CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
1520 West Adams St.
Phoenix, AZ 85007
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

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Arizona Department of Mines and Mineral Resources Mining Collection

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PRINTED: 11/20/2001

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES AZMILS DATA

PRIMARY NAME: LONE STAR GROUP

ALTERNATE NAMES:
- KENNECOTT SAFFORD
- KIRTLAND HILL GROUP
- CONSOLIDATED METALS MS 4590
- SPALDING
- LEAD HILL
- ANDERSON CLAIMS
- THE COPPER
- IRON KING
- MARAVILLA COPPER CO.
- LINDSEY CLAIMS
- BEAR CREEK
- LONE WOLF SHAFT

GRAHAM COUNTY MILS NUMBER: 99

LOCATION: TOWNSHIP 6 S RANGE 27 E SECTION 5 QUARTER C
LATITUDE: N 32DEG 55MIN 27SEC LONGITUDE: W 109DEG 37MIN 24SEC
TOPO MAP NAME: SAFFORD - 15 MIN

CURRENT STATUS: PAST PRODUCER

COMMODITY:
- COPPER OXIDE
- COPPER SULFIDE
- LEAD
- SILVER
- GOLD
- MOLYBDENUM

BIBLIOGRAPHY:

- ADMMR LONE STAR GROUP FILE
- AZBM BULL. 180, MINERAL AND WATER RESOURCES OF AZ. 1969, P. 122
- ADMMR SLOOP PROJECT FILE
- ADMMR U FILE
- ADMMR LONE STAR GROUP COLVO FILE
- USGS CRIB DATA
- PAYDIRT DEC. 17, 1965

CONTINUED ON NEXT PAGE

CONTINUATION OF LONE STAR GROUP

ADMMR LONE STAR-ESPERANZA PROJECT FILE
BLM AMC FILE 1724
TITLEY & HICHS, GEOLOGY FO THE PORPHYRY
COPPER DEPOSITS 1966, P. 251
UNPAT. CLAIMS EXTEND INTO SEC. 13, 18 OF
T5S-R26E

06/13/91

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES FILE DATA

PRIMARY NAME: LONE STAR GROUP

ALTERNATE NAMES:
KENNECOTT SAFFORD
KIRTLAND HILL GROUP
CONSOLIDATED METALS MS 4590
SPALDING
LEAD HILL
ANDERSON CLAIMS
KNOTHE
ROBERTS GOLD
ROBERTS SILVER
BOULDER PLUG CLAIMS

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ADMMR U FILE
ADMMR LONE STAR GROUP COLVO FILE
USGS CRIB DATA
PAYDIRT DEC. 17, 1965

CONTINUED ON NEXT PAGE

CONTINUATION OF LONG TOM

ADMMR LONG TOM MINE FILE
WILSON, E.D., & OTHERS, AZ. LODE GOLD MINES
AND GOLD MINING, AZBM BULL. 137, 1967, P.194
ADMMR FILE

LONE STAR GROUP
KENNECOTT - SAFFORD PROJECT -- References

GRAHAM COUNTY
LONE STAR DIST.
T6S R27E Sec. ~~7-C~~ 5 SW

SEE: MINING WORLD, May, 1960, p 88
See: MINING WORLD, August 1961, p 46
" " July, 1962, p 43
" " Dec. 1962, p 36

ABM Bull. 180, p. 122

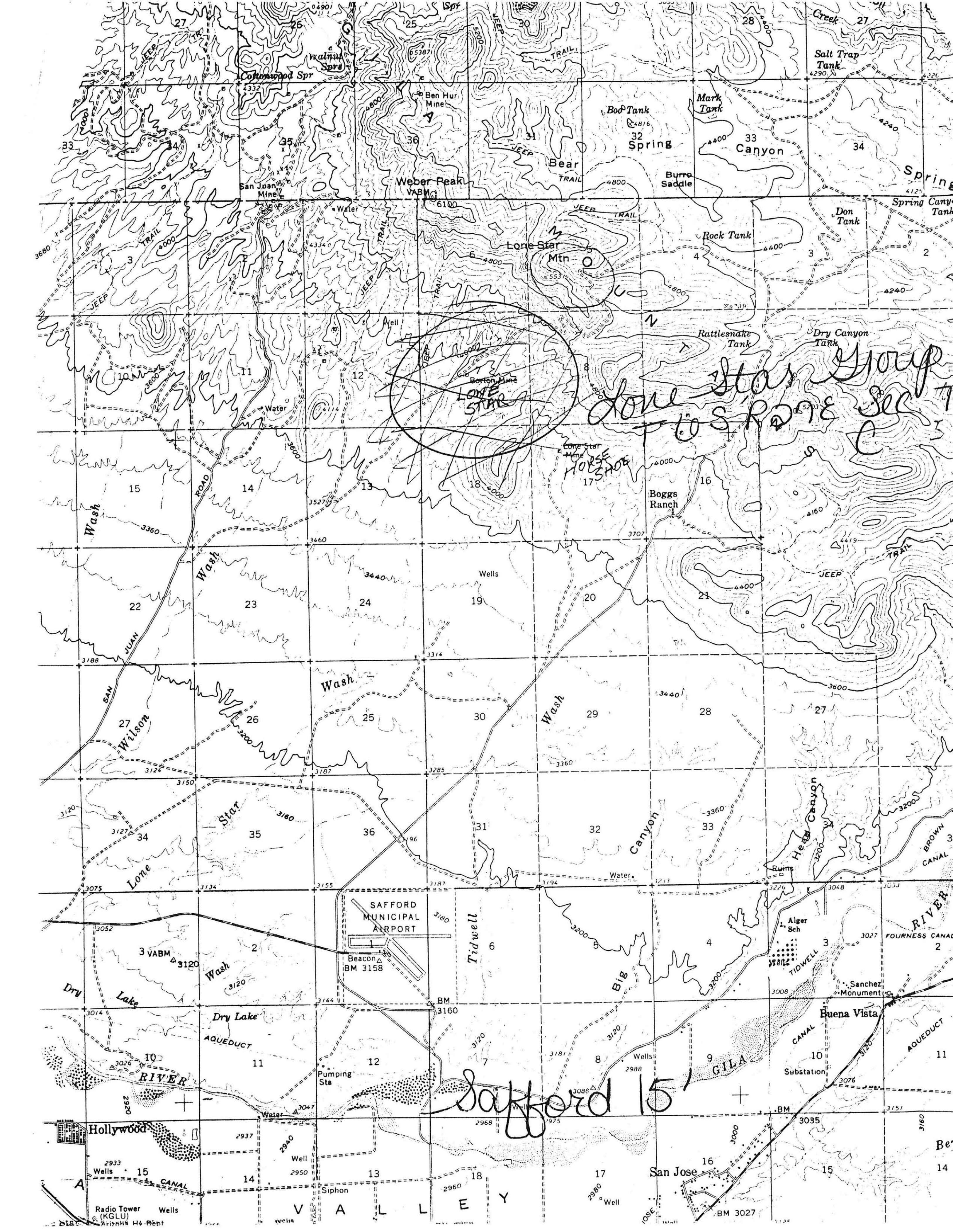
Graham County MILS Index #99

AKA: Kirtland Hill Group, Consolidated Metals H S 4590, Spalding, Lead Hill, The copper Iron King, maravilla copper co, lindsey and anderson claims, bear creek, clara, lone wolf shaft

See: Map I-1310-B p. 3; Mineral Deposit Map of the Silver City 1^{o} x 2^{o} Quad., NM & AZ

Safford 15' (included in file)

THIS FILE CONTAINS
DATA ON OLD MINE - THE
LONE STAR SHAFT IN SEC 17
AS WELL AS LONE STAR PROSPECT
IN SEC 5. NJN - 88



Cottonwood Spr
Walnut Sprs
Ben Hur Mine
Weber Peak
San Juan Mine
Bear
Spring
Canyon
Burro Saddle
Boo Tank
Mark Tank
Salt Trap Tank
Don Tank
Rock Tank
Lone Star Mtn
Rattlesnake Tank
Dry Canyon Tank
Borton Mine
LONE STAR
Lone Star Mine
HORSE SHOE
Boggs Ranch
Lone Star Group
Wells
Wash
SAN JUAN ROAD
Wilson Wash
Lone Star Wash
Canyon
Head Canyon
Ruins
SAFFORD MUNICIPAL AIRPORT
Beacon BM 3158
Tidwell
Big Canyon
Alger Sch
Sanchez Monument
Buena Vista
Dry Lake
AQUEDUCT
RIVER
GILA
Pumping Sta
Substation
Safford 15'
Hollywood
CANAL
Siphon
San Jose
Radio Tower (KGLU)
V A L L E Y

MK-4

ARIZONA DEPARTMENT OF MINERAL RESOURCES
MINERAL BUILDING, FAIRGROUNDS
PHOENIX, ARIZONA

February 26, 1958

To the Owner or Operator of the Arizona Mining Property named below:

V KIRTLAND HILL GROUP X (Property) — GOLD SILVER COPPER LEAD (ore)

We have an old listing of the above property which we would like to have brought up to date.

Please fill out the enclosed Mine Owner's Report form with as complete detail as possible and attach copies of reports, maps, assay returns, shipment returns or other data which you have not sent us before and which might interest a prospective buyer in looking at the property.

Frank P. Knight

FRANK P. KNIGHT,
Director.

Enc: Mine Owner's Report

Mr. Knight: The Kirtland Hill Group of claims was long ago incorporated into the Consolidated Metals Group. This section group was purchased by Bear Creek Mining Co. by an option agreement on March 2nd 1956. A program of drilling is in progress and has been since they took over.
Thanks for your interest-

Albert Spalding
702 10th Ave, Oakland

1606 Hobart Bldg
San Francisco 5
Calif.

Present Operations

#A Across 15-1
Cons. Mt #4
Str. S 20 W

New Work Planned

Miscl. Notes

DEPARTMENT OF MINERAL RESOURCES

News Items Tonecito

Date 1-2-47

Mine Consolidated

Location Metals Group

Owner

Address Albert Spalding

27 claims

Operating Co.

Address Lode

Pres. T S R

Genl. Mgr.

Mine Supt. El. 4000'

Mill Supt.

Principal Metals Graham Cy

Men Employed 10 M H. E. Stafford

Production Rate

Mill, Type & Capacity J D Merrill

Atty

Power, Amt. & Type Adams Hotel

Signed

(Over)

DEPARTMENT OF MINERAL RESOURCES

News Items

Date 3-4-47

Mine Lone Star

Location Mines Inc.

Owner Albert Spalding

Address P. O. Box 563, Safford

28 claims

Operating Co. 10 m NE Safford

Address X [illegible]

[illegible]

Pres. Lead & Copper

Genl. Mgr. [illegible]

Mine Supt. [illegible]

Mill Supt.

Principal Metals Tel.-273 [illegible]

Men Employed " 276 [illegible]

Production Rate Cerrusite

Mill, Type & Capacity Azurite & Crysocolla

Carbon Tetrachloride

Power, Amt. & Type Mask

Signed

(Over)

Graham Co.

DEPARTMENT OF MINERAL RESOURCES

News Items ✓

Lone Star Date Nov 5 1947

Mine Lone Star ✓

Location ✓

Owner Marion [illegible]

Address S-60 W

dip W 65 ESE

Operating Co.

Address [illegible] 4 [illegible]

#5

Pres. also on 4

Genl. Mgr. N 63° E

Mine Supt. [illegible]

Mill Supt. dip 70° N

Principal Metals #5

Men Employed

Production Rate 25' [illegible]

Mill, Type & Capacity [illegible]

[illegible]

Power, Amt. & Type

[illegible]

[illegible] Signed [illegible]

(Over)

United States Senate

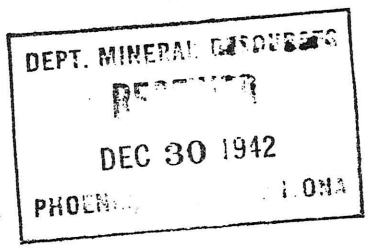
MEMORANDUM

Dec. 26, 1942

Dear Sam,

This case will be referred to the Field engineers for study on the ground.

Bill Broadgate



C

United States Senate

W

C

MEMORANDUM

Dec. 15

The boys are not too stuck on the Fields application and Merrills is weakened by the turndown on the B loan which we had to then get reviewed.

I would hate to file this case on top of the Fields case and ruin the deal.

Merrill will stand a much better chance if the Fields application is approved as a precedent.

Bill Broadgate

NAME OF MINE: LONE STAR ✓

COUNTY: GRAHAM
DISTRICT:
METALS: PB, CU, AG, AU

OPERATOR AND ADDRESS: DATE:	MINE STATUS DATE:	
		RFC loan $5000
J. D. Merrill		7 men working
Box 409 ✓		
Safford, Arizona	2/44	Idle

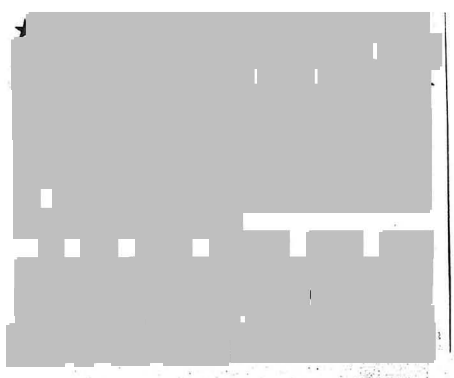
Mining Journal
9/30/42

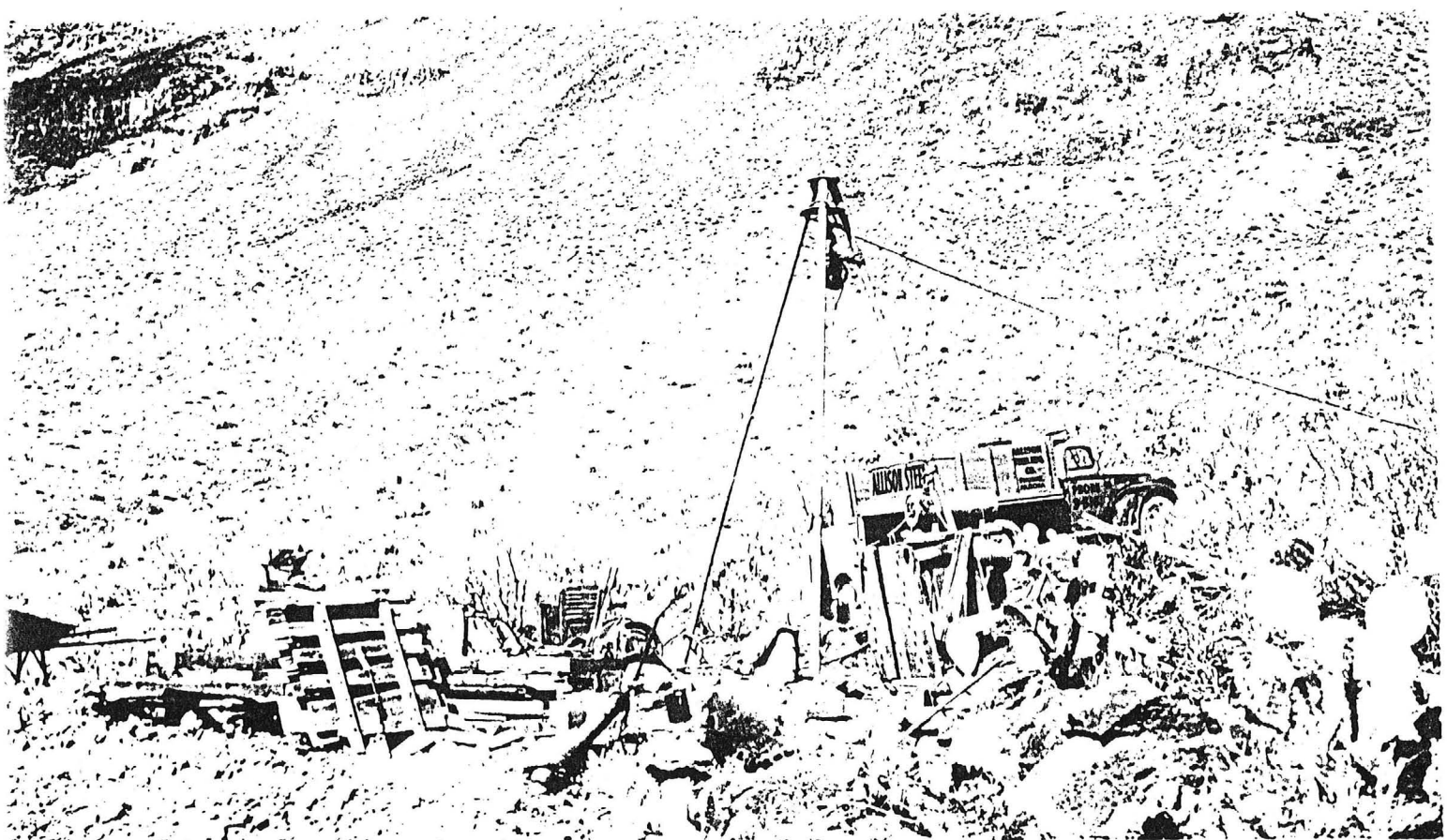
The following are quotations from a Mine Report by Charles O. Parker, E. M. under date of Sept. 12, 1941, covering the reconnaissance of the Lone Star Mine of the Consolidated Metals Group by Mr. Parker.

'' The Consolidated Metals Group of mining claims embraces, except for some few open areas, an entire possible Copper mining district. A system of veins start in the Gila Mountains and extend roughly perpendicular to the range into the Gila River Valley and are easily found and traced for considerable distances. Practically all of the veins examined showed evidences of heavy mineralization and intensive oxidation. Copper oxide, silicate and carbonate were seen in nearly every exposure. Trenches, open pits and shafts have been dug to tracethe various veins. Several shafts were sunk in an effort to penetrate through the oxidized zone into the sulfide zones. Except in isolated cases, sulfide ores have not been reached. Those reached were apparently in protedted portions of the veins, since oxides were invariably found beneath all such sulfide occurrences. The two deepest shafts in the district, the Clara, 565 ft. in depth, and the Lone Star, 485 ft. in depth, had not reached their objective of the sulfide zones before cessation of work. No work of consequence has been undertaken within the past twenty years. The work prior to that time was principally stock-promotion in nature.

''It is my opinion that the primary mineralization of many of the veins examined was principally copper-iron sulfides. The intensity of oxidation and extreme depth of the water table leads one to the conclusion that the bulk of the copper content originally in the veins was leached and migrated downward in the veins to the water level. Undoubtedly some gold and silver values will be obtained but these should be of secondary importance to the copper content. Because the vein filling and the oxidation products of the primary copper minerals are persistent over great distances along many of the veins, a secondary zone of enrichment as well as the primary sulfide zone should likewise be persistent.

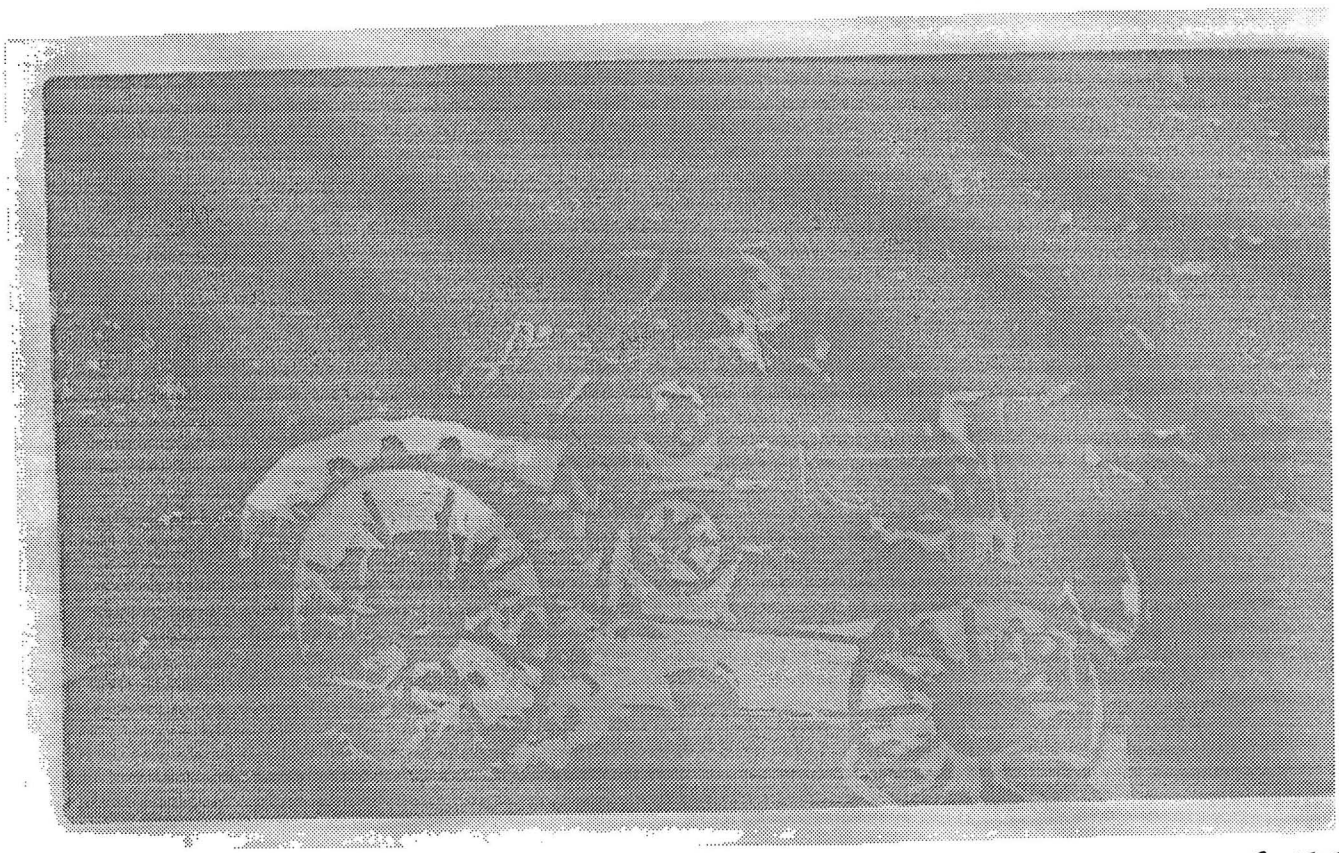
'' Inasmuch as the secondary enrichment and the primary ore zones have never been penetrated and in view of the apparent fact that the majority of the veins were originally high in copper mineral content, I feel that the expenditure of sufficient monies necessary to reach the objective of the primary ore zone in several of the more intensely mineralized veins is justified. There are three points which should be developed to prove the district, i.e., the Lone Star shaft, the Clara shaft, and the Kirtland shaft. The desirability of development is in the order named.''





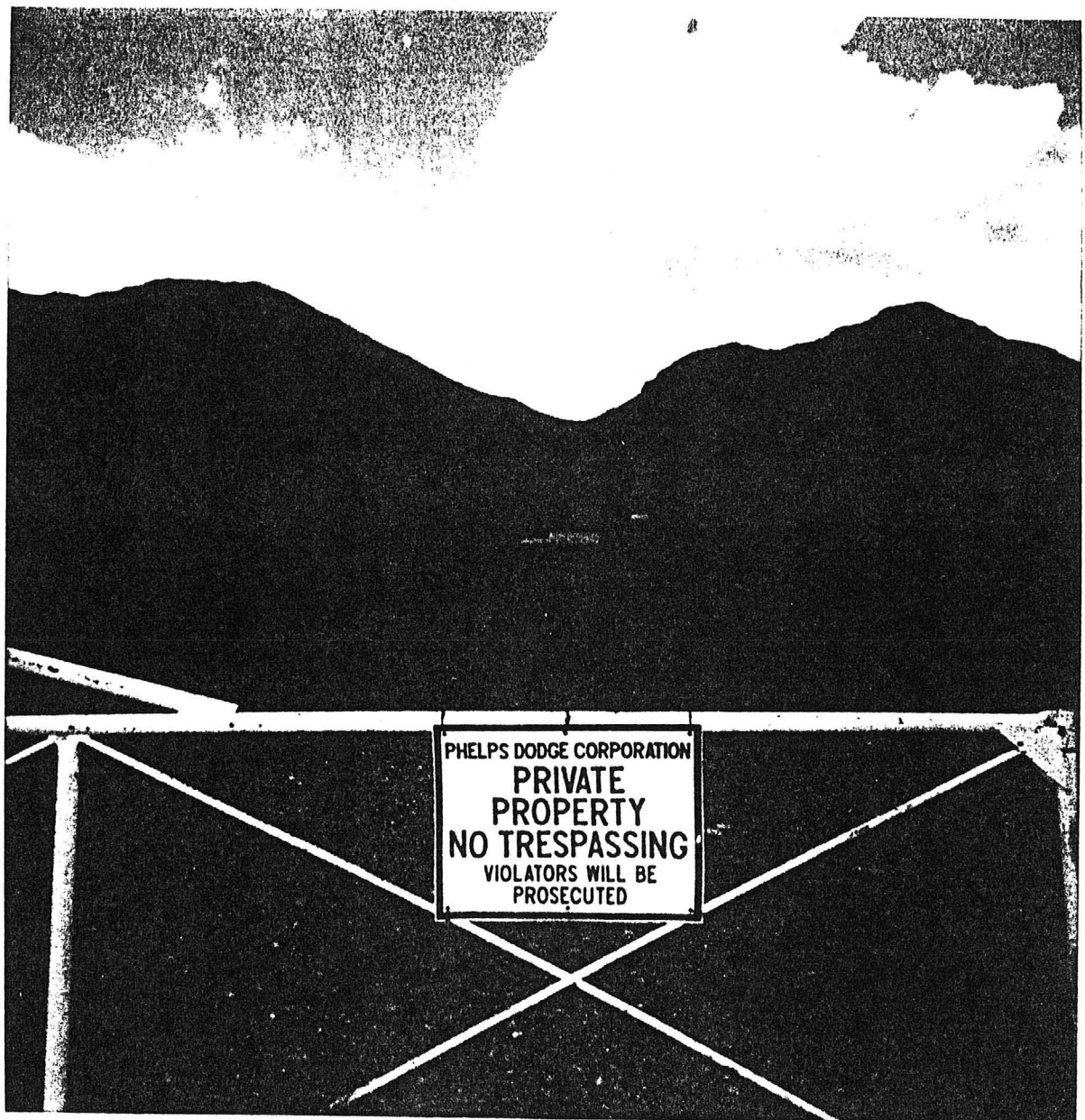
C-1950

19-111-1



A-111-2

C-1950

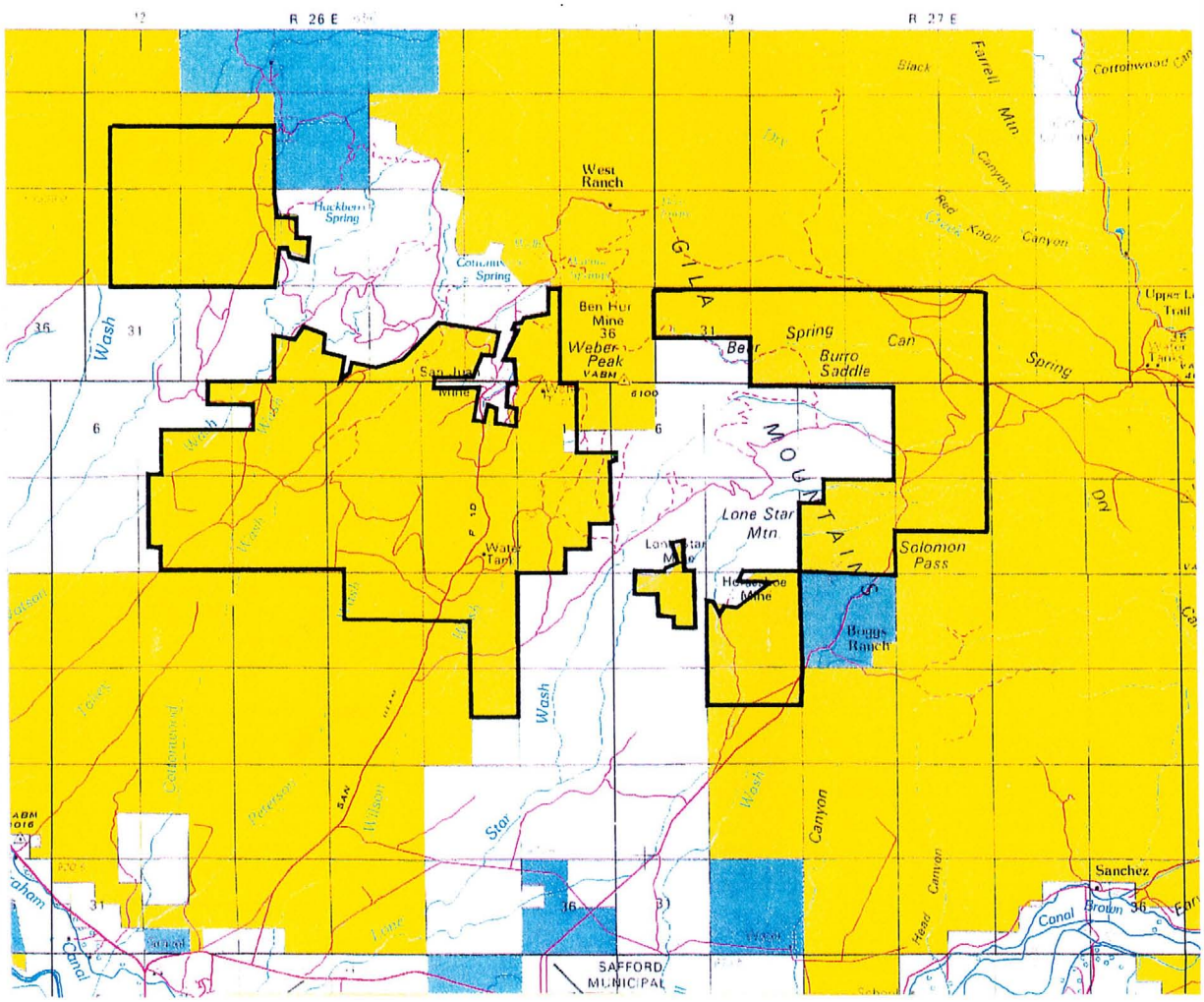

PHELPS DODGE CORPORATION
PRIVATE
PROPERTY
NO TRESPASSING
VIOLATORS WILL BE
PROSECUTED

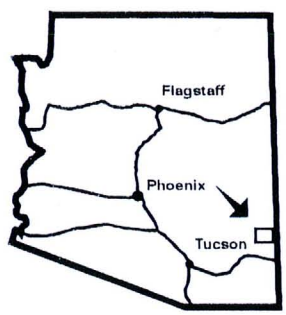
A-111-3

1988


PHELPS DODGE CORPORATION
PRIVATE
PROPERTY
NO TRESPASSING
VIOLATORS WILL BE
PROSECUTED

LONE STAR (7) GMRM





Selected Lands

Public Lands (Administered by Bureau of Land Management)

Patented Lands

State Lands

0 2500' 5000'

NORTH

SAFFORD LAND EXCHANGE

Figure 2. Selected Lands Location Map
(base map: BLM Surface Management Map, Safford. 1991 edition.)

SWCA Inc. Environmental Consultants	Proj No: 28-94854	Drawn By: MRA	Date: 10/94
	File Name: saff1.cdr	Checked By: TL	Revision Date:

LONE STAR GROUP GRAHAM COUNTY

Kennecott has completed their drilling at their Lone Star Mine (Sloop Project), and will wait for the government on the next step of the Sloop at atomic blast project.

GWI Quarterly Report 4/1968

Mine visit. Kennecott Sloop project (3 rigs drilling). (Near Old Borton Mine) GWI WR 10/19/71

Kennecott is active on their Lone Star project. GWI 4 ½ '72

Mine visit to Kennecott's Safford project. New office & core storage near Safford Airport. Pete Dunn, resident geologist for Kennecott, is leaving to work for Quintana in Tucson. GWI WR 12/21/72

Mine visit. Kennecott's Safford project office. (Linda Sandonato, Lab. Tech.) GWI WR 2/20/73

Mr. Sonive at Inspiration's assay office in Safford said Kennecott Copper Company was working at its Lone Star mine and that guards would admit no one without a prior appointment. VBD WR 4/22/75

RRB WR 5/20/88: Visited the Lone Star Mine (file) formerly owned by Kennecott, now by Phelps Dodge. Found locked gate and Phelps Dodge sign in Sec 7, T6S R27E. See photo in file. DEPOSIT IS ACCESSED FROM EAST AND IS IN Sec 5. !

↳ Rm 2-9-1996
KH

SAFFORD COPPER MINE (F) GRAHAM CO. SAN JUAN (F) GRAHAM CO.
LONE STAR GR P (F) GRAHAM CO

Bureau of Land Management · Arizona

Update: Phelps Dodge Mining Plan of Operation

August 1996

Summary:

Phelps Dodge Corporation, a mining company, has submitted a Mining Plan of Operation to BLM which outlines their intended use of public lands adjacent to their mining properties near Safford, Arizona. As an alternative of the Mining Plan of Operation, Phelps Dodge has proposed a land exchange in which Phelps Dodge would acquire approximately 15,000 acres of public lands (selected land) adjacent to their existing Dos Pobres, San Juan, and Lone Star properties located near Safford. In exchange, BLM would acquire approximately 3,000 acres of privately held land (offered land) occurring in four parcels located in Graham, Cochise, Santa Cruz and Pima counties.

Background:

Phelps Dodge Mining Company, the mining and metals division of Phelps Dodge Corporation, is one of the world's largest producers of copper and continuous-cast rod. In the United States, Phelps Dodge Mining Company operates three open-pit copper mines, three concentrators, three solution extraction/electrowinning plants and two smelters.

Phelps Dodge is seeking to utilize and consolidate its land holdings within and adjacent to their existing Dos Pobres, San Juan and Lone Star properties. Phelps Dodge intends to use a portion of the selected land to support and expand mining-related operations, with the remainder used for site security and environmental buffers. Through the exchange, BLM has the opportunity to acquire lands containing important natural resources and other values which would meet desired management objectives.

The proposed exchange is consistent with BLM's Safford District Resource Management Plan (RMP), which identifies the selected lands for potential disposal. The offered lands are located within three Long-Term Management Areas (LTMAs) identified by the RMP.

BLM will prepare an Environmental Impact Statement (EIS) to analyze the mining plan of operation and the exchange alternative. Also included in the EIS study, will be an application under the Clean Water Act for a Section 404 permit.

Current Status:

Three public open house meetings will be held during September 1996, in Safford, Phoenix, and Tucson to provide information to the public concerning the proposed mining plan of operation and exchange. A Draft Environmental Impact Statement will be published in April 1997. The Final EIS will be prepared and distributed to the public in November 1, 1997. A Record of Decision will be published in January 1998.

BLM Position:

BLM has authority to approve the proposed land exchange under Section 206 of the Federal Land Policy Management Act of 1976, after considering whether the exchange will 1) provide the opportunity to achieve better management of federal lands; 2) meet the needs of state and local residents and their economies; and 3) secure important objectives, including but not limited to, protection of fish and wildlife habitats, cultural resources, watersheds, and wilderness and aesthetic values. After careful analysis and consideration, which includes the preparation of an EIS, the BLM will be in a position to finalize its decision.

Contact:

Carol Kershaw, BLM Arizona State Office
602/650-0235

Denise Meridith, BLM Arizona State Director
602/650-0500

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Kennecott Safford Project Date Feb. 5, 1963

District Lone Star District, Graham Co. Engineer Axel L. Johnson

Subject: Field Engineers Report. Information from Annan Cook.

References Report of Dec. 5, 1962 and previous reports.

Present Mining Activity Underground diamond drilling was completed in December. Diamond drilling from surface was completed in December. Surveying and mapping has been completed. 6 engineers and geologists, including Annan Cook and Sam Smith are now writing the 'final reports'. Mr. Cook says he does not know how long they will be working.

Active Mine List Oct. 1963 - 4 men

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Kennecott Safford Project Date Dec. 5, 1962

District Lone Star District, Graham Co. Engineer Axel L. Johnson

Subject: Field Engineers Report. Information from Sam Smith.

References Report of Oct. 3, 1962 and previous reports.

Present Mining Activity

(1) Diamond drilling underground by Boyles Bros. on contract. 3 drills were operating until a short time ago. Now, only 1 drill is operating, and they expect to finish up about next Friday, Dec. 7.

(2) Diamond drilling on surface by Boyles Bros. on contract. 3 drills were operating until a short time ago. Now, only 1 drill is operating, and they expect to finish up about Friday, Dec. 14.

25 men are employed with Kennecott Copper Corp. at present. Most of these will be laid off shortly after the drilling program is finished, and some time before the first of the year. A skeleton crew, consisting of Mr. Cook, Mr. Smith, and a few engineers and draftsmen will be kept on office work.

Future Plans Mr. Smith reports that there are no plans for next years operations. He intimated that some work will be done to take care of the next years assessment work (this year's has been done). This will not have to be done before 1964.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Kennecott Safford Project Date Oct. 3, 1962

District Lone Star Distridt, Graham Co. Engineer Axel L. Johnson

Subject: Field Engineers Report. Information from Annan Cook.

References Report of April 4, 1962, and previous reports.

Present Mining Activity

(1) Diamond drilling underground by Boyles Bros. on contract, with 3 diamond drills operating.

(2) Diamond drilling on surface by Boyles Bros. on contract, with 3 diamond drills operating.

(3) Diamond drilling on surface by Safford Drilling Co. on contract, with 1 diamond drill operating.

25 men are now employed with the Kennecott Copper Corp, including both mine and office workers.

Annan Cook, Resident Geologist in charge of operations.
Sam Smith, Mining Engineer
Morris Carter, Surface and Underground Foreman.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Kennecott Safford Project Date April 4, 1962

District Lone Star District, Graham Co. Engineer Axel L. Johnson

Subject: Field Engineers Report. Information from Annan Cook.

References: Report of Feb. 7, 1962 and previous.

Present Mining Activity: (1) Diamond drilling underground by Boyles Bros. on contract with 3 diamond drills operating.

(2) Diamond drilling on surface by Boyles Bros. on contract with 2 diamond drills operating.

21 men employed by Kennecott Copper Corp., 13 of these being at the mine and 8 in the office.

Review of Operations: The underground diamond drilling is done from the drill stations on the 3900 ft. level of the mine. See Feb. 7, 1962 report - Item (3).

The pilot leaching plant was operated for experimental purposes until about one week ago, when the experimental tests were completed. See Feb. 7, 1962 report - Item (4).

Research work on above leaching tests is now being done at Research Center, Western Mines Division, Kennecott Copper Corp., Salt Lake City, Utah. A report on this work is expected to be submitted in from 6 to 8 weeks.

Proposed Plans: Mr. Cook stated, quoting from Kennecott Corp. annual report, "there are no plans to bring Safford into production in the immediate future."

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Kennecott Safford Project Date Feb. 7, 1962

District Lone Star District, Graham Co. Engineer Axel L. Johnson

Subject: Field Engineers Report. Information from Sam Smith

References Report of Dec. 6, 1962 and previous

Present Mining Activity (1) Diamond drilling underground by Boyles Bros. on contract, with 2 diamond drills operating.

(2) Pilot leaching plant operated by Kennecott Copper Corp.

16 men employed with Kennecott Corp.
11 men employed with Boyles Bros.

Review of Recent Operations

(1) The 2 drifts on the 3900 ft. level (750' to the NE and 750 ' to the SW) from the 3900' cross cut have now been completed.

(2) 7 drill stations on the side of these drifts have also been completed.

(3) Boyles Bros. are diamond drilling on contract from these drill stations, with 2 diamond drills operating. All drilling is done from the 3900 ft. level. A minimum of 4 holes are drilled from each station, with, sometimes, additional holes, as determined by geologic interpretations. The holes are, generally, drilled at an angle of 45 degrees, either up or down. Wire line drilling is being used. The depth of the holes vary from 400' to 1,000', and, generally, started with NX core, and finished with BX core. Drilling is expected to continue for the balance of the year.

(4) The pilot leaching plant, constructed last fall, and operated since the last part of November, is being operated, for experimental purposes. Each day, one ton of ore is added to one of the units for leaching. Sulphuric acid is run through the ore for 7 days,and water is run through for 5 days, 12 days completing the cycle. Mr. Smith reports that the ore stockpiled in 6 ton piles is now being blended, making composite samples for test leaching. He expects that their experiments will be finished in about 2 months, after which the plant will be shut down.

Proposed Plans Mr. Smith stated that they have plans for doing development drilling from the surface in the near future.

Not for publication

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Kennecott Safford Project Date Oct. 4, 1961

District Lone Star District, Graham Co. Engineer Axel L. Johnson

Subject: Field Engineers Report. Information from Sam Smith and Whalen Brown.

References Report June 8, 1961

Present Mining Activity (1) Driving drifts NE & SW on the 3900 ft. level, this work being done by Boyles Bros. on contract.

(2) Diamond drilling from the drifts on the 3900 ft. level. 2 diamond drill rigs operating.

(3) Construction of a pilot leaching plant, this work being done by Kennecott, with the assistance of sub-contractors.

15 men working for Kennecott, and 21 men working for Boyles Bros.

Review of Recent Operations (1) The cross cuts on the 3900 ft. level (100 ft. SE and 1500 ft. NW of the shaft)were finished about Sept. 1. Drifting both NE & SW from the 1500 ft. cross cut was then started. Both these drifts are now in about 350 ft. each, and these drifts will be driven ahead to a distance of about 750 ft. each. A Gardner Denver mucking machine is used, which mucks the ore into mine cars, these cars being trammed to the shaft and dumped into a slusher trench, from which the ore is slushed into the shaft loading pocket. Both drifts are driven ahead simultaneously. This work is done on contract to the Boyles Bros. Drilling Co.

(2) The company is now diamond drilling from diamond drill stations along these drifts. This work was started about one month ago, and 2 diamond drill holes have been put down to date. One of these holes was drilled horizontally, and the other one went down at about an angle of 45 deg. The remainder of the holes to be drilled will be drilled at 45 degree angle, and will be drilled through the ore body for an estimated distance of 700 ft. on the incline. Two diamond drill rigs are operating at the present time.

(3) Company is now constructing a pilot leaching plant at a location about 1/2 mile to the east of the mine shaft. This work is done by Kennecott personnel, with the assistance of sub-contractors. The work was started on about Sept. 1, and the plant is expected to be finished about Oct. 15.

Capacity of the plant will be one ton of ore per 24 hours.

The plant consists principally of the following:

(a) 12 metal columns, each 16" dia. x 16' in height, with insides rubber lined. These will hold about 1 ton of ore each. The ore will be leached in these columns, sulphuric acid being run through from the top for 6 days, and water being run through from the top for another 6 days --- 12 days completing the cycle.

(b) 12 acid storage tanks, mounted above the top of the 12 columns, and supplying and feeding acid for the operation.

(c) 12 solution tanks, each 4 ft. in dia. x 30" high, made of concrete and painted with acid proof compound. The solutions from the 12 columns,in which the ore is leached, drains into these tanks, one tank being provided for each column.

(d) An electrolytic precipitation plant (This had not been installed at time of engineer's visit). The solutions will be pumped from the 12 solution tanks into the precipitation plant, and precipitated electrolytically.

Operation will be as follows:

Each day, one ton of ore will be taken from each 6 ton pile of ore now stockpiled a short distance from the plant, and one of the leaching columns will be filled with this ore. At the end of 12 days, all of the columns will have been filled. On the 13th day, the first column that was filled, will be emptied of the waste material, and refilled with another ton of ore, repeating the cycle of operations.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Kennecott Safford Project Date Dec. 6, 1961

District Lone Star District, Graham Co. Engineer Axel L. Johnson

Subject: Field Engineers Report. Information from Sam Smith

References: Report of Oct. 4, 1961

Present Mining Activity: (1) Drifting NE & SW on the 3900 ft. level and excavating for drill stations by Boyles Bros. on contract.
(2) Diamond drilling on contract by Boyles Bros. with 2 diamond drills operating.
(3) Pilot leaching plant operated by Kennecott Copper Co.
15 men working for Kennecott Copper Co.

Review of Recent Operations:
(1) The two drifts on the 3900 ft. level are now nearing completion to a length of 750 ft. NE & SW of the 3900 ft. crosscut.
7 drill stations were excavated on the sides of these drifts to facilitate diamond drilling operations. Each of these drill stations are 8' wide and 25 ft. long. They are also nearing completion.
(2) Boyles Bros. are doing diamond drilling on contract from these drill stations with 2 diamond drills operating. A minimum of 4 drill holes are being drilled from each station, with possibly additional holes to be added as determined by the results obtained.
(3) Construction of the pilot leaching plant was completed about two weeks ago, and is now operating. Mr. Smith reports a successful operation, but states that some adjustments may be necessary, and that a longer leaching time might be required from that originally planned.

Proposed Plans: Mr. Smith stated that they have at present no plans for additional mine development.

Not for publication

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Kennecott Safford Project Date June 8, 1961

District Lone Star District, Graham Co. Engineer Axel L. Johnson

Subject: Field Engineers Report. Information from Annan Cook, Geologist in charge.

References Reports of Apr. 5, 1961, Feb. 8, 1961, and previous reports.

Location About 15 miles NE of Safford. Starting from Hwy. # 70 at 8th Ave. and 5th St., Safford, take road north for a distance of 1 1/2 miles. Turn right (east) and drive 4 miles on the Air Port road. Turn left at Kennecott Shaft sign and drive for 9 miles on unpaved road.

Owners and Operators Kennecott Copper Corp., Rte. # 1, Box 30, Safford, Ariz.
Annan Cook, Resident Geologist in charge. Sam Smith, Mining Engr.

Principal Minerals Copper

Present Mining Activity Driving cross cut into the ore body by Boyles Bros. Drilling Co. on contract. Drilling for water by Boyles Bros. on contract. Operation of sampling plant by Kennecott Copper Corp. 19 men working for Boyles Bros, and 12 men working for Kennecott.

Geology See report of Oct. 6, 1960.

Milling Facilities A sampling plant has been constructed and is now in operation. A pilot leaching plant is scheduled for construction soon.

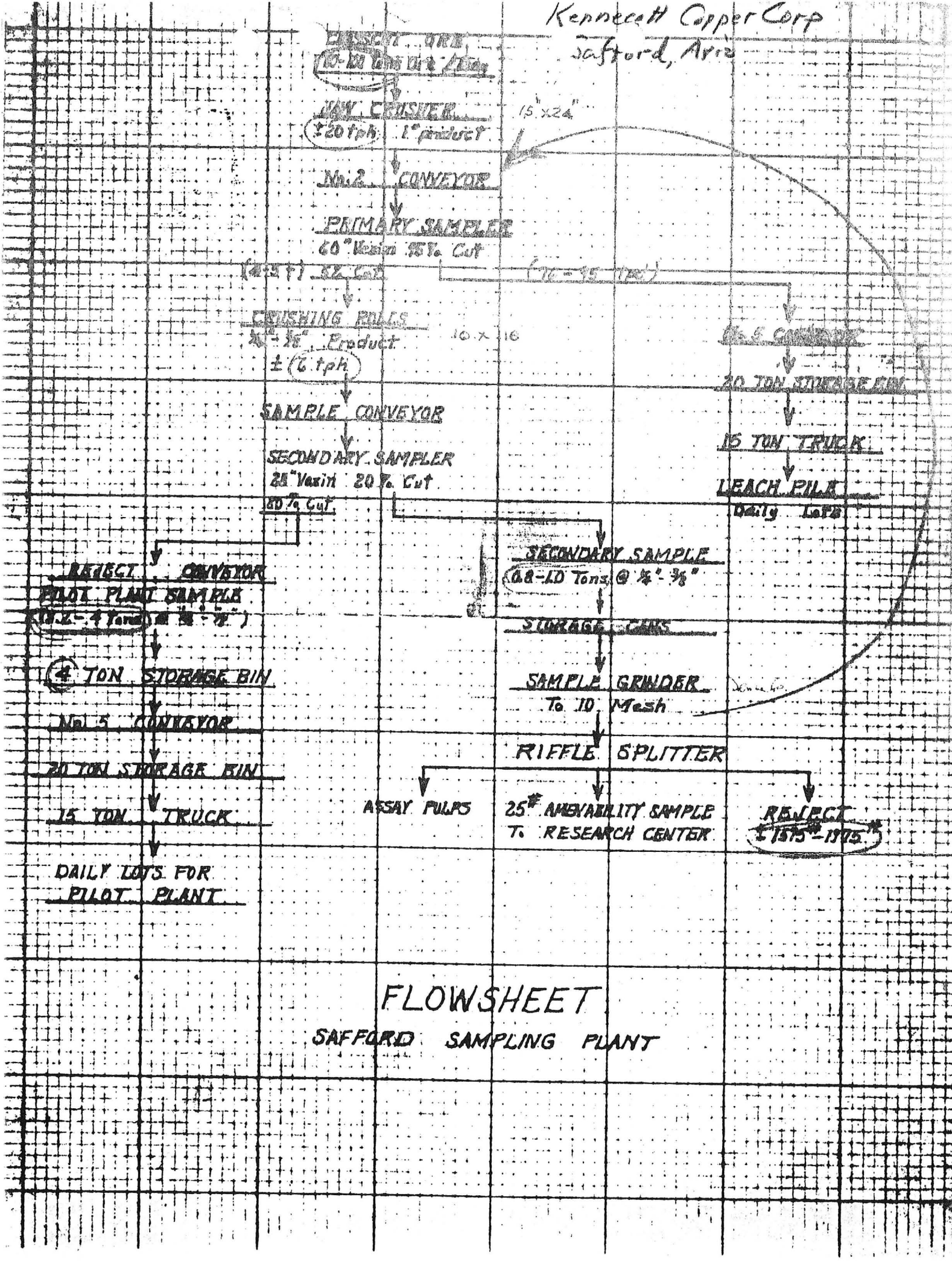
Reviewof Current Operations Boyles Bros. was awarded the contract for the underground development consisting of drifting and cross cutting on the 3900 ft. level, and this work was started on April 6. This contract calls for 1600 ft. of cross cutting (100 ft. SE and 1500 ft. NW of the shaft), and either 1,000 ft. or 2,000 ft. of drifting in the ore body, starting from the NW end of the cross cut, and extending from 500 ft. to 1,000 ft. each way. (NE and SW).

The cross cut to the NW of the shaft is now reported to be in about 600 ft. 3 shifts are being worked and the cross cut is being advanced at a rate of about 24 ft. per day. A Gardner Denver mucking machine is used, which mucks the ore and rock into mine cars, which are then trammed to within 20 ft. of the shaft, and dumped into a slusher trench, which is adjacent to the shaft. From the slusher trench, the ore and rock is slushed into the shaft loading pocket, from where it is hoisted by the skip.

A sampling plant has been constructed near the shaft during the past two months, and this started operating 4 days ago. All the ore obtained from the underground development is run through this sampling plant. The material is first crushed to one inch by means of a jaw crusher, and then passed through a Primary Sampler. From the Primary Sampler, 95 % of the material is sent to a 20 ton storage bin, from where it is later transported by trucks to a leaching pile to be stored for future leaching. The remaining 5 % of the material is passed through rolls, and then run through a Secondary Sampler. From this Secondary Sampler, 80 % of the material is sent to a 20 ton storage bin, where it will later be transferred to trucks and transported to the pilot leaching plant. The remaining 20 % is passed through another Secondary Sampler, then ground to - 10 mesh, and then sent through a riffle splitter. The riffle splitter takes out daily 25# amenability samples, which are sent to the Kennecott Copper Corp.'s Research Center at Salt Lake City for testing, and also takes out samples for assaying. (See Flow Sheet)

Boyles Bros. has also been drilling for water at a location near the Air Port. 2 holes have been drilled to a depth of about 2,000 ft., and a 3rd. one is now being drilled Water developed to date is reported to be hot and salty, & possibly not suitable for leachir

Kennecott Copper Corp
Safford, Ariz



FLOWSHEET

SAFFORD SAMPLING PLANT

Not for publication

DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

FIELD ENGINEERS REPORT

Mine Kennecott Safford Project Date ~~Mar.~~ Apr. 5, 1961

District Lone Star District, Graham County Engineer Axel L. Johnson

Subject: Present Status. Information from Annan Cook and personal visit.

References Report of Feb. 8, 1961 and previous reports.

Present Mining Activity Installation of ore skip and shaft dumping arrangement by Boyles Bros. Drilling Co., who has the contract for the underground development.

The shaft was completed to a depth of 804 ft. on March 29.

Boyles Bros. were given a contract for the underground development consisting of drifting and cross cutting on the 3900 ft. level, and this work will commence tomorrow, March 6.

This contract calls for 1600 ft. of crosscutting (100 ft. SE and 1500 ft. NW of the shaft), and either 1,000 ft. or 2,000 ft. of drifting in the ore body, starting from the NW end of the crosscut, and extending 500 or 1,000 ft. to the NE and SW from this point.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Kennecott Safford Project Date Feb. 8, 1961

District Lone Star District, Graham County Engineer Axel L. Johnson

Subject: Present Status. Information from Annan Cook.

References Report of Dec. 6, 1960 and previous reports.

Present Mining Activity Shaft sinking on contract to Boyles Bros Drilling Co. (Bob Williams, Supt.), with operations on a 3 shift basis. 17 men working for Boyles Bros. 6 men working for Kennecott Copper Co. full time, and, in addition 2 students from Eastern Arizona Junior College working part time.

Mr. Cook reports that the shaft is now down to a depth of 500 ft. (ultimate depth 795 ft.) Progress has been 370 ft. in 2 months.

Mr. Cook also reports that the company has called for separate bids on the development work, which will be started after the shaft is completed. Development of the 3900 ft. level (754 ft. below the collar), including drifting, cross cutting and raising, is first on the development program.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Kennecott Safford Project (formerly Lone Star) Date December 7, 1960

District Lone Star District, Graham Co. Engineer Axel L. Johnson

Subject: Field Engineers Report. Information from Annan Cook.

References: (1) Report of Oct. 6, 1960.
(2) Report of Lone Star Mine under date of Nov. 5, 1959 and previous reports of the Lone Star.
(3) Mining World - June 1959 - page 29.

Present Mining Activity: Shaft sinking under contract to Boyles Bros. Drilling Co. (Bob Williams, Supt.) Operations now on a 3 shift basis. 17 men working for Boyles Bros. 6 men working for Kennecott Copper Co., and in addition 2 students from Eastern Arizona Junior College are doing part time work.

Present Operations: The shaft is now down to a depth of 130 ft. The rate of progress is now down to a depth of 130 ft. The rate of progress is now approximately 10 ft. per day. The drilling is done with 2 Ingersoll Rand jack hammers, the holes being drilled to a depth of 6 to 7 ft. Only 40 minutes are required for drilling a round.

Many different kinds of explosives have been tried out, and some experiments have been made with ammonium nitrate. Round breaks to a depth of 4' to 5', and the mucking is done with a Cryderman mucking machine.

The shaft is timbered with conventional mine timber and lagging.

'Sam Smyth, Engr. - Safford - GG - 2-11-61 - WR

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine: Kennecott Safford Project (see Lone Star Mine for previous reports)
Date: October 6, 1960
District: Lone Star District, Graham Co.
Engineer: Axel L. Johnson

Subject: Field Engineers Report. Information from Annan Cook and Sam Smith.

References: (1) Report of Lone Star Mine under date of Nov. 5, 1959 and previous reports on the Lone Star.
(2) Mining World - June 1959 - page 29.

Location: About 15 miles NE of Safford.

Owners & Operators: Kennecott Copper Corp., Rte #1, Box 30, Safford, Arizona.
Annan Cook, Resident Geologist (in charge)
Sam Smith, Mining Engineer

Principal Mineral: Copper

Present Mining Activity: Shaft sinking under contract to Boyles Bros. Drilling Co. 10 men working - 1 shift.

Geology & Mineralization: Annan Cook stated that about 3/4 of the ore is oxidized or partly oxidized, the oxides being chrysocolla and brochantite. The sulphides are mostly chalcopyrite, with a small amount of bornite, and chalcocite mixed with oxidized minerals in the upper ore horizons. The company is considering the installation of a pilot leaching plant some time next year for the purpose of making leaching tests and experiments.

The log of the shaft was given by Annan Cook as follows:

0-240' - Intermediate volcanics, consisting of andesites and conglomerates. Not mineralized.
240'-795' - Older volcanics, consisting of andesites and latites. Mineralized in most localities, but have been leached out at the shaft location.
795' - Bottom of the shaft, according to present plans.

Ore Values: Said to average less than 1.0% copper by other informants.

Ore in Sight & Probable: Said to be more than 100,000,000 tons by other informants.

Review of Recent Operations: Diamond drilling on contract by Boyles Bros. Drilling Co. was finished last June.

Road building of access roads to the new shaft location on contract to David Holladay was finished in September.

A contract was let for the shaft sinking to Boyles Bros. Drilling Co., and the shaft work was started on Sept. 27. This contract includes the construction of the necessary buildings and other structures required for the shaft sinking and future development. This is a development shaft, sunk for the purpose of facilitating additional exploration and development.

The shaft is located on the east slope, a short distance east of the summit of the range of mountains (Gila Mts.) crossing the Kennecott property. The elevation of the collar of the shaft is 4654 ft.

The shaft will be a 2 compartment with inside dimensions of 9'-2" x 5'-6". The hoisting compartment will be 5'-6" x 5'-0" inside measurements and the manway compartment

will be 5'-6" x 3'-6" inside.

The shaft will be 795 ft. deep, with a station cut for one level, the 3900 ft. level, at a distance of 754 ft. below the collar. This allows for a 41' sump below the 3900 ft. level. The shaft may eventually be sunk deeper, and additional levels added. Shaft will be concreted down to solid rock and then timbered. The shaft is now down to a depth of about 20 ft. At present a clam shell bucket is used for mucking, but after the shaft gets down to a depth of 60 ft., a Cryderman mucking machine will be installed, and operations will be on a 3 shift basis.

Another contract will be let for the development of the 3900 ft. level, which will include drifting, crosscutting and raising.

Future Plans: Mr. Cook stated that he expects that the property will have to be operated by underground methods on account of the high stripping ratio. The overburden averages approximately 600 ft. in depth, varying from about 400 ft. to 800 ft.

As remarked above the company is considering the installation of a pilot leaching plant some time next year for making leaching experiments.

DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

FIELD ENGINEERS REPORT

Mine: Lone Star Mine — Date: November 5, 1959

District: Lone Star District, Graham Co. — Engineer: Axel L. Johnson

Subject: Field Engineers Report. Information from Sam Smith & Annan Cook.

References: Report of July 2, 1959.

Location: About 10 miles NE of Safford.

Owners: Kennecott Copper Corp.
Sam Smith, Mining Engineer, in charge of operations.
Annan Cook, Resident Geologist

The Bear Creek Mining Co., after completing the purchase of the property this spring, turned it over to the parent company for long range development work, this transfer being made as of July 1, 1959.

Principal Minerals: Copper

Present Activity: Diamond drilling on contract to Boyles Bros. Drilling Co., who are now drilling with 2 diamond drills and 1 rotary drill. Mr. Smith classifies this as development drilling, stating that the exploration drilling was completed by Bear Creek Minin g Co. prior to Jan. 1, 1959.

Geological field work, mapping and estimating is also being done by 5 engineers and geologists of the Kennecott Copper Corp. Offices of the company are located in the old dairy building at the road Y, about 1.7 miles N of Safford.

Proposed Plans: According to Mr. Smith and Mr. Cook, no definite plans for shaft sinking or the driving of adits have been made as yet.

DEPARTMENT OF MINERAL . .SOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Lone Star Mine Date July 2, 1959

District Lone Star District, Graham Co. Engineer Axel L. Johnson

Subject: Field Engineer's Report. Information from Sam Smith.

References: Report of Jan. 8, 1959 and several previous reports.

Location: About 10 miles NE of Safford.

Owners: Kennecott Copper Corp.
Sam Smith, Mining Engineer in charge of operations.
Annan Cook, Resident Geologist

The Bear Creek Mining Co., after completing the purchase of the property this spring, turned it over to the parent company for long range development work, this transfer being made as of July 1, 1959.

Principal Minerals: Copper

Present Activity: Diamond drilling on contract to Boyles Bros. Drilling Co. 2 diamond drill rigs are working 2 shifts, 6 days per week. According to Mr. Smith, this drilling is done for a dual purpose of assessment work and additional exploration work. Additional geological field work and mapping will also be done. Mr. Smith states that the company has acquired the old dairy building north of Safford, which will be used for an office.

DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

FIELD ENGINEERS REPORT

Mine Lone Star Mine Date Jan. 8, 1959

District Lone Star District, Graham Co. Engineer Axel L. Johnson

Subject: Field Engineer's Report. Information from Albert Spalding. No visit.

References: Report of April 3, 1957 et al.

Location: About 10 miles NE of Safford.

Owners: Lone Star Consolidated Copper Co. and several other owners.

Status: Albert Spalding states that the Bear Creek Mining Co. has finished their diamond drilling and exploration work on this property, have moved out of their Safford offices, and are moving all their equipment to Tucson.

Mr. Spalding states that the Bear Creek Mining Co. is still making monthly payments on their option to purchase.

M-L-10

DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

FIELD ENGINEERS REPORT

Mine Lone Star Mine ✓ Date November 6, 1958

District Lone Star, Graham County Engineer Axel L. Johnson

Subject: Present status. Information from Albert Spalding, Safford, Arizona.

Location: About 10 miles NE of Safford.

Owner: Lone Star Consolidated Copper Company and several other owners.

Option to Purchase: Bear Creek Mining Company, 516 3rd Ave., Safford, Arizona.

Principal Mineral: Copper ore.

Present Mining Activity: Mr. Spalding reports that no exploration work is being conducted on the property at the present time. Presumably all the drilling exploration has now been completed.

DEPARTMENT OF MINERAL R OURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Lone Star Mine Date Apr. 3, 1957 and previous.

District Lone Star Mining Dist., Graham Co. Engineer Axel L. Johnson

Subject: Field Engineers Report. Information from Albert Spalding, et al., and personal visits to the property on April 5, Sept. 13, and Oct. 4, 1956, and on April 3, 1957.

Location: About 10 miles NE of Safford. On the south end of the Bila Mt. range.

Number of Claims: An estimated 250 claims reported to be under option to or located by Bear Creek Mining Co. 30 claims in the Lone Star Consolidated Copper Co. Group.
88 claims in another group (as reported,but not confirmed).
66 claims in a third group (as reported, but not confirmed).
A large number of claims staked out by Bear Creek Mining Co., some of which are on State land. (7 claims patented. (possibly a few more)

Owners: (1) Lone Star Consolidated Copper Co., owned by Albert Spaulding, Paul Merrill, et al.
(2) Relocation of old mining claims by Leslie West, et al.
(3) Several other owners.

Option to Purchase: Option to purchase was reported as having been acquired by the Bear Creek Mining Co., a subsidiary of Kennecott Copper Corp. on March 3, 1956. Bear Creek Mining Co. has a main office at 719 E. Copper, Tucson, Ariz. They also have an office in Safford, Ariz. Raymond Robinson is the Manager.

Principal Minerals: Copper ores. Some lead and silver also reported.

Present Mining Activity: Exploration work by the Bear Creek Mining Co.
The following work has been done to date:
(1) Bear Creek Mining Co. have done geological reconnaissance and have located additional claims.
(2) Robert Lenon, Patagonia has been surveying and mapping the property.
(3) Tate Mining and Contracting Co., Tucson, location work and building roads.
(4) " " " " " " , shaft rehabilitation work.
(5) Alfred Claridge, Safford, Ariz., building access roads.
(6) McClintock Drilling Co. has been diamond drilling the property, using NX (2 1/2 inch core). Drilling was started in July, 1956 on the claims under option from the Lone Star Mining Co. and others. This diamond drilling is still continuing, according to last reports.
(7) White Mountain Drilling Co. did considerable drilling, using two rotary drills and making 5 1/4 inch diameter drill holes. The rotary drills were used for drilling from the surface down to a point where it was required to take samples. From that point on, the remainder of the hole was drilled with a diamond drill.

Geology and Mineralization: See reports on Lone Star Mine for Jan. 7 & March 6, 1953.
Past History and Production: " " " " " " " " " " " "
Old Mine Workings & Condition: " " " " " " " " " " " "

DEPARTMENT OF MINERAL R OURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Not for publication

Mine Lone Star Mine ✓ Date June 6, 1957

District Lone Star Mining District, Graham Co. Engineer Axel L. Johnson

Subject: Additional Information. Information from F. E. Sainsbury, Supt. Boyle Bros. Drilling Co.
Tel. Phoenix Crestwood 7-3273

References Report of April 3, 1957

Chamges and Additions from report of April 3, 1957.

Present Mining Activity

(1) to (5) inclusive ------- same.

(6) McClintock Drilling Co. now diamond drilling using 4 diamond drills. One more drill rig may be added. Deepest hole now reported as being 2300 ft. deep, and still going down. (One drill rig on the west side and 3 on the east side of the project.)

(7) White Mountain Drilling Co. pulled out some time ago. Reason given was that they could not make any money on the contract which they had with Bear Creek Mining Co.

(8) Boyles Bros. Drilling Co., 1321 So. Main St., Salt Lake City, Utah, now drilling at the property, using 1 rotary drill and 2 diamond drills. The rotary drill is used for drilling from the surface down to a point where it is required to get cores and take samples. Generally, the rotary drill is used for going through the 200 ft. to 800 ft. (aver. 400 ft.) of basalt capping covering the east part of the Bear Creek holdings. The diamond drills are used to finish the hole from the point where drill cores and samples are required to the bottom of the hole. The deepest hole drilled by Boyles Bros. is now down to a depth of 1800 ft.

(9) A helicopter is now being used for the transportation of Bear Creek Mining Co. engineers and geologists.

(10) No results of the exploration are available. It has been reported, however, that the Gold content found is far above expectations.

(11) Bear Creek Mining Co. is reported to have made an option to purchase several mining claims owned by Harold Elmer, and reported to be located near the Safford Air Port. Mr. Elmer has, as yet, not been interviewed for a verification of the report. His address is Box 836, Clifton, Ariz.

DEPARTMENT OF MINERAL RESOURCES
State of Arizona
MINE OWNER'S REPORT

Date March 6, 1953

1. Mine: Lone Star Mine --- Consolidated Metals Group +

2. Location: Sec. 7,8,16, 17 Twp. 6 S Range 27 E Nearest Town Safford

   Distance 10 miles Direction NE Road Condition 7 miles good, 3 miles fair

3. Mining District & County: Lone Star Mining District ----- Graham County

4. Former Name of Mine: Lone Star Consolidated Copper Co.

5. Owner: Albert Spaulding, Paul Merrill, Mrs. Margaret McAllister

   Address: 702 -- 10th Ave., Safford, Ariz.

6. Operator: Not in operation

   Address:

7. Principal Minerals: Copper with a little silver and gold.

8. Number of Claims: 30 (25 copper-5 lead) Lode yes Placer
   (This report covers the 25 copper claims. The 5 lead claims reported 1/7/53)
   Patented no Unpatented yes

9. Type of Surrounding Terrain: The mine is located at the south end of the Gila Mountain Range. There is a general slope from the Gila River at an elevation of 3200 ft. to the mine located at an elevation of about 4400 ft.

10. Geology & Mineralization: The country rocks in this area of volcanic origin, and include quartz porphyry, andesite porphyry, diabase, basalt and rhyolite. There are 5 principal ore veins found on the property, and a number of smaller veins (See accompanying map). These veins range in width from 1 to 4 ft., have a strike of approximately E. and W., with an almost vertical dip. There are also a number of Quartz porphyry dykes, running parallel to the veins, and varying from 2 to 20 ft. in width. The minerals found in the veins and dykes are mostly copper oxides, copper silicates, and copper carbonates, witha very small amount of pyrite, chalcopyrite, and chalcocite. All the workings, so far, have been in the oxidized zone--- deepest workings not reaching the sulfide zone.

11. Dimension & Value of Ore Body:

The 5 principal veins are as follows:

(1) Lone Star vein	-----	6000 ft. long.
(2) Bullonneire vein	-----	4800 ft. long.
(3) Anderson vein	-----	2000 ft. long.
(4) 1 vein	-----	3600 ft. long.
(5) 1 vein	-----	1500 ft. long.

Besides there are a number of smaller veins and numerous dykes (See Map)
The average of a number of old samples (not including shipments, stockpiles, or hand sorted ore) are as follows: Copper--- 3.24 %; Gold 0.13 oz.; Silver 1.40 oz. 17 samples, which I thought would be representative, was used to obtain this average.

Geology & Mineralization

The predominant country rock in this area is a rhyolitic porphyry ... movement and pressure have resulted in fracturing and schistosity to a considerable degree. The veins on the property have been formed by mineralization along the fracture zones. These have a general NE-SW trend, and the main vein has a variable but rather steep dip to the NW. This vein varies from 2 to 6 feet in width. Ore minerals are melaconite, chrysocolla and some chalcocite, carried in a gangue of limonite, hematite, quartz and manganese. The gold and silver values are associated with the copper minerals, although there is some free gold also.

Ore: Positive & Probable, Ore Dumps, Tailings

The inaccessibility of the deeper workings makes it impossible to estimate any definite tonnage of ore, although there is some ore exposed in places along the surface outcrop of the vein.

Mine, Mill Equipment & Flow Sheet

There is no surface equipment of any kind on the property.

Road Conditions, Route

The road from Safford to the property is fair for the first six miles, then rather rough but perfectly passable for the balance of the distance. For directions, consult owners.

Water Supply

No water has been developed on the property, although the owners state that the bottom of the deeper shaft was just getting into water when work was suspended.

Brief History

This property was worked and shipments of ore made a good many years ago, and the owners are making an effort to secure the smelter settlement records. It is known however that the ore which was extracted was never less than $20 per ton in value. Since the initial shut-down, there has never been any work of importance done in the main workings, although leasers have taken out some ore from surface open-cuts.

Special Problems, Reports Filed

Financial assistance to re-open and continue development of the property is the chief problem of the present owners.

Remarks

Mr. Spalding stated that of the many samples he has taken along the main vein on this property, none has ever assayed less than 0.14 ozs. in gold.

If property for sale: Price, terms and address to negotiate.

The property is for sale or lease. Consult owners for price and terms.

Signed Newton Wolcott

Use additional sheets if necessary. Separate sheets on each problem.

DEPARTMENT OF MINERAL RESOURCES
State of Arizona
MINE OWNER'S REPORT

Date Jan. 7, 1953

1. Mine: Lone Star Mine (West End only) By Personal inspection.

2. Location: Sec. 1 Twp. 6 S Range 26 E Nearest Town Safford

Distance 10 miles Direction NE Road Condition 8 1/2 mi. good -- 1 1/2 mi. poor.

3. Mining District & County: Lone Star Mining Dist., Graham County.

4. Former Name of Mine: always Lone Star.

5. Owner: Lone Star Mines, Inc. ----viz: (1) A. F. Spalding, 702-- 10th Ave., Safford, Ariz.------(2) C. A. Spalding, Rte. #1-Box 102, Safford, Ariz.------(3) Paul Merrill, Address Safford, Ariz.,-----(4) Jack Folks, 802 Mt. View Ave, San Bernandino, Calif.-----(5) Mrs. Margaret McAllister, Lady Lake, Fla. ------- (6) Daunt Merrill estate, Phoenix, Ariz.

6. Operator ~~xxxxxxxxxx~~ Operator Not operated

7. Principal Minerals: Lead and Silver

8. Number of Claims: 30 in all -- 5 in W. End Lode claims Placer

Patented No Unpatented Yes

9. Type of Surrounding Terrain: On the lower slopes of the Gila Range Mts.

10. Geology & Mineralization: Contact enrichment from a monzonite porphyry intrusion in granite. The ore is formed at and near the contact between the monzonite porphyry and the granite.. There are several veins in this West End area comprising 5 claims. These veins all run east and west, are almost vertical, and are from 3 to 4 ft. wide. Four distinct veins have been opened up, but there may be more that would be worth exploring. Minerals are cerussite principally. This runs from 8 to 10 % Lead, and from 10 toll ounces of Silver according to Mr. A. F. Spalding.

11. Dimension & Value of Ore Body: As far as can be determined by a cursory examination in the field, three of these veins are about 2400 ft. long, and the fourth is about 1200 ft. long. Each vein is from 3 to 4 ft. wide, and of a depth still unknown. Lead runs from 8 to 10 %, and Silver runs from 10 to 11 ounces.

Geology & Mineralization Property shows a series of strong veins trending NE-SW through dioritic porphyry. Veins are found on both sides of a very prominent outcrop of white and almost barren quartz which forms the top of a small hill. Veins vary in width from 3 to 5 feet, are strongly silicious with considerable hematite and copper staining. Lead occurs as cerrusite and some galena in porous silica, the copper as chrysocolla, azurite and malachite. Silver probably occurs as cerargyrite.

Ore: Positive & Probable, Ore Dumps, Tailings

No developed tonnage of ore, although it is exposed in several places in various veins.

Mine, Mill Equipment & Flow Sheet

None

Road Conditions, Route The road to the property is fair for about four miles from Safford, then slow and rough for the balance of the distance. It is however, perfectly passable. Best to inquire locally for route.

Water Supply

None developed.

Brief History This property was located a good many years ago by a Mr. Kirtland, after whom the quartz-capped hill was named. Present owners have not had the necessary capital to carry development to depth, and shallow work is all that has been done.

Special Problems, Reports Filed

Owners now negotiating for prospecting one or two of the strongest veins by diamond drilling to a depth of four or five hundred feet.

Remarks

If property for sale: Price, terms and address to negotiate.

Owners willing to make any reasonable agreement which will enable them to do more development work.

Signed W. Olcott

Use additional sheets if necessary. Separate sheets on each problem.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Date December 9, 1939.

Mine Lone Star Group

Engineer Newton Wolcott

District Lone Star Mining District

Location 9 Miles Northeast of Safford

Former name

Owners (Albert Spalding
(Paul Merrill
(Jack Folks

Address Safford, Arizona.

Operator

Address

President

Gen. Mgr.

Mine Supt.

Mill Supt.

Principal Metals Copper, gold and a little silver

Men Employed

Production Rate

Mill: Type & Cap.

Power: Amt. & Type

Operations: Present

Property not active at present.

Operations Planned

Additional development work when possible.

Number Claims, Title, etc.

Thirteen unpatented claims.

Description: Topog. & Geog.

Low, rolling hills at the foot of the Gila Mountains. Elevation approximately 3000 feet above sea level. Very sparse vegetation. Property lies north of and approximately 1000 feet higher than the Gila River which is eight miles distant.

Mine Workings: Amt. & Condition

One inclined shaft approximately 485 feet in depth with 350 feet of drifting on the 100 foot level. Very little lateral work below that. Also one 40 foot shaft and various shallow open cuts and pits. Collar of deep shaft blocked by material placed there by vandals, but could be easily reopened. Other workings are accessible.

(over)

12. Ore "Blocked Out" or "In Sight": None. All available tonnage of ore in sight has, apparently, been mined out and shipped. Some ore, could, no doubt, be developed and blocked out by doing some more exploration work.

Ore Probable: There is a great amount of milling ore, but the amount of direct shipping ore is small and limited. The amount of direct shipping ore would depend on what grade of ore can be marketed, and to what degree of success hand sorting can be carried out. The property needs a mill or leaching plant for treating this large quantity of milling grade ore.

13. Mine Workings—Amount and Condition:

	No.	Feet	Condition
Shafts	12		Inaccessible for lack of ladders. See Map for location and depths.
Raises	6		
Tunnels	6		See map for location and lengths.
Drifts ~~Crosscuts~~	3	350	From the Lone Star shaft on the 150 ft. and 50 ft. lev.
Stopes	2		From Lone Star shaft above the 100 ft. level.

14. Water Supply: Can obtain small amount of water at a windmill 1 1/2 miles away. Water for milling purposes can be obtained at the Gila River about 8 miles south of the property.

15. Brief History: (1) Discovered and located by James Lindsay in 1878, who operated 10 yrs.
(2) Operated by Lindsay and Anderson from 1888 to 1899, who worked the Lone Star vein, and shipped some ore intermittently. No records of amount shipped.
(3) Bought by I. L. Qualey in 1899 for $10,000. Qualey was a stock promoter, who operated the mine for 9 months, and is reported to have mined and shipped 3,000 tons.
(4) Sam Campbell, one of the stockholders, got control of the company in 1900, and reorganized same under the name of Moravilla Copper Co. New company spread their work out on all the veins, and is reported to have spent $100,000 in development.
(5) Present owners located the claims in 1930, and formed the present company.
(6) Consolidated Copper Co. had one year option for exploring in 1949, and also an option on part of the propety (10 claims) in 1951. Option not exercised.

16. Signature: Axel L. Johnson

17. If Property for Sale, List Approximate Price and Terms: Owners wish to sell or lease.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Kirtland Hill Group Date July 8, 1939

District Name not known Engineer Newton Wolcott

Subject:

Location: 9 miles northeast of Safford.

Owners: A. F. Spalding and Paul Merrill

Address: Safford, Arizona.

Principal Metals: Gold, silver, copper, lead.

Operations: Present Occasional development work.

Operations Planned Have deal pending to prospect by diamond drilling.

Number Claims, Title, etc.: 8 unpatented claims.

Description: Topog. & Geog.: Rolling foothill country at south base of Gila Mts. at an elevation approximately 1000 feet above the Gila River.

Mine Workings: Amt. & Condition: One shaft 90 feet in depth
Three " 60 " " "
One " 40 " " "
Approximately 130 feet of tunnel, and various open cuts.
All workings open, but timber gone in shafts.

Geology & Mineralization: Property shows a series of strong veins trending NE-SW through dioritic porphyry. Veins are found on both sides of a very prominent outcrop of white and almost barren quartz which forms the top of a small hill. Veins vary in width from 3 to 5 feet, are strongly silicious with considerable hematite and copper staining. Lead occurs as cerrusite and some galena in porous silica, the copper as chrysocolla, azurite and malachite. Silver probably occurs as cerargyrite.

Ore: Positive & Probable, Ore Dumps, Tailings: No developed tonnage of ore, although it is exposed in several places in various veins.

Mine, Mill Equipment & Flow Sheet: None.

Road Conditions, Route: The road to the property is fair for about four miles from Safford, then slow and rough for the balance of the distance. It is however, perfectly passable. Best to inquire locally for route.

Water Supply: None developed.

Brief History: This property was located a good many years ago by a Mr. Kirtland, after whom the quartz-capped hill was named. Present owners have not had the necessary capital to carry development to depth, and shallow work is all that has been done.

Special Problems, Reports Filed: Owners now negotiating for prospecting one or two of the strongest veins by diamond drilling to a depth of four or five hundred feet.

If property for sale: Price, terms and address to negotiate: Owners willing to make any reasonable agreement which will enable them to do more development work.

(Signed) WOLCOTT

MK-4

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Date July 8, 1939.

Mine Kirtland Hill Group

Engineer Newton Wolcott

District Name not known.

Location 9 Miles Northeast of Safford

Former name

Owners A.F.Spalding and Paul Merrill

Address Safford, Arizona.

Operator

Address

President

Gen. Mgr.

Mine Supt.

Mill Supt.

Principal Metals Gold, silver, copper, lead.

Men Employed

Production Rate

Mill: Type & Cap.

Power: Amt. & Type

Operations: Present

Occasional development work.

Operations Planned

Have deal pending to prospect by diamond drilling.

Number Claims, Title, etc.

8 Unpatented Claims.

Description: Topog. & Geog.

Rolling foothill country at south base of Gila Mts. at an elevation approximately 1000 feet above the Gila River.

Mine Workings: Amt. & Condition

One shaft 90 feet in depth
Three " 60 " " "
One " 40 " " "
Approximately 130 feet of tunnel, and various open cuts.
All workings open, but timber gone in shafts.

(over)

12. Ore "Blocked Out" or "In Sight":.....No ore actually blocked out.

Ore Probable:.....Very hard to determine, as so much of the ore appears to be marginal.

13. Mine Workings—Amount and Condition:

	No.	Feet	Condition
Shafts	6	280 ft. total	Fair
Raises			
Tunnels	1	60 ft.	Good
Open Cuts	5		
~~xxxxxxxx~~			
Stopes			

14. Water Supply:.....No water supply on or in the vicinity of the property.

15. Brief History:.....Property first located by Bill Kirtland around 1905. Kirtland did most of the work done on the property, doing this in 1907. Kirtland held the property until about 1915, and then abandoned same. Property located by A. F. Spalding, et. al. in 1930, and was held as a partnership basis until 1942, when the Lone Star Mines, Inc. was formed.

Proposed Plans.....The company intends to bring up a compressor, and to start doing more exploration work on the property. They intend to work week ends at first, and, afterwards to work 2 men steady, concentrating on the four veins already partially explored.

16. Signature:

17. If Property for Sale, List Approximate Price and Terms:.....Will lease with option to buy the 5 lead-silver claims in the West End of the Lone Star Mines, Inc. properties separately for $25,000 purchase price and 10 % royalty------ or will lease entire holdings of 30 claims at a price and terms to be determined.

MK-4

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
OWNERS MINE REPORT

Date July 7, 1939

Mine Kirtland Hill Group

District Lone Star Mining District

Location Gila Mt. range 10 miles N.E. of Safford

Former name

Owner A. F. Spalding -- Paul Merrill

Address Safford, Ariz.

Operator " "

Address " "

President None

Gen. Mgr. None

Mine Supt. None

Mill Supt. None

Principal Metals Lead, Silver, Copper, Gold

Men Employed None

Production Rate No production at present

Mill: Type & Cap. None

Power: Amt. & Type None

Operations: Present Assessment work and prospecting

Operations Planned Have secured compressor and jackhammer and contemplate sinking on ore shoot.

Dealing at present with concern to do some diamond drilling on property.

Number Claims, Title, etc. Eight full sized claims, held by right of location

Description: Topog. & Geog. Claims are located in foothills of the Gila Mountains. Country rock diorite and andesite with numerous intrusions, and with a system of generally parallel veins running from southwest to northeast.

Mine Workings: Amt. & Condition One 90 foot shaft-three 60 foot shafts-one forty foot shaft. One hundred fifty foot tunnel. Numerous shallow pits and open cuts. All the shafts and the tunnel are prior old workings and are not in immediate usable condition.

(over)

Geology & Mineralization Heavily mineralized area containing a stock work of veins large and small. Many of these veins produced a high grade shipping ore in the early development of the property. Sulphide minerals are Pyrite, Chalcopyrite and Chalcocite.

Ore: Positive & Probable, Ore Dumps, Tailings A considerable tonnage of a shipping grade ore can be mined above the 100 foot level in the Lone Star shaft with the lower grade bodies to be almost assured with a very short distance of sinking in the shaft. Other rich ore can be obtained with some development to be done on the Mineral Hill No. 1 claim.

Mine, Mill Equipment & Flow Sheet No statement

Road Conditions, Route The road condition is very good

Water Supply At present water is hauled from Safford

Brief History Early working of this property dates back to the '80s Many carloads of ore having been shipped running very high in copper values with some silver and gold.

Special Problems, Reports Filed My broblems are about in line with everyone elses I presume. Looking for some one with financial aid that will believe my story and have faith enough to go along with me on any sort of a proposition.

Remarks

To get a much clearer picture of this property, I am sending along with this questionnaire, a copy of Mr. A.E. Alminds report and a letter descriptive of the Lone Star workings as written up by my father, the late C. B. Spalding.

If property for sale: Price, terms and address to negotiate. I will negotiate with any one for any sort of a deal they wish to make so long as it is an honest deal within reason. The price is $ 50,000 Fix it up any way they like and push operations legitimately.

Address -- A.F. Spalding
Box 563, Safford, Ariz.

Signed A. F. Spalding

Use additional sheets if necessary.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
OWNERS MINE REPORT

Date July 7th. 1939

Mine Kirtland Hill Group

District Lone Star Mining District

Location Gila Mt. range 10 Miles N.E. of Safford

Former name

Owner A.F.Spalding -- Paul Merrill

Address Safford, Ariz.

Operator " "

Address " "

President None

Gen. Mgr. None

Mine Supt. None

Mill Supt. None

Principal Metals Lead, Silver, Copper, Gold

Men Employed None

Production Rate No Production at present

Mill: Type & Cap. None

Power: Amt. & Type None

Operations: Present Assessment work and prospecting .

Operations Planned Have secured compressor and jackhammer and contemplate sinking on ore shoot.

Dealing at present with concern to do some diamond drilling on property.

Number Claims, Title, etc. Eight full sized claims, held by right of location.

Description: Topog. & Geog. Claims are located in foothills of the Gila Mountains. Country rock Diorite and andesite with numerous intrusions, and with a system of generally parallel veins running from Southwest to Northeast.

Mine Workings: Amt. & Condition One 90 foot shaft-three 60 foot shafts-one forty foot shaft. One hundred fifty foot tunnel. Numerous shallow pits and open cuts. All the shafts and the tunnel are prior old workings and are not in immediate usable condition.

(over)

Geology & Mineralization Heavily mineralized area containing a stock work of veins large and small. Many of these veins produced a high grade shipping ore in the early development of the property. Sulphide minerals are pyrite, chalcopyrite and Chalcocite.

Ore: Positive & Probable, Ore Dumps, Tailings A considerable tonnage of a shipping grade ore can be mined above the 100 feet level in the Lone Star shaft with the lower grade bodies to be almost assured with a very short distance of sinking in the shaft. Other rich ore can be obtained with some development to be done on the Mineral Hill No. 1 claim.

Mine, Mill Equipment & Flow Sheet No statement.

Road Conditions, Route The road condition is very good.

Water Supply At present water is hauled from Safford.

Brief History Early working of this property dates back to the '80s, Many carloads of ore having been shipped running very high in copper values with some silver and gold.

Special Problems, Reports Filed My problems are about in line with everyone elses, I presume. Looking for some one with financial aid that will believe my story and have faith to go along with me on any sort of a proposition.

Remarks To get a much clearer picture of this property, I am sending along with this questionnaire, a copy of Mr. A. E. Alminds report and a letter descriptive of the Lone Star workings as written up by my father, the late C. B. Spalding.

If property for sale: Price, terms and address to negotiate. I will negotiate with any one for any sort of a deal they wish to make so long as it is an honest deal within reason. The price is $50,000. Fix it up anyway they like and push operations legitimately.

Address: A. F. Spalding,
Box 563, Safford, Arizona.

ATTACHED:

Report on the LONE STAR MINES,INC.
roperties at Safford,Graham County, Arizona,
E.ALMIND,M.E.5-20-1930.
9-14-1939
alding,Ex-Supt.

Signed A. F. SPALDING

dditional sheets if necessary.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
OWNERS MINE REPORT

Date July 8, 1939

Mine Lone Star Mines

District Lone Star Mining District

Location 10 miles NE of Safford at base of Gila Mt. Range.

Former name Lone Star Consolidated

Owner A. F. Spalding - - Jack Folks

Address Box 563, Safford, Arizona.

Operator Same

Address

President None

Gen. Mgr. None

Mine Supt. "

Mill Supt. "

Principal Metals Copper, with some silver & gold

Men Employed None

Production Rate No production at present

Mill: Type & Cap. "

Power: Amt. & Type None

Operations: Present Location work & assessment.

Operations Planned Would like to see the continuation of the sinking on down at least another 100 feet of the old Lone Star Shaft. This will undoubtedly tap the enrichment zone and prove the mine.

Number Claims, Title, etc. (12). Owner by location, title clear.

Description: Topog. & Geog. The mine is located at the base of the southend of the Gila Mt. Range, 8 miles northerly from the Gila River. The mine elevation is about 4000 feet, or 1000 feet higher than the river and the Gila Valley. In general, it is a porphyry formation with rocks identified as porphyritic shhist, containing disseminated IRON PYRITE now altered to iron oxides: Andesite Por. Quartz Por., etc.

Mine Workings: Amt. & Condition Lone Star shaft 485 feet deep, incline with 300 feet of drifting and stoping. These are old workings and shaft repairing would be necessary to make working conditions possible.

(over)

Geology & Mineralization The parallel system of Quartz Porphyry veins carry deposits of lead carbonate, galena, carbonates of copper iron oxides with small amounts of silver minerals and also vanadium and molybdenum minerals in varying amounts.

Ore: Positive & Probable, Ore Dumps, Tailings

No definite estimate of tonnage has been made at this time.

Mine, Mill Equipment & Flow Sheet

none.

Road Conditions, Route The route to the claims follows the county road north from Safford across the Gila and towards the San Juan and Walnut Springs mines. A branch road leaves the county road about eight miles from Safford and leads directly to the claims. The road is in fair condition.

Water Supply

There is no water supply on the claims, However there is a good well on an adjoining claim to the north east of the property.

Brief History Considerable prospecting was done on the property in the early eighties and nineties, mostly for copper. Practically all ore taken out during these operations was removed from the claims and shipped by highgraders during the time of the World War.

Special Problems, Reports Filed

No statement at this time.

Remarks

No statement.

If property for sale: Price, terms and address to negotiate.

Property is for sale subject to reasonable negotiation as to price and sale terms. Address,

A.F. Spaulding
Box 563 Safford Arizona

Signed A. F. Spalding

additional sheets if necessary. Paul Sherfee

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
OWNERS MINE REPORT

Date July 8 1939

Mine Lone Star Mines

District Lone Star Mining Dist.

Location 10 miles n.e. of Safford at base of Gila Mt. range.

Former name Lone Star Consolidated Copper Co.

Owner A.F. Spalding -- Jack Folks

Address Box 563, Safford, Ariz.

Operator Same

Address

President None

Gen. Mgr. None

Mine Supt. None

Mill Supt. "

Principal Metals Copper with some silver & Gold

Men Employed None

Production Rate No production at present

Mill: Type & Cap. None

Power: Amt. & Type None

Operations: Present Location work & assessment

Operations Planned Would like to see the continuation of the sinking on down at least another 100 feet of the old Lone Star shaft. This will undoubtedly tap the enrichment zone and prove the mine.

Number Claims, Title, etc. (12) Owner by location , titles clear

Description: Topog. & Geog. The mine is located at the base of the south end of the Gile Mt. Range, 8 miles northerly from the Gila river The mine elevation is about 4000 feet, or 1000 feet higher than the river and the Gila Valley.

In general,it is a porphyry formation,with rocks identified as, Porphyritic Schist, containing disseminated IRON PYRITE?now altered to iron oxides: Andesite Por. Quarts Por. Etc.

Mine Workings: Amt. & Condition

Lone Star shaft 485 feet deep, incline with 300 feet of drifting and stoping. These are old workings and shaft repairing would be necessary to make working conditions possible.

(over)

Geology & Mineralization The parallel system of quartz porphyry veins carry deposits of lead carbonate, galena, carbonates of copper iron oxides with small amounts of silver minerals and also vanadium and molybdenum minerals in varying amounts.

Ore: Positive & Probable, Ore Dumps, Tailings No definite estimate of tonnage has been made at this time.

Mine, Mill Equipment & Flow Sheet None

Road Conditions, Route The route to the claims follows the county road north from Safford across the Gila and towards the San Juan and Walnut Springs mines. A branch road leaves the county road about eight miles from Safford and leads directly to the claims. The road is in fair condition.

Water Supply There is no water supply on the claims. However, there is a good well on an adjoining claim to the northeast of the property.

Brief History Considerable prospecting was done on the property in the early eighties and nineties, mostly for copper. Practically all ore taken out during these operations was removed from the claims and shipped by highgraders during the time of the World War.

Special Problems, Reports Filed No statement at this time.

Remarks No statement.

If property for sale: Price, terms and address to negotiate. Property is for sale subject to reasonable negotiation as to price and sale terms. Address -

A. F. Spalding,
Box 563, Safford, Arizona

Signed A. F. Spalding
Paul Merrill

Use additional sheets if necessary.

CZM office

August 31, 1960

Kennecott Copper Corporation will start sinking a vertical two compartment shaft at its Safford, Arizona copper claims early in September. The new Co. shaft will be for development purposes only as it will be too small for ore production.

The new shaft will be 800 feet deep with a station cut for development of one level, the 3900, about 50 feet above the bottom. From the station it is planned to drift and crosscut and then diamond drill to gain further information about the very large mineralized area which cover several hundred acres and is known to extend to a depth of at least 2,000 feet.

Kennecott through its exploration subsidiary --- Bear Creek Mining Company --- has been actively exploring the district for four years and in May 1959 purchased 120 mining claims for nearly $4,000,000. The Lone Star Mines, Inc's claims were the key to this sale. Since the sale Kennecott has been doing "fill in" diamond drilling from the surface and has outlined 100,000,000 tons plus of less than 1.0 percent oxide copper. The new shaft will be the means of access to this deeply buried deposit.

Interestingly the new shaft will be sunk not far from one of the first diamond drill holes drilled to depth in the area. That was done by Consolidated Coppermines Corporation in 1949.

The new shaft will be two compartment with a minimum rock size of 11 feet 6 inches by 7 feet 10 inches. The hoisting compartment will be 5 feet 6 inches square with a counter weight in the adjoining manway compartment. Kennecott will purchase all surface equipment which will include a steel headframe, 100 kilowatt GMC Diesel electric generating set, one Ingersoll Rand 600 cubic feet per minute gyroflow compressor, and one Vulcan Denver 90 horsepower single drum hoist.

FOR AUTOMATIC RELEASE TO P.M. NEWSPAPERS, WEDNESDAY, OCTOBER 11, 1967 (10:00 A.M. MDT)

SAFFORD, ARIZONA -- Kennecott Copper Corporation has submitted a proposal to the U. S. Atomic Energy Commission for a joint experiment to determine if a contained underground nuclear explosion can be used to fracture a low-grade copper ore deposit to recover the copper by leaching the ore in place.

The proposal is based on a study released today indicating the nuclear fracturing technique could lead to recovery of copper which previously could not be produced economically. If authorized, safety and technical studies in the field would be undertaken to determine whether such an experiment could be conducted with full protection for public health and safety.

The two-year conceptual study by Kennecott, the Atomic Energy Commission, the U. S. Department of the Interior's Bureau of Mines, and the AEC's Lawrence Radiation Laboratory, Livermore, California, recommends conducting an experiment in a copper deposit owned by Kennecott near Safford, Arizona.

The proposed experiment, "Sloop," would be part of the AEC's Plowshare Program to develop peaceful uses of nuclear explosives. It would

involve the detonation of about a 20-kiloton nuclear explosive (equivalent to 20,000 tons of TNT) at a depth of 1,200 feet below the surface of the ground.

The explosion would be expected to result in a chimney of broken ore about 440 feet high and 200 feet in diameter containing about 1.3 million tons of ore. To recover the copper, a leaching solution would be introduced into the chimney to dissolve the copper. The solution later would be pumped to the surface where the copper would be removed by a processing method.

The cost of the experiment presently is estimated at more than $13,000,000, including construction of pilot processing plant facilities at the Safford site and its operation for a year. If the proposal is accepted by the AEC, terms of the joint project, including the division of costs between the Government and Kennecott, would be negotiated. Commission participation would be contingent on Congressional authorization.

The nuclear fracturing and "solution mining" concept, if successful, could greatly increase the mineable copper reserves in the United States; it would permit development of low-grade deposits which cannot be mined economically by conventional methods. In addition, this concept would keep disturbance of the natural landscape at a minimum.

The study group found the domestic mining industry is facing an accelerating demand for copper, caused in part by the Vietnam war. Consumption in the U.S. increased 74 per cent from 1.35 million tons in 1960 to 2.35 million tons in 1966. It increased 17 per cent in 1966 alone. Although

domestic copper production has increased 10 per cent in the past two years, the U.S. has had to continue importing copper to meet its needs.

If Kennecott's proposal is accepted by the government agencies involved and authorized by Congress, the first phase of the experiment -- site safety and technical evaluation -- would be begun. This six-month program would include thorough studies in the field of underground water, geologic formations, soil, structures, weather and public health and safety. Preliminary estimates indicate this evaluation might cost about $750,000.

If these studies show the Safford site to be suitable for an experiment and adequate public health safeguards can be guaranteed, the Commission could approve the full experiment. If not, the experiment would have to be dropped, modified or another location considered. The earliest possible detonation date would be in 1969. The Sloop experiment would take 2-1/2 to 3 years to complete.

During all phases of the experiment, state and local officials would be kept informed of all studies and findings.

The leaching portion of the experiment could begin as early as nine months after the nuclear explosion. As outlined in the Sloop study, a leaching solution would be introduced at the top of the rubble-filled chimney. Flowing downward over the fragmented ore, the solution would dissolve the copper minerals. The copper-bearing solution would then be pumped from the bottom of the chimney to the surface.

The full Sloop experiment would include a pilot processing plant at the Safford site to remove the copper from the leaching solution.

Leaching is now used on some low-grade ores and mine wastes above ground; it has also had limited underground use in several abandoned higher grade ore mines. The nuclear fracturing technique would allow the leaching solution to flow over large volumes of ore without bringing the ore to the surface.

In the experiment, the AEC's Nevada Operations Office, which has conducted more than 225 underground nuclear explosions, would be responsible for public health and safety. Underground nuclear explosions have been conducted in Nevada, New Mexico, Alaska and Mississippi, and other Plowshare experiments are being considered in Pennsylvania and Colorado.

Radioactive material from the explosion is not expected to reach the atmosphere or to affect ground water, according to the feasibility report. Field studies will be made to check this belief. The emplacement depth of 1,200 feet is well below that required for safe containment of a 20-kiloton explosion.

Laboratory scale experiments indicate the level of radioactivity in the leaching solution would be low enough that no special shielding would be required during the recovery process. Any traces of radioactivity in the copper are expected to be reduced even more during refining to meet market standards. No copper produced in the Sloop experiment would be permitted to enter commercial markets without further careful study and control.

# # #

October 10, 1967

SUMMARY OF THE SLOOP FEASIBILITY STUDY

* * *

A study of the feasibility of fracturing copper orebodies with nuclear explosions and the extraction of copper by in-situ leaching methods.

* * *

Prepared by the San Francisco Operations Office of the U. S. Atomic Energy Commission; the Department of Interior's Bureau of Mines; the Lawrence Radiation Laboratory, Livermore, California; and the Kennecott Copper Corporation; with technical assistance of the Oak Ridge National Laboratory, Oak Ridge, Tennessee.

1. Introduction

This is a summary of a feasibility study to theoretically evaluate the use of nuclear explosives to fracture a low-grade copper orebody for the subsequent extraction of copper by in-situ leaching methods.

Such a method, in which the metal would be dissolved from the fractured rock by percolating a chemical solution through it, would permit recovery of the metal without the expense of mining and crushing the ore. Broadly applied, the technique could provide access to millions of tons of copper in deposits that are too low in grade to be mined economically with today's conventional technology.

The study was conducted jointly by the Kennecott Copper Corporation, the U. S. Atomic Energy Commission's San Francisco Operations Office, the Department of the Interior's Bureau of Mines and the Lawrence Radiation Laboratory, Livermore, with the technical assistance of the Oak Ridge National Laboratory. It is one of the efforts in the Atomic Energy Commission's Plowshare Program, the purpose of which is to investigate and develop peaceful uses for nuclear explosives.

The study disclosed no major problems related to public or industrial safety involved in the technique. Further investigations would be needed, however, to make certain that this is the case.

The study recommends that, providing field studies assure that public safety will not be compromised, an experimental project be undertaken jointly by the Government and Kennecott Copper Corporation to develop the technique. It suggests that a nuclear explosive, of about 20 kilotons yield, be detonated underground in a low-grade copper orebody owned by Kennecott near Safford, Arizona. A leaching plant would be operated to extract copper from the rock fractured by the explosion.

2. The Need for Copper

World production of copper has risen progressively from about 18,000 tons in 1800, to more than 6 million tons in 1965. The U. S. Bureau of Mines reports that the United States refined copper consumption increased from 1.35 million tons in 1960 to 2.35 million tons in 1966. This represents an increase of 74 percent in six years. During the same period, U. S. mined production of copper increased by only 10 percent, despite the efforts of producers to add new capacity. Intensive exploration has failed to yield any new, large, high-grade ore deposits, although a number of deposits are known which are uneconomic to mine using presently available techniques.

Prior to World War II the United States possessed a high degree of self-sufficiency in copper and exported substantial quantities to other users. Today this basic metal is in short supply in the United States with the result that the country, to satisfy its industrial and defense demands, is in the unfavorable position of being a net importer of copper. Rising standards of living and increasing populations in the developing nations indicate a growth in consumption for the world approximately twice the United States level. The availability and competition for metal will probably make it more expensive to buy for import in the future.

To insure adequate supplies of this strategic commodity at reasonable prices for industrial and defense needs, the copper industry has intensified its efforts to discover and develop deposits in this country. Some additional copper production will come from expansion of existing operations and from new deposits with ore grades equal to those now being mined. However, the major portion, in the long run, must come from development and utilization of deposits with ore grades not presently considered economic.

3. Leaching of Copper Ores

Leaching of copper ores is not a new process. Its use in the extraction of copper from mine waste dumps has been increasing. It has also been used to recover copper directly from certain ores which are mined and leached. By 1965, 12 percent of the domestic copper production was obtained by leaching.

Successful practice of in-situ leaching methods has been previously restricted to the abandoned workings of old higher grade underground mines. Mines in Butte, Montana; Ray and Miami, Arizona; and Bingham Canyon, Utah have practiced in-situ leaching to a limited extent in the mined-out areas of old mining operations. The zones treated by leaching were well fractured and had been made permeable by the previous mining operations. In these operations the leaching solution was generally recovered through the existing underground openings.

In-situ leaching eliminates the high costs of excavating and transporting the material to a plant for further treatment. To be economically effective, this method of leaching requires preparation of the deposit so that the process of dissolving the mineral may proceed at an economic rate and with good efficiency. The deposit must be shattered and broken to develop the permeability required to allow air and leaching solutions adequate contact with the minerals.

4. Extent of Resources

How large are the United States reserves of copper? The answer depends upon which authority one consults. In a 1960 survey the U. S. Bureau of Mines estimated the United States to have 32.5 of the world's 212 million tons of copper in ores averaging 0.9 percent copper. In 1965 these domestic reserves were indicated to be 75 million tons in ores averaging 0.86 percent. Reported reserves have always been only a fraction of what the earth will ultimately yield.

Large sums of money are required to outline a deposit sufficiently for it to be classed as a mining reserve. Producers can only justify investigating that portion of the total that offers a reasonable promise for a profitable operation. If many years of potential production exists with presently commercial grade material, there is often little impetus for diverting funds to prove the existence of sub-ore material. As producers approach their known ore reserve limits, they attempt to develop additional reserves. These additions can be obtained by new discoveries, by lowering recovery costs through advances in technology, or by raising the price. Thus, the border between mineral reserves and mineral resources is constantly shifting.

It would be very difficult to establish reliable figures for the amount of sub-ore material that could be reclassified as ore reserves by the development of a mining method that would allow a substantial lowering of the present economic grade limits. The closest approximation is available in what is often referred to as "potential" ore, namely, material known by its location and quality and considered likely to be profitably minable in the future. The amount of such potential reserves is known to be enormous. Vast tonnages of sub-ore material exist as halos around the economic limits of operating properties in this country. Exploration activities, presently on a 100 million dollar a year quest for additional ore, often observe, partially define, and subsequently abandon great quantities of this type of material in the search for today's commercial ores. The U. S. Bureau of Mines estimates that an additional 58 million tons of metallic copper probably exist in potential ores averaging about 0.47 percent (9.4 pounds of copper in 1 ton of ore). Some definite information is available for eighteen such deposits containing about 16 million tons of copper.

A complete answer to the question of how much copper is in the United States in a sub-ore resource category will be determined only when a new method of mining technology is tried and proven, giving industry an impetus to fully explore the extent of these resources.

5. Nuclear Fracturing

If a nuclear explosive is emplaced deep underground, upon detonation the blast will be fully contained. The energy of the explosion is released in a fraction of a microsecond and it vaporizes, melts and crushes the surrounding rock. A cavity forms and expands spherically around the blast center following the outward moving shock wave until the pressure of the gas in the cavity approaches equilibrium with the weight of the overlying rock. The molten rock that initially lines the cavity walls will flow and form a pool on the cavity bottom. As this material cools and solidifies into a relatively inert glass, it traps and entrains up to 95 percent of the radioactive fission products generated by the explosion. The roof over the cavity, having been fractured by the shock wave and effectively undercut, will start to collapse and a cylindrical chimney of caved and very permeable broken rock will develop upward. The chimney will have a radius that approximates that of the cavity and the height will normally extend to a distance of four or five times the radius of the cavity. Chimney material formed by nuclear explosions in granitic rock is extremely permeable and has been observed to have about 25 percent void space with 75 percent of the fragments smaller than 12 inches in size. The force of the explosion will also fracture rock out beyond the chimney boundary. This outside fracturing will also increase, to a lesser extent, the original rock's permeability for a distance approaching three cavity radii.

6. The Sloop Experiment

In the Sloop study, a concept for an experiment is proposed to evaluate the nuclear fracturing/in-situ leaching technique for recovery of copper from low-grade orebodies. The Safford deposit of Kennecott Copper Corporation, about nine miles northeast of the town of Safford in southeastern Arizona, is suggested as the experiment site.

As now conceived, the experiment would involve detonating a nuclear explosive with a yield of about 20 kilotons* underground in the oxide portion of the Safford deposit to fragment a test zone of copper ore. A pilot leaching plant, having commercial size equipment, would be built to leach and extract copper from the broken ore. It is anticipated that at least one year of leaching tests would be required to provide enough data for a reliable evaluation of the experiment.

If Sloop site evaluation is authorized, the AEC will make detailed field investigations to determine the suitability of this proposed site. These investigations would provide the basis for final design of the experiment, including the selection of a nuclear explosive, its yield, and method of emplacement and all aspects related to public health and safety.

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* One kiloton is equivalent to 1,000 tons of TNT high explosive.

The nuclear explosive would be emplaced in a hole drilled from the surface, approximately 20 inches in diameter. The hole would then be plugged to prevent venting to the atmosphere and the explosive would be detonated at a depth of 1,200 feet. It is expected the explosion would create a chimney of broken rock with a diameter of about 200 feet, a height of about 440 feet, and containing approximately 1.3 million tons of broken rock.

After the shot, holes would be drilled from the surface into the chimney to define its height, to take samples of the atmosphere inside it, and to measure the void volume. Holes would also be drilled to investigate the extent and radius of fracturing outside the chimney. As soon as the post-shot safety requirements are satisfied, existing underground openings would be rehabilitated and facilities installed for the leaching tests.

For the leaching tests, leach liquid input holes would be drilled to the top of the chimney. An access drift and a system of drill holes would be installed beneath the chimney to collect the pregnant (metal-bearing) leach solutions. The copper would be recovered from the solution by treatment with iron to precipitate a copper powder. A precipitation plant using cone precipitators similar to those now used at Kennecott's western mines would be constructed near the shaft. The plant would be capable of treating a throughput of about 2,600 gallons per minute of pregnant solution obtained from the collection system, and of recycling the barren (stripped) solutions to the chimney zone.

The pilot leaching plant would be operated at least a year to develop operating techniques and to provide data for the economic evaluation of the commercial potential of the nuclear fracturing/in-situ leaching process.

The operation of the pilot leaching plant should produce a moderate amount of copper that, after suitable treatment, could be made available for ordinary usage. A portion of the copper precipitates would be used for developmental studies to determine the most efficient process for refining the crude copper for marketing on a commercial scale.

Laboratory scale experimental work indicates that possible radioactive contamination of the copper is a manageable problem. Radioactivity in the leaching solutions should be at low enough levels that shielding for personnel protection would not be required. Any residual contaminants in the raw copper product should be removable by refining processes so that the finished copper should be virtually free of any contaminant.

The feasibility study concludes that there appears to be no safety problems that cannot be satisfactorily managed and that the project can be conducted at the Safford site without hazard or serious inconvenience to the population in that area.

8. Cost Estimate and Schedule

The preliminary cost estimate for the entire experiment, including construction and operation of the leaching system for a year, is about 13 million dollars.

It is expected that about nine months would be required to complete the pre-shot safety studies and prepare the project site for the detonation after authorization to proceed is granted. An additional period of nine months after the shot would be required for evaluation of the explosion's effects, decay of residual radioactivity in the chimney, and construction of the leaching system. Then the leaching plant would be operated for a minimum of one year to accumulate sufficient data for development of process techniques and economic evaluation.

9. Project Organization and Administration

Project Sloop would be a joint effort of the U. S. Government and Kennecott Copper Corporation. The Atomic Energy Commission would provide the nuclear explosive, conduct the nuclear operations and the programs for the protection of public health and safety. Kennecott would be responsible for the leaching and copper recovery phase of the experiment. The U. S. Bureau of Mines would participate in all phases of the experiment, would evaluate the results, estimate the applicability of the technique to other potential orebodies, and would cooperate with the other participants in reporting the results of the experiment.

LONE STAR MINES INCORPORATED

Safford, Arizona,
November 10, 1942.

Mr. J. S. Coupal, Director,
Arizona Department of Mineral Resources,
413 Home Builders Building,
Phoenix, Arizona.

Dear Sam:

Pursuant to your request, I am enclosing herewith a copy of STATEMENT OF DEVELOPMENT COSTS used by us for reporting the progress of work under our Class C Preliminary Development Loan. This system has seemed to satisfy R F C in every detail and we have reported on this form on the 5th and 20th of each month during the progress of our work. Receipts for each expenditure were attached to one copy of the report which Mr. Gohring approved and returned to us for our files. The break-down as to estimates in borrowers application could be arranged to suit the particular case, but apparently need not be in great detail.

We are a little discouraged to date with reports on our Class B Application since I can not receive word from Washington, nor have confirmed by R F C the receipt of our papers sent them on October 21, nineteen days ago. Telegraphic advice yesterday from Washington also says that the Phoenix Office R F C Report has not yet been received although we have been told it left Phoenix "several days ago"--from last week. No doubt Washington is severely crowded with work, but if you could get Bill Broadgate on the case for us, it would surely be appreciated.

We enjoyed very much your visit with us the other day and hope you can get around often. Best personal regards.

Very truly yours,

J. D. Merrill, President,
Lone Star Mines,
Safford, Arizona.

JDM/a

SAMPLES RECEIVED FROM A. P. SPALDING

(Lone Star Mine, Ariz.)

February, 1947

No.	Au.Oz.	Ag.Oz.	Pb.%	Cu.%	Zn.%	Description
1	0.010	0.8	None	2.14	None	Treasure Box #1. Sample cut across 20'. High grade vein running through this, not represented in sample.
2	Trace	0.2	32.6	0.51	0.2	Lead Hill. Sample (Spalding) No. 1 40' shaft. E. side of vein. Sample width 2' in 4' vein. Cut at 30' depth.
3	0.010	0.6	0.8	0.10	None	Lead Hill. Sample (Spalding) No. 2 - 40' shaft West side. Depth 30'. Width of vein 5' W. of Sple 3'.
4	None	0.1	None	0.10	None	Sample (Spalding) #4. N. of L.S. shaft. Taken on both sides of canyon and in bottom for 300'.
5	0.040	0.8	None	0.05	None	Lead Hill. (Sample - Spalding - #5) General sample of vein material piled on dump.
6	0.010	0.8	6.0	0.10	0.8	Lead Hill. (Sample - Splading - #6) Taken from cut on vein 100' S. of No. 1 vein and 300' above No. 5 - 50' shaft. Depth 4' - Width 4'.
7	0.030	4.5	None	0.76	None	Iron King #5. This material is off big No. 1 vein. (Is this iron pyrites or copper pyrites?) AS.
8	Trace	0.2	None	3.46	0.3	Iron King #4. Another vein 150' above big No. 1 vein. Not uncovered enough to determine any width.
9	Trace	2.0	None	1.12	None	Spalding Sample #2. Ledge width of sample 4' alongside of cut 1st canyon N. of L.S. shaft.
10	Trace	3.1	None	5.81	0.1	Iron King #1. Representative sample of shipping ore 4' vein off top.
11	Trace	0.3	None	1.63	None	#1 Long Star vein. Vein width 2' Dept. 10'.
12	Trace	1.1	None	0.15	None	Lead Hill. Sample (Splading) #4, 50' shaft on same vein as Nos. 1-2-3. 300' east. Dump sample.
13	Trace	0.4	None	0.91	None	Iron King #2. This material is out of same vein as #1.
14	0.010	3.7	None	8.05	None	Norquay Shaft. Depth 20' - Width 6'.

No.	Au.Oz.	Ag.Oz.	Pb.%	Cu.%	Zn.%	Description
15	Trace	0.6	1.4	0.45	0.8	Lead Hill. Sample (Splading) #7. Taken from large pile of vein material on dump. 15' shaft. Width of vein in shaft 6'. About 300' S. of #1 Shaft.
16	Trace	0.4	None	1.53	0.1	No. 2 Blue Jay. Same vein as #1. 300 or 400' W. and cut over 3' width.
17	0.060	0.5	27.0	0.81	None	Lead Hill. Sample (Spalding) #3. Same vein as Nos. 1 and 2 but on top of veing 50' E. from shaft. Cut on 2'-0".
18	Trace	0.5	None	1.32	0.1	Clara Shaft and Tunnel dump sample.
19	0.300	0.5	None	6.01	0.3	#1 Blue Jay. Pay streak in 4' vein. W. of streak 1'. E. of tunnel 200'.
20	Trace	0.6	2.2	3.00	0.1	Blue Jay No. 3 Sample. Several hundred feet W. of No. 2. Same vein. About 3' width.
21	Trace	0.3	None	1.22	None	#5. Claim #4. Sample cut over 25' width. Large outcrop of low grade.
22	Trace	0.3	None	1.22	0.4	Iron King #3. 1' vein. Sple. taken off top. About 150' above vein #1.
23	Trace	0.4	None	1.02	None	#3. 6' ledge at the sample. 100' E. of open cut on same ledge.

Lone Star Mines, Inc.

XXXXXXXXXXXX 702- 10th Ave.
SAFFORD, ARIZONA

Feb. 28, 1948

Roger Manning, Field Eng.
Dept. of Mineral Resources
Mineral Bldg-- Fairgrounds
Phoenix, Arizona.

Dear Roger:

It has been some time since I have written you keeping you up to date on progress being made at the mine. You may be in touch with Mr. Allison and know all about what's going on. If so, fine, if not, here is a short summary of transactions as of this date.

Their work is centered as you probably know, in the Creech shaft starting at 18'. The eighth round was shot today, each round being sampled by Allison. The ore holds up very consistently ranging from over 1% to over 2%. Of course the high grade that has been stubbornly hanging around, all thru this development, shows 8 to 11% carrying considerable glance. This material naturally was omitted from the samples. They are now down to about 43' and to go on much deeper in there would be extremely hazardous. If sinking is continued, it will become necessary to do some timbering and collaring the shaft to the point of safety.

You or Newt never saw this area of the property. It never belonged to our group but was held by two associates. It has now been deeded in to The Lone Star Mines, Inc. They have a very interesting thing there. That whole hill is cut thru with one dyke after another and has the appearance of making one large ore body at not too much depth. There is ore exposed all over the place. So they are working in a very favorable spot it seems to me. It certainly would be tragic to cease developments there now without doing some cross-cutting. I wish you could see why I make this statement, I'm sure you would agree.

I have had several talks with Mr. Allison over the phone, and I'm convinced we are dealing with a man that pushes a mighty hard deal. We're not going to give the property to him, and we're not dropping down to 5% royalties on all ores and concentrates under 6%. In other words, it means we would get 5% of the net returns after Allison deducts whatever costs he desires, and from what I gather, that runs the gauntlet of just about every conceivable cost all the way down the line. I can't believe we have come to that yet. No one wants to see that property go any more than we do, but good heavens we also are due some sort of consideration. We might take a beating, but not an annihilation. I only hope we can get together on some sort of reasonable terms, perhaps we can.

Some time when you are over this way and can spare a full day, I sure want you to see the Blue Jay portion of this property, and thanks a million for everything.

Lone Star Mines, Inc.

P. O. BOX ~~243~~ 563
SAFFORD, ARIZONA

May 19, 1947

Chas. H. Dunning, Director,
Department of Mineral Resources,
Mineral Building
State Fairgrounds
Phoenix, Arizona.

Dear Mr. Dunning:

In connection with Mr. Sweeney's visite covering the Lone Star Mining property about 10 miles north of Safford, first, I want to express our thanks and deep appreciation for your kindness and obliging nature in giving us this break. Mr. Merrill and I are indeed very grateful.

To further acquaint you and the Department with the property's merits, I am enclosing some compiled data that I think you will be glad to look over. You may use all or any part of it you may desire in connection with your filing system for reference. As soon as you have had time to make copies, I should like to ask that this be returmed.

Mr. Paul Merrill will be in Phoenix perhaps some time next week. He will call on you and Mr. Sweeney so that an exchange of ideas, thoughts, and needs connected with our mining problem can be discussed.

In the mean time I would be pleased to hear a word from you with reference to Mr. Sweeney's findings and conclusions of the property, as he saw it.

I am pleased to state that the County Supervisors have agreed to put in a new road to the lead hill group. The work is expected to be completed at an early date.

Mr. Merrill and myself are well pleased with the showing thus far encountered at the diggins' We have just opened up some very high grade lead-carbonates just under the vein where Mr. Sweeney cut his sample the other day. The going is tough however, for all the time we can put in on it is each Saturday afternoon and all day Sundays. We do not have very efficient equipment with which to work with either. We do have one thing tho, and that is FAITH in what we have set about to accomplish, but we do need help in a way to get the mine opened up and producing. Right now all we can do is the best we can with what we have.

Please consult Mr. Manning regarding some 23 assays recently made by U.S.S.R.& M. Co. to tie in with this data.

Very truly yours,

Albert Spalding

Albert Spalding

Washington, D.C.
Feb. 10, 1943

SUBJECT: Mine Loans
Lone Star Mines, Inc.
J. D. Merrill

As you know by now, this applicant has again been turned down.

It seems as though he has had every chance and there definately must be something wrong with the property.

At the same time, if he should do some work which would show that there still are potentialities, the case could yet be reopened.

Bill Broadgate

RECONSTRUCTION FINANCE CORPORATION
WASHINGTON

December 24, 1942

Mr. J. D. Merrill, President
Lone Star Mines, Inc.
Safford, Arizona

Re: Lone Star Mines, Inc.
Docket No. ND-5242

Dear Mr. Merrill:

This will acknowledge receipt of two copies of the above-captioned application for a mining loan to be made on your property in Graham County, Arizona.

This application was presented to the Corporation by Mr. W. C. Broadgate, Assistant Director, Arizona Department of Mineral Resources. This application has been given the above-captioned docket number, and in all future correspondence you are requested to refer to this number.

Please be assured this application will be given our immediate and careful consideration.

Very truly yours,

CHAS. W. TULLY
Assistant Chief, Mining Section

RHN/cl

Dec. 23, 1942

Hotel Harrington,
Washington, D.C.
or
% Senator Hayden

Mr. J. D. Merrill,
Lone Star Mines, Inc.,
P. O. Box 549,
Safford, Ariz.

Dear Mr. Merrill,

The question of policy regarding additional funds when Class C loans have been exhausted has been decided.

These additional loans, when thought to be necessary by the RFC Mining Section, will be issued under section 5-d-2 of the RFC Act as amended, and not as another C loan.

As the policy has been decided, I have filed your application for consideration by the Mining Section.

Very truly yours,

W. C. Broadgate
Asst. Director

Washington, D.C.
Dec. 21, 1942

SUBJECT: Mine Loans,
C loan plus 5-d-2
Merrill, Lone Star.

I filed this today, but I don't feel at all encouraged about it when you consider the attitude on the Fields application I have run into.

There is no reason why such cases should not be filed, and as we have instructed Fields, not as additional C loans, but supplementary loans to continue the work under subparagraph 4 of section 2 of paragraph 5d of the Reconstruction Finanee Corporation Act as amended. I am assured that this procedure will get the proper attention for the application.... but it looks to me as though the scrutiny would be pretty tough when Rait gets them.

Bill Broadgate

DEPT. MINERAL RESOURCES
RECEIVED
DEC 17 1942
PHOENIX, ARIZONA

Dec. 15, 1942

Hotel Harrington,
Washington, D.C.

C

Mr. J. D. Merrill, Pres.,
Lone Star Mines, Inc.,
P. O. Box 549,
Safford, Arizona.

Dear Mr. Merrill,

I have at hand today your letter of the 12th with the enclosed applications to the RFC for an extension of your C loan.

I have a test case before the RFC at the present time in which case further C loan funds are requested.

This is the first of its kind and the decision hanging thereon will be in the nature of a precedent.

I have been assured the decision will be made in a few days.

It is my judgement that it would be better not to confuse the issue by filing another case until the RFC policy is decided.

However, the application is yours and if you wish me to file it immediately you need only wire me and I shall do so.

Assuring you of our cooperation and thanking you for your complimentary remarks,

Very sincerely yours,

W. C. Broadgate
Asst. Director

Sam — The Generals wrote Pres. F.D.R. re exemption for the mine according to telephone message from Col. Duffy.
CHH.

December 11, 1942

MEMORANDUM

SUBJECT: 5-d-2 Application

TO: W. C. Broadgate

FROM: J. S. Coupal

Judge Merrill of the Lone Star Mining Company has just called. I understand that the engineer from the RFC was at the property and was in contact with the owners of the property and a decision was made that before an examination for a reconsideration of their "B" loan application was made, the Lone Star people would like to open up more ore showings, and are doing this on their own money, from the 150 foot level of the mine.

Meanwhile Judge Merrill wishes to consider ways and means of keeping the work on the deep shaft to make it available for examination under an extension of the "C" loan if this is possible. The mine does not make water and there is comparatively little water in the deep shaft below the 150 foot level. They know that certain amount of caving has occurred and it looks as though the timbers have arched there and are supporting a plug of about 20 feet in depth. They have driven a pipe through this plug and find the ground open below. The shaft may call for a certain amount of retimbering, but the property is fully equipped to go ahead with this work, and this work may take anywhere from $1000 to $4000 or $5000 to complete depending on the conditions encountered.

The only suggestion I could offer in this instance was to apply for an additional "C" loan under the emergency amendment to the RFC ACT and submit it to you to see whether or not you consider it wise to try and follow this procedure and then act according to your judgment. Accordingly I have suggested to Judge Merrill that he make out such an application and submit all of the evidence to you and then await your decision.

December 4, 1942

Judge J. D. Merrill
Box 349
Safford, Arizona

Dear Judge Merrill:

I am returning herewith your petition to reconsider application for development loan on the Lone Star Mine.

I have just been advised by Mr. Brooks that on our report of the property, it has been reconsidered and that undoubtedly a field examination will be made or that your petition will call for a reconsideration of the application.

I hope that it results favorably.

With best wishes and kindest regards, I am

Very truly yours,

J. S. Coupal
Director

JSC:kk
Enclosure

Washington, D.C.
Nec. 2, 1942

SUBJECT: Mine Loans,
Petition for reconsideration
Docket No. B-ND-3965
Lone Star Mine, J.D.Merrill,
Box 349, Safford, Ariz.

I am sure that Mr. Merrill will be pleased to know that the Supervising Engineer will be instructed to re-examine the Lone Star at his earliest convenience.

I am afraid from the rather dubious sounding memo which came to me from Sam with the petition this may not "cut the buck".

I hope it will, however, as otherwise I will have this thrown in my face the next time we want a case reppened.

Bill Broadgate

Washington, D.C.
Nov. 27, 1942

SUBJECT: Mine Loans,
Petition Reconsideration,
Docket No.BND-3965
Lone Star Mine, J. D. Merrill,
Box 349, Safford, Ariz.

I talked to the Engineer Examiner who had this case in charge.

The Merrill petition has not as yet reached him.

I explained the situation as well as I could and confirmed our conversation with a letter copy of which is attached.

Bill Broadgate

Nov. 27, 1942

Hotel Harrington,
Washington, D.C.
or
% Senator Carl Hayden

Mr. J. F. Steadman, Engineer Examiner,
Mining Section,
Reconstruction Finance Corporation,
Washington, D.C.

Dear Mr. Steadman,

As per our conversation of this morning, if when the petition for further consideration of the Lone Star Mine loan, Docket No. B-AD-3956 reaches you you find that you require further information I shall be pleased to discuss the matter, at your convenience.

Although this is a narrow vein mine Mr. Coupal believes it may have a chance and the further discovery since Mr. Rasor examined it may warrant one of the field engineers taking another look at it and we hope you will so conclude.

The fact that they have everything arranged to go ahead and that they have started to pay out the "C" loan indicates decided good intentions.

It would seem as though, if the B loan is authorized, operating possibilities would be proven before a great deal of it is disbursed.

Mr. Coupal states "I question the advisability of pushing for a "B" loan on marginal properties, but at the same time, feel as though additional money would get out some copper production from this property and it may possibly develop into one that could pay back the loan."

We are generally reluctant to support requests for reopening a rejected B loan after an expenditure of a C loan has not revealed satisfactory indications, especially now the field staff is so overloaded and I feel that Mr. Coupal would not have encouraged this unless he felt there is reasonable merit involved.

Very truly yours,

W. C. Broadgate
Asst. Director

14.

November 25, 1942

MEMORANDUM

SUBJECT: Petition Reconsideration
"B" Loan
Docket No. B-ND-3956
Lone Star Mine
J. D. Merrill
Box 349
Safford, Arizona

TO: Bill Broadgate

FROM: J. S. Coupal

I am enclosing copy of my letter to J. D. Merrill and also a copy of his petition. I made a brief inspection of the property. It is very marginal as the vein is narrow and the ore bodies short and irregular. It is possible, however, to get some production from the mine, and if an increase in the plan for copper becomes effective, they may be able to produce at a profit.

I have suggested that Merrill consider leasing in the event that he does not get assistance on a "B" loan.

Please return this correspondence after you have looked it over.

I question the advisability of pushing for a "B" loan on marginal properties, but at the same time, feel as though additional money would get out some copper production from this property and it may possibly develop into one that could pay back the loan.

November 25, 1942

Judge J. D. Merrill
P. O. Box 349
Safford, Arizona

Dear Judge Merrill:

I am sorry to have missed seeing you on November 23, and I have looked over your petition for reconsideration of your "B" loan.

I am forwarding your petition to W. C. Broadgate at Washington so that he may be advised as to your petition, and I am asking him to investigate and see if it is possible to assist in getting the loan granted. The fact that you have found ore and have shipped certain tonnage should warrant your petition being reconsidered. If you do not get a reconsideration of your loan, I believe you should be in a position to give some of the operators a lease on your property and further development by taking out ore, and at the same time, extend the drift to the west on the 100 foot level, and if you encounter ore, begin taking it out.

I hope you will be able to get government funds to do this, and we will do our best for you. In the event of failure to get the loan, I believe a lease plan most feasible way for you to continue.

With best wishes and kindest regards,

Very truly yours,

J. S. Coupal, Director

JSC:kk

cc - Mr. W. C. Broadgate
Hotel Harrington
Eleventh and E Streets, N.W.
Washington, D. C.

November 25, 1942

Judge J. D. Merrill
P. O. Box 349
Safford, Arizona

Dear Judge Merrill:

I am sorry to have missed seeing you on November 23, and I have looked over your petition for reconsideration of your "B" loan.

I am forwarding your petition to W. C. Broadgate at Washington so that he may be advised as to your petition, and I am asking him to investigate and see if it is possible to assist in getting the loan granted. The fact that you have found ore and have shipped certain tonnage should warrant your petition being reconsidered. If you do not get a reconsideration of your loan, I believe you should be in a position to give some of the operators a lease on your property and further development by taking out ore, and at the same time, extend the drift to the west on the 100 foot level, and if you encounter ore, begin taking it out.

I hope you will be able to get government funds to do this, and we will do our best for you. In the event of failure to get the loan, I believe a lease plan most feasible way for you to continue.

With best wishes and kindest regards,

Very truly yours,

J. S. Coupal, Director

JSC:kk

cc - Mr. W. C. Broadgate
Hotel Harrington
Eleventh and E Streets, N.W.
Washington, D. C.

November 11, 1942

MEMORANDUM

SUBJECT "B" Loans
Lone Star Mines, Inc.
Safford, Arizona
Docket No. C-ND-7517

TO: Bill Broadgate

FROM: J. S. Coupal

I visited the Lone Star Mine which has expended the funds on their "C" loan. An application for a "B" loan was mailed to Washington on October 21. Telegraphic advice on November 9 states that the engineer's report from the Phoenix office, after examination for the "B" loan, had not arrived in Washington although the engineer made his examination some two weeks ago.

The Lone Star is trying to get out a small shipment now so as to hold their crew together pending the "B" loan.

My understanding was that an attempt would be made to streamline the granting of "B" loans or at least have a decision on them very shortly after workings were made accessible and examined after the "C" loan work.

Unless this is done, most of the crews gathered and operating under the "C" loan will be disorganized pending a decision on the "B" loans.

I would suggest that you follow up the Lone Star "B" loan.

November 11, 1942

J. D. Merrill
Lone Star Mines, Inc.
Safford, Arizona

Dear Judge:

Many thanks for your letter of November 10, 1942 with the statement of development fund distribution under the "C" loan. It is in good form, and I know must be appreciated by the Reconstruction Finance Corporation office and believe some of our other "C" loan operators can well afford to follow it.

I am sending a memorandum to Bill Broadgate in Washington, and he may be able to assist in getting a decision for your "B" loan.

I would like very much to be posted as to when you make your shipment of the results obtained.

With best wishes and kindest regards,

Very truly yours,

J. S. Coupal
Director

JSC:kk

J. D. Merrill, President
Lone Star Mines,
Safford, Arizona

August 5, 1942

Mr. Albert Spalding,
Safford, Arizona.

Dear Albert:

I have your letter of August 3 relative to your application for a preliminary development loan.

There has been a considerable delay in getting these loans handled because the machinery was not set up to put them through. I feel sure that they will be handled much more expeditiously when the machinery is lined up, but the routine is such that it needs a lot of smoothing out.

I know that your particular application is in process because I have seen it and, judging by a comment I heard regarding it, the delay has been caused by the fact that you gave insufficient information.

It has to be remembered that a loan is finally passed upon by a board sitting in Washington who know nothing whatsoever regarding you or your property and who have no other way of judging except by the evidence submitted to them. Therefore, it has to be very complete and I think that 95 per cent of the delay in loans is due to the lack of appreciation of the applicant of the necessity for telling the whole story, and the omission of certain details which the loan board requires.

We have known of cases that were completely presented on which the loans have come through very quickly, but where it is necessary to get into a considerable exchange of correspondence to amplify an application, it takes an unusual amount of time.

I will have Sam and Bill Broadgate check upon it, although I feel sure that I have given you the correct answer in that the delay has been caused because the machinery and routine was not set up to handle these loans.

With kindest personal regards, I am

Yours very truly,

CHARLES F. WILLIS
State Secretary

CFW:MH

Safford, Arizona,
August 3, 1942.

Mr. Charley Willis,
Secretary, A S M O A,
528 Title & Trust Bldg.,
Phoenix, Arizona.

Dear Charley:

You will recall some months back I wrote you about an application we had made to R F C for a Development Loan of $20,000 on the Lone Star Properties. On July 1st we submitted another application for a $5,000 Preliminary Development Loan such as was recently authorized, feeling that if we could obtain such a loan we could certainly make a showing that would warrant further development of the property. We contemplate re-timbering down to the 100 ft. level and on some of the drifts together with an extensive program of assaying and feel very confident that the expenditure of $5,000 will make an excellent showing on our property. This latter application has been given the designation with R F C as "Lone Star Mine (a partnership) Docket No. C-ND-7517". We have written the Congressional Representatives in Washington and they have spoken to Bill Broadgate about it, and the last word we have from there is that it would take about ten days to "process" the application, which has been almost a month now so we feel that some action should be forth-coming on our application.

We will certainly appreciate anything you can do for us in this application and I am writing to ask that you actively give us all the assistance possible in the matter. Will you please let me hear from you as to whether or not you have heard concerning our application and just what you may be able to do toward giving it an early consideration.

Yours very truly,

Albert Spalding

Albert Spalding,
Safford, Arizona.

August 5, 1942

Mr. Albert Spalding
Safford, Arizona

Dear Albert:

Your letter of August 3 to Charlie Willis along with his reply to you on August 5 has been given to me for my attention.

On July 28 I wrote you stating that your application for a preliminary development loan had been referred to me for reviewing. I asked you in that letter to send me the copy of your original application for a development loan bearing docket No. B-ND-3956. I find that this letter was addressed to you at Willcox through some error and have been holding up my review of your preliminary development loan awaiting the copy of your original development loan application. Please rush this along and I will submit my review immediately upon receipt of it.

For your interest I am enclosing the letter written you on July 28 bearing the wrong address.

Yours very truly,

J. S. Coupal, Director

JSC:LP
Enc.

August 14, 1942

Mr. Albert Spalding
Safford, Arizona

Dear Albert:

Many thanks for your letter of August 8 and the application for the development loan, your office copy. I will review your application and pass it along to the R.F.C. today.

With best wishes and kindest regards, I am

Yours very truly,

J. S. Coupal, Director

JSC:LP

COPY

CLEVE CURTIS
CLERK

Superior Court of Graham County

J. D. MERRILL, JUDGE
SAFFORD, ARIZONA

August 8, 1942

Mr. J. S. Coupal, Director,
Department of Mineral Resources,
413 Homebuilders Building
Phoenix, Arizona

Dear Mr. Coupal:

Thank you very much for your letter of August 5, concerning our application for a preliminary Development Loan on the Lone Star property. Pursuant to your request, I am enclosing herewith our office copy of the application for a Development Loan, Docket Number B-ND-3956. I am also enclosing as an additional exhibit pertinent to not only our latter application but also the previous application, a clipping from the local newspaper containing valuable information concerning the Lone Star property written by Michael Flaherty. Will you please incorporate this in the file, Docket Number B-ND-3956 and advise me if any additional copies are required for mailing to Washington or if this will be sufficient to return with your action in the matter. Since this is the only copy we have left of our first application, we would request that upon the completion of your investigation, the file be returned to us.

I am in receipt of a letter from Charlie Willis, bearing date the same as the one received from you, in which he states that our application has been delayed because of insufficient information. It is true in our first application we had a request for additional assay and exploration reports. We are financially unable to furnish the information they required and feel that this request on the part of R.F.C. squarely places our subsequent application within the category of properties contemplated to be benefited by the Class C. legislation recently enacted and the tenor of our two applications has been with that thought in mind, and that is the reason that our first application is specifically referred to in the latter. You will notice that the applications are very similar and they contain all the data we have available at present.

We realize that your department is doing all in their power to expedite these loans and we will greatly appreciate your continued prompt attention to our application.

Will you please call on us if there is any additional information necessary. If the department has engineers in this district or close to this district, we would urge that they be sent in to look the property over and I assure you that at any time that might be done we shall be glad to fully detail the property to the engineer.

Thanking you and with kindest personal regards,

I am

Yours very truly,

Albert Spalding

and J. D. Merrill

J. D. Merrill

JDM/pr

Enclosures.

Copy to:

Charles F. Willis, State Secretary,
Arizona Small Mine Operators Association,
528 Title and Trust Building,
Phoenix, Arizona

COPY

Safford, Arizona

Apr. 21, 1940

Mr. Sam Coupal, Director,
Dept. of Mineral Resources
Phoenix, Ariz.

Dear Sir:

Replying to your letter of Apr. 17, I would like to state here, that in the "Lone Star Mining District", there are two properties that have seen anything like mining operations. They are the Lone Star property, or formerly call such, Now split up into several smaller operations, one of which includes my own. The other, was the old San Juan mine, 3 miles to the N.W. I am sorry I do not have anything on this property, but will give you a brief outline of it's history as I remember it.

At the time the Lone Star mine was working at it's best, 1900 to 1907, the San Juan was also going great. Some where along there a 50 ton Mill was installed. Considerable success was attained - To what extent I cannot say. These operations were carried on for several years. The Co. then ran into varyous difficulties which in the end, resulted in the property being jumped by four local men. After long court proceedings, a decision was handed down in favor of the jumpers. These 4 men sold the property to a Co. called the Atlas Mining Co. Thru these operations, 3 churn drills were put to work & an extensiwe drilling campaign was carried on. As a result of these holes, a considerable ore body was developed & mined. Three cars per week was sent over to the Douglas Smelter - This was during the war days of 1915 to 1918. At one time I had in my possession, copies of all these settlement sheets, assay reports, dozens of letters and other valuable data regarding this period of operations. I was corresponding with Arthur Houle of Tucson, who I used to work for in the Shattuck Mine at Bisbee. Mr. Houle was intensly interested and kept calling for more data - Finally he asked for copies of the drill holes assays. These I could not get but did succeed in getting the samples themselves, a whole box of them put up in small envelopes. I sent these to him and then he was ready & willing to negotiate a deal. The owner Mr. Whitney of New York who as you know now, is in prison, refused to deal only by cash consideration. Mr. Houle of course would not consider such a transaction and away went another good chance. Mr. Houle did not return any of the data sent him, consequently I am left flat - nothing at all on this property. As I remember, those settlement sheets ran between 3 & 7 % copper with an occasional car of high grade. All the surface workings show a solid body of low grade copper - All machinery and dwellings are gone - stolen, what is left has been stripped and of course is all out of date. My suggestion on this, would be to write the Douglas people asking them if it would be possible for them to supply you with copies of all these operations, I believe they would gladly accommodate you.

What you mean by the Lone Star District must be the Lone Star Mine. There are of course several properties out there, but all are in the Lone Star Mining District. You have in your office now copies of everything I have on the property. A. E. Almind's report - & a letter descriptive of the early history of the Lone Star Mine individually - and of course old company officials have plenty other & much more valuable information on this, that you tried to recover while in Boston, and I have tried many times. Having seen the property yourself should help greatly also.

Our Kirkland Hill area is not covered by any reports or other data. I have however, outlined it's history briefly on one of the questionnairs put out by the Dept. of Mineral Resources, and also by Newt Walcott's statement. I don't know what else I could add that would help beyond all what you have.

Now a little personal information for you. Last Wed. afternoon, one of my associates, drove out to Tom Norquay's property to take a box of groceries. Things didn't appear natural he said, when he reached the cabin. He opened the door & got the shock of his life - There stretched across the bed in his underwear, lay Tom - dead. According to the doctors report - he died of heart trouble of which he had been treating for some time. There was no indications of a struggle at all. A week ago last Fri., Tom came in the plant to see me & gave me 2 new A.S.M.O.A. members. Very pert & jolly he walked out & an hour later he brot in 3 more, & by noon he had given me 8. I never saw him feeling any better or looking better. That afternoon Jack Folks, the one that found him dead, tookhim out to the mine. Then last Monday, Jack took him a load of ties & timbers so he would collar his shaft he was working in. Jack carried them over to the shaft for him. We went up yesterday to get his belongings & noticed he had done considerable work on the timbers, figuring he had over worked & over heated himself resulting fatally. Tom was our local councils chairman you know.

Now for a problem you might help us out on. Last week we took in a fourth partner on our mine. In return he is fixing up this old homemade compressor & going to finance all the expense of getting out a car load of that rich lead-silver ore. We none of us have any confidence in the compressor, but he is willing to buy a second hand one if he can locate one pretty cheap. Know where we can pick up one? We're going to put two miners out there & what chalk line do we have to walk? Is insurance on them necessary at present? Let me hear from you soon, and by the way, if you see Walcott or write him, please tell him about poor old Tom, will you?

Hope the information I have given will suffice.

With best wishes, I am,

Yours very truly,

ALBERT SPALDING

P. S.

Glancing over your letter I note you asked about the work that has been done & the owner.

There has been considerable work done there,by Shaft & open pit & cuts. Considerable drifting & stoping underground. They are to a depth of 300 ft. & there are several shafts.

The owner is Mr. Whitney of N. Y. a Stock Manipulator I believe - Anyway he manipulated himself into prison & so that will be his address.

Mr. G. A. Golding - Safford Ariz. is in charge of looking after the property. You may get in touch with him.

A. F. S.

Please pardon me for the pencil but I'm writing this while at work in the plant.

REPORT
On the

LONE STAR MINES INC.

PROPERTIES AT SAFFORD,

GRAHAM COUNTY, ARIZONA

Post History.

PROPERTY..

The property consists of fifty five mining claims grouped around the original Lindsey and Anderson claims, later known as the LONE STAR MINE. THE very recent acquisition of two claims that were centrally located, now consolidates the entire group making an unrestricted area of one thousand and eighty acres.

This block of claims extend easterly, southerly, westerly, and northerly from the ground that was the original LONE STAR MINE, and which was operated during the late eighties and nineties.

The above claims are held by deeds duly recorded or by location and annual representation, the owner in either case being the LONE STAR MINES INC. The exception to the above being the two claims just recently acquired and the title to which is now in the proces of being obtained.

HISTORY..

The early working of the LONE STAR claims was started about 1886 by Lindsey.

The rich oxide and carbonate copper ores, containing small amounts of gold and silver, are said to have been exposed on the surface of the Lindsey claims as bold outcrops. The copper content was from 15 to 60%.

Lindsey built a small smelter on the Gila River eight miles from the mine and proceeded to reduce these oxidized ores to metallic copper. His operations attended with some degree of success, continued until 1898, when Lindsey and Anderson sold the property to I. L. Qualey.

Qualey in turn organized a stock company with headquarters in Boston, Mass. He at once caused to be mined the rich black sulphide ore body which had been encountered near the LONE STAR SHAFT. on the hundred foot level. Five tons of this ore was selected and shipped to Boston and placed on exibition there, resulting in the sale of considerable stock.

These operations resulted in a considerable tonnage of very rich ore being mined and shipped to the El Paso Smelter. The superintendent of the mine, C.B. Spalding, was told that this concentration of work was solely for the purpose of stimulating investment in

the property, that very shortly an extensive development program would be inaugurated.

The development program was not started until after Qualey had been removed from the company for gross misappropriation of funds. Thus the working capital for development purposed started off in a very limited fashion. For a period of years no further work was done in the LONE STAR SHAFT and mine workings.

On the adjacent ground the MILES shaft, also the CIARA, EISIE and other shafts were sunk to depths of 100 to 500 feet. Finding that they would have to sink still deeper, and having equipment with limited capacity for depth of operations, the final development work was carried on in the LONE STAR SHAFT. Superintendent C.B. Spalding, describes the work briefly as follows:-

"After doing some repair work in the shaft, we started sinking at 117 feet. From this point on down as far as we went, 485 ft. the vein is continuous without a break. Assays taken all the way down show copper from one to eight per cent. The six and eight per cent returns were coming in, in greater frequency during the last 50ft. of sinking, and it was at that time my firm conviction that another 50 to 100 feet of depth would put us into commercial ore--that is, shipping. But there was no money to go on with."

PRODUCTION..

THE LONE STAR production is said to be about 1200 tons of 15 to 60 per cent copper ore, for the period of active mining operations by Qualey. During the late war period of nigh priced copper, some considerable production was made by the then owners and leasers, probably ten or more car loads were shipped.

Thus it appears that the LONE STAR and immediately adjacent properties have produced from 50 to 75 car-loads of oxide and carbonate copper ores, averaging from 15 to 60 per cent copper with small values in gold and silver. Althou sulphide ore has been developed at some points, none of the above production can be credited to sulphide ores. THE LONE STAR MINES INC., during some of the work of testing out the surface ores, made two small-lot test shipments. The results of these shipments are of interest and copies of the settlement sheets are given as follows:-(Note:Attached to original).

During the former operations of the LONE STAR under the qualey corporation, there was a profit accruing to the company from the scale of working then carried on. A conservative statement made by the then superintendent, was to the effect that during during the time that the ore body was being mined above the 100ft. level, the returns from shipments made, paid considerable profit above the cost of operation. There is no way of getting any record of the amount of production of profit made at that time.

ECONOMICAL GEOLOGY OF LONE STAR MINES..

COUNTRY ROCKS..

The country rocks of the immediate vicinity of the LONE STAR are acid intrusive volcanics. The prevailing strike is E.15 to 40 N.

The vein is dipping north under the porphyry. The entire formation has the appearance of large dikes that have varying widths up to many hundreds of feet. These dikes can be followed on the surface for great distances and are finally obscured by the capping of younger volcanic rocks. This capping of volcanics forms the mountain of this part of the Gila Range. In contrast to the south west are the Pinaleno Mountains, where the uplift has been much greater. The granites form the entire mass of the mountain. The capping volcanics have been entirely eroded away.

The rocks identified are as follows:- PORPHYRITIC SCHIST containing disseminated IRON PYRITE, now altered to IRON OXIDES; ANDESITE PORPHYRY; QUARTS PORPHYRY; DIABASE and DIORITE at the north end of the district. The younger volcanics are made up of BASALT, RHYOLITES, TUFF and AGGLOMERATES. Of the main rock area there was also QUARTZITE, SECONDARY LIME and large bodies of silica, as of hot water depodition.

Developments workings to date show numerous veins ranging in width from two feet to as wide as twenty feet. The general strike of these veins is northeast and southwest. There are probably ten or more such veins crossing the property and easily traceable because of the heavy GOSSAN cap.

Of very great importance are the zones of the quartz PORPHYRY DIKES, in which are found frequent stringers of copper minerals. These stringers are rich in copper content and increase both in size and in copper content as they are developed in depth. The PORPHYRY for extensive widths is highly kaolinized. This then appears to be the reason for the finding of the sulphides and the copper minerals at a much less depth below the surface in the QUARTZ-PORPHYRY MASS, than in crushed, shattered and oxidized veins. At some favored points within the veins, the walls may be impervious and the vein contents therefore protected from leaching by this or other means. Here the copper veins, with always a small gold and silver value, is found as rich ore within the vein. More generally the open crushed vein matter is leached of the copper values for several hundred feet of depth.

The following sulphide minerals were recognized: PYRITE, possibly MARCESITE, CHALCOPYRITE and CHALCOCITE. Also GALENA occurs in the area to the northwest and southeast. The only SULPHIDE mineral observed within the veins was CHALCOCITE, as all primary sulphides are oxidized within the vein walls. In depth at permanent water level, the enriched secondary copper ores are unquestionably in these veins to be opened by the deeper development of the veins. The rich oxides and copper glance probably will form the greater part of the mineralization of the ENRICHMENT ZONE.

TOPOGRAPHY & VEGITATION..

The general country of the mines is just above the base of the south end of the Gila Mountain Range. A general and unbroken mountain slope ranges from the Gila River at an elevation of 3000 feet to the mine at an elevation of 4200 feet. About 800 feet covers the difference in elevation of the high and low ground of the mining property.

Being the southerly exposure of the Gila Mountains the country is entirely devoid of timber or even small trees.Small mesquite yucca,cacti,and grasses constitute the vegetation of the mine area.In general the above grow thruout the area with the exception of one or two spots where the heavy mineral content of the soil or rock prevented all growth.

CLIMATE & TRANSPORTATION..

The general climatic conditions are the most vaforable possible to obtain,for all year round operations.

The road and hauling conditions from mine to rail at Safford are most favorable being an all down-hill haul.Ores should be hauled from the mine to rail for $1.50 per ton or less on large contracts. At such times as the hauling of very large tonnages may be necessary,a branch line or the railroad can be run directly to the mining property without excessive costs of construction.

During short periods of the rainy season one or two spots of the road may need attention and the crossing of the Gila River without a bridge will occassion several days delay at a time. It is contemplated that the County will construct a bridge over the Gila in the near future.

ASSURED MINERAL..

With the number of shafts on the property of depths up to 500 ft. we would expect to find an important tonnage of assured or blocked out ore. But, because of the occurance in the veins at shallow depths of shipping value of ores,practically all this surface ore has been mined and shipped to the smelter. There are several carloads of shipping ore still available in the Lone Star Workings above the 100 foot level.Also to the east on the Lone Star No.2 claim,and to the west on the MARION claim. Shipping grade of ore can be mined after doing a very small amount of development work. This is not ore blocked out and no estimate of tonnage will be made.

PROSPECTIVE AND PROBABLE ORES..

At the points above mentioned on the Lone Star and Marion Claims good grade of shipping ore can be mined continuously in moderate tonnage,after carrying on of about sixty days of development work. There are several other points on the surface offering nearly as attractive assurance of ore tonnage from reasonable amounts of development work.

The development of the richer ore horizons of the veins has not yet been accomplished.The Lone Star Shaft is at 485 feet,bottomed in a GRAY PORPHYRY FORMATION,with a dip to the north under the mountain. Without doubt the level of sulphide ores will be encountered within the next one or two hundred feet.While at the surface down to the 100 foot level,15 to 60% copper content shipments of ore were made; it is reasonable to expect that the richer ores as shipped from the veins in depth will carry from 15 to 40 % copper with increasing values especially in GOLD. With the opening of the sulphide ore horizon an important tonnage of shipments of excellent grade of ore can be maintained.

The cost of marketing the ore to smelters is attractively low.there are six or more plants located at distances up to about 100 to 150 miles rail haul from Safford,the shipping point.

The development of large tonnage copper ores disseminated in the QUARTZPORPHYRY or in the large shear zone that diagonals across the PORPHYRY,is the ultimate to accomplish for the making of a very large copper mine. There are two or more areas on the property that amply justify detailed study and development work to determine such ore bodies. The proving of the lower grade ores will entail a large milling plant and therefore a large investment of capital.

Large outlay of capital for such ore development is not to be attempted too rapidly.The tonnage of ore contained in an ore body of 300 feet vertical extent and of areal extent equal to half a mining claim,would amount to over TEN MILLION TONS of ore.

As mentioned above,the shear zone in the PORPHYRY,and also the area that now shows almost a stock-work of veinlets,both contain small values at the surface. The geological conditions are in every way favorable for the large tonnage bodies of the lower grade ores. A study of the geology of the entire surrounding areas,a survey of all the developments as work progresses at the Lone Star,and a complete record of all data kept during operations,will all assist greatly towards developing the probable large tonnage lower grade ores.

GENERAL MINE SUPPLIES..

LABOR..

The supply of labor at present is easily obtained at the Arizona scale of wages.Transient and Mexican help are available for the general inexperienced work. Proximity to the larger copper mining areas,and the nearness to rail and highway,are beneficial as to labor conditions and the obtaining of all other mine supplies.

WATER..

There is no supply of surface or running water over the properties. Excellent supply of well water is available at from one to two miles distance and at 150 to 350 feet lower elevation than the mine. For large water supply the Gila River will always afford unlimited supply at eight miles distance from the mine.

POWER..

At present power will be supplied by means of internal combustion fuel oil engines. Later it may be economical to bring in an electric line and power from plant located on the railroad at Safford.

Explosives are obtainable from the Apache Powder Co. at prices less than is generally paid by mining companies. Local timber is available from saw mills about 30 miles from the mine.

MARKET ECONOMICS..

The recent lowered price of copper has been a necessary economic adjustment,brought about by the heavy production of copper with an attempt to sustain higher price levels,and the competitions of other metals. The present price levels of fwmm 12 to 14 ¢ per pound,appears to be conservatively low.

There will,no doubt,be adjusted scale of wages,also possibly a shorter number of days per week worked out in the very near future,the same prevailing in Arizona and other parts of the west.

The slump in copper price is not affecting the programs of expansion now being carried on by the British. Frood and Copper Cliff,of the International Nickle Co. of Canada,are going forward with their expansions. The same is true of Rhodesian Copper mines.

The above mentioned psice of metal permits a very safe margin of profit to be made by the well established and going copper companies. Moderate production and a well balanced development will make a successful copper mining enterprise at this time.

RECOMMENDATIONS..

The major development operation to be carried under the present conditions,is the sinking of the Lone Star main shaft to a depth of at least (200) feet deeper on the vein. This work should develope the vein below the sulphide ore level.

Conditioning, re-timbering and benefiting the present shaft must carried on first,in order to obtain safe and more economical working conditions for shaft sinking. A station must be cut at the 500 foot level of the shaft,and cross-cut drifts should be driven at this level,to the foot and hanging walls,to determine definitely the position of the vein. The shaft from the 500 foot level downshould follow as closely as possible the same angle of dip as the bottom 200 feet of the present shaft.

Two or more secondary developments should be carried on coincident with the Lone Star shaft sinking. It is reasonable to expect that a considerable amount of good ore can be produced and marketed as a result of these secondary developments.

Firstly,the large vein on the Marion claim near the west side line should be opened by sinking a shaft at the point of intersecting veins,as shown on the surface. Because of the surface conditions it is likely that work should be carried on a little to the east of the above point mentioned.

Secondly, the extending of the Lykins adit tunnel until it cuts the Lone Star vein,and from this point open the vein by driving a drift easterly to the east side line of the Lindsey No. 2 claim. Showing some of the best ore observed on the property occur at this point, as well as the fact that some of the richest shipments of ore mined near the surface at this working.

Thirdly; opening up the lone Star vein on the Silver Star No. 1 claim at the point of intersection with the Silver Star vein and the Northwest fault. The opening of the last two points named, will be productive of marketable ores, as the work proceeds.

The installation of air compressor, power drills and equipage, as well as a hoist capable of sinking to a thousand foot depth, will be necessary.

Respectfully submitted,

A.E.Almind,

May 20th. 1930 Mining Engineer

SUMMARY AND CONCLUSION

In summerizing this report, I wish to emphasize the following pertinent facts:

1st- Definately a production of shipping ore has been made from the lone Star Mine.

2nd- Profits have been made from individual ore shipments and over-time periods, by making production from the veins.

3rd- For a period of 25 years tha property was held in small parcels, making for but small and individual operations.

4th- No co-ordinated development work has ever been carried on, and the vein ores from below the water level have never been reached.

5th- The character of the sulphide ores thus far encountered, is such that great enrichment in the value of the ore may be expected in the deeper levels of the veins.

6th- The average value of the vein ore thus far produced, are sufficiatly high to assure good profit with even the marketing of but small tonnages.

In view of the above, my conclusion is that a reasonable amount of capital is necessary to develop the mine. That is, with specific reference to the vein system, and the shipping ores down to and below water level. And, also, that additional capital be alloted to make a geophysical survey, with a view to proving and later developing the areas of large tonnage and lower grade milling copper ores. The cost of the above survey should range from five to ten thousand dollars. Exceptional care as to obtaining competent and experienced operatives should be exercised in this connection. A study of the development work to be done and the probable cost of the same, would cause us to recommend that the company provide a working fund amounting to fifty thousand dollars for the development work and operation of the mine.

Messers Leonard Mickey and K.S.Lykins,
Hollywood, Calif.

Gentlemen:

In accordance with your request, I have made an examination of the Lone Star Mines, Inc., properties at Safford, Ariz., spending on the property time from May 1st. to May 10th. inclusive, and further time in traveling and detail work. I beg herewith to submit report.

The property that you now have, after getting groups of claims from various owners and consolidating them under the one ownership of the Lone Star Mines, Inc., is of sufficient size and scope, and evident merit to justify the statement that it will become an important producer of copper. Gold, Silver

The proximity to very productive areas, as Morenci-Clifton, Globe and Miami, may or may not be of moment. The study of the geological conditions from the Pinaleno range, the Gila range and the Clifton and Morenci area, show that the uplifts of formation, mountain forming and mineralization conditions are caused by the same deep seated intrusive and also probably the same volcanic intrusives. The strike of the quartz-porphyry dikes and also the source of the faults are such that it may be possible to definately tie the Lone Star and the Clifton- Morenci areas to the same system of fractures and fissures.

The Lone Star Mine exibits definately two types of ore bodies. The first occur as veins, which are along the fault fractures, having a general strike of a little north of east. Two or more of these veins have been productive to date of a shipping grade of copper ores, containing both gold and silver values. Further ore will, no doubt, be found in other of the veins. Secondly -- replacement ore bodies in the shear zone, or the stock-work tpye ore body. Thirdly -- is the possible disseminated ores thruout the quartz-porphry. Having as a basis the first type of ores to develop, as these ores proving to be of very excellent values containing high-grade copper content, with ~~always some~~ good values in gold and silver. This class of ore, is shipping ore. Can be marketed at the near by smelters at a profit, which should benefit your enterprise greatly. Tonnage of these ores have been shipped and further tonnage from several points on the property, with but little development work, can be mined and shipped at a good profit. Thus, having a shipping ore will assist greatly in developing the large ore tonnages.

The development of tonnage, in bodies of milling grade ores, must be closely kept in mind and work outlined to obtain this end. Deeper developments in the porphyry of your area, has proven the ore occurrence within the porphyry as good sized veins containing sulphide ores. These are high-grade milling ores, capable of producing very rich concentration products. That, with the proving of a suitable large tonnage of these ores, milling operations should be carried on.

A fact that the production cannot be made entirely as direct smelting,or shipping grade ores,urges that any adjacent property that can contribute tonnage of milling ores,should be acquired on a reasonable basis for the Lone Star Mines,Inc.,organization. This to be done in order to co-ordinate development work,and build up a large tonnage for reserve and milling.

It is entirely reasonable to consider that there may be large tonnage of leachable ores,within the area of the Lone Star Mine and adjacent property.

This should be held in mind and further study and work done to prove this condition.

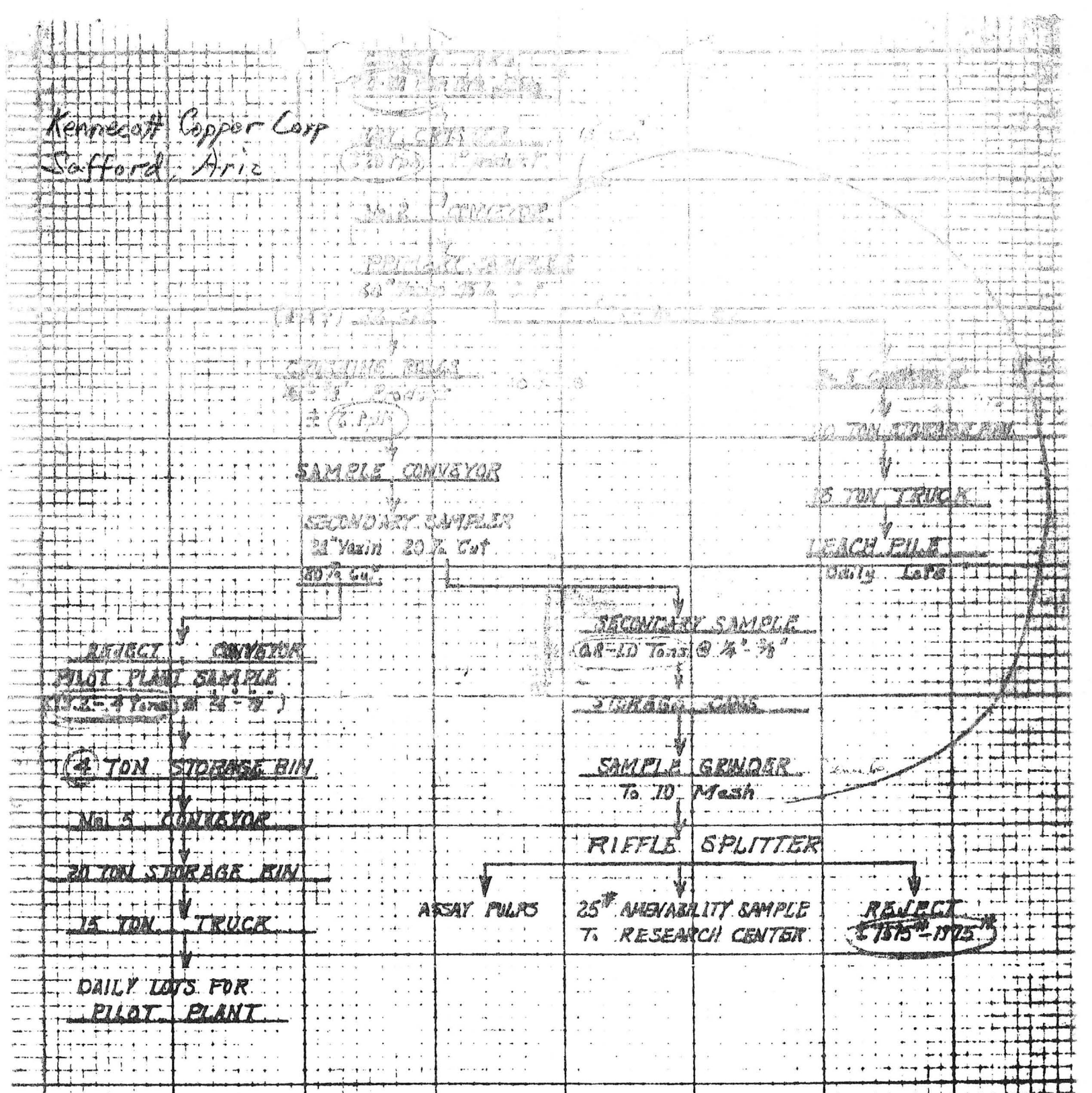
Respectfully submitted,

A.E.Almind,

Mining Engineer

May 20th. 1930

Kennecott Copper Corp
Safford, Ariz



FLOWSHEET

SAFFORD SAMPLING PLANT

August 31, 1960

Kennecott Copper Corporation will start sinking a vertical two compartment shaft at its Safford, Arizona copper claims early in September. The new Co. shaft will be for development purposes only as it will be too small for ore production.

The new shaft will be 800 feet deep with a station cut for development of one level, the 3900, about 50 feet above the bottom. From the station it is planned to drift and crosscut and then diamond drill to gain further information about the very large mineralized area which cover several hundred acres and is known to extend to a depth of at least 2,000 feet.

Kennecott through its exploration subsidiary --- Bear Creek Mining Company --- has been actively exploring the district for four years and in May 1959 purchased 120 mining claims for nearly $4,000,000. The Lone Star Mines, Inc's claims were the key to this sale. Since the sale Kennecott has been doing "fill in" diamond drilling from the surface and has outlined 100,000,000 tons plus of less than 1.0 percent oxide copper. The new shaft will be the means of access to this deeply buried deposit.

Interestingly the new shaft will be sunk not far from one of the first diamond drill holes drilled to depth in the area. That was done by Consolidated Coppermines Corporation in 1949.

The new shaft will be two compartment with a minimum rock size of 11 feet 6 inches by 7 feet 10 inches. The hoisting compartment will be 5 feet 6 inches square with a counter weight in the adjoining manway compartment. Kennecott will purchase all surface equipment which will include a steel headframe, 100 kilowatt GMC Diesel electric generating set, one Ingersoll Rand 600 cubic feet per minute gyroflow compressor, and one Vulcan Denver 90 horsepower single drum hoist.

SAMPLES RECEIVED FROM A. P. SPALDING

(Lone Star Mine, Ariz.)

February, 1947

No.	Au.Oz.	Ag.Oz.	Pb.%	Cu.%	Zn.%	Description
1	0.010	0.8	None	2.14	None	Treasure Box #1. Sample cut across 20'. High grade vein running through this, not represented in sample.
2	Trace	0.2	32.6	0.51	0.2	Lead Hill. Sample (Spalding) No. 1 40' shaft. E. side of vein. Sample width 2' in 4' vein. Cut at 30' depth.
3	0.010	0.6	0.8	0.10	None	Lead Hill. Sample (Spalding) No. 2 - 40' shaft West side. Depth 30'. Width of vein 5' W. of Sple 3'.
4	None	0.1	None	0.10	None	Sample (Spalding) #4. N. of L.S. shaft. Taken on both sides of canyon and in bottom for 300'.
5	0.040	0.8	None	0.05	None	Lead Hill. (Sample - Spalding - #5) General sample of vein material piled on dump.
6	0.010	0.8	6.0	0.10	0.8	Lead Hill. (Sample - Splading - #6) Taken from cut on vein 100' S. of No. 1 vein and 300' above No. 5 - 50' shaft. Depth 4' - Width 4'.
7	0.030	4.5	None	0.76	None	Iron King #5. This material is off big No. 1 vein. (Is this iron pyrites or copper pyrites?) AS.
8	Trace	0.2	None	3.46	0.3	Iron King #4. Another vein 150' above big No. 1 vein. Not uncovered enough to determine any width.
9	Trace	2.0	None	1.12	None	Spalding Sample #2. Ledge width of sample 4' alongside of cut 1st canyon N. of L.S. shaft.
10	Trace	3.1	None	5.81	0.1	Iron King #1. Representative sample of shipping ore 4' vein off top.
11	Trace	0.3	None	1.63	None	#1 Long Star vein. Vein width 2' Dept. 10'.
12	Trace	1.1	None	0.15	None	Lead Hill. Sample (Splading) #4, 50' shaft on same vein as Nos. 1-2-3. 300' east. Dump sample.
13	Trace	0.4	None	0.91	None	Iron King #2. This material is out of same vein as #1.
14	0.010	3.7	None	8.05	None	Norquay Shaft. Depth 20' - Width 6'.

No.	Au.Oz.	Ag.Oz.	Pb.%	Cu.%	Zn.%	Description
15	Trace	0.6	1.4	0.45	0.8	Lead Hill. Sample (Splading) #7. Taken from large pile of vein material on dump. 15' shaft. Width of vein in shaft 6'. About 300' S. of #1 Shaft.
16	Trace	0.4	None	1.53	0.1	No. 2 Blue Jay. Same vein as #1. 300 or 400' W. and cut over 3' width.
17	0.060	0.5	27.0	0.81	None	Lead Hill. Sample (Spalding) #3. Same vein as Nos. 1 and 2 but on top of veing 50' E. from shaft. Cut on 2'-0".
18	Trace	0.5	None	1.32	0.1	Clara Shaft and Tunnel dump sample.
19	0.300	0.5	None	6.01	0.3	#1 Blue Jay. Pay streak in 4' vein. W. of streak 1'. E. of tunnel 200'.
20	Trace	0.6	2.2	3.00	0.1	Blue Jay No. 3 Sample. Several hundred feet W. of No. 2. Same vein. About 3' width.
21	Trace	0.3	None	1.22	None	#5. Claim #4. Sample cut over 25' width. Large outcrop of low grade.
22	Trace	0.3	None	1.22	0.4	Iron King #3. 1' vein. Sple. taken off top. About 150' above vein #1.
23	Trace	0.4	None	1.02	None	#3. 6' ledge at the sample. 100' E. of open cut on same ledge.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
304 HOME BUILDERS BLDG.
PHOENIX, ARIZONA

REPLY TO

REPORT ON THE SPALDING MINE

The Spalding Mine, lying eight miles Northeast of Safford, consists of five claims called LEAD HILL and twenty-two claims called THE COPPER.

The entire area is in a granite porphyry cut with parallel veins. The Lead Hill has six parallel veins with a large intrusive of quartz. The veins are all parallel. They dip to the north on the north side of the quartz blowout and to the south on the south side. They are very persistent, about four feet wide.

Seven samples taken in various places on the property showed that the veins as a whole are not merchantable. The values occur in chutes or pockets. The north end of the property shows a high value in copper, which would indicate that the mineralization would run to copper at a very moderate depth.

The twenty-two claims lying North and East of Lead Hill are a continuation of the same formation, the same series of veins running parallel, but all showing the ore copper. At the end of the claims adjacent to a large mountain they run into a very large deposit of oxidized formation, very red, badly leached, all openings on all veins showing copper glanc and carbonate in places to a width of thirty feet.

Several deep shafts were put down on the property years ago - one to a depth of four hundred feet, which was just entering the sulphide zone; another with a depth of a little more than five hundred feet, which definitely entered the sulphide. From the showing, the property looks like it should be a big low-g rade.

DATED MAY 20, 1947.

E. H. Sweeney
E. H. Sweeney

No. 233 De

Phoenix, Arizona,

CHAS. A. DIEHL

May 17, 1947.

ARIZONA ASSAY OFFICE

Mail: P. O. Box 1148

815 North First Street

Phone 3-4001

THIS CERTIFIES That samples submitted for assay by DEPARTMENT OF MINERAL RESOURCES contain as follows per ton of 2000 lbs. Avoir.

MARKS	No.	SILVER Ounces	SILVER Tenths	VALUE (oz.) 90½¢	GOLD Ounces	GOLD Hndths	VALUE (oz.) $35.00	TOTAL VALUE Of Gold & Silver	% PERCENTAGE LEAD	REMARKS
SPAULDING										
LONE STAR-18"H-Wall face50'cut-200'East of camp.	1	Trace			.01	$.35			.30	
D p fines	2		.2	$.18	.02	$.35	$.53		.19	
Dump-H-1-Cut heavy.	3		.5	$.45	.03	$1.05	$1.50		19.11	
Dump-H-2 parallel vein	4	2	.6	$2.35	.04	$1.40	$3.75		8.00	
Dump-30'shaft/ 4'vein.	5		.4	$.36	.01	$.35	$.71		.30	
Dump-150'tunnel #3-North end.	6	1	.7	$1.53	.02	$.70	$2.23		.42	
SORTED ORE-70'shaft 4'v apex#3 vein.	7	1	.5	$1.35	.08	$2.80	$4.15		.19	

Charges $ 14.00

Assayer ARIZONA ASSAY OFFICE

No. 363 De

Phoenix, Arizona,
Jan.13,1948.

VALUES
1 oz. Gold.....
1 oz. Silver.....
1 lb. Copper.....
1 lb. Lead.....
1 lb. Zinc.....

CHAS. A. DIEHL

Arizona Assay Office

Phone 3-4001

815 North First Street

P. O. Box 1148

THIS CERTIFIES *That samples submitted for assay by* Department of Mineral Resources Mineral Bldg.,Fairgrounds *contain as follows per ton of 2000 lbs. A*

MARKS	SILVER Ozs.	SILVER Tenths	VALUE	GOLD Ozs.	GOLD 100ths	VALUE	TOTAL VALUE of Gold & Silver	% PERCENTAGE COPPER	REMARKS
No.11								1.16	
✓									
Lone Star									
✓									
Mineral Smelting									

Charges $ L.))

Assayer ARIZONA ASSAY OFFICE

SUMMARY OF THE SLOOP FEASIBILITY STUDY

* * *

A study of the feasibility of fracturing copper orebodies with nuclear explosions and the extraction of copper by in-situ leaching methods.

* * *

Prepared by the San Francisco Operations Office of the U. S. Atomic Energy Commission; the Department of Interior's Bureau of Mines; the Lawrence Radiation Laboratory, Livermore, California; and the Kennecott Copper Corporation; with technical assistance of the Oak Ridge National Laboratory, Oak Ridge, Tennessee.

1. Introduction

This is a summary of a feasibility study to theoretically evaluate the use of nuclear explosives to fracture a low-grade copper orebody for the subsequent extraction of copper by in-situ leaching methods.

Such a method, in which the metal would be dissolved from the fractured rock by percolating a chemical solution through it, would permit recovery of the metal without the expense of mining and crushing the ore. Broadly applied, the technique could provide access to millions of tons of copper in deposits that are too low in grade to be mined economically with today's conventional technology.

The study was conducted jointly by the Kennecott Copper Corporation, the U. S. Atomic Energy Commission's San Francisco Operations Office, the Department of the Interior's Bureau of Mines and the Lawrence Radiation Laboratory, Livermore, with the technical assistance of the Oak Ridge National Laboratory. It is one of the efforts in the Atomic Energy Commission's Plowshare Program, the purpose of which is to investigate and develop peaceful uses for nuclear explosives.

The study disclosed no major problems related to public or industrial safety involved in the technique. Further investigations would be needed, however, to make certain that this is the case.

The study recommends that, providing field studies assure that public safety will not be compromised, an experimental project be undertaken jointly by the Government and Kennecott Copper Corporation to develop the technique. It suggests that a nuclear explosive, of about 20 kilotons yield, be detonated underground in a low-grade copper orebody owned by Kennecott near Safford, Arizona. A leaching plant would be operated to extract copper from the rock fractured by the explosion.

2. The Need for Copper

World production of copper has risen progressively from about 18,000 tons in 1800, to more than 6 million tons in 1965. The U. S. Bureau of Mines reports that the United States refined copper consumption increased from 1.35 million tons in 1960 to 2.35 million tons in 1966. This represents an increase of 74 percent in six years. During the same period, U. S. mined production of copper increased by only 10 percent, despite the efforts of producers to add new capacity. Intensive exploration has failed to yield any new, large, high-grade ore deposits, although a number of deposits are known which are uneconomic to mine using presently available techniques.

Prior to World War II the United States possessed a high degree of self-sufficiency in copper and exported substantial quantities to other users. Today this basic metal is in short supply in the United States with the result that the country, to satisfy its industrial and defense demands, is in the unfavorable position of being a net importer of copper. Rising standards of living and increasing populations in the developing nations indicate a growth in consumption for the world approximately twice the United States level. The availability and competition for metal will probably make it more expensive to buy for import in the future.

To insure adequate supplies of this strategic commodity at reasonable prices for industrial and defense needs, the copper industry has intensified its efforts to discover and develop deposits in this country. Some additional copper production will come from expansion of existing operations and from new deposits with ore grades equal to those now being mined. However, the major portion, in the long run, must come from development and utilization of deposits with ore grades not presently considered economic.

3. Leaching of Copper Ores

Leaching of copper ores is not a new process. Its use in the extraction of copper from mine waste dumps has been increasing. It has also been used to recover copper directly from certain ores which are mined and leached. By 1965, 12 percent of the domestic copper production was obtained by leaching.

Successful practice of in-situ leaching methods has been previously restricted to the abandoned workings of old higher grade underground mines. Mines in Butte, Montana; Ray and Miami, Arizona; and Bingham Canyon, Utah have practiced in-situ leaching to a limited extent in the mined-out areas of old mining operations. The zones treated by leaching were well fractured and had been made permeable by the previous mining operations. In these operations the leaching solution was generally recovered through the existing underground openings.

In-situ leaching eliminates the high costs of excavating and transporting the material to a plant for further treatment. To be economically effective, this method of leaching requires preparation of the deposit so that the process of dissolving the mineral may proceed at an economic rate and with good efficiency. The deposit must be shattered and broken to develop the permeability required to allow air and leaching solutions adequate contact with the minerals.

4. Extent of Resources

How large are the United States reserves of copper? The answer depends upon which authority one consults. In a 1960 survey the U. S. Bureau of Mines estimated the United States to have 32.5 of the world's 212 million tons of copper in ores averaging 0.9 percent copper. In 1965 these domestic reserves were indicated to be 75 million tons in ores averaging 0.86 percent. Reported reserves have always been only a fraction of what the earth will ultimately yield.

Large sums of money are required to outline a deposit sufficiently for it to be classed as a mining reserve. Producers can only justify investigating that portion of the total that offers a reasonable promise for a profitable operation. If many years of potential production exists with presently commercial grade material, there is often little impetus for diverting funds to prove the existence of sub-ore material. As producers approach their known ore reserve limits, they attempt to develop additional reserves. These additions can be obtained by new discoveries, by lowering recovery costs through advances in technology, or by raising the price. Thus, the border between mineral reserves and mineral resources is constantly shifting.

It would be very difficult to establish reliable figures for the amount of sub-ore material that could be reclassified as ore reserves by the development of a mining method that would allow a substantial lowering of the present economic grade limits. The closest approximation is available in what is often referred to as "potential" ore, namely, material known by its location and quality and considered likely to be profitably minable in the future. The amount of such potential reserves is known to be enormous. Vast tonnages of sub-ore material exist as halos around the economic limits of operating properties in this country. Exploration activities, presently on a 100 million dollar a year quest for additional ore, often observe, partially define, and subsequently abandon great quantities of this type of material in the search for today's commercial ores. The U. S. Bureau of Mines estimates that an additional 58 million tons of metallic copper probably exist in potential ores averaging about 0.47 percent (9.4 pounds of copper in 1 ton of ore). Some definite information is available for eighteen such deposits containing about 16 million tons of copper.

A complete answer to the question of how much copper is in the United States in a sub-ore resource category will be determined only when a new method of mining technology is tried and proven, giving industry an impetus to fully explore the extent of these resources.

5. Nuclear Fracturing

If a nuclear explosive is emplaced deep underground, upon detonation the blast will be fully contained. The energy of the explosion is released in a fraction of a microsecond and it vaporizes, melts and crushes the surrounding rock. A cavity forms and expands spherically around the blast center following the outward moving shock wave until the pressure of the gas in the cavity approaches equilibrium with the weight of the overlying rock. The molten rock that initially lines the cavity walls will flow and form a pool on the cavity bottom. As this material cools and solidifies into a relatively inert glass, it traps and entrains up to 95 percent of the radioactive fission products generated by the explosion. The roof over the cavity, having been fractured by the shock wave and effectively undercut, will start to collapse and a cylindrical chimney of caved and very permeable broken rock will develop upward. The chimney will have a radius that approximates that of the cavity and the height will normally extend to a distance of four or five times the radius of the cavity. Chimney material formed by nuclear explosions in granitic rock is extremely permeable and has been observed to have about 25 percent void space with 75 percent of the fragments smaller than 12 inches in size. The force of the explosion will also fracture rock out beyond the chimney boundary. This outside fracturing will also increase, to a lesser extent, the original rock's permeability for a distance approaching three cavity radii.

6. The Sloop Experiment

In the Sloop study, a concept for an experiment is proposed to evaluate the nuclear fracturing/in-situ leaching technique for recovery of copper from low-grade orebodies. The Safford deposit of Kennecott Copper Corporation, about nine miles northeast of the town of Safford in southeastern Arizona, is suggested as the experiment site.

As now conceived, the experiment would involve detonating a nuclear explosive with a yield of about 20 kilotons* underground in the oxide portion of the Safford deposit to fragment a test zone of copper ore. A pilot leaching plant, having commercial size equipment, would be built to leach and extract copper from the broken ore. It is anticipated that at least one year of leaching tests would be required to provide enough data for a reliable evaluation of the experiment.

If Sloop site evaluation is authorized, the AEC will make detailed field investigations to determine the suitability of this proposed site. These investigations would provide the basis for final design of the experiment, including the selection of a nuclear explosive, its yield, and method of emplacement and all aspects related to public health and safety.

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* One kiloton is equivalent to 1,000 tons of TNT high explosive.

The nuclear explosive would be emplaced in a hole drilled from the surface, approximately 20 inches in diameter. The hole would then be plugged to prevent venting to the atmosphere and the explosive would be detonated at a depth of 1,200 feet. It is expected the explosion would create a chimney of broken rock with a diameter of about 200 feet, a height of about 440 feet, and containing approximately 1.3 million tons of broken rock.

After the shot, holes would be drilled from the surface into the chimney to define its height, to take samples of the atmosphere inside it, and to measure the void volume. Holes would also be drilled to investigate the extent and radius of fracturing outside the chimney. As soon as the post-shot safety requirements are satisfied, existing underground openings would be rehabilitated and facilities installed for the leaching tests.

For the leaching tests, leach liquid input holes would be drilled to the top of the chimney. An access drift and a system of drill holes would be installed beneath the chimney to collect the pregnant (metal-bearing) leach solutions. The copper would be recovered from the solution by treatment with iron to precipitate a copper powder. A precipitation plant using cone precipitators similar to those now used at Kennecott's western mines would be constructed near the shaft. The plant would be capable of treating a throughput of about 2,600 gallons per minute of pregnant solution obtained from the collection system, and of recycling the barren (stripped) solutions to the chimney zone.

The pilot leaching plant would be operated at least a year to develop operating techniques and to provide data for the economic evaluation of the commercial potential of the nuclear fracturing/in-situ leaching process.

The operation of the pilot leaching plant should produce a moderate amount of copper that, after suitable treatment, could be made available for ordinary usage. A portion of the copper precipitates would be used for developmental studies to determine the most efficient process for refining the crude copper for marketing on a commercial scale.

Laboratory scale experimental work indicates that possible radioactive contamination of the copper is a manageable problem. Radioactivity in the leaching solutions should be at low enough levels that shielding for personnel protection would not be required. Any residual contaminants in the raw copper product should be removable by refining processes so that the finished copper should be virtually free of any contaminant.

The feasibility study concludes that there appears to be no safety problems that cannot be satisfactorily managed and that the project can be conducted at the Safford site without hazard or serious inconvenience to the population in that area.

8. Cost Estimate and Schedule

The preliminary cost estimate for the entire experiment, including construction and operation of the leaching system for a year, is about 13 million dollars.

It is expected that about nine months would be required to complete the pre-shot safety studies and prepare the project site for the detonation after authorization to proceed is granted. An additional period of nine months after the shot would be required for evaluation of the explosion's effects, decay of residual radioactivity in the chimney, and construction of the leaching system. Then the leaching plant would be operated for a minimum of one year to accumulate sufficient data for development of process techniques and economic evaluation.

9. Project Organization and Administration

Project Sloop would be a joint effort of the U. S. Government and Kennecott Copper Corporation. The Atomic Energy Commission would provide the nuclear explosive, conduct the nuclear operations and the programs for the protection of public health and safety. Kennecott would be responsible for the leaching and copper recovery phase of the experiment. The U. S. Bureau of Mines would participate in all phases of the experiment, would evaluate the results, estimate the applicability of the technique to other potential orebodies, and would cooperate with the other participants in reporting the results of the experiment.

PROJECT SLOOP

A CONCEPT OF MINING IN YEARS TO COME

by

I. G. Pickering

(Approved by N.Y. Publ. Comm. 2/14/68)

In this jet age of challenging and exciting developments, I'd like to brief you on an imaginative proposal to utilize one of the 20th century's greatest discoveries for the benefit of mankind and in one of man's oldest industries.

I refer to "Project SLOOP." This is such an exciting development that I am anxious to "blast off," but I think we had better hold here on the launching pad for a few minutes to provide you with some background so that "Project SLOOP" will be more meaningful to you, and you'll have a better idea of the motivation behind this atomic age proposal.

For centuries, mining has been associated with underground activities and the removal of huge amounts of material from which the desired mineral -- copper, gold, iron, silver, etc. -- could be removed by more or less complicated processes. In more recent years, much of the underground mining has been replaced by open pit mining, but the principle remains the same, clawing the desired material from Nature's grasp, hauling, crushing, separating, smelting, refining, plus numerous other steps. This is the story of mining as we know it today in every country of the free world and behind the iron curtain.

What I have just described for you is the modus operandi of Kennecott Copper Corporation -- the world's largest mine producer of copper. Here in the western United States we have divisions in Utah, Nevada, New Mexico and Arizona. These four properties had a combined output of 473,000 tons of copper in 1966, or 33.7% of all the new copper produced in the United States. Because of the USWA-led strike, our production last year did not nearly come up to the 1966 figure.

Allow me to utilize a few figures at this point to make our present mining program just a little clearer to all of you.

It requires 1,500 employees to keep Ray Mines Division running 24 hours a day, seven days a week. During each 24-hour period the men and machines in the open pit mine will blast, load and haul about 75,000 tons of ore and waste.

About 25,000 tons of that output will be processed to remove the copper, while the balance will be deposited on the many dumps at the mine because it is waste or near-waste. After we treat that 25,000 tons of low-grade copper ore for about four days -- we'll wind up with less than 200 tons of copper. In other words, we'll recover about 15 pounds of copper from every ton of ore.

That's a "mini"-description of mining today. It is a process that involves great numbers of people, using hundreds of millions of dollars worth of equipment and requiring continuous movement and treatment of millions and millions of tons of heavy, hard material.

Now let's explore "Project SLOOP" -- a peek at what conceivably could be the mining of tomorrow.

First of all . . . Project SLOOP is <u>not</u> a reality. It <u>is</u> a proposal which has been submitted by Kennecott to the U. S. Atomic Energy Commission. This proposal calls for a joint experiment by Kennecott and the AEC to study the feasibility of fracturing copper

orebodies with nuclear explosives, and the extraction of copper by in-situ leaching methods. I have thus defined SLOOP as being the "Study - Leaching Of Ore in Place."

Now that you know what Project SLOOP is; let's take a few moments to see what was behind this proposal to develop a new concept in mining.

World production of copper has risen progressively from about 18,000 tons in 1800, to more than six million tons in 1965. The U. S. Bureau of Mines reports that the United States refined copper consumption increased from 1.35 million tons in 1960 to 2.35 million tons in 1966. This represents an increase of 74 per cent in six years. During the same period, U. S. mined production of copper increased by only 10 per cent, despite the efforts of producers to add new capacity. Intensive exploration has failed to yield any new, large high-grade ore deposits, although a number of deposits are known which are uneconomic to mine using presently available techniques.

Prior to World War II the U. S. possessed a high degree of self-sufficiency in copper and exported substantial quantities to other users. Today this basic metal is in short supply in the U. S. with the result that the country, to satisfy its industrial and defense demands, is in the unfavorable position of being a net importer of copper. Rising standards of living and increasing populations in the developing nations indicate a growth in consumption for the world approximately twice the U. S. level. The availability and competition for metal will probably make it more expensive to buy for import in the future.

To insure adequate supplies of this strategic commodity at reasonable prices for industrial and defense needs, the copper industry has intensified its effort to discover and develop deposits in this country. Some additional copper production will come from expansion of existing operations and from new deposits with ore grades equal to those now being mined. However, the major portion, in the long run, must come from development and utilization of deposits with ore grades not presently considered economic.

Perhaps at this point some of you are wondering if there are enough deposits like this to make this entire program worthwhile.

Vast tonnages of sub-ore material exist as halos around the economic limits of operating properties in this country. Exploration activities, presently on a $100 million a year quest for additional ore, often observe, partially define, and subsequently abandon great quantities of this type of material in the search for today's commercial ores. The U. S. Bureau of Mines estimates that an additional 58 million tons of metallic copper probably exist in potential ores averaging about .47 per cent (9.4 pounds of copper in one ton of ore).

A complete answer to the question of how much copper is in the United States in a sub-ore resource category will be determined only when a new method of mining technology is tried and proved, giving industry an impetus to fully explore the extent of these resources.

Kennecott proposes to try "a new method of mining technology" on its Safford property, which the company has owned for a number of years, but which has not been developed.

slide	audio
Gilas	Much time and many dollars have been expended already on the Safford property attempting to find the key to unlock the copper in this deposit from its host rock. Because the copper lies deeply buried in the Gila Mountains and is covered by layers of volcanic rock ranging from 200 to 800 feet thick, normal mining methods are completely impractical.

slide	audio
Pilot Plant	In 1961, a pilot plant with a capacity of one ton per day was constructed adjacent to the Safford shaft site, which was some 800 feet deep to provide access to some 3,000 feet of underground drifts.
Pilot Plant	The plant was built to determine the amenability of the copper-bearing material to a leaching program using a combination of sulphuric acid and water to dissolve the copper and then the removal of the copper from the solution through electrolysis or, inother words, the plating of the copper from the solution. Our studies convinced us the process would work, but it would not be economical to mine the mineral-bearing material by conventional methods.
Shaft Site	After investing several millions of dollars in property acquisition, in drilling exploration holes, sinking shafts and doing all the other details which must be undertaken to prove a mining prospect, Kennecott believed that there must be a way other than a normal mining method by which this property could be brought into production to supply additional

slide	audio
Shaft Site (continued)	copper which our nation needs. Because of this feeling, a study group composed of representatives of Kennecott, the Atomic Energy Commission and the U. S. Bureau of Mines was formed in 1966.
	The end result of the formation of that study group is what we know today as Project SLOOP.
SLOOP Cover	The study report on which the proposal is based is the result of a two-year effort on the part of Kennecott, the U. S. Atomic Energy Commission, the U. S. Bureau of Mines and the Lawrence Radiation Laboratory. If SLOOP is approved by the Atomic Energy Commission, and authorized by Congress, it will become an important part of the AEC's Plowshare Program, which was started 11 years ago to investigate and develop peaceful uses for nuclear explosives.
Graham County Courthouse	Where would the project be located? About 10 air miles from Safford and 175 miles from where you are sitting today.
Location Map	It is a rough, desert and mountain area with no vegetation other than hardy desert plants, no signs of civilization. Just desolate, barren desert.

slide	audio
Pilot Plant w/arrow	This photo of the pilot plant gives you some idea of what is around the approximate location of Project SLOOP's ground zero, indicated by the arrow.
Ground Zero Map	At Ground Zero it is proposed to detonate a 20-kiloton nuclear device (20 kilotons is equivalent to 20,000 tons of TNT). The device would be emplaced 1,200 feet below the surface of the ground.
Cavity Formation Sequence	What happens when the device is triggered? Based on studies of cavities created by other underground nuclear devices this is what would take place:
3 ms	About three milliseconds after detonation, the device is vaporized and a pocket of high temperature and pressure is created. The cavity continues to expand spherically around the blast center following the outward moving shock wave until the pressure of the gas in the cavity approaches equilibrium with the weight of the overlaying rock.
300 ms	Some 300 milliseconds after detonation, a puddle of molten rock has been formed... additional rock melts and drips down into the pool and the shock wave continues to fracture the rock around the blast area.

slide	audio
3 sec	A longer time lapse now. In the period from a few seconds to a few hours after detonation, more rock collapses as the cavity grows upward . . . some of the rock continues to fall into the pool of molten material.
Final Configuration	The final configuration hoped for will probably look like this. The roof over the cavity, having been fractured by the shock wave and effectively undercut, will start to collapse and a cylindrical chimney of caved and very permeable broken rock will develop upward between 400 and 500 feet. The chimney will have a radius that approximates that of the cavity and the height will normally extend to a distance of four or five times the radius of the cavity. Chimney material formed by nuclear explosions in granitic rock is extremely permeable and has been observed to have about 25 per cent void space with 75 per cent of the fragments smaller than 12 inches in size. The force of the explosion will also fracture rock out beyond the chimney boundary. This outside fracturing will also increase, to a lesser extent, the original rock's permeability for a distance approaching three cavity radii.

slide	audio
Schematic	It is from this broken rock and ore that we would hope to recover the copper in this fashion: A mixture of water and sulphuric acid would be fed into the chimney at the top. This liquid would filter down through the broken material with the acid dissolving the copper on the way down. This copper-bearing solution would be recovered at the bottom of the chimney.....
Flow Sheet	.....and pumped into a precipitation cone to which iron is added. An ion exchange takes place with the iron replacing the copper in solution. The solution is dewatered and the copper -- known as precipitate copper -- is extracted. Whether final processing would be done by electrolysis or in a smelter must be determined at a later date.
Timetable	I'm sure many of you are curious about a time table for this proposal. Naturally, because SLOOP is still in the proposal stage, no one can say that it will be approved and underway on any specific date. However,

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Timetable (continued)	this chart will give you a fair idea of the overall time table. We can safely say that about eight months from the date of authorization ... providing all tests and evaluations indicate a completely safe environment for the shot ... the nuclear device would be fired.
	Plant operation could begin seven months after the shot, with an evaluation of the entire project starting about 30 months after the detonation and continuing about one year.
	Total elapsed time from date of authorization to completion of the evaluation would be approximately four years.
	Since we are always concerned with money, it might be of interest to you to know something of the estimated costs of Project SLOOP.
SLOOP Total	It is estimated the total cost would be $13,175,000. The project would be divided into three phases.
Phase I	Phase I would include field start-up and initial support facilities, a series of pre-shot sampling holes and the site safety study. Incidentally, I want to touch on this latter program briefly in just a moment.

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Phase II	Phase 2 would cover the actual project start-up, scientific programs, the emplacement hole, actual emplacement, stemming, communications, engineering and inspections.
Phase III	Phase 3 would take care of the construction of the precipitation plant, operation of the plant for one year and a complete final evaluation.
Phase III	(Ad lib comment.)
SLOOP Cover	If SLOOP is authorized, one of the first programs to get underway will be the site safety study, of which I spoke a moment ago. It is expected to take some six months and will be conducted jointly by the Atomic Energy Commission and Lawrence Radiation Laboratory. This study will be a continuation of the preliminary study already made and will go into depth in every situation that can be imagined.

The men who will make this very detailed safety study will be applying knowledge gained over long range safety studies together with experience of over 225 underground contained nuclear explosions. First and foremost, there will be specific studies of the ground water situation. The detonation is proposed to be well above the water table so there should be no question of contamination of ground water. However, the hydrology study of the SLOOP site will be one of the most intensive and complete investigations ever made of the area.

In-depth studies will be made on predictions of ground motions and a team of experts on structures will carefully evaluate every structure in the area to see if they can stand the ground motion. Another area which will get special attention will be the containment study to make sure that no venting takes place from the emplacement area. In connection with this study, the weather will be checked, forecast, checked again and checked constantly right to the moment the device is triggered.

After all these and other studies are completed, they will be carefully reviewed by a group of independent consultants, people who are eminent in their own technical fields. These consultants look critically at these studies and the conclusions which have been drawn from them and come up with independent conclusions or recommendations.

In short, we can safely say that no stone will be left unturned in an effort to make this nuclear blast as safe as possible for everybody concerned. It has to be 100% safe, or it will be delayed until it can be completed safely.

There are many more things which could be said about this project, but we don't want to keep you here too long. In just a moment, if there is any time left, I'll try to answer some of your questions.

First ... I'd like to answer a question that is frequently asked ... when the precipitation plant starts to operate, will there be any danger of radio-active contamination to the workmen?

Laboratory scale experimental work indicates that possible radio active contamination of the copper is a manageable problem. Radio-activity in the leaching solutions should be at low enough levels that shielding for personnel protection would not be required. Any residual contaminants in the raw copper product should be removed by refining processes so that the finished copper should be virtually free of any contaminants.

If there are any questions on Project SLOOP, I'd be glad to try to answer them now.

Almost simultaneously with the beginning of the copper strike in July last year, there was a marked slump in demand for copper in the world. Here in the United States the copper picture changed almost over night from acute shortage to a surplus of large proportion.

By the time the strike was well underway, the Arizona Department of Mineral Resources estimated the total stock of copper in this country at more than 973,200 tons, with more than 640,400 tons refined and in the warehouses of fabricators. The refined copper alone represented the equivalent of about 10 average months of Arizona production at the pre-strike rate.

As recently as December 1, this same source estimated the stockpile of refined copper in the hands of America's fabricators at more than 480,000 tons -- the highest level since 1965.

Where did all this copper come from when production within the United States was virtually cut off by the strike? Some had been stockpiled by fabricators in late 1966 and early 1967, with the expectation that the industry would be struck. Much of this copper, however, was brought into the United States when European business went into a slump at about the same time the strike was called. Imports of refined copper -- some of it African and some South American, but most of it from Canada -- tripled in the third quarter of 1967, and the trend continued into the fourth quarter.

The Department of Mineral Resources said at the start of 1968 that stocks of refined and blister copper on hand totaled almost half of the United States' entire 1966 consumption.

With all domestic production now knocked out by the strike, it was true that there was a shortage of 38 cent copper. It may interest you to know that over half of the United States copper comes from Arizona, and the daily loss in production during the strike has averaged 1,750 tons. (Multiplying that by the strike days to date gives

_____tons)*. At this writing there is no shortage of imported copper if buyers are willing to pay the price . . . currently quoted at _____ a pound by the London Metals Exchange.

What happens if the situation in Europe is reversed and consumption of copper climbs back up to pre-strike tonnages? Kennecott researchers say that the deflationary period in the United Kingdon and West Germany has now bottomed and the economy will climb; that the economies of France and Italy are rising at a healthy rate, and they forecast about a 4 per cent growth in the Eurpean "GNP" in the year ahead. If this is true, European fabricators should soon be back in the marketplace, buying rather than selling, and supplies of copper would shrink rapidly.

This brings us to the question of post strike operations. How soon after the termination of the strike can normal production be resumed?

After a strike, it's difficult to get all the workers back immediately and return to normal routines.

Assuming that about 50 per cent of the normal work force at Ray Mines Division were available to go to work on the day a new contract is signed, we could expect a limited amount of copper to be produced as anodes at the Ray Mines Division in about a 10-day period. Furnaces must be brought up to operating temperature; trucks and shovels would have to be checked and put to use; rod and ball mills could be fed with ore and flotation cells reactivated within hours -- provided manpower were available.

Assuming that a nigh percentage of employees return to work within a one week period after the settlement of the strike, we believe that fairly normal production could be regained within a two-week period. This does not mean that refined copper would be available to fabricators at that time. It means only that blister and anode copper from our furnaces in Arizona would be on their way to the refineries . . . "in the pipeline" . . .

* Figure inserted here according to date of presentation.

with, again, a delay of up to several weeks before the output from the refineries could reach fabricators in any real volume.

You may be assured, however, that the copper industry is preparing in every way possible during this strike so operations can be resumed with the minimum of delay and so that customers will be served just as rapidly and efficiently as possible.

I thank you for your time and attention, and I will attempt to answer any questions you may have.

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SLOOP PROJECT GRAHAM COUNTY

Kennecott has completed their drilling at their Lone Star Mine (Sloop Project), and will wait for the government on the next step of the Sloop or atomic blast project.

GWI Quarterly Report 4/1968

Kennecott closed their Safford offices.

GWI Quarterly Report 6/1968

No report of Progress (GWI Quarterly Report 12/1968)

No activity at Kennecotts Lone Star operations, (Sloop Project).
GWI Quarterly Report 9/1969

U. S. ATOMIC ENERGY COMMISSION
SAN FRANCISCO OPERATIONS OFFICE
2111 Bancroft Way
Berkeley, California 94704

SAN NO. 566
PHONE 841-5121 Ext. 611

ADVANCE FOR PUBLICATION
AFTER 10 A.M. (MDT)
WEDNESDAY, OCTOBER 11, 1967

NEW MINING METHOD FOR COPPER RECOVERY IS PROPOSED

Kennecott Copper Corporation has submitted a proposal to the U. S. Atomic Energy Commission for a joint experiment to determine if a contained underground nuclear explosion can be used to fracture a low-grade copper ore deposit to recover the copper by leaching the ore in place.

The proposal is based on a study released today indicating the nuclear fracturing technique could lead to recovery of copper which previously could not be produced economically. If authorized, safety and technical studies in the field would be undertaken to determine whether such an experiment could be conducted with full protection for public health and safety.

The two-year conceptual study by Kennecott, the Atomic Energy Commission, the U.S. Department of the Interior's Bureau of Mines, and the AEC's Lawrence Radiation Laboratory, Livermore, California, recommends conducting an experiment in a copper deposit owned by Kennecott near Safford, Arizona.

The proposed experiment, "SLOOP," would be part of the AEC's Plowshare Program to develop peaceful uses of nuclear explosives. It would involve the detonation of about a 20-kiloton nuclear explosive (equivalent to 20,000 tons of TNT) at a depth of 1,200 feet below the surface of the ground.

The explosion would be expected to result in a chimney of broken ore about 440 feet high and 200 feet in diameter containing about 1.3 million tons of ore. To recover the copper, a leaching solution would be introduced into the chimney to dissolve the copper. The solution later would be pumped to the surface where the copper would be removed by a processing method.

The cost of the experiment presently is estimated at more than $13,000,000, including construction of pilot processing plant facilities at the Safford site and its operation for a year. If the proposal is

(more)

accepted by the AEC, terms of the joint project, including the division of costs between the Government and Kennecott, would be negotiated. Commission participation would be contingent on Congressional authorization.

The nuclear fracturing and "solution mining" concept, if successful, could greatly increase the mineable copper reserves in the United States; it would permit development of low-grade deposits which cannot be mined economically by conventional methods. In addition, this concept would keep disturbance of the natural landscape at a minimum.

The study group found the domestic mining industry is facing an accelerating demand for copper, caused in part by the Vietnam war. Consumption in the U.S. increased 74 per cent from 1.35 million tons in 1960 to 2.35 million tons in 1966. It increased 17 per cent in 1966 alone. Although domestic copper production has increased 10 per cent in the past two years, the U.S. has had to continue importing copper to meet its needs.

If Kennecott's proposal is accepted by the government agencies involved, site safety and technical evaluation would begin. This six-month program would include thorough studies in the field of underground water, geologic formations, soil, structures, weather and public health and safety. Preliminary estimates indicate this evaluation might cost about $750,000.

If these studies show the Safford site to be suitable for an experiment and adequate public health safeguards can be guaranteed, the Commission could approve the full experiment. If not, the experiment would have to be dropped, modified or another location considered. The earliest possible detonation date would be in 1969. The SLOOP experiment would take 2½ to 3 years to complete.

During all phases of the experiment, state and local officials would be kept informed of all studies and findings.

The leaching portion of the experiment could begin as early as nine months after the nuclear explosion. As outlined in the SLOOP study, a leaching solution would be introduced at the top of the rubble-filled chimney. Flowing downward over the fragmented ore, the solution would dissolve the copper minerals. The copper-bearing solution would then be pumped from the bottom of the chimney to the surface.

The full SLOOP experiment would include a pilot processing plant at the Safford site to remove the copper from the leaching solution.

Leaching is now used on some low-grade ores and on mine wastes above ground; it has also had limited underground use in several abandoned higher grade ore mines. The nuclear fracturing technique would allow the leaching solution to flow over large volumes of ore without bringing the ore to the surface.

(more)

In the experiment, the AEC's Nevada Operations Office, which has conducted more than 225 underground nuclear explosions, would be responsible for public health and safety. Underground nuclear explosions have been conducted in Nevada, New Mexico, Alaska, and Mississippi and other Plowshare experiments are being considered in Pennsylvania and Colorado.

Radioactive material from the explosion is not expected to reach the atmosphere or to affect ground water, according to the feasibility report. Field studies will be made to check this belief. The emplacement depth of 1,200 feet would be well below that required for safe containment of a 20-kiloton explosion.

Laboratory scale experiments indicate the level of radioactivity in the leaching solution would be low enough that no special shielding would be required during the recovery process. Any traces of radioactivity in the copper are expected to be reduced during refining to meet market standards. No copper produced in the SLOOP experiment would be permitted to enter commercial markets without further careful study and control.

# # #

(NOTE TO EDITORS AND CORRESPONDENTS: A summary of the feasibility study is attached for your information. This announcement is also being distributed by AEC Headquarters in Washington, D. C.; Nevada Operations Office, Las Vegas; and Kennecott Copper Corporation, Salt Lake City, Utah.)