

Donovan's Mill
Silver City
Lyon County
Nevada

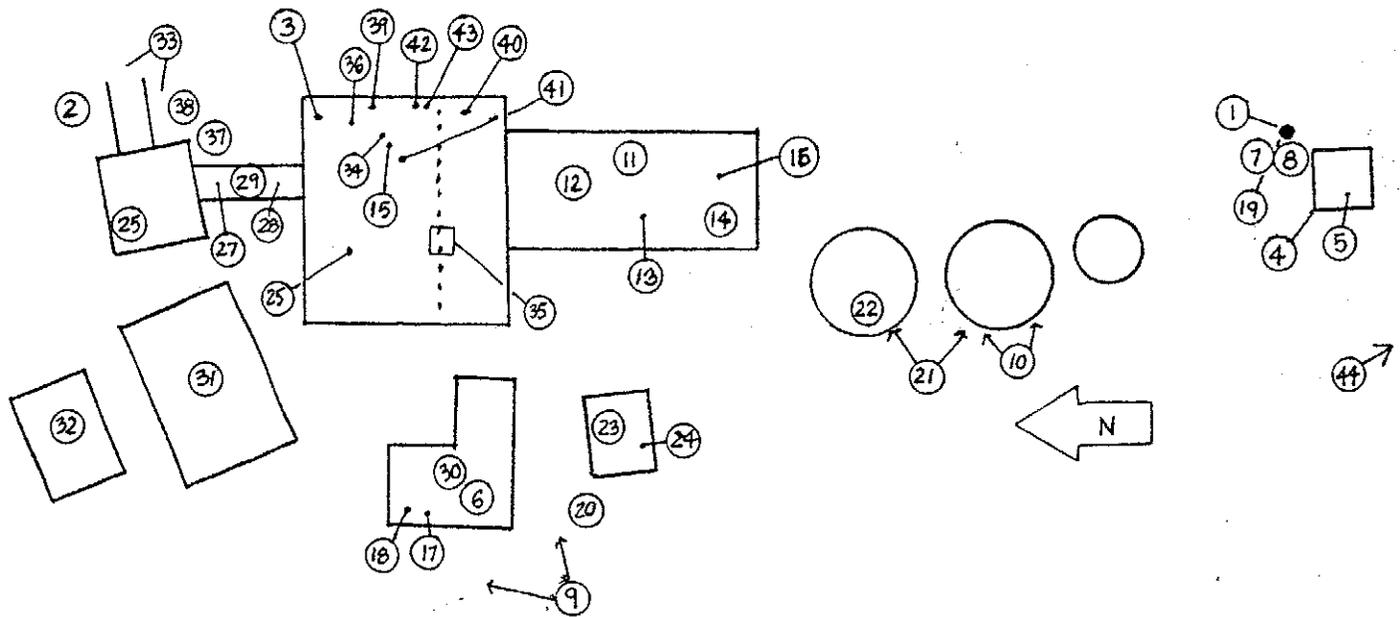
HAER No. NV-3

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PHOTOGRAPHS

HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service, Western Region
Department of the Interior
San Francisco, California 94102



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HISTORICAL AMERICAN ENGINEERING RECORD

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Donovan's Mill

HAER No. NV-3

Location: Silver City, Lyon County, Nevada

Date of Operation: 1890-1959

Present Owner: Mike Donovan

Present Use: Donovan's Mill ceased operations completely in 1959.

Significance: The Donovan Mill was the first cyanide process mill established on the Comstock, and opened the way for the great technological revolution in metallurgy.

Report Preparation: Rebecca Herbst, NPS

By 1900 Jackson's Mill had been fitted to work both ore and tailings by the cyanide process with a twenty-five ton daily capacity. Harry E. Stewart and Charles McGill were employed to insure the capable operation of the mill. In 1900 Jackson formed a partnership with Dr. J. Warne Phillips of the University of Nevada Chemistry and Physics Department, who later designed and installed the huge tailings derrick at the plant. Jackson sold the mill to Phillips in 1904, having achieved a production of \$32,663 for the years 1898-1903. Phillips succeeded in almost doubling that production figure for the years 1905-1911 with a total of \$58,757.

The success of Jackson and Phillips in cyaniding Comstock ores attracted investment for building new cyanide plants on the Comstock during the first two decades of the twentieth century.

One of the earliest to follow Jackson's example in Silver City was R. A. Trimble, who built a small cyanide leaching plant just below that of Jackson's in about 1900. The Pollard and Trimble Mill put out \$250,000 in bullion between 1902-1906. The plant thereafter came under the ownership of the Nevada Reduction and Power Company, which shortly transferred the property to William Donovan, Sr.

The Years of the Donovan Operation

In 1912 Donovan expanded his milling operation by purchasing Phillip's cyanide plant along with a quartz mill known as the "Oazel" or "Oazet" (presumably Lacrou's ten-stamp mill).

The Donovan Mill operated very successfully over the next thirty years under the capable management of William Donovan, Sr., and later under his son. The mill was enlarged over the years to an all-slime cyanide plant with a capacity for treating 100 tons of ore daily.

One of the contributing factors to the large output of the Donovan Mill over the years, was the considerable activity of the Silver Hill Mining Company which was managed for many years by William Donovan, Sr. and his son after him. The Silver Hill Mining Company was incorporated in 1872 by Mackay and Fair and renewed its charter in 1922, about the time that William Donovan, Jr. became associated with the Company. The company was part owner of several claims which were under lease to the Donovans including the St. Louis, Echo, Lucerne, Succor, Tarta, and Hartford claims. Although the Donovan Mill also received custom ores, the various claims worked by the Donovans and the Silver Hill Mining Company, almost exclusively kept the mill in operation.

The Donovan Mill also worked tailings which flowed by gravity from plants such as the Trimble Mill, a few hundred feet to the north. During its later period, the mill worked tailings from all over the Comstock region.

William Donovan, Jr. made several additions to the cyanide plant over the years, particularly during the 1930s. About 1935 a ball mill, Dorr bowl classifier and various other milling equipment was added. In 1936-1937, four five-stamp batteries from the Risdon Iron Works in San Francisco were added for a total crushing facility of thirty stamps. The north half of the building was constructed at this time to house the new section of stamps. Several other buildings were constructed during this period including a shop building of corrugated metal and a frame office building with a vault of reinforced concrete construction. The refinery building, probably dating from before 1936-1937, was recovered with galvanized metal at this time.

In 1943 the operation of the Donovan Mill was suspended by the intervention of the war.

The mill was reopened in 1948, treating ore from the mill stock pile, and from cleanup in the Lucerne open pit which had provided about one-third of the mill feed prior to the war. Donovan continued to operate the mill sporadically during the 1950s, ceasing operation completely in 1959.

The 1950 University of Nevada, Reno report on Mineral Resources of Storey and Lyon Counties credited a production of over \$1,200,000 from about 2,000,000 tons of ore, to the Donovan operation since 1922. This outstanding record was unique during a period in which only a few large companies made a milling profit on Comstock ores.

Donovan Mill Operation

Throughout the history of its operation, the milling process employed at the Donovan Mill was constantly converted and updated. From a small ten-stamp mill in 1890, it thereafter was converted to employ the MacArthur-Forrest cyanide process, and with the continued addition of new equipment, to a 100-ton all-sliming cyanide plant in the late 1930s. The milling process used over the years at the Donovan Mill is worthy of recording, having achieved an extraction rate of 95% plus.

The Donovan Mill was equipped to work both tailings and ore by the MacArthur-Forrest cyanide process, the method most extensively in use at the mill, involving the separate treatment of sand from slimes. A partial separation of slime was made by settling the sand in tailings ponds and draining off the slime which was then treated in decantation vats. The sand was removed from the ponds by a clamshell dredge bucket operated by a derrick with a 300 degree turning radius. The tailings were then spread out to dry, plowed and disc-harrowed thoroughly and discharged into a series of five redwood leaching vats, each five feet deep by twenty feet in diameter. The sand was mixed with a small amount of lime prior to leaching and subjected to a five-pound-per-ton sodium cyanide solution for leaching, followed by a two-pound solution and a water wash. The gold and silver, in solution, was precipitated out by means of zinc thread placed in compartmented wooden boxes. In the cleanup procedure, the zinc was washed and returned to the boxes, and the precipitate was filtered out over cloth in a small cleanup tank and dried and melted without further preparation.

The raw ore was first treated at the stamp mill where ore was crushed and cyanide solution added. A fifty-ton ore bin fed into the ore crusher. The ore was transferred from grizzly to shaker and then into the jaw crusher. The ore was delivered to the stamps after preliminary crushing and cyanide solution was added during the stamping process. Any free gold in the pulp was caught by copper amalgam plates. A Dorr screw classifier on an incline table at the foot of the stamps received the pulp and removed primary slimes before transferring the muck to a five foot ball mill for fine grinding. At one time Donovan may have used concentrating tables to treat very finely crushed material, the most valuable part of the ore, at a profit.* A Dorr bowl classifier, consisting of a shallow steel bowl with a rotating raking mechanism, made a further separation of slimes and sand. After classification, the sands were treated in the leaching process while the slimes were treated by counter-current decantation.

In the leaching process, cyanide solution percolated through the ore mass, "leaching" out gold and silver, dissolving it in solution. The pregnant solution was then exposed to zinc which replaced the gold and silver values which precipitated out. The mill later employed three Merrill-Crowe vacuum filter presses in the precipitation process. In this process, strong cyanide solution was added at the same time as zinc dust to aid precipitation. The Merrill-Crowe Process worked as a simultaneous clarification-precipitation system with a mixed stream of pregnant solution and zinc emulsion passing through a series of "cells", each individually coated with fine zinc. Excess zinc and metals were deposited on the filter leaves and cleaned up.

The slimes were treated in a series of five redwood thickening tanks of one hundred tons each, with two agitators employed to facilitate aeration. The thickeners operated in a counter-current fashion, mixing mud and slimes in one direction, and cyanide solution in the other. The thickeners worked in continuous action with overflow solution decanted and sent to precipitation. In a complete cycle, the slimes went through two thickening tanks, an agitating cycle, and two more thickeners. From thickener tank #4, the solution was pumped back inside the building into clarifier tanks where canvas sheets filtered out slime from the solution, producing a clear solution ready for precipitation. The precipitation process employed was the same as that used for the leached product.

Donovan modernized the mill in 1936-37, converting it to an "all-slime" plant and abandoning the leach tanks in the southern end of the mill. After this date presumably all ore was treated by cyanidation with the counter-current decantation method.

*This is indicated by a proposed flow sheet drawn up for William Donovan by the Dorr Company dated November 13, 1935.

Present Condition of the Donovan Mill

The Donovan Mill complex remains almost virtually intact with the following original corrugated metal and frame structures on the property: the main mill building, machine shop, office building with reinforced concrete vault attached, refinery, and blacksmith shop. The main building, including an assay office, is equipped with the original ten-stamp battery, a twenty-stamp battery (added later), three clarifying tanks, two redwood leaching tanks, two Merrill vacuum filter presses, zinc box precipitation equipment and assaying equipment. Among the missing equipment is the ball mill and Dorr classifiers. The machine shop also houses original equipment, including the derrick boom. The interior condition of the refinery, or melt house, remains exactly as it was at the time of its closure. The frame blacksmith shop, on the northern part of the property has been on this site since it was purchased in 1912, with the old forge and blacksmithing equipment intact. Located to the south of the mill complex, are the remains of the crane hoist house and various equipment from the derrick operation. Three of the five thickening tanks are still on the property and agitating equipment also remains. The remains of the Pollard and Trimble Mill, consisting of a series of zinc precipitation boxes, remnants of the cyanide leaching vats, stone foundations and debris, are located below the millsite.

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