium Plant in Texas and the Otis Helium Plant in Kansas, the Navajo Helium Plant in Shiprock, New Mexico, and the Cunningham Helium Plant in Kansas. Of these, the Exell Helium Plant would eventually become the largest helium producer in the nation (National Park Service 1999, 9).



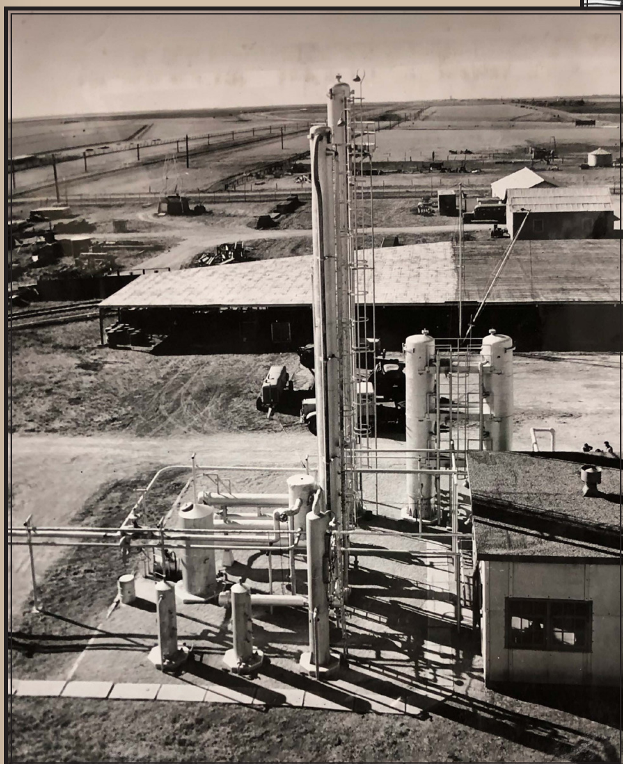
Amarillo Helium Plant, 1944.
Source: BLM, Amarillo Field Office.

Like other war-based industries, helium experienced a marked decline in demand during the postwar demobilization period, with only the Exell plant remaining in operation, though research and development of the gas continued. At war's end in 1945, the USBM initiated a conservation program with helium shipped from the Amarillo and Exell plants for storage at the Cliffside Gas Field. During this time, researchers discovered more non-military uses for helium. In the process, they developed an activated-charcoal filtering system that increased helium purity from

The Amarillo Helium Plant in World War II and Postwar Period



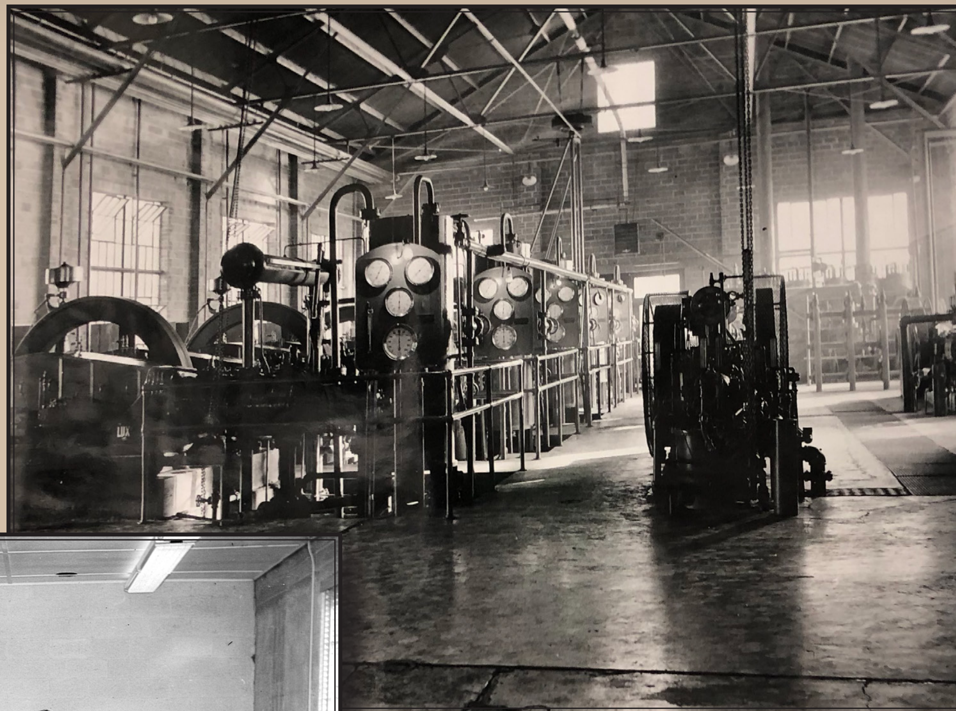
Amarillo Helium Plant power house, 1952.
Source: National Archives, College Park, Photograph No. F-74-50.



Equipment to remove carbon dioxide at the Amarillo Helium Plant pumphouse, 1942.
Source: National Archives, College Park, Photograph No. F-76-50.

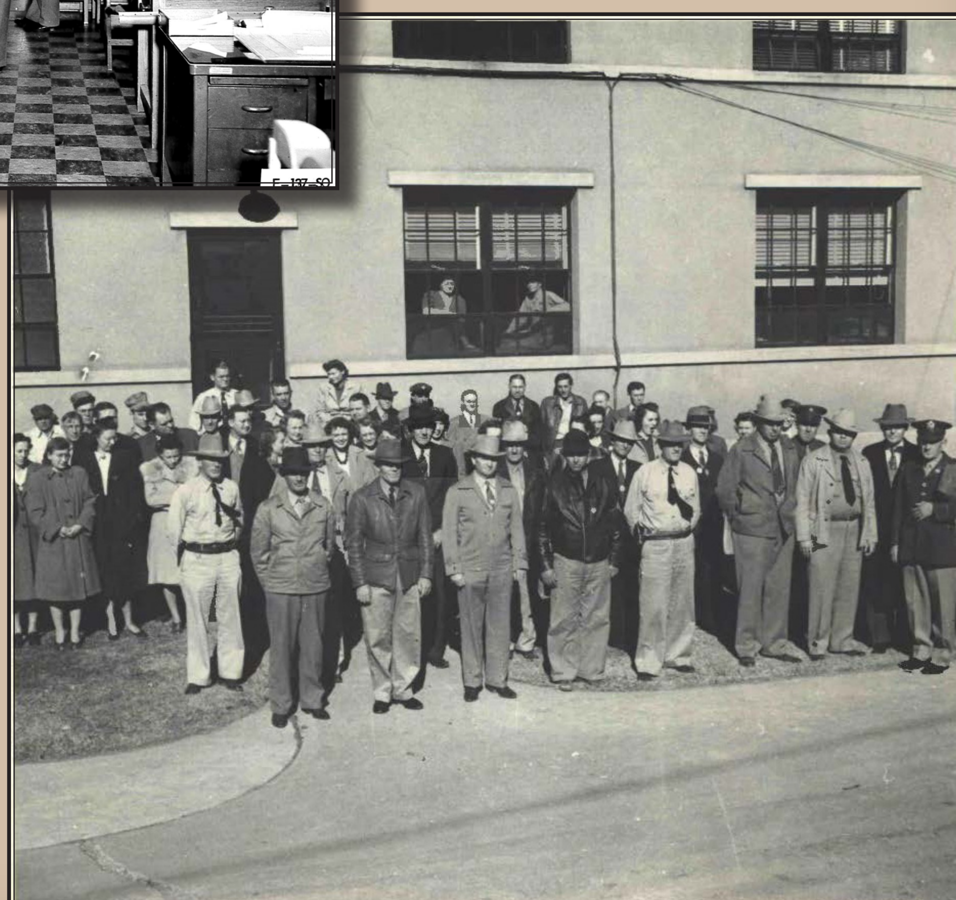
Empty helium cylinder containers, 1953.
Source: National Archives, College Park, RG 70, Entry 6Y, File 074.60, Box 6.

Helium tank car loaded with full cylinders, 1943.
Source: BLM, Amarillo Field Office.



Nitrogen and helium compressors in the Amarillo Helium Plant power house, 1952.
Source: National Archives, College Park, Photograph No. F-139-SO.

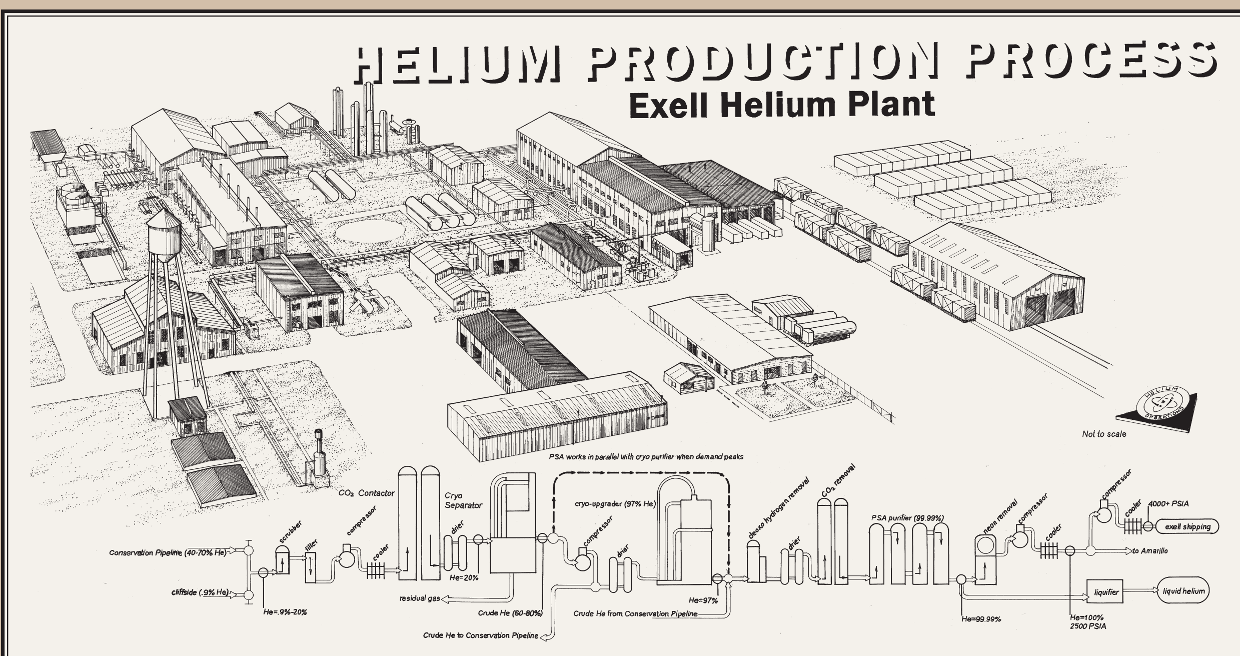
Amarillo Helium Plant working draftsmen and engineers, ca. 1955.
Source: “Region VI: Helium Plants.Book II.”



Amarillo Helium Plant administrative staff, ca. 1950s.
Source: BLM Archives, Photograph Number 55890.

Exell Helium Plant

Located 35 miles north of the Amarillo Helium Plant, the Exell Plant was the largest and most productive of the new plants. The facility included improved carbon dioxide removal units, natural gas, nitrogen, and helium compressors, helium separation units and steam boilers. The 320-acre site included 75 employee houses and at its wartime height, employed over 1,000 people. Due to wartime labor shortages, women played a prominent role in the construction and operation of the Exell Plant. Because of its modern infrastructure and equipment, the Exell Plant outproduced all other government helium plants and played a significant role in supplying the military with helium. Helium proved vital to wartime efforts—Navy dirigibles protected convoys from enemy submarines. In addition, Manhattan Project scientists used helium in the development of the atomic bomb. Following the war, the Exell Plant (unlike other helium plants) continued production and helped supply rocket propulsion systems such as Intercontinental Ballistic Missiles (ICBM). After the closure of the Otis Plant in 1981, Exell was the only federal production plant in operation. The privatization of helium in 1996 ceased government helium production leading to the plant's auction in 2011 (Center for Land Use Interpretation 2023, Historic American Engineering Record 2001).



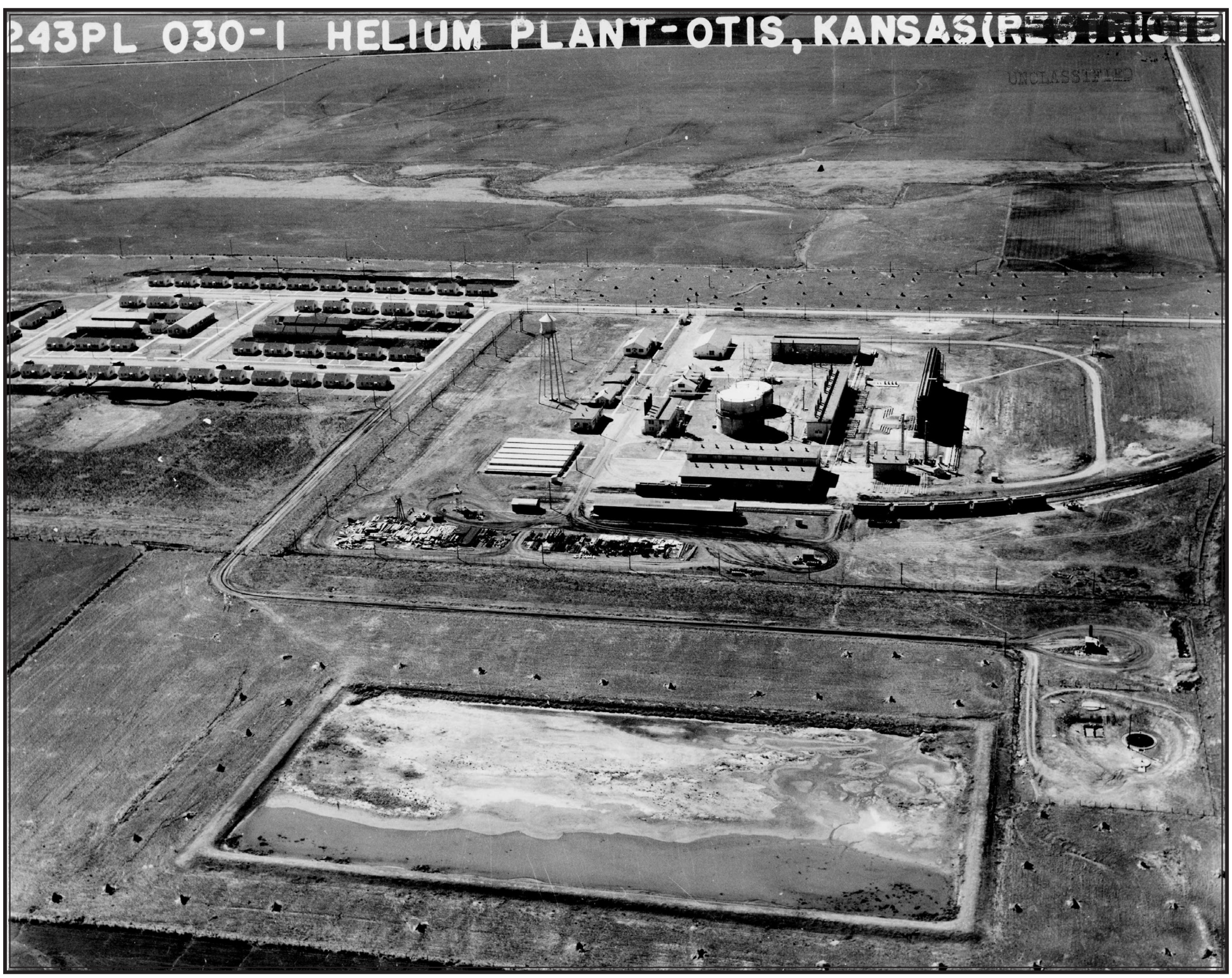
Exell Helium Plant was constructed in Texas in 1943.
Source: Library of Congress, Historic American Engineering Record.

98.2 to 99.995 percent, or Grade A (National Park Service 1999, 13). Grade A helium was used to reclaim magnesium from faulty castings in aircraft development, a process called "heliarc" welding. Welds produced in an atmosphere of pure helium were so superior that the wartime helium standard became unacceptable for industry use (Seibel 1968, 110).

These advances, combined with the onset of the U.S.-USSR Cold War in 1947, accelerated the demand for helium in support of national defense and other innovative uses. In turn, the U.S. reversed its helium conservation policy and began to withdraw helium from the Bush Dome Reservoir in 1953 to meet the growing demand for military applications as well as meteorological, medical, and industrial purposes (Mielke 1992, 1).

During the Cold War era, the onset of the Vietnam War and U.S.-USSR Space Race in 1955 further accelerated demand. This prompted the U.S. Central Intelligence Agency (CIA) to investigate the USSR's helium extraction and production capacity. According to a declassified report, the CIA estimated that the USSR had the capacity to produce 1.4 billion cubic feet of helium per year compared to the U.S.'s ability to produce about 4.2 billion cubic feet per year (Central Intelligence Agency 1958, 1).

The surge in uses during this decade depleted the U.S. stockpile from 87 million cubic feet in 1950 to less than 17 million cubic feet in 1959 (National Park Service 1999, 14). Since the 1925 Helium Act gave the government first rights to the helium supply, the private sector experienced shortages more acutely. Nevertheless, the U.S. government helium plants remained the sole supplier of domestic private sector helium (Mielke 1992, 1).



Otis Helium Plant was constructed in Kansas in 1943 and photographed in 1945, showing four rows of employee housing (left background). Source: National Archives, RG 18, NAID: 23940251.

The Conservation Period and Construction Boom at Cliffside, 1960–1969

The U.S. expected Cliffside Gas Field and its two billion cubic feet of naturally occurring helium to supply the country's needs for 100 years when it was purchased in 1929; however, after unanticipated demand in the 1940s and 1950s, and the notable depletion of the naturally occurring reserve, the government established a comprehensive helium conservation policy.

The resultant 1960 Helium Conservation Act established the federal helium stockpile in an attempt to ensure the federal government had a sufficient supply of helium to meet demand. The revised law incentivized private companies to manufacture helium as a byproduct of natural gas processing, after which the government would purchase the helium and provide for its long-term storage and conservation at Cliffside. The act directed the Secretary of the Interior to operate and maintain helium production and purification plants, related storage, and transmission and shipping facilities (Mielke 1992, 2).

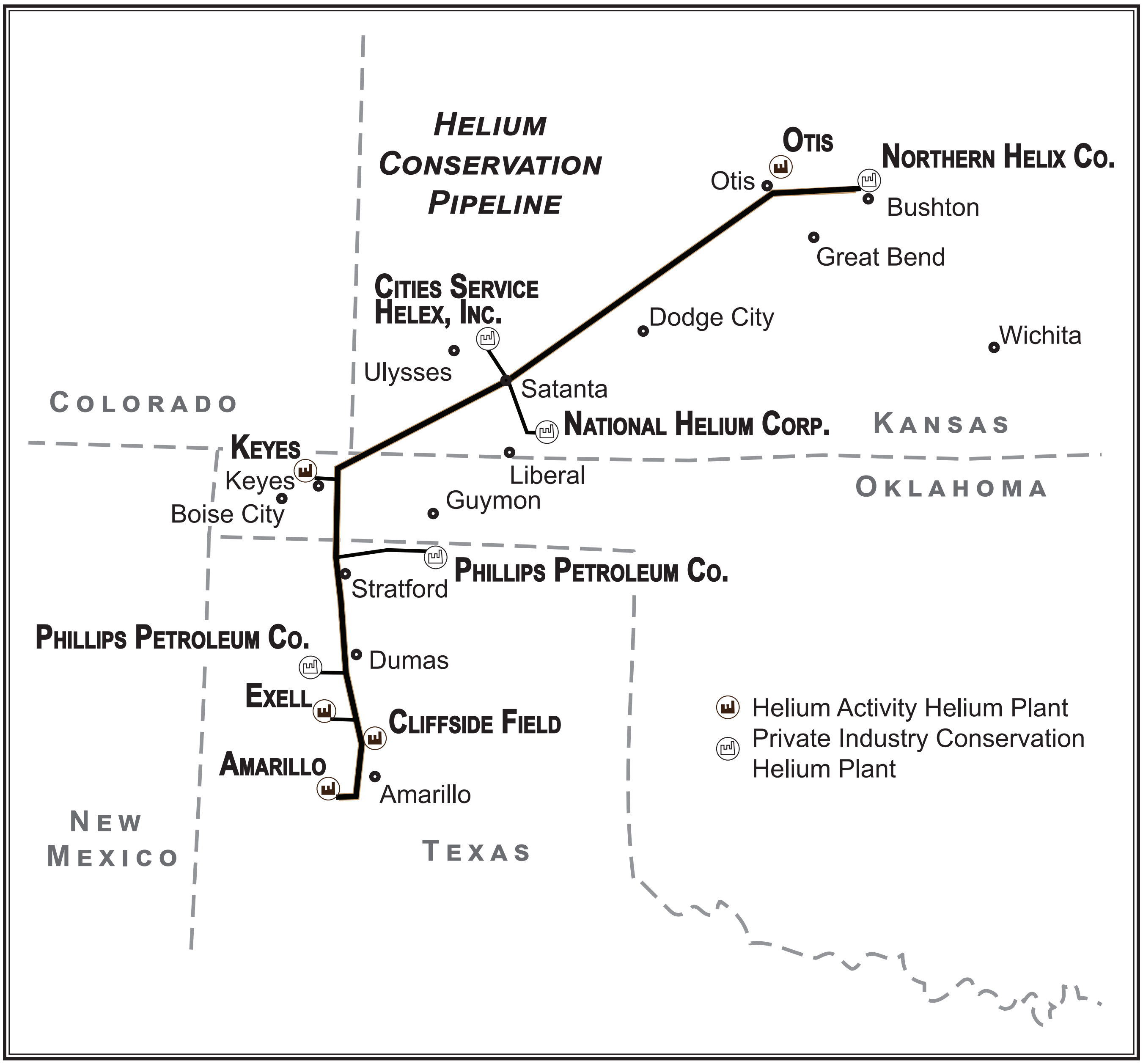
It also allowed the USBM to construct the wells at Cliffisde Gas Field and facilities at Cliffside Field Terminal to pump helium into the Bush Dome Reservoir and manage its long-term storage there. The Bush Dome, though a natural formation, was a unique and significant resource for the conservation program because it was able to hold natural gas with a high concentration of helium. The reservoir's large capacity for storage, 45 billion standard cubic feet, was exceptional. Almost 40 years later, a 2000 report on the sale of the Federal helium reserve noted that there was still no known comparable storage facility for helium storage in the world (National Research Council 2000, 21).

Further, the act required federal agencies and federal contractors to purchase helium from the USBM rather than from private processors. By dictating that all federally funded projects were required to use federally sourced helium, the government could monitor usage and try to prevent shortages that could impact national security.

The act also fostered development of the private helium industry. The availability of helium from non-government sources augmented use in the private sector, including metallurgy, undersea activities, chromatography, and cryogenics (Seibel 1968, 127). For the first time, helium was stored, not simply extracted and processed from naturally occurring gas fields. Dedicated in Amarillo on October 10, 1962, the Helium Conservation Program was "to conserve the limited and irreplaceable resources of helium gas—dedicated to the public welfare in assuring maximum benefit from this unique and valuable element in the scientific and economic progress of the Nation and its people" (U.S. Secretary of the Interior 1962, 3).

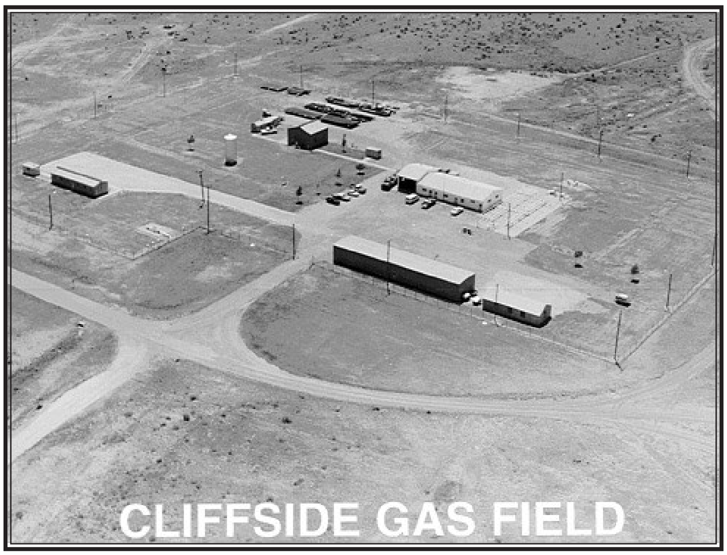
The 1960 Helium Act launched a regional private and federal construction boom that extended from the Texas Panhandle to central Kansas. Between 1961 and 1963, Northern Helex, Cities Service Helex, National Helium Corporation, and Phillips Petroleum Company constructed and operated five private plants that extracted helium from natural gas; and the USBM built the subterranean federal helium pipeline connecting public and private helium plants to the Cliffside, a gas metering facility to monitor private helium coming into the new line near Satanta, Kansas, and Cliffside Field Terminal, which was an office, lab, and testing facility at the Cliffside Gas Field in Texas.

Northern Helex, Cities Service Helex, and National Helium Corporation constructed plants in Kansas at Bushton, Ulysses (identified as Hugoton in the system's as-built documentation), and Liberal, respectively. Phillips Petroleum Company constructed two plants in Texas, one in Dumas and one in Sherman County. Upon extracting the helium-bearing natural gas, the private plants sold the helium to the



Constructed 1961-1962, the Federal Helium Pipeline connected new and existing federal and private industry helium plants to the new federally operated Cliffside Terminal Field offices and Satanta Station metering facility. Adapted from: *Helium: Child of the Sun,* Clifford Seibel.

Federal Helium Pipeline installation, 1962.
Source: BLM, Amarillo Field Office.



Cliffside Field Terminal office, lab, and testing facility, ca. 1965.
Source: BLM.

Satanta Station office and garage, Kansas, 1968.
Source: BLM, Amarillo Field Office.

USBM and transferred it to the Cliffside Field Terminal (Sears 2015, 85-130).

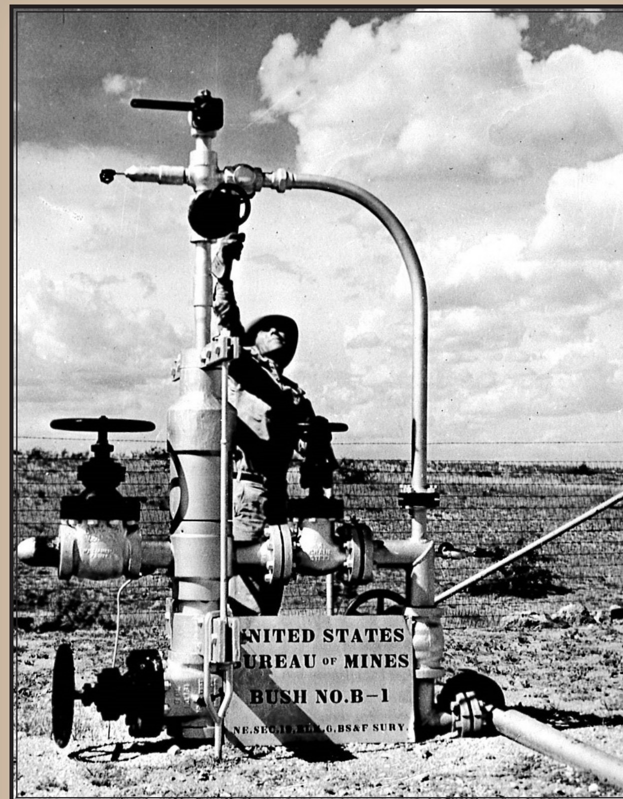
In 1961, the USBM hired the Williams Brothers Company of Tulsa, Oklahoma, to build the federal helium pipeline between the helium recovery plant in Bushton, Kansas, and and the fields and reserve in Cliffside. Founded in 1908, the Williams Brothers Company were leaders in international pipeline construction and pioneered numerous construction techniques (Schell 2023). The company designed the pipeline based on existing natural gas pipelines, acquired right-of-way for its entire 425-mile length, and supervised construction. From Bushton to Otis to Satanta, Kansas, they installed a 4-inch-diameter pipe, and from Satanta to Cliffside, an 8-inch-diameter one. Both segments were buried about 40 inches underground (August 4, 2022, personal telephonic communication with Sam Burton).

Concurrently, Williams Brothers built the Satanta metering facility between the 4-inch and 8-inch pipes near the federal pipeline's halfway point. The Satanta Station consisted of pipeline access ports, a small office, and a large maintenance garage. Historically, it was used to monitor the quality and purity of helium coming into the federal pipeline from two privately owned 3-inch-diameter lateral pipeline spurs connected to the recovery plants in Ulysses and Liberal, Kansas (U.S. Secretary of the Interior 1964; Williams Brothers Company 1963). Additional spurs to the south originally connected the federal pipeline to the Phillips Petroleum Company plants in Dumas and Sherman

County and the Exell Helium Plant at Masterson, Texas.

As part of the multiple-state helium processing system, several functional improvements were constructed on and below the Cliffside Gas Field in 1962. This included the Cliffside Field Terminal, an administrative office building and laboratory for day-to-day management and helium quality testing. The underground pipeline and storage tanks incorporated design elements to protect the gas from Cold War enemies. The gas field's naturally sheltered rural location simplified this, of course, but for decades, helium had been stored in metal aboveground tanks, exposing it to potential threats. Twenty-three wellheads were reconstructed and installed underground in vaults with camouflaged earth-colored covers that concealed them from aerial and ground-level views. The wellheads safely controlled the pressure and flow of gas through a collection of valves and fittings. The changes helped safeguard the strategic resource's location from potential threats. Buried underground, the pipeline and well cellars were representative of postwar design that safeguarded helium transfer and storage (Sears 2015, 85-130).

The pipeline delivered its first helium for conservation in December 1962 (U.S. Secretary of the Interior 1963, 3). It and the storage facility at the Cliffside Field were integral to the private helium plants in the area; the ability to store helium minimized the impacts of global supply-and-demand cycles and allowed



Typical helium-bearing gas well connection at Cliffside Gas Field, ca. 1950.
Source: TxDOT Time Capsule Event File, DOC.1950s, Book I.

One of 23 newly buried wellheads at Cliffside Gas Field, ca. 1965.
Source: BLM, Amarillo Field Office.

the federal government to maintain a perpetual stockpile for federal use. The rising national defense demands relating to the Cold War and Space Race made such a stockpile increasingly important (Mielke 1992, 3).

NASA's Helium Use, 1958-2000

During the Cold War, the National Aeronautics and Space Administration (NASA) was established in 1958 to focus on the Space Race. Thereafter, demand for helium increased substantially as it allowed the agency to pressurize engine propellant tanks and purge liquid hydrogen engines. Because helium is inert, the element is uniquely suited to pressurize systems in place of hydrogen, the highly explosive cryogenic main fuel component that is not loaded until right before launch. Without pressurization, such tanks would collapse under vehicle-imposed structural loads (National Research Council 2000, 32). The combination of liquid hydrogen fuel utilizing a liquid oxygen oxidizer is a common rocket propellant and is currently used on the Ariane 5, Delta IV, New Shepard, H-IIB, GSLV, and Centaur rocket launch systems.

NASA scientists and the 6,000 PSI gaseous helium bottle, Rocket Engine Test Facility, NASA, Lewis Research Center (now the John H. Glenn Research Center at Lewis Field), 1979. Source: National Archives, RG 255.

Helium is also used to purge such systems in instances where hydrogen fuel must be removed. As helium's boiling point (-269.96 degrees Celsius) is lower than hydrogen's (-252.88 degrees Celsius), it is the only element capable of flushing highly complex cryogenic engines. Other gases with higher freezing points run the risk of producing frozen particles that may clog engines or dissolve in the liquid hydrogen, thus compromising the fuel's integrity.

NASA also uses helium in other applications such as welding, cooling scientific payloads, refrigerating fuel-handling systems to liquid hydrogen test temperatures, and as a pneumatic control system fluid in spacecraft and other rocket-propelled systems. As of 2000, NASA used the equivalent of 150 million combined cubic feet of liquid and gaseous helium (National Research Council 2000, 32).

Ebbing Demand for Federal Helium, 1969-1996

Global events triggered decreased governmental demand for helium beginning in the late 1960s. After the culmination of the Space Race with the Apollo 11 mission in 1969, the need for helium to support NASA declined. The end of the Vietnam War in 1975, combined with strategic arms reductions during the late Cold War in the 1970s and 1980s, lessened the military's need for a readily available surplus of helium. As early as 1970, nearly all government helium plants, including the Amarillo facility, had ceased production. However, private helium processing continued using the Federal Helium Pipeline for shipment and the Cliffside Gas Field for storage. By the mid-1970s, the bureau had long-term contracts to store privately owned crude helium at Cliffside for a fee (National Park Service 1999, 11).

In the late 1970s, private demand for helium skyrocketed. End users were researchers, engineers, and scientists exploring properties of and potentials for the gas. By this time, private contractors working with the federal government were allowed to source less expensive helium from private companies. Unlike the federal government, private companies were not burdened with constant pipeline and-storage maintenance costs, despite the fees they paid for access to the system. Because they could often sell helium for 40 percent less than federal rates, private companies essentially supplied the commercial helium market. When federal agencies no longer required Cold War–level helium supplies, demand decreased to the extent that the Federal Helium Program was $1.4 billion in debt by the 1980s (Mielke 1992, 6).

Privatization and Advances in Helium Refining, 1996-Present

Federal Helium Program funding had evolved since its inception and, by the early 1990s, it was based on national demand and market rate. The helium program came under heavy scrutiny in the first half of that decade when the executive and congressional branches sought a federal deficit reduction. One approach to deficit reduction resulted in the 1996 Helium

Lt. Michael Shilko, laser effects system engineer, aligns the CO_2 laser with a helium neon laser, 1980. Source: National Archives, RG 330.

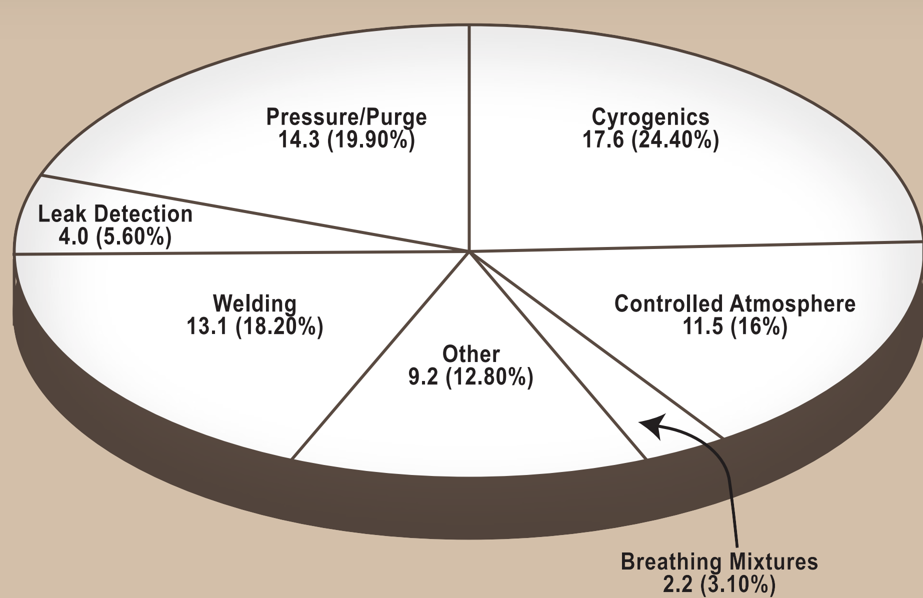
Navy and Air Force personnel unload a 20,150-pound tank of liquid helium from a C-141B aircraft for National Science Foundation researchers in Antarctica to apply to cosmic background radiation studies, 1988. Source: National Archives, RG 330.

Aerographer's mates launch a helium-filled weather balloon from the fantail of the battleship USS IOWA, 1984. Source: National Archives, RG 330.

Privatization Act (National Park Service 1999, 14). The law terminated the government-sponsored helium program for the United States, instructing the disposal of all facilities and all underground crude helium reserves by 1998. The government would continue to collect royalties and fees for helium extracted from or stored on federal property, setting a minimum price for helium. These proceeds were intended to retire the program's debt to the Department of the Treasury by 2015 (104th Congress 1996). Following congressional closure of the USBM in 1996, responsibilities for the Federal Helium System including those at the Amarillo and Exell plants transferred to the Bureau of Land Management (BLM). In 1998, the BLM partnered with the National Park Service to survey historic and archeological properties associated with the helium program. These efforts included Historic American Engineering Record documentation as well as interpretative exhibits such as state historical markers.

In the era of privatization, experts continued to improve the efficiency of helium extraction and production processes. Prior to this period, helium delivered to the refining plants along the government's pipeline experienced excess methane levels, resulting in impurities. The Crude Helium Enrichment Unit (CHEU), which was constructed and operated by a private industry consortium and began operation at the Cliffside Field Terminal in 2005, solved these byproduct issues (BLM Helium Operations Amarillo Field Office 2010). The CHEU expediently enriched crude helium that was then transferred through the Federal Helium Pipeline to privately owned facilities. Although the federal government actively transferred helium development to the private sector, discoveries were made to increase the efficiency of helium production in the U.S. at the end of the 20th century.

Congress enacted the 2013 Helium Stewardship Act to ensure continued access to federal crude helium reserves. The law instituted an orderly transition to privately owned helium processing with minimal market disruption. Selling crude helium at market-rate prices was predicted to stimulate private sources of the gas with a goal of maintaining a global assessment of the resource, including forecasts of helium demand. The act also established conservation and research programs focused on long-term helium acquisition for all federal users. It further required the DOI to sell a portion of the Federal Helium Reserve, held in conservation at the Cliffside Gas Field, in 2014, with the purchase completed by October 2018. The BLM transferred the Federal Helium System, considered surplus property by this time, to the U.S. General Services Administration (GSA) in September 2021. The GSA has listed the property for public sale.



Private consumption of helium totaled 71.9 million cubic meteres in the United States in 1996.
Source: BLM, Amarillo Field Office.

The CHEU at the Cliffside Field Terminal, ca. 2010.
Source: BLM, Amarillo Field Office.

Cliffside Field Terminal, 2022.
Source: BLM, Amarillo Field Office.

References Cited

Anderson, H. Allen. 1952. "Frying Pan Ranch." *Handbook of Texas Online*, *Texas State Historical Association*. https://tshaonline.org/handbook/entries/frying-pan-ranch.

---. 1994. "Bush, William Henry (1849-1931)." *Handbook of Texas Online*, *Texas State Historical Association*. https://www.tshaonline.org/handbook/entries/bush-william-henry.

BLM Helium Operations Amarillo Field Office. 2010. 2010 OPA *Field Briefing*. BLM Helium Operations (Amarillo).

Center for Land Use Interpretation. 2023. "Exell Helium Plant, Texas." [Website]. https://clui.org/ludb/site/exell-helium-plant.

Central Intelligence Agency. 1958. *Occurrence and Availability of Helium in the USSR (Confidential): CIA Historical Review Program Released as Sanitized 1998.* Office of Research and Reports. https://www.cia.gov/readingroom/docs/DOC_0000496259.pdf.

Feldman, Carol, and Kay Sallee. 1999. *Cultural Landscape Inventory: Phase I, Amarillo Helium Plant and Exell Helium Plant and Landis Property*. Amarillo: U.S. Bureau of Land Management.

Historic American Engineering Record, Creator. *U.S. Bureau of Mines, Helium Plants, Exell Helium Plant, Highway 287N, Masterson, Moore County, TX*. Moore County Texas Masterson, 1968.

Mielke, James E. 1992. *Congressional Report for Congress: The Federal Helium Program*. Washington, DC: Congressional Research Service, Library of Congress.

National Park Service. 1999. *History and Historic Structures Inventory of the Amarillo Helium Plant and Exell Helium Plant, 1928–1996*. U.S. Department of the Interior.

National Research Council. 2000. *The Impact of Selling the Federal Helium Reserve*. National Academies Press.

Schell, Kent A. . 2023. Williams Companies. *In The Encyclopedia of Oklahoma History and Culture*: Oklahoma Historical Society.

Sears, Wheeler M. "Bo". 2015. "The Helium Industry." In *Helium: The Disappearing Element*, edited by Wheeler M. "Bo" Sears, 85–130. Springer International Publishing.

Seibel, Clifford Winslow. 1968. *Helium, Child of the Sun*. University Press of Kansas.

U.S. Congress. *Helium Privatization Act of 1996*. 110 Stat. 3315. October 9, 1996.

U.S. Court of Claims. 1969. Caroline Bush Emeny et al. v. the United States, 412 F.2d 1319. Justia.

U.S. Secretary of the Interior. 1962. *Fiscal Year 1962 Report to the Congress on Matters Contained in the Helium Act, Public Law 86–777*. U.S. Department of the Interior.

---. 1963. *Fiscal Year 1963 Report to the Congress on Matters Contained in the Helium Act, Public Law 86–777*.

---. 1964. *Fiscal Year 1964 Report to the Congress on Matters Contained in the Helium Act, Public Law 86–777*.

Williams Brothers Company. 1963. As-Built Drawing Manual: Pipeline and Plant Facilities, Crude Helium Pipeline System.

Cover Image Credits

BACKGROUND: Otis Helium Plant, Kansas, 1945 (National Archives, RG 18, NAID: 23940251)
FRONT: U.S. Navy blimp C-7 on one of its first flights (Library of Congress: LC-USZ62-138970)
BACK: U.S. Navy diver rebreathing into a special apparatus which measures the amount of helium gas (Library of Congress: LC-H22-D- 4359)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