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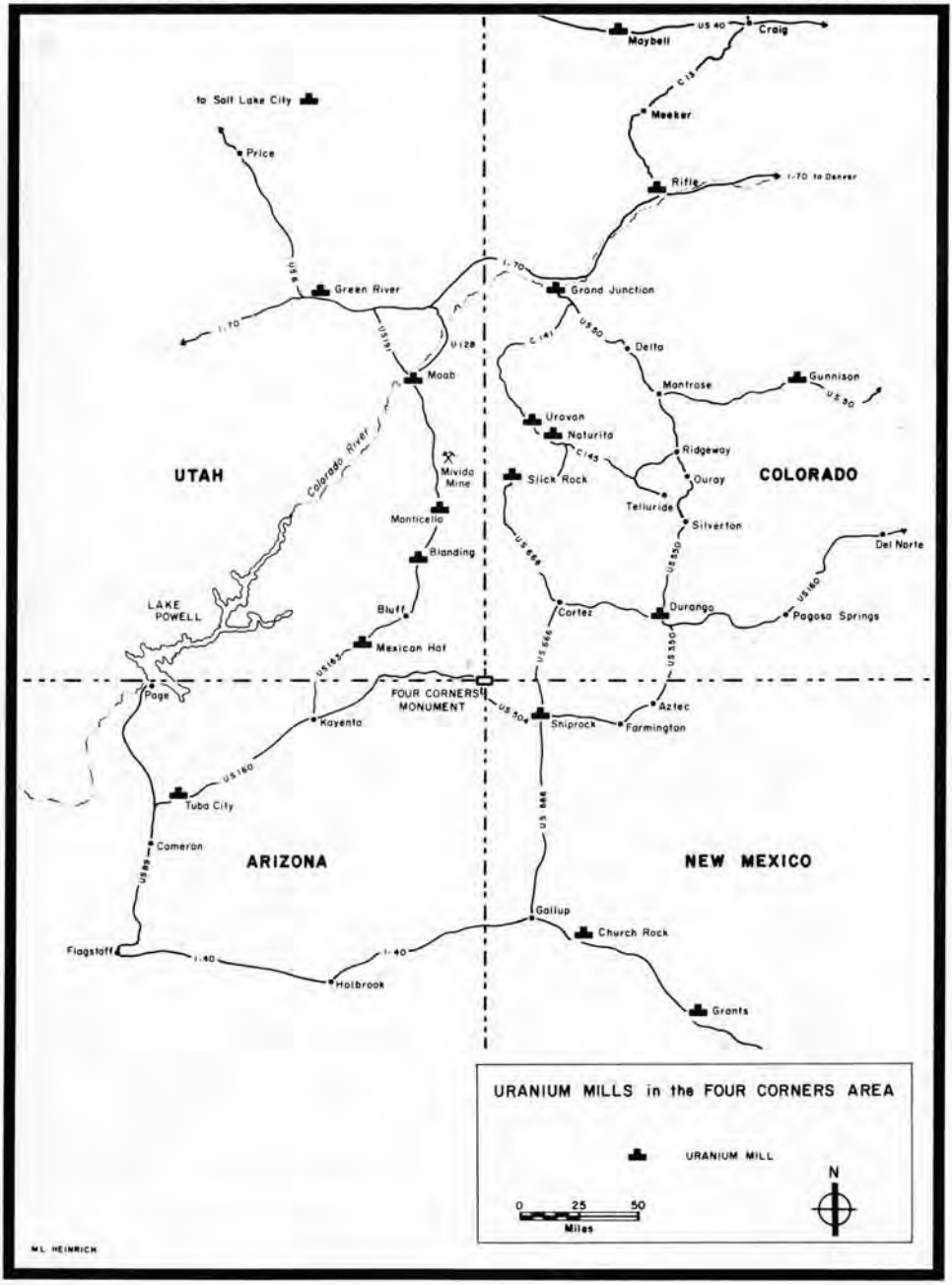

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JOURNAL OF THE WESTERN SLOPE

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100 YEARS OF URANIUM ACTIVITY IN THE FOUR CORNERS REGION
PART II

By

ROBERT SULLENBERGER

TABLE OF CONTENTS

EDITORS NOTE

I would like to extend my apology as editor of THE JOURNAL OF THE WESTERN SLOPE to both the author and subscribers for the confusion of the photo captions appearing in the first segment of *100 Years of Uranium Activity in the Four Corners Region* by Robert Sullenberger. Below are the correct photo captions corresponding to the proper page numbers.

1. Photo on page twenty was taken at USVC's Egnar, Colorado mining camp on the Dolores Canyon Rim near Slick Rock, Colorado. The initial caption stated USVC's mine employees, Colorado mining camp.

2. Photo on page twenty-four is of USVC's mill at Uravan, Colorado, not at Egnar, Colorado.

3. Photo on page twenty-six should read USVC's Egnar, Colorado mining camp, not mining survey camp in Coal Bed Canyon, Utah.

4. Photo on page fifty is of North Continent Vanadium mill at Slick Rock, Colorado instead of North Continent Mine.

Again, I apologize for this mix up and the unprofessional nature in which it reflects on the JOURNAL OF THE WESTERN SLOPE.

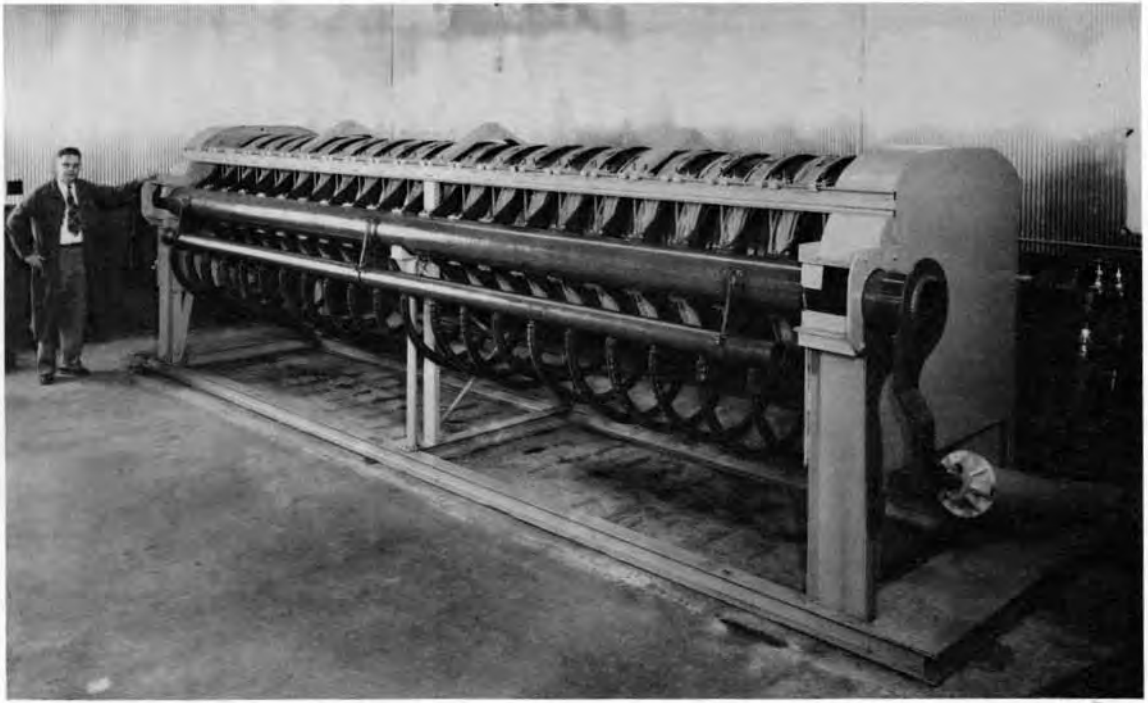
INTRODUCTION

The United States Vanadium Corporation (USVC) hired Robert Sullenberger in 1940 for a uranium mining claim survey position near Egnar, Colorado on the Dolores River Canyon rim. Later, he worked in the company machine shop at their mill site in Uravan, Colorado. During the course of his employment with U.S.V.C., he acquired considerable insight on mining methods, uranium-vanadium ore refining processes, mill and mine equipment maintenance and new uranium mill construction.

Numerous incidents in the early 1940s that occurred are lacking in previous publications. Most former Uravan employees have passed beyond the horizon and one objective in writing this narrative was to record some of the author's Uravan memories of working for USVC at the beginning of World War II.

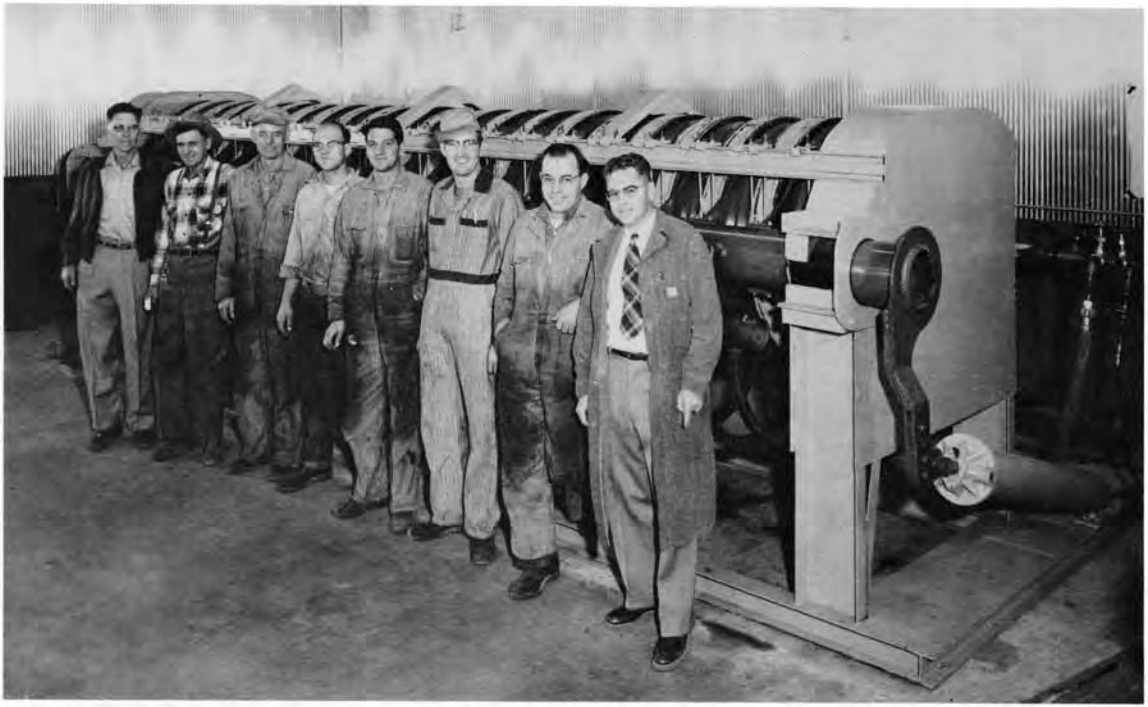
A resurgence of activity occurred in the Four Corners region during the Uranium boom of the 1950s. With the discovery of several new uranium ore bodies, the demand for new uranium processing mills in Colorado, Utah, Arizona, and New Mexico rose.

Most of the Four Corners uranium mills no longer exist. Many have been dismantled, while others remain on a stand-by status awaiting direction from the United States Department of Energy to determine their future. Removal of radioactive tailings created by the mill operations began in 1977 and is expected to continue well into the twenty-first century.



(Courtesy of author)

Robert Sullenberger with Vitro Chemical's uranium filter press in Grand Junction, Colorado (1955).



(Courtesy of author)

Minerals Engineering Company employees with Vitro Chemical's uranium filter press in Grand Junction, Colorado (1955).

CHAPTER FIVE

CLIMAX URANIUM COMPANY'S GRAND JUNCTION, COLORADO URANIUM MILL

LOCATION

The Grand Junction mill site encompassed a 65-acre tract on the south side of the city and on the north bank of the Colorado River, adjacent to the industrial district. The site's elevation is approximately 4590 feet above sea level.[1]

OWNERSHIP AND HISTORY OF MILLING OPERATIONS AND PROCESSING

A sugar beet factory occupied the site when the Climax Uranium Company, a division of American Metals Climax (AMAX Incorporated), began milling operations in 1951. Initially, the site included 200 acres; however, 85 acres were later developed into an industrial complex, 40 acres deeded to the State of Colorado as a repository for a remedial action program, and 10 acres sold to private individuals. The mill ceased operation in March of 1970. Shumway Incorporated bought the mill tailings in 1976 and Castings incorporated purchased the remaining six-acre mill site.

The Grand Junction mill site processed 2.2 million tons of ore during its 19 years of operation, of which 1.9 million tons remain. The ore delivered to the mill from all parts of the Uranium Mineral Belt averaged .28% U3 08 and 1.41% V2. The tailings pile covered 59 acres of the site and contained both uranium and vanadium tailings, rubble, and contaminated earth.[2]

OFF-SITE TAILINGS USE

An estimated 300,000 tons of uranium tailings were removed from the tailings pile to serve as filler material for various construction projects, including 50,000 tons under Grand Junction's own structures. Door to door gamma surveys identified six thousand locations that contained tailings in their construction. These locations became part of a uranium clean up program sponsored by the United States Government in the mid-1980s and continues today. Preliminary disposal planning for the site included an average tailing depth of 40 feet, with 14 feet of ground cover.

In 1990 and 1991, a special uranium haulage road was built to transport tailings from Grand Junction to the Whitewater Mill tailings disposal site, just 6.5 miles east of the city. The paved haulage road parallels U.S. Highway 50 for the majority of its route and is restricted to any vehicles not transporting uranium mill tailings. A 1977 estimate placed the cost of transportation of mill tailings at $11,650,000. Fifteen years of inflation has most probably doubled or tripled the original estimate.[3]

Robert Sullenberger observed Japanese earth moving shovels loading dump trucks with mill site tailings during his 1992 visit to the Grand Junction uranium mill site. Radiation teams washed off the contaminated tailings from the underside of each truck before allowing it to proceed through the city streets to the tailings haulage road on the south side of the city.

GUNNISON, COLORADO URANIUM MILL LOCATION

The Gunnison mill site stands just outside of Gunnison's city limits at an elevation of 7,635 feet above sea level. Tomichi Creek enters the Gunnison River near the site.

OWNERSHIP

(Courtesy of author)

Climax Uranium Company's Uranium Tailings Removal Project, Grand Junction, Colorado (1992).

(Courtesy of author)

Hauling Climax Uranium Company's tailings from Grand Junction, Colorado mill site (1992).

(Courtesy of author)

Hosing down uranium tailings truck at the Climax Uranium Company's Grand Junction, Colorado mill site (1992).

Gunnison Mining Company operated the mill between February 1958 and December 1961, at which time they merged with the surviving company—Kermac Nuclear Fuels, a wholly owned subsidiary of Kerr-McGee Oil Industries. In December of 1964 Colorado Ventures Incorporated (CVI) purchased the entire property. CVI deeded 3.5 acres at the northern end to Gunnison County for airport expansion in 1966. In August of 1973 they sold the remaining 61.5 acres to a limited partnership that included Messrs. Clarence A. Decker, N. Marcus Bishop, and Roger L. McEachern of Denver, Colorado. Solutions Engineering then leased the property from the partnership.[4]

HISTORY

Gunnison Mining Company operated the mill to provide uranium for the Atomic Energy Commission. Kermac then assumed operations until its closure in April 1962. The initial design capacity allowed for 200 tons of ore production daily. During its four years of production, the mill possessed roughly 540,000 tons of ore, averaging .15% U3 08. Mines in the Cochetopa Pass region, southeast of the site, supplied the mill with the majority of its ore.

Ground ore at a minus 65-mesh size was leached by using sodium chlorate and sulfuric acid. The pregnant solutions and solids became separated after leaching by a four-stage counter current classifier and thickener circuit, with the washed solids from the final units being sent to tailings. Pregnant solutions were then treated by solvent extraction to recover and concentrate the uranium.[5]

MILL TAILINGS

Of the original mill structures, only a steel water tower, an office building, and a metal mine building remained in 1977. The mill tailings covered 39 acres of the site after its closure, amounting to 540,000 tons. Five long-term disposal sites were evaluated in 1977: South Gold Basin, West Steers Gulch Peak, West Long Gulch,

Maggie Gulch Depression, and Maggie Gulch Peak. The estimated cost of moving the tailings from Gunnison to South Gold Basin Site # 1 reached $5,009,000, assuming trucks could transport the tailings at a rate of 3,500 tons per day in a twelve month period.

The Government contracted the Morrison Knudsen Ferguson Company to remove the water tower and an additional building in 1991. After their closure in 1962, the Kermac Nuclear Fuels Corporation leveled out the mill tailings and covered them with a thin topsoil. Currently, the mill tailings remain on the mill site since the United States Government has yet to decide about their final disposition.[6]

UNION CARBIDE CORPORATION'S MAYBELL, COLORADO URANIUM MILL

LOCATION

The Maybell mill site is located 6,200 feet above sea level, in Colorado's northwestern region.

OWNERSHIP AND HISTORY OF MILLING OPERATIONS AND PROCESSING

The Union Carbide Corporation has retained ownership of the mill site since its inception in 1957. The Maybell mill site processed 2.6 million tons of ore graded at .098 percent U3 08, from 1957 until its closure in 1964. Open-pit mines nearby provided low-grade ore, while the plant's upgrader circuit treated it prior to leaching.[7]

TAILINGS

Deep open pits, piles of removed overburden, and the relatively flat sloping surface of the 80-acre tailings pile characterized

the Maybell site. Six inches of earth and vegetation stabilize the tailings. Erosion exposed 20 percent of the pile's surface in 1977, while vegetation covered about 40 percent of the tailings. The construction of off-shore ditches and a dike on the east side diverted upslope water away from the tailings pile. Water that collected on the tailings drained off the pile into a drainage system and was channeled into nearby Johnson Wash.

Union Carbide Corporation used another portion of the site for heap leaching operations utilizing low grade ore in 1977. The additional site contained 2.6 million tons of tailings. A dike failure during mill operations left 200 tons of tailings in the gulch leading to Johnson Wash. In 1977, a cost estimate for adding 1.5 feet of cover material and the removal of tailings from the contaminated wash equaled $94,000. The alternative of moving the tailings to a nearby open-pit mine and burying the tailings two feet down, plus removing the tailings from Johnson Wash proved more expensive, at an estimated cost of $4,520,000.[8]

Fifteen years later, a *Denver Post* article entitled "Radon Barrier Planned" announced the scheduling of the project:

The Maybell uranium mill tailings removal, a $24 million remedial plan to make a radon-proof barrier to last 1,000 years, is scheduled to begin in the spring of 1994. The site contains 3 million cubic yards of tailings. Some 600,000 cubic yards will be relocated. More than 60 people will work on the project by 1994, and the project is to be completed by 1997.[9]

UMETCO MINERALS CORPORATION'S BLANDING, UTAH URANIUM MILL

The *San Juan Recorder* newspaper in Monticello, Utah ran a front page article entitled "Carbide Seeks Interest in White Mesa Mill,":

Union Carbide Corporation and Engineering Fuels Limited have signed a preliminary agreement which may lead to joint ownership of the White Mesa mill at Blanding, presently owned and operated by Energy Fuels.

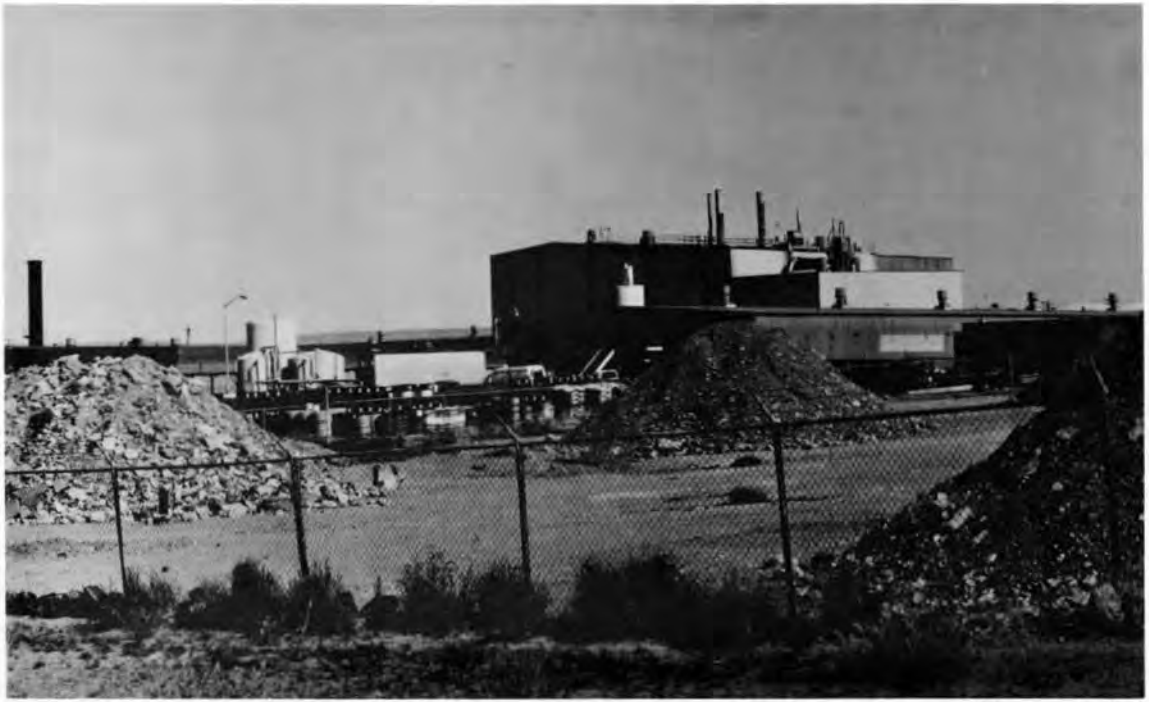
Under the proposed terms, Union Carbide will become the majority owner and operator of the mill. Union Carbide will maintain its mill at Uravan, Colorado and will continue with its plan to provide additional tailings disposal facilities which will permit the continued operation of the Uravan Mill.

Union Carbide continues to believe that market conditions will eventually improve and will allow a return to normal operations. However, it is expected that production will continue to be severely curtailed during the next few years.[10]

The Blanding mill closed down in 1991 because of declining uranium market conditions, but resumed operations in May of 1992. The mill's uranium output supplies nuclear power plants with fuel for its reactors.[11]

Union Carbide presently uses a butane fueled gun that prevents birds from landing on the mill's tailings ponds. These guns fire at regular intervals and can be heard over the entire mill operations. Wildlife are not endangered by this system and it seems quite successful in eliminating the problem of waterfowl landing on radium contaminated tailings ponds.[12]

UMETCO's Blanding, Utah mill is the only mill, out of the fifteen mills built in the Four Corners region, that currently operates.



(Courtesy of author)

UMETCO uranium mill at Blanding, Utah (1992).

NOTES: CHAPTER FIVE

[1]Phase II-Title I Engineering Assessment of Inactive Uranium Mill Tailings, Grand Junction, Colorado. U.S. Department of Energy, October 1977.
[2]Ibid.
[3]Ibid.
[4]Phase II-Title I Engineering Assessment of Inactive Uranium Mill Tailings, Gunnison Site, Gunnison, Colorado. U.S. Department of Energy, November 1977.
[5]Ibid.
[6]Ibid.
[7]Phase II-Title I Engineering Assessment of Inactive Uranium Mill Tailings, Maybell Site, Maybell, Colorado. U.S. Department of Energy, October 1977.
[8]Ibid.
[9]"Radon Barrier Planned," *Denver Post*, 25 February 1992.
[10]"Carbide Seeks Interest in White Mesa Mill," *San Juan Recorder*, 10 February, 1983.
[11]Interview with G.G. (Jerry) Ray, Production Superintendent, Umetco Minerals Corporation, May 1992. Transcripts in the hands of Robert Sullenberger, Arvada, Colorado.
[12]Ibid.

CHAPTER SIX
NAVAJO INDIAN RESERVATION URANIUM MILLS

New uranium ore deposits were discovered during the 1950s in northwestern New Mexico, northeastern Arizona, and southeastern Utah, on the Navajo Indian Reservations, which included the Carrizo Mountains, Monument Valley, Cane Valley, Many Farms, and Hoskinnine Mesa. Ore extracted from the Navajo Indian Reservation mines went to the Vanadium Corporation of America's (VCA) uranium mill at Durango, Colorado, with the main ore haulage route passing through Shiprock, New Mexico. The Navajo Tribe realized the demand for an ore processing facility closer to reservation mines and began constructing the Navajo Uranium Company's uranium mill at Shiprock in 1951, which became operational on January 3, 1952.[1]

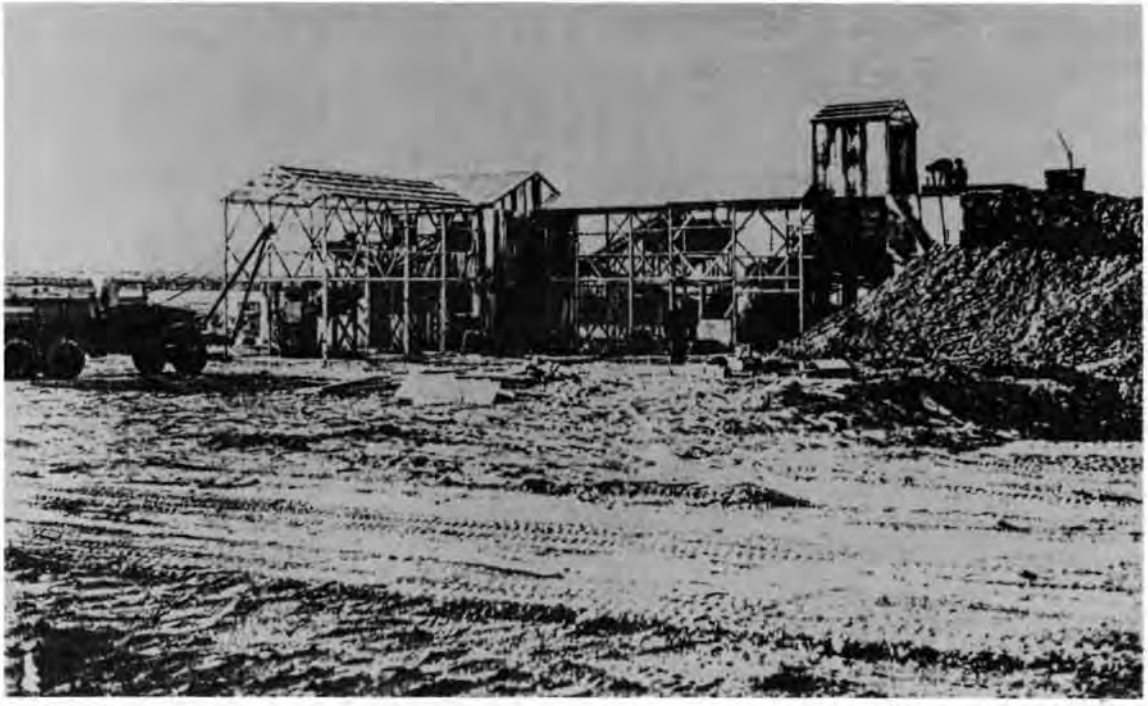
In the mid 1950s additional reservation mills were erected at Monument Valley and Mexican Hat, Utah, as well as Tuba City, Arizona.

SHIPROCK URANIUM MILL LOCATION

The Shiprock site occupied a 230-acre tract on the south side of the San Juan River, at an elevation of 5,000 feet above sea level.

SHIPROCK URANIUM MILL HISTORY

The original mill, built by the Navajo Uranium Company, became operational in January 1952. Kerr-McGee Oil Industries Incorporated assumed operations in 1954 and continued to run the facility until 1963 when the VCA acquired control. The Vanadium



(Courtesy of Perry H. Charley)

Navajo Uranium Company's Shiprock, New Mexico uranium mill (1952).

Corporation of America and its successor Foote Mineral Company continued to run the mill until 1968. Kerr-McGee, VCA, and Foote Mineral Company all leased the plant from the Navajo Tribe. When the Foote Mineral Company's lease expired in 1973, several years after they ceased operations, full control of the site reverted back to the Navajo Nation.

Between 1954 and 1968, the mill processed 1.5 million short tons of ore—including ore concentrate from the Monument Valley Mine. The average grade was .25 percent U3 08 and 1.07 percent V2 05 and the mill produced 3,711 tons of U3 08 concentrate. The production of vanadium concentrate also occurred in 1955 and again from 1960 to 1968.

The ore extracted at Shiprock was predominantly derived from sandstone containing carnotite as the principal mineral. Under the operation of Kerr-McGee, company-controlled mines in northeastern Arizona supplied approximately 80 percent of the ore. Small mines in the Arizona and northwestern New Mexico regions furnished the remainder of the ore. The Uravan Mineral Belt supplied over half of Shiprock's ore after the transfer of ownership in 1963. Ore hauled to the mill traveled an average of 100 miles.

TAILINGS

Two adjacent tailings piles covered approximately 72 acres. After disassembling, some of the mill buildings and equipment were buried in the tailings and washes.

In November 1973, the Navajo Tribal Chairman asked the Environmental Protection Agency (EPA) and other federal agencies for assistance in stabilizing the tailings and developing procedures for site decontamination. In April 1974, the EPA's radiation surveys of the site disclosed the extent of wind and water erosion of mill tailings. This provided a decontamination plan and an estimated cost of the project. The EPA submitted their plan to the Navajo Tribe in October 1974.

In 1973, however, the Navajo Tribe had authorized the Navajo Engineering and Construction Authority (NECA) to employ

the site as a vocational school that instructed Navajo students in heavy duty equipment operations. At the time of the EPA survey, the NECA training program used the tailings piles to practice earth moving techniques. The EPA decontamination plan specified that the contaminated soil from areas surrounding the tailings piles would serve as a stabilizer. An interim stabilization cover of six inches of dirt on the lower pile and containment dikes required construction. Decontamination procedures included all buildings, as well as the entry road, parking lots, and ore storage areas. The plan required input from the Navajo Environmental Protection Commission (NEPC), Indian Health Service (IHS), New Mexico Environmental Improvement Agency (NMEIA), as well as the EPA and the NECA. On March 31, 1977, a U.S. Energy Research and Development Administration report indicated that the plan had accomplished 80 percent of the proposed cleanup, but that fencing and offsite decontamination still remained.

Decontamination of fifteen surrounding properties began in April 1985 under three separate contracts and concluded in February, 1986. The completed site consisted of a single embankment, covering 76 acres on the southeast half of the site, with the top of the embankment equalling an average slope of 3.55 percent. Based on predicted rates of erosion of the escarpment, the embankment was moved a minimum of 300 feet from the escarpment edge.[2]

FINAL MATERIAL QUANTITY SUMMARY

Started/Completed	Activity	Quantity
7/85-10/85	Erosion Protection (Rock)	217,000 cy
7/85-4/86	Railings Consolidation	1,031,440 cy
8/85-2/86	Surrounding Properties	22,000 cy
8/85-10/86	Site Grading Work	375,000 cy
10/85-7/86	Radon Barrier Placement	775,000 cy

This project performed by local Navajo laborers provided 1.5 million dollars in wages to the area's economy, including the employment of 40 crew members who worked 120,000 man hours.

(Courtesy of author)

Mexican Hat, Utah uranium mill site (1992).

The Shiprock mill site became one of 24 mill sites mandated for stabilization by Public Law 95-604 and the 1978 Uranium Mill Tailings Radiation Control Act. Congress authorized one hundred percent funding for work at these Tribal Land sites.[3]

MEXICAN HAT, UTAH URANIUM MILL

LOCATION

The Mexican Hat site included a 555 acre tract called "Halchita" on the Navajo Indian Reservation one mile southwest of Mexican Hat, Utah. Adjacent to U.S. Highway l63, the area contained low, rolling hills and washes that drained into the San Juan River. This site is 4,330 feet above sea level and sparse in vegetation.

OWNERSHIP AND HISTORY OF MILLING OPERATIONS AND PROCESSING

Texas Zinc Minerals Corporation constructed the mill in 1957 and continued operations until July 1963, when purchased by Atlas Corporation. Atlas operated the Mexican Hat mill until its closure in 1965. The Navajo tribe owned the site and leased it to both companies. When the Atlas lease expired in 1970, control of the site reverted back to the Navajo Nation.

The mill processed 2.2 million dry tons of ore, with an average grade of .28 percent U3 08 in concentrate (yellow cake). In addition to the uranium operation, a sulfuric acid plant operated at the site and continued until 1970.

In 1977, most of the buildings remained intact, but all of the milling equipment had been removed. A trade school, however, used some of the buildings during the day while an elementary school, with 160 students and faculty, occupied an area .3 miles southwest of the mill site. The "Halchita" housing area occupied a tract .6 miles south of the mill site, also with a population of 160.

TAILINGS

In March 1977, the Mexican Hat uranium mill site contained approximately 2.2 million tons of tailings in two adjacent tailings piles that covered 689 acres. One pile covered 25 acres and contained 880,000 tons of material; the other pile contained 1.32 million tons on 43 acres of the site. The tailings were deposited at a depth of 40 feet.[4]

A July 25, 1984 Department of Energy News Fact Sheet stated:

Remedial action at vicinity properties will be accomplished in conjunction with the processing site. In Mexican Hat, seventeen vicinity sites and 50 acres contaminated with wind blown tailings may require remedial action. Remedial action usually consists of removing the contaminated materials from the vicinity properties and disposing of them with the mill site tailings. Remedial action is scheduled to begin in 1986.[5]

The site of removed tailings rested only a short distance north of their original location. In May 1992, the area was fenced off and posted with radiation hazard signs. Some of the remaining housing units were abandoned; however, the Indian School and some company housing units still housed occupants.

Eight years after the DOE July 25, 1984 publication of its News Fact Sheet on the Mexican Hat Uranium Mill Tailings Project, an article appeared in the Wednesday May 13, 1992 issue of Monticello, Utah's *San Juan Recorder* newspaper, entitled "Mexican Hat Tailing Action," which read:

At a recent public meeting in Halchita, Steve Hamp told residents that plans are going forward for a restart of the tailings remedial action at Mexican Hat. Hamp is the Mexican Hat site manager for the Department of Energy's uranium mill tailings remedial action program.

Hamp told the group that as soon as the bids are in, they will be reviewed and the contracts will be awarded early in June. Notice to proceed is tentatively expected by mid June. Mobilizing at the site will begin after June 16th.

The project will continue for three construction seasons, finalizing in September 1994. The plan calls for the hauling of tailings for two seasons, and cover design and construction in the third season.

The Navajo Nation Employment Service Manager Norman Scott reports that applications for employment on the project are being accepted at the Arizona Department of Economic Security in Kayenta.

According to Ki Tecumseh of the DOE office in Albuquerque, an order was recently signed by Secretary of Energy Watkins placing a priority on getting input from Native Americans in the planning stage of DOE projects. The efforts of Peterson Zah and his deputy are considered largely responsible for this order.[6]

TUBA CITY, ARIZONA URANIUM MILL SITE DESCRIPTION

The 114-acre Tuba City site included the Navajo Indian Reservation, five miles east of Tuba City in Coconino County, Arizona—70 miles north of Flagstaff and 5,000 feet above sea level.

OWNERSHIP AND HISTORY OF MILLING OPERATIONS AND PROCESSING

Rare Metals Corporation of America built the Tuba City mill in 1955 and 1956. The company constructed ten houses and a trailer court on the north side, as well as sixteen houses and a trailer court for employees on the south side of U.S. Highway 160.

The mill merged with El Paso Natural Gas Company in July 1962. The Navajo Nation owned the land before and during the milling operations. Shortly after the mill's closure in 1966, full control of the site reverted back to the Navajo Nation.

The mill began operation in 1956 with treated ores obtained principally from the Cameron area, located about 25 miles to the southwest of the Tuba City Mill. Initially, the plant processed 300 tons per day using an acid-leaching, sand slime separation and resin-in-pulp ion-exchange process. By 1962, the Orphan Lode Mine, located near Grand Canyon Village, Arizona, supplied the majority of the ore. This high-lime content ore proved unfit for acid leaching. Consequently, the mill was converted to the carbon-

ate-leach process in 1963. Using the carbonate-leach process decreased production to 200 tons per day between April 1963 and September 1966, when the plant closed. The Tuba City Mill processed 800,000 tons of ore with an average grade of .33 percent U3 08 and produced 2,348 tons of U3 08 in concentrate (yellow cake) during its total operation.

In a 1967 survey conducted by the Ford, Bacon, and Davis Utah Incorporation, the housing area was found inhabitable. All of the mill equipment and some of the buildings had been removed.[7]

TAILINGS

On July 24, 1984, the Tuba City mill site contained about 800,000 tons of material on 105 acres, of which 22 acres were covered by the tailings pile and 44 acres were former evaporative ponds. All of the mill equipment and most of the buildings had been removed from the site with the exception of the structural steel frame of the main mill building. Ten former housing units located north of the site along U.S. Highway 160 were occupied on an occasional basis. Remedial action on tailings disposition, scheduled to begin in 1986, relied on the Federal Government to bear 100 percent of the cost for stabilizing the uranium tailings.[8]

In May 1992, the Tuba City uranium mill tailings had been leveled and covered with a layer of asphalt to prevent radon gas and wind blown tailings from escaping the disposal site. All of the mill site housing units had been removed and only their concrete foundations remain.

MONUMENT VALLEY, ARIZONA URANIUM MILL

LOCATION

The 101 acre Monument Valley site included the Navajo Reservation in Cane Valley 20 miles east to Highway 163 and five miles south of the Utah border.

OWNERSHIP AND HISTORY OF MILLING OPERATIONS AND PROCESSING

Constructed in 1955, VCA and its successor Foote Mineral Company, operated the Monument Valley mill through 1967. The companies leased the site from the Navajo Tribe before and during the milling operations. When the lease expired in 1968, full control of the site reverted back to the Navajo Nation.

Monument #2 mine, approximately one mile west of the site, became the source of ore for the mill. Between the summer of 1955 and July 1964, VCA used the sand-slime separation process to recover the uranium from the ore. In October 1964, Foote Mineral Company installed equipment for batch-leaching of the sand fraction that had been stored on the property from earlier operations. About one million tons of the sand tailings underwent treatment. An additional 100,000 tons of low-grade ore were heap-leached. The plant ceased operations in November 1967. Recovery of both uranium and vanadium from the ore while using the aforementioned process was between 65 and 70 percent.

Because the fine clay fraction contained radium in the ore, most of the radium in the upgraded ore concentrates went to a Durango, Colorado mill or to the Shiprock mill for further processing.[9]

TAILINGS

On July 24, 1984 the Monument Valley mill site included two tailings piles that covered about 30 acres. The old heap-leach pile covered roughly ten acres to an average depth of two to three feet, and contained about 165,000 tons of material. The cone shaped tailings pile stood 55 feet high. It covered 20 acres and contained 935,000 tons or approximately 85 percent of the tailings at the site. Little remained at the site except tailings and rubble.

The U.S. Government, through its remedial action project

on the mill's radioactive tailings promised to finance 100 percent of the cost incurred in stabilizing the tailings beginning in 1987.[10] The tailings cleanup failed to meet the DOE's scheduled start date; therefore, it was delayed for another five years. According to a May 6, 1992 *Arizona Republic* newspaper article, "Navajos Get A Shot At Cleaning Up Hazardous Waste", the U.S. Government appropriated about 70 million dollars in a "Superfund" grant to the Navajo Nation for cleaning up the uranium tailings in Monument Valley, Arizona and Church Rock, New Mexico. VCA operated the uranium mill at Monument Valley and Kerr McGee created the uranium tailings pile at Church Rock during their operations.

PROSPECTING FOR URANIUM IN MONUMENT VALLEY, ARIZONA

During the summer of 1954, George Davis, a Sandia Corporation engineer, and Robert Sullenberger spent weekends and vacation time prospecting for uranium on the Navajo Indian Reservation at Monument Valley, Arizona where they discovered two uranium deposits. One deposit was northeast of Kayenta near Agathia Peak and the other near Dinnehotso—northeast of Kayenta.

Climax Uranium Company in Grand Junction, Colorado assayed samples from both sites and sent their geologist, Robert Sayer, to Kayenta where Sullenberger and Davis met him for a field trip to the Agathia Peak discovery. Climax Uranium Company showed little interest in the Dinnehotso site primarily because the samples contained more thorium than uranium. Climax Uranium, on the recommendation of Sayer, declined negotiations on acquiring the claims and suggested Sullenberger and Davis contact Kerr McGee Uranium Company at Shiprock.

John Kroeger, a licensed Colorado surveyor registered with the Navajo Tribe's mining office at Window Rock, Arizona, surveyed and plotted the mining claims. The Tribe's mining engineer informed them that they had thirty days to post a $10,000 perfor-

(Courtesy of author)

Robert Sullenberger, author, prospecting for uranium in Monument Valley, Arizona (1954).

mance bond on the claims before a lease allowed mining activity to begin. They failed to raise the funds and decided to contact the Kerr McGee Company and inquire about their interest in acquiring the claims. Kerr McGee appeared interested and arranged for their pilot to meet with them at Kayenta for a scintillator flight over the Agathia Peak claims.

Don Telker, Sullenberger's associate at Sandia Corporation, and Sullenberger flew to Kayenta from Albuquerque to meet with the pilot. He arrived at Kayenta in a World War II surplus Piper Cub aircraft. The plane's main wing spar had broken in two above the pilot's head in an earlier landing and was held together by two pieces of wood mounted on each side of the break and held in place with bailing wire. The pilot was an Oklahoma cowboy who flew under the Marble Canyon Bridge over the Colorado in the Grand Canyon a few weeks before meeting with Sullenberger and Telker.

Their flight over the mining claim at Agathia Peak proved the roughest airplane ride either man had ever experienced. The 95 degree temperature and the thermal updrafts lifted the airplane and then dropped it like a brick, making it nearly impossible to take the readings off the plane's scintillator which detected the presence of uranium. After several bumpy, low level, tight turn flights over the area, they returned to Kayenta. The Kerr McGee pilot flew back to Shiprock and Sullenberger and Telker began their trip back to Albuquerque.

Over Canyon de Chelly, their airplane engine lost its oil pressure, forcing them to make an emergency landing at Window Rock. They continued their trip to Albuquerque after replenishing their oil supply.

The Kerr McGee Uranium Company operated a uranium mill at Shiprock at the time and controlled some of the uranium mines on the Navajo Indian Reservation. The thirty day limit for the $10,000 bond expired and they lost their rights—if any—to the uranium deposits they discovered at Monument Valley, Utah. Kerr McGee later mined some of the ore on the Agathia Peak claims.

(Courtesy of author)

George Davis, Sandia Corporation engineer, prospecting for uranium in Monument Valley, Arizona (1954).

NOTES CHAPTER SIX

[1]Interview with Perry H. Charley, Navajo AML Reclamation Department, Shiprock, New Mexico, February, 1992.

[2]"A Summary of the Phase II, Title I Engineering Assessment of Inactive Uranium Mill Tailings Shiprock Site, New Mexico," U.S. Energy Research and Development Administration, Grand Junction, Colorado. March 31, 1977.

[3]"UMTRA Shiprock Site Completion Overview Shiprock, New Mexico," October 3, 1986.

[4]Phase II of Title I Engineering Assessment of Inactive Uranium Mill Tailings, Mexican Hat, Utah," U.S. Energy Research and Development Administration, Grand Junction, Colorado. March 31, 1977.

[5]"DOE News Fact Sheet, Mexican Hat Uranium Mill Tailings Site, Mexican Hat, Utah," U.S. Department of Energy. July 25, 1984.

[6]"Mexican Hat Tailings Action," The San Juan Recorder, May 12, 1992, p. 3.

[7]"Phase II of Title I Engineering Assessment of Inactive Uranium Mill Tailings, Tuba City Site, Tuba City, Arizona," U.S. Energy Research and Development Administration, Grand Junction, Colorado. March 31, 1977.

[8]"DOE News Fact Sheet, Tuba City Uranium Mill Tailings Site, Tuba City, Arizona," U.S. Department of Energy. July 24, 1984.

[9]"A Summary of the Phase II, Title I Engineering Assessment of Inactive Uranium Mill Tailings, Monument Valley Site, Arizona," U.S. Energy Research and Development Administration. Grand Junction, Colorado. March 31, 1977.

[10]"DOE News Fact Sheet, Monument Valley Uranium Mill Tailings Site, Arizona," U.S. Department of Energy. July 24, 1984.

CHAPTER SEVEN

GRANTS, NEW MEXICO AREA URANIUM MINES AND MILLS

The Grants uranium district is located in northwestern New Mexico, along the southern flank of the San Juan Basin between Gallup and Albuquerque.

Paddy Martinez, a Navajo Indian, discovered the uranium mineralization in the Grants district during the spring of 1950. Mr. Thomas O. Evans, chief mining engineer for the railroad, initiated an exploration program in December of 1950, following a field examination of the Santa Fe Railway Company's holdings within the district. Test pits 6 feet square were sunk on 100-foot centers through the Todilto Formation. The drilling and blasting of the rim enabled the company to ascertain the magnitude of surface leaching. Hand-held jackhammer drilling, costing about $2.00 per foot, soon replaced the more expensive method of test-pitting, which cost approximately $35 per foot of depth. Later, the Santa Fe Railway Company performed the exploration by using half-track mounted wagon drills, at an expense of approximately $1.50 per foot.

The Anaconda Copper Mining Company secured leases from Stella Dysart, along with other rights owners in the region, and began exploration of the district in January 1951. Extensive programs of both airborne and ground radiometric reconnaissance were followed by trenching, wagon-drilling, test-pitting, bulldozing, and the driving of prospect adits. Open-pit mining methods accounted for the extraction of roughly 2,000 tons of limestone ore to determine costs and grade cut-offs.

Herbert V. Lee, of the Atomic Energy Commission (AEC), performed an initial reconnaissance in November of 1950. Mr. Millard Reyner and Mr. Jack Sheridan of the AEC spent two weeks in the area during November of 1950 preparing a detailed description of the known deposits. The Denver Exploration Branch of the AEC established a sub-office at Prewitt, New Mexico in January of 1950 to study the geology and promote the development of the Grants District. The lack of a suitable market handicapped the smaller companies; however, the establishment of a buying station by the Anaconda Copper Mining Company in the spring of 1952, under contract of the AEC, helped promote development.[1]

In 1953 the Anaconda Company constructed a carbonate leach uranium mill near Bluewater, New Mexico to provide a means of fabricating a marketable product from the ores. In addition to processing custom ores from a wide area in New Mexico and Arizona, Anaconda also conducted exploration work. The production in the Grants area came from shallow limestone ores, as well as some shallow sandstone mines such as the Alta, Evelyn and Silver Spur between Grants and Gallup. The discovery of the Mesa Top deposit also occurred at this time and was the first one in the district to develop a vertical shaft.

The Anaconda Company uncovered the first large sandstone uranium deposit in the region by using aerial prospecting on the Laguna Reservation—roughly 32 miles east of Grants. The Jackpile deposit outcropped at a place near the south end of a large mesa. This discovery probably influenced other large companies to investigate the Grants district for significant deposits of uranium. In the spring of 1955 ore was discovered in the Ambrosia Lake region at a depth of 300 to 400 feet. The knowledge that Ambrosia Lake was underlain by the Morrison Formation, known to contain several vanadium-uranium deposits on the Colorado Plateau, prompted deep exploration. Louis Lothman made the initial discovery in McKinley County, New Mexico. Miss Stella Dysart originally acquired the mineral rights on several tracts of land in the vicinity of Ambrosia Dome for oil exploration.

In 1955 the discoveries of ore in Sections 10, 15, 22, 24 and 39

of T14N R10W reorganized the district as a significant discovery. Thirty-five to forty drills operated to explore the Morrison sandstone in the Ambrosia Lake vicinity, with 60 other drills busy in Valencia and McKinley Counties. Exploration covered a strip 15 to 20 miles wide by 100 miles long—adjacent to Highway 66 between Laguna and Gallup.

In the early stages of extraction, individuals and small groups lacking the financial resources to fund extensive exploration programs provided land acquisitions. Obtaining the needed finances required consolidation of groups capable of raising $200,000 to $500,000 for a drilling program. Once a discovery occurred, the question of acquiring capital to develop a mine and build a mill added extra financial burdens. This necessitated consolidation with such companies as Kerr-McGee Oil Industries, Homestake Mining Company and Phillips Petroleum Company. In most cases the holders of the original mineral leases drilled their property enough to reveal orebodies, thus enticing large companies to further investigate and determine if the property warranted further production expenses. These companies then explored sufficiently to determine the justification of a mine and mill. Although the original major orebodies in the Ambrosia Lake area were confined to less than 20 sections, extensive exploration doubled or tripled the number of existing sections. Drilling in the Ambrosia Lake area, and elsewhere, advanced at a rapid pace. New discoveries occasionally appeared until November 24, 1956, when the AEC disclosed that they no longer guaranteed a market for any ores discovered after this time. Most wildcat drilling ceased following the AEC's announcement; however, drilling to delineate known orebodies continued for several more years.

Anaconda's carbonate-leach-mill circuit started accepting ore in August 1953. Anaconda later constructed an acid-leach-mill circuit to treat ore from the Jackpile mine and began operation in December 1955. Construction of the Homestake New Mexico Partners mill started in April 1957 and produced the first gram of yellowcake on August 1958. Kermac selected the mill site in September 1957 and the mill began treating ore on November 28, 1958.

The Homestake-Sapin mill started construction in September 1957, with the first yellowcake produced on August 14, 1958.

Anaconda operated both the carbonate-leach and the acid-leach mills until May 1959 when the company shut down its limestone operations at Section 33, 34 and 12-9. They closed the carbonate-leach-mill and discontinued purchasing limestone ores from custom shippers. Initially, the construction of the acid circuit treated the sandstone ores from the Jackpile and Paguate mines.

Homestake-Sapin Partners and Homestake New Mexico Partners consolidated in November 1961 with Homestake-Sapin becoming the surviving company. The New Mexico Partners mill shut down April 14, 1962 as a result and the Homestake-Sapin Partners mill then treated all feed. The Homestake-Sapin mill continued to use some facilities. United Nuclear emerged from the consolidation Sabre-Pinon Uranium Corporation and United Nuclear Corporation on March 29, 1962. United Nuclear, an eastern company, maintained plants to process uranium into fuel rods and cores for nuclear reactors. The New York Stock Exchange listed the corporation in 1962. Phillips Petroleum sold all their uranium interests in the Grants area to United Nuclear effective March 28, 1963. The Phillips mill shut down and United Nuclear ore was tolled through the Homestake-Sapin mill.

On November 17, 1962 the Atomic Energy Commission proposed that milling contractors defer part of their 1-1-63 balance of pounds containing U3 08 in their contracts, due to expire on January 1, 1967, and the market deferred pounds in 1967-68. The Commission provided a market for an additional pound to be purchased in 1969 or 1970 for every deferred pound. This proposal hoped to sustain the uranium industry from 1966 to 1970, with the Commission anticipating the formation of a commercial market thereafter. Eleven of the 27 mills originally built agreed to stretch out their terms.

The dry, firm soil of the first Ambrosia Lake Mine, Dysart No. 1, permitted trackless ore level mining, similar to the method practiced in the Carlsbad's potash mines. When Kermac's Section 22 and 30 mines opened they were designed for trackless, on-level

operation. Except for the mines in the vicinity of the Dysart No. 1, the Ambrosia Lake mines proved wet, with the sandstone too soft to support openings without timberings or bolting. The maintenance of trackless roadways became futile since the mixture of water and sand created an abrasive substance that hindered equipment upkeep. Homestake-Sapin started all their wet mines with below-ore tracked drifts; nevertheless, Kerr-McGee and Phillips attempted on-ore trackless development. After designing and equipping the mines for trackless equipment, they determined that underground haulage required steel rails and haulage drifts below the ore level, thus allowing drainage of the ore bodies before mining. The changeover delayed production startup for several months. In the meantime, the company completed mill construction and began waiting for ore.

Most of the large mines started production in 1960 and 1961; however, overburden produced numerous fatal accidents. At the insistence of the State Mine Inspector's office, a code of safety regulations was established to govern underground activity; consequently, the fatality rate dropped remarkably.

Prior to 1965 there were 57 sandstone uranium mines and 21 limestone mines operating in the Grants Mining District—by 1965 only 27 mines continued operations. The depletion of reserves closed most of these mines.[2]

GRANTS, NEW MEXICO URANIUM MILL OPERATIONS DURING THE 1970s

Four uranium mills operated in the Grants, New Mexico Mining District at the height of the uranium boom in the 1970s, with three additional mills still in the planning stage before the crash in the 1980s. They included:

MILL	TONNAGE CAPACITY
KERR-MCGEE	7,000 tons/day
UNITED NUCLEAR	3,500 tons/day

Homestake Taylor Mt.	
ANACONDA	6,000 tons/day
PHILLIPS	2,500 tons/day (intended)
GULF MINERAL RESOURCES	4,200 tons/day (intended)
SOHIO-RESERVE Oil & Minerals	1,660 tons/day
BOKUM RESOURCES	2,000 tons/day

During the peak uranium mining years in the Grants region 46 major mines operated within the Morrison Formation. A listing of some of the major mine owners and operators follows:

SOHIO RESERVE Oil & Minerals	PHILLIPS
GULF MINERAL RESOURCES	KERR-MCGEE
UNITED NUCLEAR (HOMESTAKE)	KOPPEN MINING
COBB NUCLEAR	ANACONDA
WESTERN NUCLEAR	UNITED NUCLEAR

The Grants, New Mexico uranium boom launched its downward spiral in 1979 and continued into the mid-1980s. Uranium mining and milling operations came to a standstill in 1986. Robert Sullenberger obtained the following record of events leading to the collapse in May 1992 from Grant's Mining Museum.

MINE AND MILL CLOSURES AS OF AUGUST 1986

Quivira		(Kerr-McGee) 60 employees remain
August	1980	Rio Puerto Pit closed
June	1981	Lee Ranch Mine standby
July	1982	30% cutback at Ambrosia
Nov.	1982	20% reduction at Church Rock
May	1984	40% at Ambrosia Lake
UNC		10 - 20 employees left
Nov.	1978	UNC has highest earnings in history

July	1979	Mill tailings dam break; mill closed until December
Dec.	1979	St. Anthony mine closed; layoff at Church Rock
June	1980	Last at St. Anthony
Nov.	1980	Ambrosia Lake mines closed
April	1981	Homestake buys UNC's share of Ambrosia Lake
May	1982	Church Rock operations suspended
Nov.	1982	20% reduction Church Rock
Homestake		Approximately 58 remain employed on property
Aug.	1981	Ambrosia Lake cutback
Sept.	1981	Section 13 closed
April	1982	Cut mill to 32 hours per week
June	1982	Section 25 closed
Nov.	1983	Ambrosia Lake (UNC) cutback
Sept.	1984	Mill closed
April	1984	Mines closed
March	1985	Mill closed
Aug.	1985	Continued reduction
Gulf		Approximately 160 current employees
April	1982	Mariano Lake closed (out of ore)
May	1982	Cutback at Taylor Mt. Mine
Dec.	1982	Taylor Mt. on standby
Aug.	1985	Reopened
Phillips:		
July	1981	Nose Rock Project on standby in process of reclamation by end of 1986
Anaconda		Skeleton staff of approximately 10-15 employees
Oct.	1981	Phase-out of operations announced
Feb.	1982	Bluewater mill closed
March	1982	Jackpile mine closed
Sohio, L-Bar at Seboyeta		Skeleton crew of 5-10
May	1981	Mill closed
June	1981	Mines closed
Ranchers:		
March	1981	Crown Point Project halted

Aug.	1982	Crown Point abandoned, reclaimed
Todilto:		
Oct.	1980	Piedra Triste mine closed
June	1981	Haystack mine closed (The Haystack mine was one of the original 1950's mines that had re-opened after last boom)
Western Nuclear:		
June	1982	Mines near Thoreau on standby
Jan.	1984	After re-opening, re-closed. Reclamation of mine property completed in 1985.

This list does not include a number of small one-man or family-type operations that closed. Most of these employed up to 10 people and the bust forced them out early. Also not included are the drilling, mine-supply and allied support companies involved in the mining business. The addition of these figures brings the total of lost jobs to more than 7,000.[3]

NOTES: CHAPTER SEVEN

[1]U.S. Department of Atomic Energy, "An Interim Report on the Ore Deposits of the Grants District, New Mexico." Mesa State College, Grand Junction, Colorado, May 1952.

[2]R.J. Holmoust, U.S. Department of Atomic Energy, "The Discovery and Development of Uranium in the Grants Mineral Belt, New Mexico." Grand Junction, Colorado, June 1970.

[3]"Grants, New Mexico Uranium Mill Operators During the 1970s and 1980s." Grants, New Mexico Mining Museum, May 1992.

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