



CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
520-770-3500
<http://www.azgs.az.gov>
inquiries@azgs.az.gov

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Southwestern Exploration Division

October 3, 1991

A.R. Raihl

Geology about T-3
Santa Cruz Project
Pinal Co., Arizona

Attached is a description of the geology about T-3 for purposes of developing the acid attenuation, fluid flow model. This description is based on the results of the widely spaced exploration drill holes.

If you or anyone receiving a copy of this memorandum has any questions, please contact me before October 9th or after October 23rd.

A handwritten signature in dark ink, appearing to read "H.G. Kreis".

H.G. Kreis

HGK:mek
Att.

cc: D. Davidson (SAIC) via FAX
D. Marozas (USBM) " "
S. Swan (USBM)
R. Lantz (Intera) via FAX
C. Barter (Mont. and Assoc.) via FAX
F. Graybeal
W. Kurtz
J. Sell

H.G. Kreis
October 2, 1991

GEOLOGY OF AREA ABOUT T-3

Area of Investigation:

Horizontally: within 1000' of T-3
Vertically: between depths of 1200' and 2400'

Area A:

Rock Types: 70-80% altered Precambrian granite
20-25% altered bio.-qtz.-feld. porphyry
1-2% altered diabase

Alteration: described in the Phase I & II rough draft report.

Mineralization (% of rock): 55% iron oxide capping
35% chrysocolla mineralization
55% of the rock has iron oxide capping characteristics
≤5% chry.-atacam. mineralization
≤5% high grade atacam. mineral.
5% chalcocite mineralization
2% chalcopyrite

2% of the rock contains chalcocite

Area B:

Rock Types: same abundance as in Area A.

Alteration: same as in Area A, except in Area B there is substantially fresher rock below a depth of 2300' (± 200').

Mineralization (% of rock): 85% iron oxide capping
≤5% chrysocolla mineralization
≤5% chry.-atacam. mineralization
5% chalcocite mineralization

SC-56

2520' T.D.

1000 ft.

SC-14

2150-190'-0.73
2585' T.D.

SC-59

1456-113-0.94 ox
2515-813-0.56 cpy
3609' T.D.

SC-18

1560-230-0.97 ox
2513' T.D.

SC-22

2326' T.D.

SC-49

1271-59-0.52 cc
1665-71-1.29 ox, cc
2275-86-1.07 cc
2709' T.D.

SC-52

1236-61-1.05 ox
1462-85-1.61 ox, cc
1870-430-0.58 ox, cc
2497' T.D.

SC-19

1193-127-0.84 ox
1620-150-2.98 ox
2826' T.D.

SC-36

1918-104-0.89 ox
2392' T.D.

SC-40

1824-62-0.65 cc
1953-207-0.39 ox
2417' T.D.

SC-47

2567' T.D.

SC-35

1647-35-1.08 ox
2140-80-1.22 ox
2330' T.D.

SC-24

1180-100-0.51 ox
1550-110-1.10 ox
2220-200-0.58 cc
2441' T.D.

SC-37

1780-113-0.58 ox, cc
2802' T.D.

SC-48

1507-231-0.61 ox,
1976' T.D.

SC-51

1676-88-0.95 ox
2478' T.D.

SC-46

1570-215-1.28 ox
1910-130-0.92 cc
2669' T.D.

SC-38

1830-89-1.93 ox
2807' T.D.

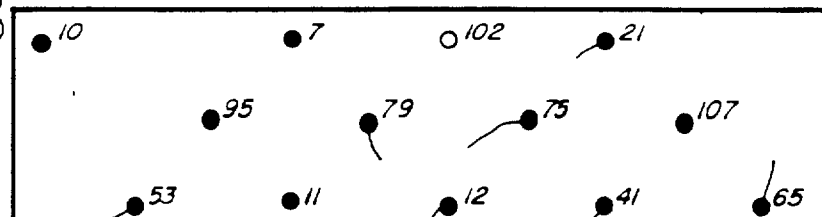
SC-39

1478-62-1.09 ox
2490' T.D.

SC-20

1380-80-0.36 ox
2423' T.D.

13



SANTA CRUZ PROJECT

GEOLOGY ABOUT T-3

H.G.K. 10-2-1991

ASARCO

Exploration Department
Southwestern United States Division

November 4, 1991

Mr. Steve Swan
Twin Cities Research Center
5629 Minnehaha Avenue South
Minneapolis, Minnesota 55417

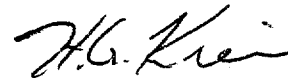
Re: Zonge CSAMT Survey

Dear Steve:

Enclosed for your review is Zonge's executive summary of the CSAMT survey results for use in the Phase I and II report.

Please let me have your comments in the near future so the summary can be corrected and forwarded to SAIC for use in the final Phase I and II report.

Sincerely,



H.G. Kreis

HGK:mek
Enc.

cc: A.R. Raihl (w/Xerox copy)
F.T. Graybeal (w/Xerox copy)
W.L. Kurtz (w/Xerox copy)
J.D. Sell (w/Xerox copy)
C. Barter (w/Xerox copy)
W. McCulloch (w/Xerox copy)

CSAMT Monitoring of the
Santa Cruz In-Situ Test Site
for
ASARCO, Incorporated

(With H.K. comments/
corrections)

Summary

Zonge Engineering and Research Organization has performed a series of geophysical tests at the Santa Cruz In-situ Test Site. The tests are directed towards refining methods for non-intrusive monitoring of the leachate plume. The goal of the tests is to develop a surface technique for mapping the drop in rock resistivity caused by the leachate.

Controlled Source Audio-frequency Magnetotellurics, CSAMT, was picked as the method of choice because of its great depth of investigation, relatively high resolution and resistance to background electrical noise. Tests of an alternative method, Transient Electro-Magnetic (TEM), have also been conducted. Both methods provide information about the vertical variation of resistivity under each sounding point, but CSAMT has better lateral resolution.

Two phases of a three-phase ^{geophysical} project have been completed. The goal of ^{Geophysics} Phase I was to provide a three-dimensional grid of background resistivity values before any conductive fluids were injected into the test site. Two ^{Geophysics} Phase I surveys established the resistivity pattern of the background geology. ^{Geophysics} Phase II followed with a repeat survey after the injection of a salt-water tracer. Comparisons of ^{Geophysics} Phase I and II results showed the effects of both the salt-water tracer and new sources of background electrical noise. ^{Geophysics} Phase III surveys will monitor changes in the background resistivity pattern due to the leaching operation.

All three CSAMT surveys have been conducted over a closely spaced grid (see the CSAMT Line Location Map). A total of 107 stations are spaced at 30 foot intervals along eleven lines. A three-person crew requires about three days to complete measurements over the entire grid.

The first ^{Geophysics} Phase I survey was conducted in late April, ¹⁹⁹⁰ ~~1991~~. The crew established the survey grid and made a complete set of CSAMT measurements using a N45E transmitter antenna orientation. This original survey established that good quality data could be obtained in the geological and cultural environment present at the test site. The effects of well casings, pipelines and powerlines were minimal. The results also showed very good correlation with the known geology.

The CSAMT data show the alluvial fill as a low-resistivity surface layer. The basement rocks are apparent as an underlying zone of high resistivity. An offset in the resistive basement response marks the location of the Pinal fault, which runs through the survey area near well T-4.

The encouraging results prompted an immediate extension of the first survey. The crew returned to the site in early May, 1990 and made a set of measurements to extend the grid coverage and to obtain some comparison soundings using a transmitter antenna orientation of N45W. Data obtained using the second transmitter site were consistent with data obtained using the first transmitter site. There were no distortions due to the particular locations of the transmitter antennas. Data repeatability was very good. The data were consistent from line to line and from station to station.

A second ^{Geophysics} Phase I survey was performed in February, 1991. The second ^{Geophysics} Phase I survey updated the information about the pattern of background resistivity prior to the injection of a salt-water tracer. There were some changes in the background resistivity pattern between May, 1990 and February, 1991 due to ground-water circulation tests and changes in surface cultural features. However, in general the results were very encouraging. There was very good correlation between the first and second ^{Geophysics} Phase I data sets.

A smooth-model-resistivity cross-section along Line 1 SE is shown as Figure 2. The contoured values are the result of inverting apparent resistivity and impedance phase from the February 1991 survey to a smooth-model profile under each CSAMT sounding point. Model resistivities are constrained to vary smoothly with depth along each vertical profile. The alluvium is visible in Figure 2 as a conductive surface layer. The underlying basement rocks are resistive. There is an offset in the depth to basement between stations -45 and -15, showing the offset across the Pinal Fault.

The cross-sections for each line can be combined into plan-maps showing smooth-model resistivity at a constant depth. Figure 3 shows smooth-model resistivities at a depth of 1700 feet based upon inversion of data from the February, 1991 survey. The background resistivity distribution at 1700 feet is imaged as a relatively smooth pattern with lower resistivities in the western quadrant of the grid. Cross sections and plan maps from successive surveys can be compared to estimate time-dependent changes in resistivity.

The field crew also made a TEM measurements during the second ^{Geophysics} Phase I survey. Although a TEM monitoring system would be faster than CSAMT, the TEM results did not show resolution obtainable with CSAMT.

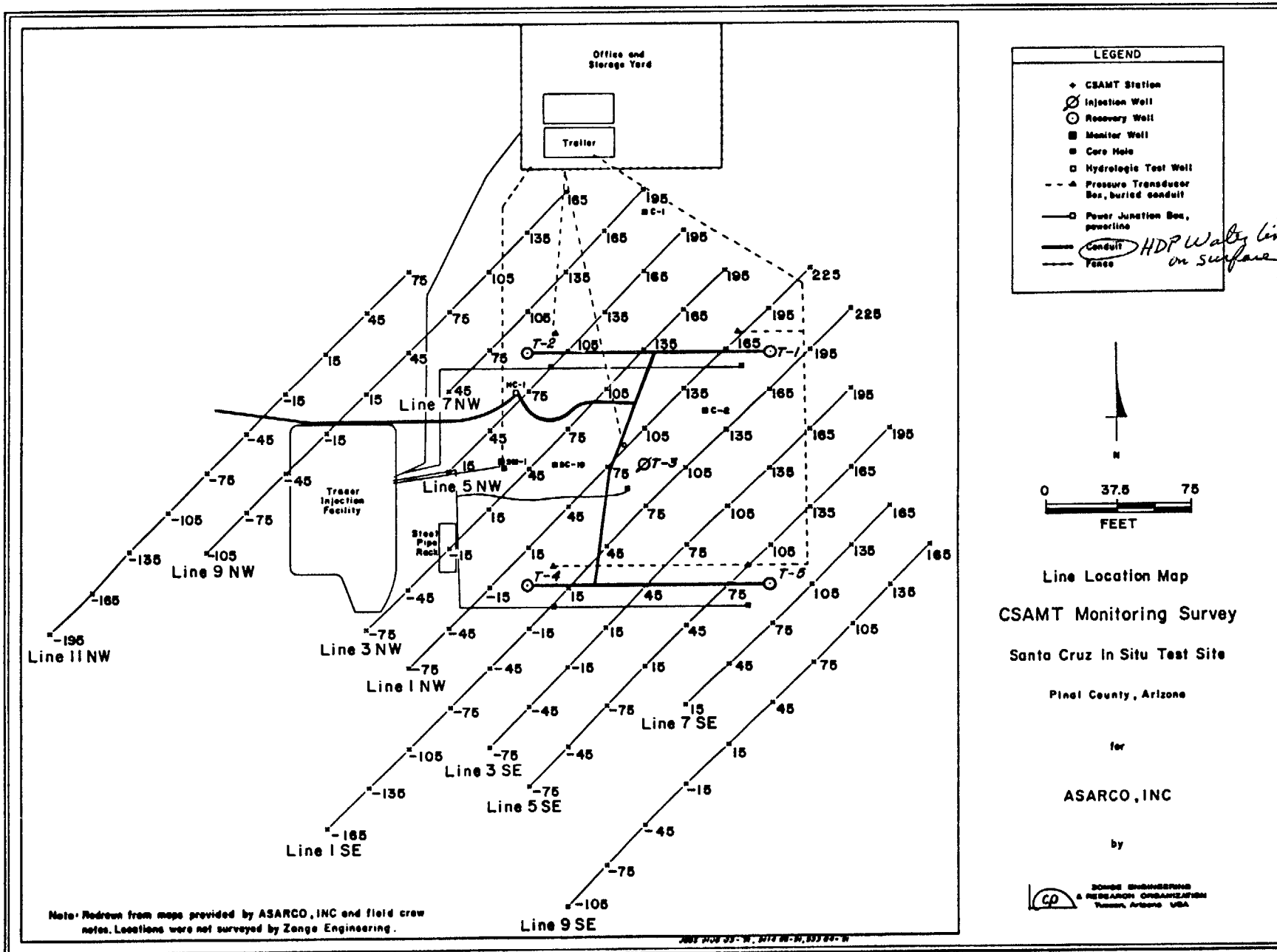
The ^{Geophysics} Phase II CSAMT survey was in June of 1991. The survey was made after ^{three months} ~~several weeks~~ of salt-water injection. The injection and recovery pumps were not operating during the ^{Geophysics} Phase II survey, but electrical power to the site office and lab trailer was on.

The results of the ^{Geophysics} Phase II survey were encouraging, but not conclusive. The background noise created by new powerlines obscured the pattern of resistivity change at the injection depth. Figure 4 shows the percent change in smooth-model resistivity after salt-water injection. Warm colors indicate a drop in resistivity and cool colors indicate an increase. There is a distinct drop in resistivity extending east and north from well T-4. There is an increase in resistivity near wells C-2, T-1 and T-3. The decrease in resistivity east of well T-4 is consistent with the trend of the Pinal fault.

Background powerline noise affected the data quality at 64, 512, and 2048 hertz. All three frequencies are close to harmonics of 60 hertz, the frequency used for power distribution. Collecting more closely spaced frequency data using harmonic-frequency CSAMT should reduce the problem of powerline noise interference.

The absence of a substantial change in resistivity is most likely due to the relatively low concentration of salt in the tracer (Three to four grams per liter at injection and one gram per liter or less at recovery.) The changes in resistivity expected from the leachate solution are expected to be detectable based upon the data repeatability observed to date at the Santa Cruz Site and upon results from surveys over leachate plumes at other sites.

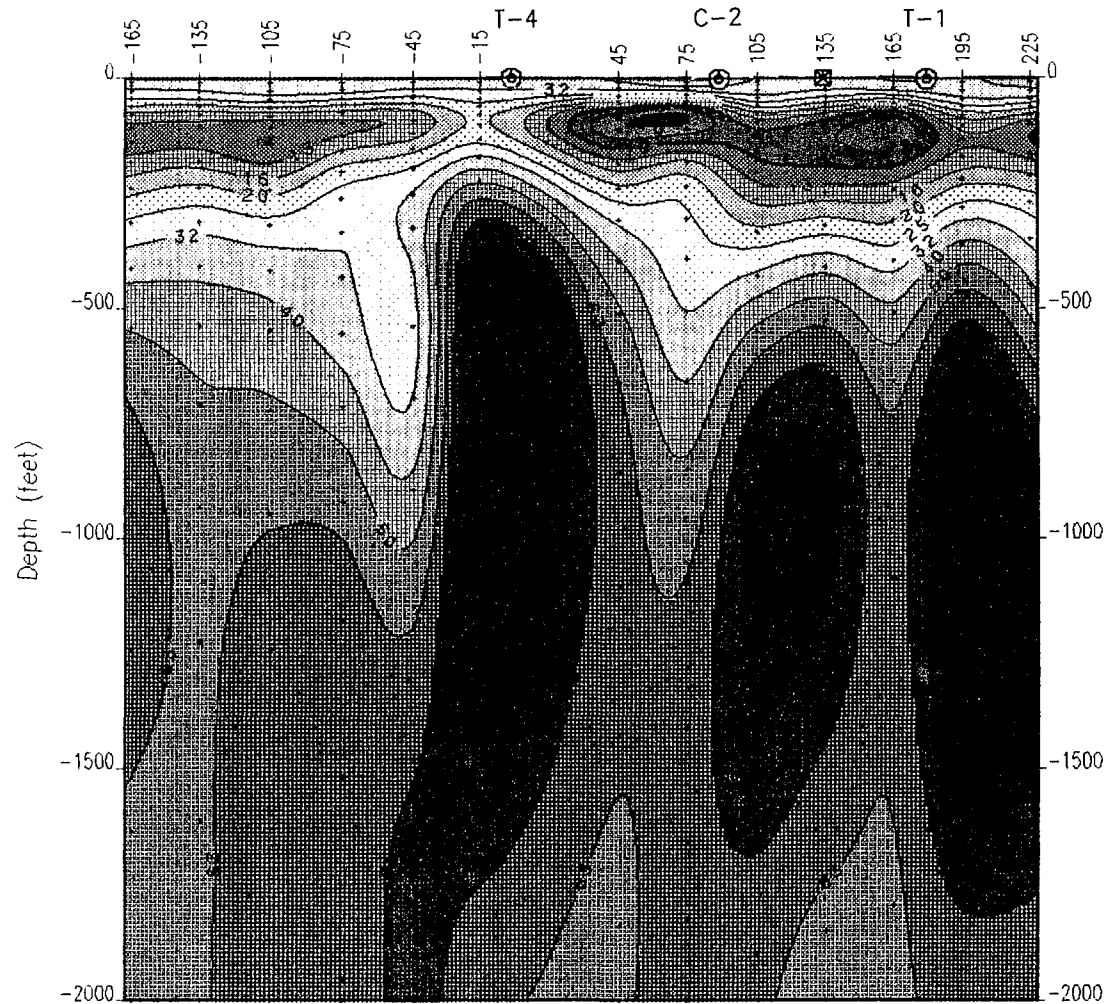
No logistical changes are envisioned for the ^{Geophysics} Phase III work. Grid stations will be re-occupied and data will be measured using same transmitter location and frequencies. Harmonic-frequency CSAMT data will be collected to reduce the effects of powerline noise.



Smooth-model Resistivity

CSAMT Line 1 SE

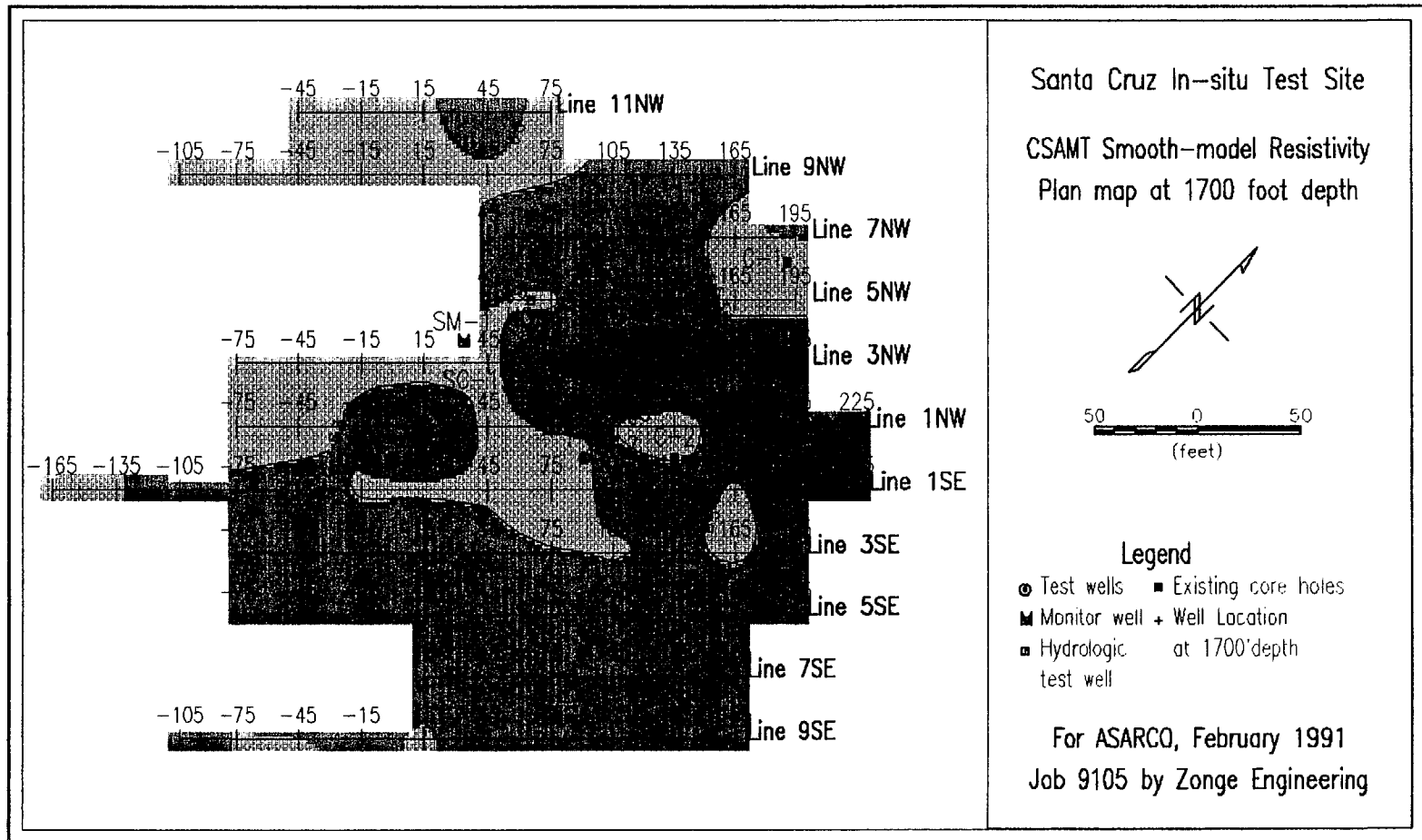
February 1991 Survey

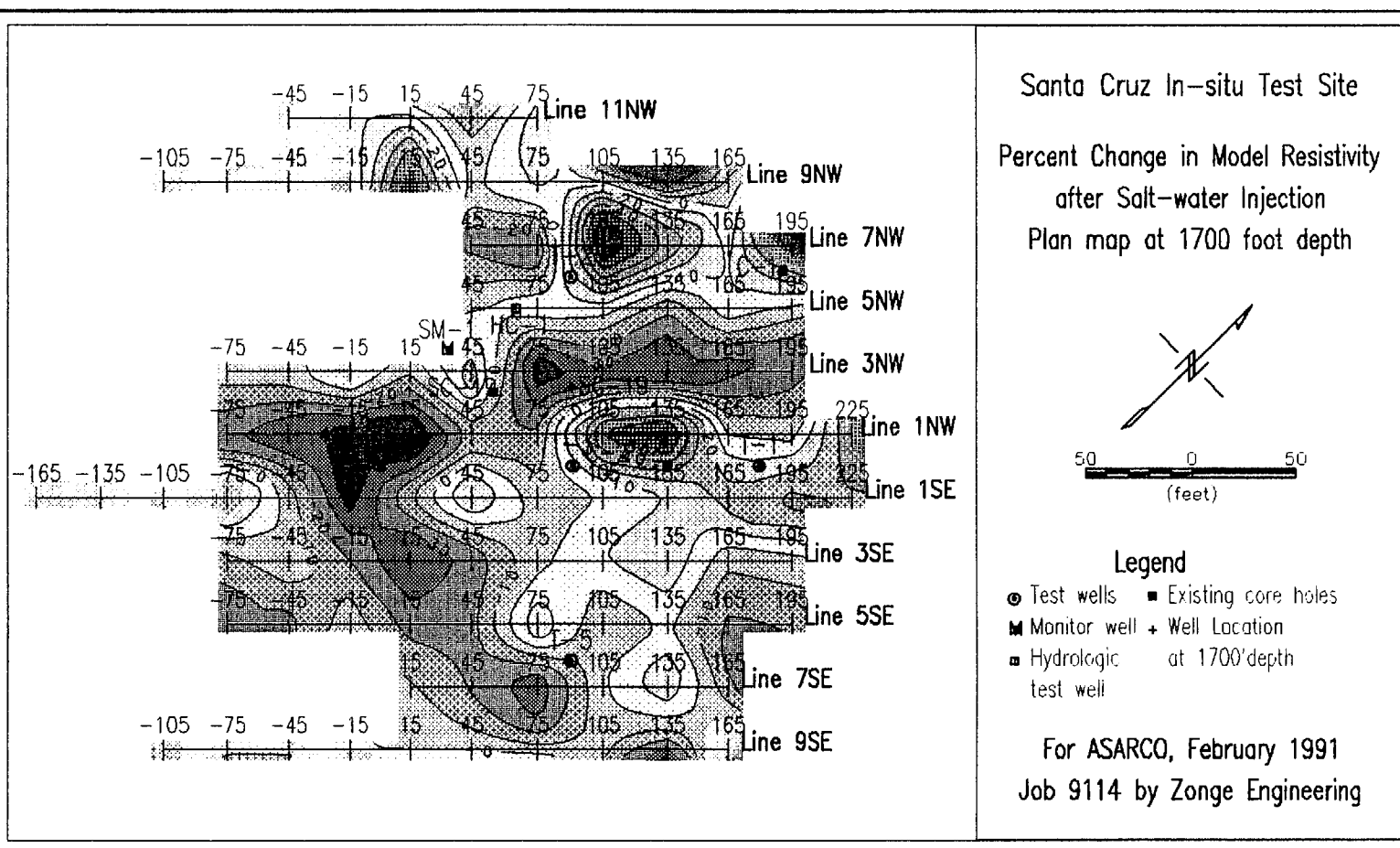


Smooth-model Resistivity (ohm-meters)

Plotted 09/20/91 for ASARCO

Zonge





ASARCO

Exploration Department
Southwestern United States Division

November 6, 1991

Mr. Dan Millenacker and
Ms. Pam Watson
U.S. Bureau of Mines
Twin Cities Research Center
5629 Minnehaha Avenue South
Minneapolis, Minnesota 55417

Re: Volume Percent Atacamite

Dear Dan and Pam:

During our recent meeting Mr. Raihl requested a determination of the average volume percent atacamite in the 200' thick leach intervals of test wells T-2, -3, and -4. The average copper grade of these three two-hundred foot thick intervals is 1.1% copper by weight. All of this copper is in the form of atacamite which is composed of 60% copper by weight and has a specific gravity 3.8.

The average volume percent atacamite in the two-hundred foot thick leach intervals, based on atacamite's copper content and specific gravity, is 1.2%.

If you have any questions, please let me know.

Sincerely,



HGK:mek

H.G. Kreis

cc: S. Swan
J. Ahlness
A.R. Raihl
F.T. Graybeal
W.L. Kurtz
J.D. Sell

November 8, 1991

A.R. Raihl

Solution Mining and
Taxation of Hazardous Waste
Searles Lake, California

There is a situation regarding solution mining operations at Searles Lake, California, that will be of interest to those involved with injecting solutions of hazardous compounds, naturally occurring solutions or otherwise, into the ground.

According to a Mr. Kevin Haroff (who will be identified below), the California State Board of Equalization, a board dealing with matters of taxation, considers the Searles Lake solution mining operation as, in effect, a hazardous waste and disposal operation. As a hazardous waste and disposal operation, its operator is obligated to the State of California to pay certain taxes and fees. For this reason, the California State Board of Equalization says a past operator of the Searles Lake operation, Kerr McGee Chemical Corporation (KMCC), owes the State of California \$90,000,000.

Mr. Haroff, an attorney for Morrison and Foerster which apparently represents KMCC's interests in this matter, described the situation to me in some detail. The details of his description follow.

The mining operation consists of pumping a naturally occurring, mineral rich brine from wells through a thin, solid surface crust to the surface of the ground for processing. At the surface, the brine is subjected to a process which extracts valuable minerals from the brine. The brine, depleted of valuable minerals but otherwise of the same composition as before it was processed, is then pumped back into the "ground" (underground lake?). There it dissolves more valuable minerals and, eventually, is pumped back to the surface for processing. Thus, the natural solution from the ground is recycled, and the only change in solution composition is the solution's loss of its valuable mineral content.

The solution mining operation on Searles Lake was run by KMCC from 1960 to 1990, and in 1990 the solution mining operation was sold by KMCC to North American. In early 1991 KMCC received a letter from the California Board of Equalization. In that letter the California Board of Equalization notified KMCC that KMCC, during its ownership of the Searles Lake mining operation, had been disposing of hazardous waste down its

wells. Because of this hazardous waste disposal, KMCC was deemed to have been operating a hazardous waste and disposal facility. KMCC, as an operator of a hazardous waste and disposal facility, was duly required to pay certain taxes and fees. Within the statutes of limitations, these taxes, fees, and accrued interest amounted to \$90,000,000.

The hazardous waste put down the wells was, of course, the natural brine less its valuable minerals. Unfortunately, the natural brine contains arsenic. Because the brine contains arsenic it was declared hazardous; and, because it was put down the wells into the "ground", it was declared waste, hazardous waste.

The California Board of Equalization received its technical advice from the California EPA which is California's department of environmental quality. The California EPA relied on advice from the Federal EPA, Region 9 office. Apparently EPA Region 9 came to the "hazardous waste" conclusion because of RCRA, the Bevill Amendment, Subtitle C, and Subtitle D.

KMCC is, of course, objecting to all of this. KMCC is taking the position that the return solution is not being disposed of -- it is "solution in process."

Part of KMCC's strategy is to get this issue out of EPA Region 9 and into the direct jurisdiction of the national EPA. KMCC is working towards this goal by making the situation at Searles Lake part of a national issue involving other geographically widespread operations, such as uranium in situ leaching in Texas and Wyoming. KMCC wants to get the national EPA involved in discussions with the USBM, other government agencies, solution mine operators, and other interested parties.

Mr. Haroff is available for any discussions or questions. More importantly to him, he would appreciate comments and support from any members of our group.



H.G. Kreis

cc: F.T. Graybeal
W.L. Kurtz
J.D. Sell
P.J. Maley
S.A. Swan
W.E. McCulloch

ASARCO

Mining Department

A. R. Raihl

November 14, 1991

Mr. Alan E. Isaacson
U. S. Bureau of Mines
729 Arapeen Drive
Salt Lake City, UT 84108

Dear Alan:

Santa Cruz Project
Cooperative Agreement C0289001
T-3 Metallurgical Sample

I am shipping to you 300 pounds of sample for your metallurgical studies. The sample is in 21 bags, each bag weighing about 14 pounds.

The sample is representative of T-3 from 1560 feet to 1770 feet. This is a 210-foot interval of 1.17% Cu. The host rock is Precambrian with traces of diabase and the copper mineralization is atacamite.

The sample consists of raw, rotary cuttings which were collected as a duplicate of the assay sample.

Sincerely,



Henry G. Kreis
Site Manager

HGK:brw

cc: A. R. Raihl
S. A. Swan
F. T. Graybeal
W. L. Kurtz
J. D. Sell

ASARCO Incorporated

NOV 15 1991

SW EXPLORATION

ASARCO

Exploration Department
Southwestern United States Division

November 18, 1991

Mr. Jon K. Ahlness
U.S. Bureau of Mines
Twin Cities Research Center
5629 Minnehaha Avenue South
Minneapolis, Minnesota 55417

Re: Subsidence Monitoring

Dear Jon:

As we discussed on the phone, I have revised the Proposed Subsidence Monument Location Map to show the new locations of the outlying subsidence monuments. The outlying subsidence monuments are now 3000' from the test site, and their positions have been rotated to keep the survey lines free of trees.

If the proposed subsidence monitoring network meets with the USBM's approval, please let me know so we can proceed with its construction.

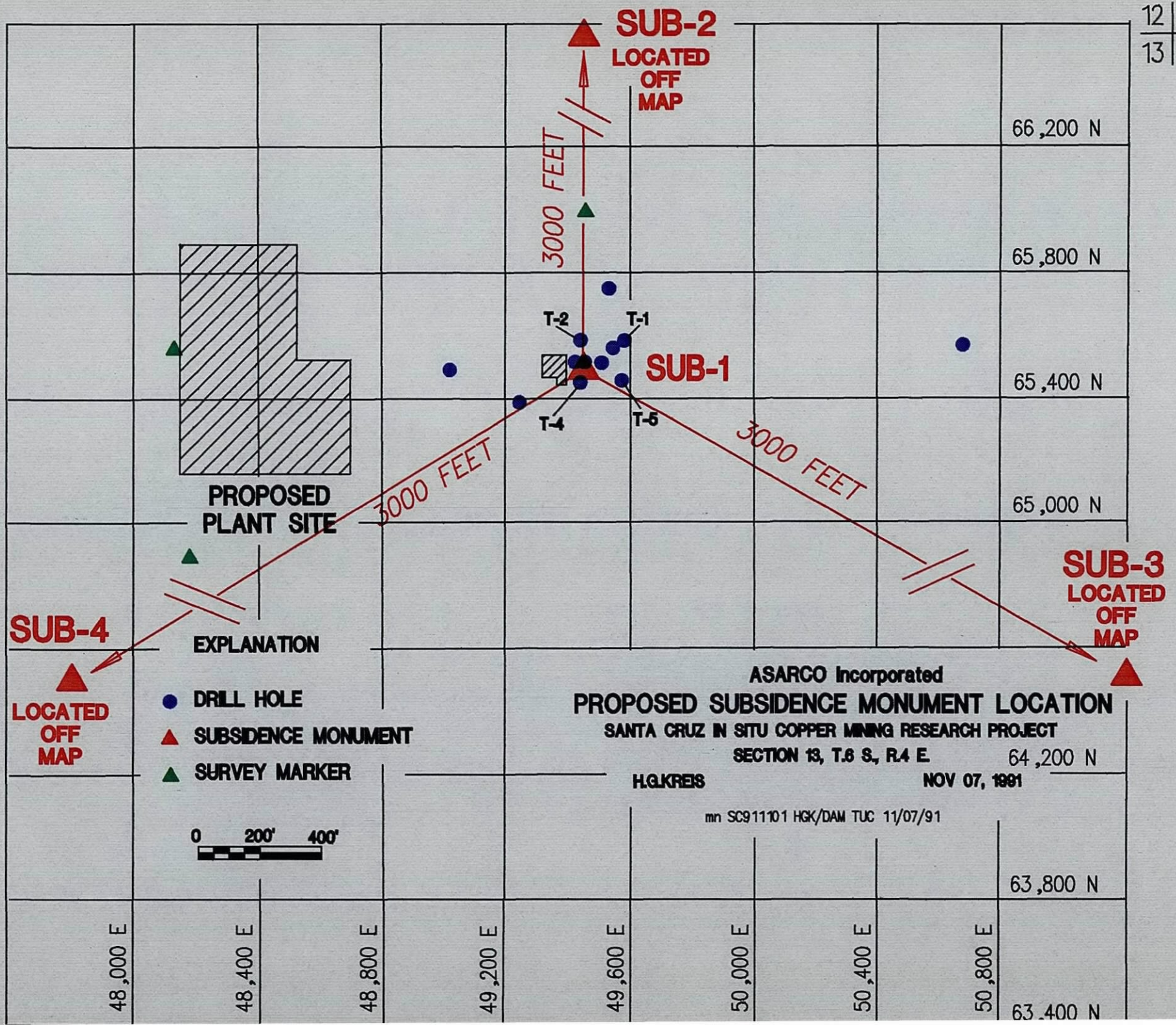
Sincerely yours,



Henry G. Kreis

HGK:mek
Enc.

cc: A.R. Raihl
F.T. Graybeal
S.A. Swan
W.L. Kurtz
J.D. Sell



Santa Cruz In Situ Copper Mining Project Offers Positive Results

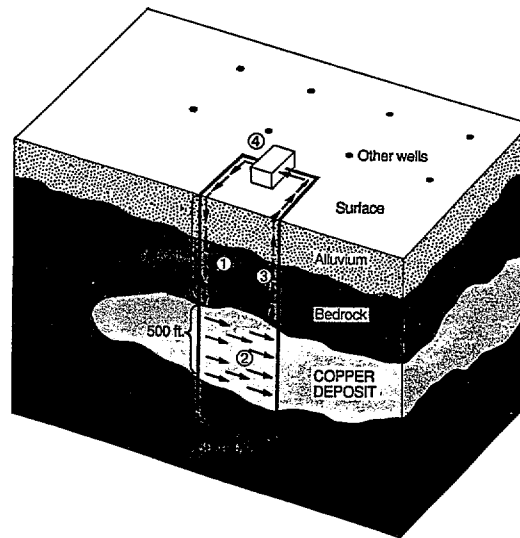
By A. R. Raihl

SUCCESSFUL INJECTION AND recovery of saline and bromine solutions at the Santa Cruz In Situ Copper Mining Research Project outside Casa Grande, Arizona, have led the joint venturers and the U.S. Bureau of Mines to begin preparing for the permitting process for a pilot scale well-field and surface plant.

Separately, in late October a joint House and Senate Conference Committee approved \$1.45 million for continuation of the research project. The funds were included in the 1992 Interior Appropriations Act by Senator Dennis DeConcini (D-AZ).

Asarco Santa Cruz, Inc. and Freeport Copper Company, the joint-venturers, subsidiaries of Asarco Incorporated and Freeport-McMoRan Inc., respectively, completed four and one-half months of tracer testing in mid-August. Good communication was achieved between the single central injection well and four peripheral recovery wells. Most encouraging, the researchers found, was that the best communication occurred in wells located in the areas with the highest copper mineralization.

The copper mining research project, a cooperative government-industry program, is designed to determine the feasibility of mining a deeply buried copper deposit in situ, or in place, by injecting a dilute solution of sulfuric acid to dissolve the contained oxide copper minerals. The copper-laden solution then would be pumped to the surface where the copper would be recovered



In-Situ Process Operation

- Dilute acid solution is pumped down an injection well to the copper deposit.
- Solution is injected into the copper deposit where copper is dissolved and solution is drawn to a recovery well.
- Solution is pumped from deposit to the surface.
- Copper is removed from solution in a surface plant and solution is circulated back to the injection well.

ered in a solvent extraction/electrowinning plant. The copper deposit is too deep and too low grade to be developed economically by conventional underground or open-pit mining methods.

The test solution was injected at an average rate of 25 gallons per minute and recovered at the rate of 26 gallons per minute. The recovery rate purposely exceeded the injection rate in order to generate a slight inward flow of groundwater to avoid an excursion of the saline solution. Monitor wells in the basin fill aquifer that overlies the mineralized zone showed no chemical or pressure response, indicating there was no migration of solution.

The results of the field tests have been in the range predicted. There was no short-circuiting of injected fluid and indications are that a large volume of rock was contacted by the solution. Based on this projection, an adequate recovery of copper can be achieved.

The saline tests were a prerequisite to injection of a dilute solution of sulfuric acid. Before the joint venture is allowed to inject the sulfuric acid,

it must obtain an Aquifer Protection Permit from the Arizona Department of Environmental Quality.

The solution tests plus other hydrological data are being used to generate a three-dimensional computer model that will examine the shape and flow paths at the test site. This information will form the basis for the Aquifer Protection Permit application.

To obtain the permit, the joint venture will have to demonstrate that the project can be designed and constructed with the best available demonstrated control technology and show that discharge will not cause or contribute to violation of an aquifer water quality standard.

The Bureau of Mines, which is studying the effects of drill core ore zone rocks on neutralization of dilute sulfuric acid, is generating the data to complete an Environmental Assessment as its portion of the project. Pending receipt of the necessary approvals, the pilot plant is expected to begin operation in 1993.

A. R. Raihl is the Manager of the Santa Cruz project.

DECEMBER 1991

AMC Journal Vol. 77, No. 12.

ASARCO

Southwestern Exploration Division

December 2, 1991

R.L. Brown
New York Office

H.G. Kreis
Monthly Report
November 1991

Santa Cruz In Situ Leach Project

Work in support of the Phase I and II report and the aquifer protection permit continued during the month of November.

A briefing on the results of the salt tracer test and other aspects of the project was given to Milt Ward of Freeport-McMoRan.

The USBM called off the AIME field trip to the Santa Cruz Test Site. The USBM felt presentations on the field trip would duplicate too much of the information being presented by the USBM and SCJV in talks at the national meeting.

Carl Windels and I met in Tucson to discuss the CSAMT Survey work. He plans to review the CSAMT results and give his opinion of the results and how the results compare to the known geology of the test site.

A 300 pound sample of the T-3 lower copper oxide zone was given to the USBM Salt Lake City Research Center. This sample will be used for on-going metallurgical test work.

Dan Millenacker, Pam Watson, Al Raihl and I reviewed and discussed an outline of the USBM's environmental assessment report. Mr. Millenacker and Ms. Watson were given information which would help them in their evaluation and report writing.

Mr. Simmons of Cimarron Farms approached Asarco with concerns about sodium in his farm soil. He says he wants reassurance the sodium is not related to the salt tracer test work. His concerns are being given due consideration.

Records of the Arizona Corporate Commission were reviewed to gather information on the corporations and corporate officers involved with Cimarron Farms and Cimarron Ranch.

Records of the Arizona Department of Environmental Quality were examined for complaints related to used oil recyclers. After this review Metro Oil of Tucson was chosen to dispose of the used oil and old diesel fuel from the test site.

A memo was written on taxation and hazardous waste disposal problems associated with the Searles Lake Solution mining operations.

Details of the subsidence survey monument network are being worked out with the USBM.

Santa Cruz Joint Venture

A quarterly meeting of the Operating Committee of the Santa Cruz Joint Venture is scheduled for December 10th at Asarco's Tucson Office.

HGK:mek



H.G. Kreis

cc: F.T. Graybeal
W.L. Kurtz
J.D. Sell ✓
A.R. Raihl

ASARCO

Exploration Department
Southwestern United States Division

December 12, 1991

Mr. S. Swan
U.S. Bureau of Mines
Twin Cities Research Center
5629 Minnehaha Avenue South
Minneapolis, Minnesota 55417

Re: Phase I and II Report

Dear Steve:

In our December 5th telephone conference call between you, me, John Nicol, John Pendleton, and Chris Manikas, we discussed the writing of the Phase I and II report. I would like to take a moment to summarize my understanding of the quality of the organization, technical writing, and editing of the Phase I and II report.

The Phase I and II report will be used only for internal USBM purposes and will not be made public. The USBM will use the Phase I and II report as source material for writing USBM interim report publications.

The quality of the organization, technical writing, and editing of the Phase I and II report is to be the same as that exhibited in the Phase I and II draft report of May 15, 1991. Such quality is adequate for the USBM's purposes, and the cost of upgrading the quality is not justified.

Three rough draft copies of the Phase I and II report will be given to the USBM in early 1991. If the USBM wishes to make changes, they can be requested at that time. Such changes will be incorporated into the final Phase I and II report.

Sincerely,



Henry G. Kreis

HGK:mek

cc: A.R. Raihl
F.T. Graybeal
W.L. Kurtz
J.D. Sell
J. Nicol
W.E. McCulloch

ASARCO

Exploration Department
Southwestern United States Division

December 13, 1991

Mr. Greg Knapp
Technical Services Center
ASARCO Incorporated
3422 South 700 West
Salt Lake City, Utah 84119

Dear Greg:

Here is a copy of the OHM Corporation's January 5, 1990 report on the closure of the landfill in Section 8, T6S, R5E.

Sincerely,



Henry G. Kreis

HGK:mek
enc.

cc: R.L. Brown (w/o enc.)
W.L. Kurtz (" ")
J.D. Sell (" ")
A.R. Raihl (" ")

ASARCO

Exploration Department
Southwestern United States Division

December 13, 1991

Mr. Carl Rutan
Cactus Productions
1507 No. Wakefield St.
Arlington, VA 22207

Dear Carl:

The original 4 reels of betacam video tape and time index sheets accompany this letter. These tapes are being provided to you for updating our existing Santa Cruz video.

Please return these original tapes to me when you are through with them.

Sincerely,



Henry G. Kreis

HGK:mek
encs.

cc: D. Noyes
A.R. Raihl
F.T. Graybeal
W.L. Kurtz
J.D. Sell

JOB: ASARCO

OPER: _____

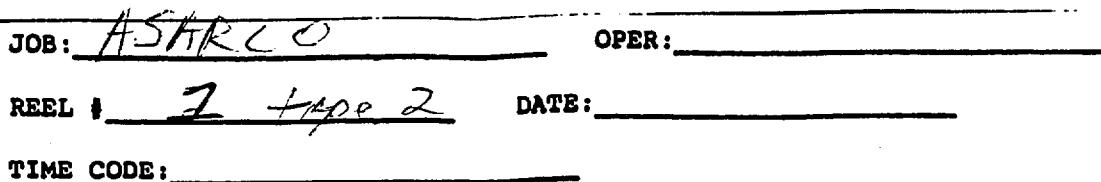
REEL # 1

DATE: _____

TIME CODE: _____

VTR LOG

SCENE DESCRIPTION/NUMBER	TAKE	COUNTER/ TIME CODE
WS of MINE from platform on forklift		01:00:50
WS w/ talent walking into shot		01:01:29
MS talent taking reading & walking back w/zoom out		01:01:50
PAW LT AS talent walks		01:02:45
*WS with talent(3) w/zoom into middle well		01:03:05
MS talent(1) w/zoom out AS talent leaves		01:03:35
WS talent walking into middle well		01:04:40
MS talent at well		01:05:13
MS w/zoom out talent leaving		01:05:25
WS from forklift of tanks		01:06:00
CU EAST BRINE MIXING TANK w/zoom out		01:07:02
*WS TANKS w/ talent(3)		01:07:45
MS Injection tank w/ pan RT		01:08:35
" " w/zoom to pump		01:08:55
WS Talent checking mixing tank		01:09:35
CU EAST BRINE MIXING TANK		01:10:00
Side view of TANKS		01:10:10
MS pump w/zoom into sample bottle	1	01:10:30
" " " "	2	01:10:50
* " " " "	3	01:11:10
CU Sampler Box w/tilt to pump	1	01:11:30
* " " " "	2	01:11:50
CU Recovery Storage		01:12:10
CU Frog		01:12:40
CU Pipes w/zoom out		01:13:00

[illegible]

JOB: ASARCO

OPER: _____

REEL # 2

DATE: _____

TIME CODE: _____

VTR LOG

SCENE DESCRIPTION/NUMBER	TAKE	COUNTER/ TIME CODE
*WS TANKS w/ gauge in foreground w/ zoom out		02:00:50
" "		02:01:25
		02:01:45
MS BRAD taking reading	1	02:01:53
* " "	2	02:02:10
CU meter		02:02:40
CU Gauges		02:02:50
WS of tanks w/ meter in foreground		02:03:20
(shows how cable is run from tanks to pump)		
CU salt bag w/ tilt up to salt mixing		02:04:05
CU salt mixing sample being taken	1	02:04:50
" " Bin	2	02:05:26
CU salt bag being dumped into bin		02:05:50
CU turning on & off water		02:06:15
MS solution being poured into bin		02:06:50
CU water sample		02:07:20
" " being put on bin		02:07:40
CU salt mixing TANK		02:08:00
*CU sample being taken from well spigot	1	02:08:20
" "	2	02:08:53
CU of well w/ zoom out to meter	1	02:09:24
	2	02:10:03
CU of meter		02:10:20
CU of gauge		02:10:40
CU of well w/ tilt up		02:11:20



JOB: ASARCO OPER: _____
REEL # 3 DATE: _____
TIME CODE: _____

VTR LOG

SCENE DESCRIPTION/NUMBER	TAKE	COUNTER/ TIME CODE
CU sample bottle w/ lab tech.		03:00:50
MS lab tech. grabbing bottle		03:01:16
MS lab. tech. working		03:01:30
CU lab tech putting ^{yellow} solution in beakers		03:03:40
CU turning on mixing machine		03:04:16
CU digital numbers moving		03:04:40
CU experiment being mixed		03:05:00
MS over the shoulder at tech w/ goggles		03:05:30
" " pushing buttons		03:06:00
CU digital numbers		03:06:25
CU newly mixed solution		03:06:35
WS of test		03:06:50
CU of mixing solution		03:07:10
Reshoot of WS w/ goggles (3:01:16)		03:07:30
* " " "		03:07:53
MS E. Brine tank w/ pan to LAB		03:08:17
MS Robert taking sample from salt mixing tank to lab 1		03:09:40
" " " "	2	03:10:13
* " " " "	3	03:10:35
CU Printer w/ pan		03:11:40
MS Printer w/ zoom in		03:12:00
CU Box w/ pan to Brad at Printer	1	03:12:30
* " " " "	2	03:13:00
CU Box w/ pan to printer		03:13:30
CU BRAD writing		03:13:50



JOB: ASARCO OPER: _____
REEL # 4 DATE: _____
TIME CODE: _____

VTR LOG

SCENE DESCRIPTION/NUMBER	TAKE	COUNTER/ TIME CODE
WS Hoses going out to pond w/zoom in	1	04:00:50
" " " "	2	04:01:15
* " " " "	3	04:01:28
WS Brad at meter by hose		04:01:50
* " " w/zoom to CU		04:02:28
WS Pond		04:03:00
" " w/PAN Lt.	1	04:03:26
" " "	2	04:03:50
" w/PAN Rt.		04:04:33
WS of mine from pond		04:04:55
" " " w/zoom to tanks	1	04:06:00
" " " "	2	04:06:30
* " " " w/CAR driving by	1	04:07:00
" " " (NO CAR)	2	04:07:35
CU of well w/zoom out (on top of forklift)		04:08:10
PAN of mine Lt & Rt		04:08:33
CU of well /zoom out to show mine		04:09:11
" " " "		04:09:30
PAN of mine Lt & Rt		04:10:00
WS Mine zoom to single well		04:10:35
WS Mine /zoom in as talent (2) walk on		04:11:00
CU talent /zoom out to WS Mine		04:11:32
WS Mine w/talent (SUNSET)		04:12:20
* WS TANKS w/talent /zoom in		04:14:40
CU TALENT on stairs w/zoom out		04:15:24

December 14, 1991

F.T. Graybeal
New York Office

Milt Ward Visit
Santa Cruz Project
Pinal County, Arizona

On November 27th Al Raihl and I updated Milt Ward and Steve Van Nort of Freeport-McMoRan on the progress of the Santa Cruz Project. Following that meeting, Mr. Raihl and I talked with you about the meeting, and you requested a memo describing Mr. Ward's questions, concerns, etc. about the project. The following is in reply to that request.

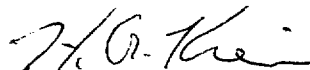
The general tone of Mr. Ward's questioning and commenting was relaxed and friendly. The questions were asked in regard to many different topics throughout our presentation. The nature of the questions expressed a positive, let's move ahead, businesslike attitude. The questions culminated in a discussion on when the test work, if successful, might result in going into commercial production, the capital costs involved, annual production rates, and operating costs.

Mr. Ward asked a number of environmentally oriented questions about the in situ leach test work, but didn't express any reservations about proceeding with the project. He was quite interested in the results of the salt tracer test and asked a number of questions about permeability and fluid flow. His interest was sparked by the fact Freeport had considered purchasing a uranium in situ mining operation some time ago, and he was interested in the differences in the fluid flow between a sandstone and a fractured granite.

Mr. Ward was interested in the possible acquisition of Texaco's 1088 acre parcel. We reviewed the mineral potential, some of the possible land problems and environmental concerns, and the status of the current negotiations. He seemed pleased with the possibility of acquiring the Texaco land.

The meeting concluded with some questions on the upcoming December 10th SCJV meeting.

HGK:mek



H.G. Kreis

cc: A.R. Raihl
W.L. Kurtz
J.D. Sell

December 14, 1991

F.T. Graybeal
New York Office

Milt Ward Visit
Santa Cruz Project
Pinal County, Arizona

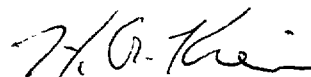
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H.G. Kreis

HGK:mek

cc: A.R. Raihl
W.L. Kurtz
J.D. Sell



Southwestern Exploration Division

December 16, 1991

FILE MEMO

Copper in Test Site
Freeport-McMoRan
Santa Cruz Project
Pinal County, Arizona

Following a presentation to Mr. Milt Ward of Freeport-McMoRan, it occurred to me that perhaps Mr. Ward was not fully aware of the lack of copper in the lower copper oxide horizon of test wells T-1 and T-5.

I talked to Walt McCulloch about this, and Mr. McCulloch said he had told Mr. Ward of this situation some time ago but wasn't sure if Mr. Ward still remembered it. Mr. McCulloch was given consideration to reminding Mr. Ward.

It is important the everyone is aware of the lack of the lower copper oxide horizon in test wells T-1 and T-5.

HGK:mek

A handwritten signature in dark ink, appearing to read "H.G. Kreis".

H.G. Kreis

cc: A.R. Raihl
F.T. Graybeal
W.L. Kurtz
J.D. Sell

ASARCO

Exploration Department
Southwestern United States Division

December 16, 1991

Ms. Linda J. Dahl
U.S. Bureau of Mines
Twin Cities Research Center
5629 Minnehaha Avenue South
Minneapolis, Minnesota 55417

Re: Geology Open File
Report

Dear Linda:

I read through our open file report "Geology of the Santa Cruz In Situ Copper Mining Research Project." I made some comments, corrections, etc., all of which are shown on the enclosed Xerox copy. Once you receive this copy, we can talk about the details by phone.

It is my understanding from talking with Steve Swan, a rough draft copy is going to be circulated by all parties concerned before going into final print.

Call me after you get a chance to look over my comments.

Sincerely,



Henry G. Kreis

HGK:mek
enc.

cc: A.R. Raihl (w/o enc.)
F.T. Graybeal (w/o enc.)
W.L. Kurtz (w/o enc.)
J.D. Sell (w/o enc.)

VIA TELEFAX
212-510-2191

December 20, 1991

Mr. Terry Hinckson
Controller's Department
NEW YORK OFFICE

Santa Cruz Project
Capital Expenditures

The following capital expenditures are estimated for the Santa Cruz In Situ Copper Mining Research Project for the next five years.

January 1992	\$ 30,000
February 1992	\$ 30,000
March 1992	\$ 30,000
2nd Quarter 1992	\$ 90,000
3rd Quarter 1992	\$ 90,000
4th Quarter 1992	\$330,000
1993	\$700,000
1994	\$340,000
1995	\$340,000

The above capital expenditures are based on the following assumptions:

1. Obtain authority to begin purchasing equipment - September 1992
2. Obtain authority to begin pilot plant construction - December 1992
3. Begin in situ leach testing - January 1994
4. Complete in situ leach testing - June 1995
5. Complete facility closure and data interpretation - December 1995

The listed capital expenditures are only for the in situ copper mining research project and do not include expenditures for other aspects of the Santa Cruz Project.



A. R. Raihl

ARR:brw

cc: R. J. Kupsch
R. L. Brown
F. T. Graybeal
WLK/HGK

RECEIVED

DEC 23 1991

EXPLORATION DEPARTMENT



ASARCO

Exploration Department
Southwestern United States Division

December 24, 1991

Mr. John Nicol
SAIC
1710 Goodridge Drive
Mail Stop T-2-2-1
McLean, Virginia 22102

Re: Phase I & II Report

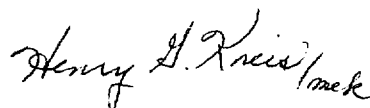
Dear John:

I am loaning the following reports to you so that you can make duplicate copies from them:

Woodward-Clyde, signed September 13, 1991, "Santa Cruz Report"
Zonge Engineering, February 1991, CSAMT Monitoring Survey
Zonge Engineering, June 1991, CSAMT Monitoring Survey
Zonge Engineering, May 1990, CSAMT Survey.

Please return these reports to me when you are through with them.

Sincerely yours,

A handwritten signature in cursive script that reads "Henry G. Kreis". To the right of the signature, the word "mek" is written in a smaller, less stylized font.

Henry G. Kreis

HGK:mek
encs.

cc: A.R. Raihl (w/o encs.)
F.T. Graybeal (w/o encs.)
W.L. Kurtz (w/o encs.)
J.D. Sell (w/o encs.)

ASARCO

Exploration Department
Southwestern United States Division

January 2, 1992

Mr. J. Nicol
SAIC
1710 Goodridge Drive
Mail Stop T-2-2-1
McLean, Virginia 22102

Re: Phase I and II Report

Dear John:

Please find enclosed Priscilla Robinson's updated revision of Section 13 in the Phase I and II Report.

Sincerely,



Henry G. Kreis

HGK:mek
enc.

cc: A.R. Raihl
F.T. Graybeal (w/o enc.)
W.L. Kurtz (" ")
J.D. Sell (" ")

ASARCO

Exploration Department
Southwestern United States Division

January 7, 1992

Cissell Drilling Company
P.O. Box 1048
Casa Grande, Arizona 85222

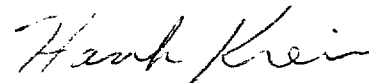
Dear Mr. Cissell:

Previously we talked about the cost of constructing four subsidence survey monuments at the Santa Cruz test site. At this time, I would like to have a written cost proposal from Cissell Drilling Company to do the work described in the accompanying Statement of Work.

As in the past, updated copies of your certificate of insurance and certificate of workers compensation insurance are also needed.

If you have any questions, please feel free to call me.

Sincerely,



Henry G. Kreis

HGK:mek
Enc.

cc: A.R. Raihl (w/enc.)
F.T. Graybeal (w/o enc.)
W.L. Kurtz (w/o enc.)
J.D. Sell (w/o enc.)

Exploration Department
Southwestern United States Division

January 17, 1992

Mr. Jim Murphy
Reno Metallurgy Research Center
U.S. Bureau of Mines
1605 Evans Ave.
Reno, Nevada 89505

Chalcopyrite Core
for Leaching Studies

Dear Mr. Murphy:

In our correspondence of last month I mentioned obtaining and sending pyrite-chalcopyrite samples for your chalcopyrite leaching studies. Accompanying this letter you will find sixty pounds of pyrite-chalcopyrite core samples from our Santa Cruz Deposit.

I looked over a number of pyrite-chalcopyrite intercepts from our Santa Cruz Deposit. Individual pieces of core with uniform pyrite (50% of total sulfide content) and chalcopyrite (50% of total sulfide content) and little or no chalcocite are difficult to find. In part, this is because the total sulfide content and the ratio of pyrite to chalcopyrite are quite variable on the scale of 4 inch lengths of split core. Consequently, I found only a rather small number of sufficiently large and geologically suitable pieces of core. Since you are pulverizing some samples and since there is more homogeneity of pyrite-chalcopyrite mineralization in samples over 5 foot intervals, I collected a half dozen bulk samples of core over 5 foot intervals. There is some variance in the geology of the samples so a brief description of each sample follows.

Thirteen pieces of split core were taken from CG-23 between 2685 feet and 2751 feet. This is an interval of altered Precambrian granite with 2.5% total sulfides, a one pyrite to one chalcopyrite ratio, and a grade of 0.6% Cu. Very small amounts of chalcocite are present, and it appears less than 15% of the copper content occurs in the form of chalcocite.

Four pieces of split core and two bulk samples are from an interval in CG-42 between 2686 feet and 2798 feet. The geology of this interval is altered Precambrian granite with 2% total sulfides, a ratio of one pyrite to one chalcopyrite, and 0.3 to 0.8% Cu. The CG-42 seven pound bulk sample from 2675 feet to 2680 feet is from a 9 foot assay interval with 0.44% Cu. The CG-42 eight pound bulk sample from 2800 feet to 2805 feet is from a 9 foot assay interval with 0.53% Cu.

Two bulk samples of Precambrian granite with pyrite-chalcopyrite mineralization were collected from CG-98, an eight pound sample from 2631 feet to 2636 feet, and a nine pound sample from 2744 feet to 2750 feet. The former sample is from a 10 foot interval of 0.47% Cu, and the latter sample is from a 10 foot interval with 0.51% Cu. The general geology in the area of these two samples is altered Precambrian granite with 2% total sulfides and a ratio of three pyrite to one chalcopyrite.

Two bulk samples of altered Precambrian granite with chalcopyrite were taken from CG-90, a nine pound sample from 2971 feet to 2980 feet with 0.57% Cu and an eight pound sample from 3001 feet to 3008 feet. The latter is from a 12 foot assay interval averaging 0.90%. These two bulk samples were taken from the same interval of individual core samples submitted to you with my letter of December 12, 1991.

Although I haven't examined any thin sections near the location where the above samples were taken, I can tell you in general about the alteration of the granite in the Santa Cruz deposit. Prior to alteration and the introduction of sulfide mineralization, the Precambrian granite originally was composed of 4% biotite, 17% plagioclase, 40% K-feldspar, and 39% quartz. These rock forming minerals were then altered during, more or less, the deposition of the pyrite-chalcopyrite mineralization.

In the altered Precambrian granite, biotite is moderately altered to secondary biotite and sericite. Plagioclase is strongly altered to sericite, clay, and secondary K-feldspar. K-feldspar is weakly altered to sericite in samples with chalcopyrite and little or no pyrite, but moderately to strongly altered to quartz-sericite in samples with more abundant pyrite. Quartz is unaltered.

As in the past, if you have any questions about the geology, please let me know.

Sincerely,

A handwritten signature in cursive script that reads "Hank Kreis".

Henry G. Kreis

cc: F.T. Graybeal
W.L. Kurtz
J.D. Sell
A.R. Raihl
D.E. Crowell
W.E. McCulloch

ASARCO

JDS

Mining Department

A. R. Raihl

VIA TELEFAX
881-1609

ASARCO Incorporated

January 16, 1992

JAN 17 1992

SW Exploration

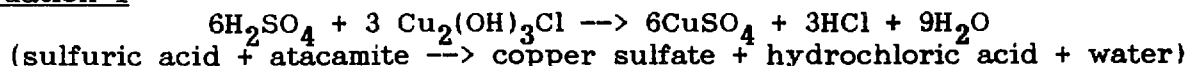
Mr. C. F. Barter
Errol L. Montgomery & Associates, Inc.
1075 E. Ft. Lowell Road, Suite B
Tucson, AZ 85719

Dear Mr. Barter:

Santa Cruz Project
Application for APP

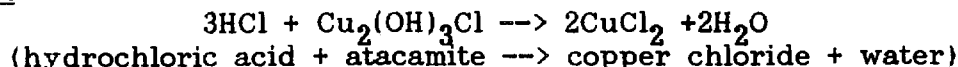
In the initial drafts of the reports by Mr. S. Paulson ("Mature Leach Solution") and Ms. D. Morosas ("Attenuation Capacity Tests"), the reader may perceive that when atacamite is leached with sulfuric acid, additional acid is generated which in turn leaches more atacamite which in turn generates more acid and so on until the world is dissolved. This is not the case. The dissolution of atacamite can best be described by a two-step chemical equation:

Equation 1



In the first step of the dissolution reaction, some hydrochloric acid is produced; however, this acid is consumed in the second step of the dissolution reaction.

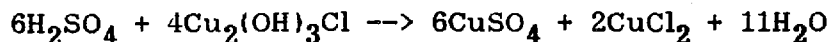
Equation 2



All acid has been consumed, as can be seen on the right hand side of the equation.

The overall dissolution chemical equation is as follows:

Equation 3



As can be seen on the right hand side of the chemical equation, no acid is generated by the dissolution of atacamite by sulfuric. All references to the generation of acid by the dissolution of atacamite by sulfuric acid should ~~either~~ be eliminated or adequately explained in Diane's and Steve's reports. *either*



When the dissolution of atacamite (pure) by sulfuric acid is combined with the removal of the copper by solvent extraction (LIX 986), additional acid is produced. However, this "excess acid" will be produced in the surface facilities where it can be controlled if required.

The solvent extraction chemical reaction is as follows:

Equation 4



For all practical purposes, the organic extractant (Org) remains unchanged in the recirculating solvent extraction circuit. Also, the copper sulfate is reduced in the electrowinning circuit and plated on the cathodes with no other overall chemical reaction except for the evolution of oxygen gas.

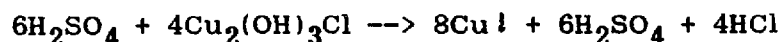
Equation 4 can be rewritten to show the chemical reaction with the exception of oxygen generation through solvent extraction and electrowinning.

Equation 5



By combining the left hand side of Equation 3 with the right hand side of equation 5, the overall chemical equation of the dissolution of atacamite by sulfuric acid through solvent extraction-electrowinning can be shown:

Equation 6



Therefore, in the overall dissolution-solvent extraction-electrowinning reaction, for each 6 moles of sulfuric acid used an additional 4 moles of hydrochloric acid (equivalent to 2 moles of sulfuric acid) is produced. This excess acid must be removed from the system.

The excess acid will be removed from the system in the following ways:

1. There will be a continuous bleed of raffinate from the system to maintain a water balance. A portion of the excess acid will be removed from the bleed stream.
2. Gangue material in the rock will consume a portion of the acid. The quantity of acid consumed in this manner is unknown.
3. Sulfuric and hydrochloric the acid will be consumed by dissolving the copper from atacamite. A portion of the dissolved copper will never be recovered during the planned period of operation.
4. Excess acid, if required, can be neutralized (consumed) by using limestone, lime, or caustic soda. The neutralization process would be conducted at the surface plant.

5. Acid (H^+) and chloride (Cl^-) could be removed from the solution by using either a separate solvent extraction circuit or a separate ion exchange resin circuit.

Controlling the acid strength in the solution being injected into the ore zone will be no problem during the two to four year planned operation period of the pilot program. If the bleed stream and the gangue consumption do not control the acid strength, a minor amount of caustic will be added to the solution being injected.

Yours truly,



A. R. Raihl
Project Manager

ARR:brw

cc: S. A. Swan
F. T. Graybeal
WLK/HGK



ASARCO

Exploration Department
Southwestern United States Division

January 21, 1992

Mr. John Nicol
SAIC
1710 Goodridge Drive
Mail Stop T-2-2-1
McLean, Virginia 22102

Re: Phase I & II Report

Dear John:

Enclosed are corrected versions of Table 3-3, Figure 3-2, Figure 4-4,
and Figure 4-13 for the Phase I & II Report.

Sincerely,



Henry G. Kreis

HGK:mek

cc: A.R. Raihl (w/o encs.)
F.T. Graybeal (" ")
W.L. Kurtz (" ")
J.D. Sell (" ")

ASARCO

Exploration Department
Southwestern United States Division

January 28, 1992

Mr. W.E. McCulloch, Jr.
Freeport Mining Company
P.O. Box 61520
New Orleans, Louisiana 70161

Re: Santa Cruz Project
Slides

Dear Walt:

Here are fourteen duplicate slides of the Santa Cruz Project. I hope these will be of use to you for your AIME talk next month.

If there are other slides for which you would like to have duplicates, please let me know.

Sincerely,



Henry G. Kreis

HGK:mek
Encs.

cc: A.R. Raihl
F.T. Graybeal
W.L. Kurtz
J.D. Sell



Southwestern Exploration Division

February 7, 1992

A.R. Raihl

Phase I & II Report
Santa Cruz In Situ
Pinal County, Arizona

Here is the distribution list for the Phase I and II report when it is completed.

	<u>Text, No. of copies</u>	<u>Appendix, No. of copies</u>
Asarco	9	5
Freeport	2	1
USBM	15	3
Mont. & Assoc.	1	0
KD Eng.	1	0
SAIC	<u>4</u>	<u>2</u>
<u>Total</u>	<u>32</u>	<u>11</u>

HGK:mek


H. G. Kreis

cc: F.T. Graybeal
W.L. Kurtz
J.D. Sell
John Nicol
Steve Swan

ASARCO

Exploration Department
Southwestern United States Division

February 7, 1992

Mr. John Nicol
SAIC
1710 Goodridge Drive
McLean, Virginia 22102

Re: Phase I and II
Report

Dear John:

Enclosed is Appendix 20, "Santa Cruz Project Press Coverage," for inclusion in the Phase I and II report. The enclosed material is in the form of both hard copy and floppy (with Word Perfect).

KD Engineering will be sending you their portion of the text by the end of next week.

Completion of the Montgomery and Associates portion of the text has been delayed by work on the Aquifer Protection permit which, as we all know, has priority over the Phase I and II report. At this time it appears Montgomery and Associates will finish their work on the Phase I and II report in a week or two (subject to Aquifer Protection permit delays).

HGK:mek
enc.


H.G. Kreis

cc: A.R. Raihl (w/o enc.)
F.T. Graybeal (w/o enc.)
W.L. Kurtz (w/o enc.)
J.D. Sell (w/o enc.)
S.A. Swan (w/o enc.)

ASARCO

Exploration Department
Southwestern United States Division

February 12, 1992

Phyllis Donato
Contract Administrator
New York Office

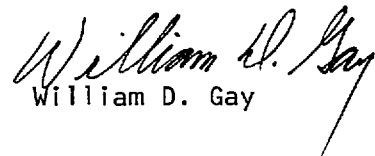
Santa Cruz Project
Pinal County, AZ
Document Book Entries

Enclosed are copies of the New Uses Statement of Claimant Forms for Other Uses on the following wells (Certificate No. 58-110104.000):

55-523899
55-523900
55-523901
55-525309
55-525310
55-528249

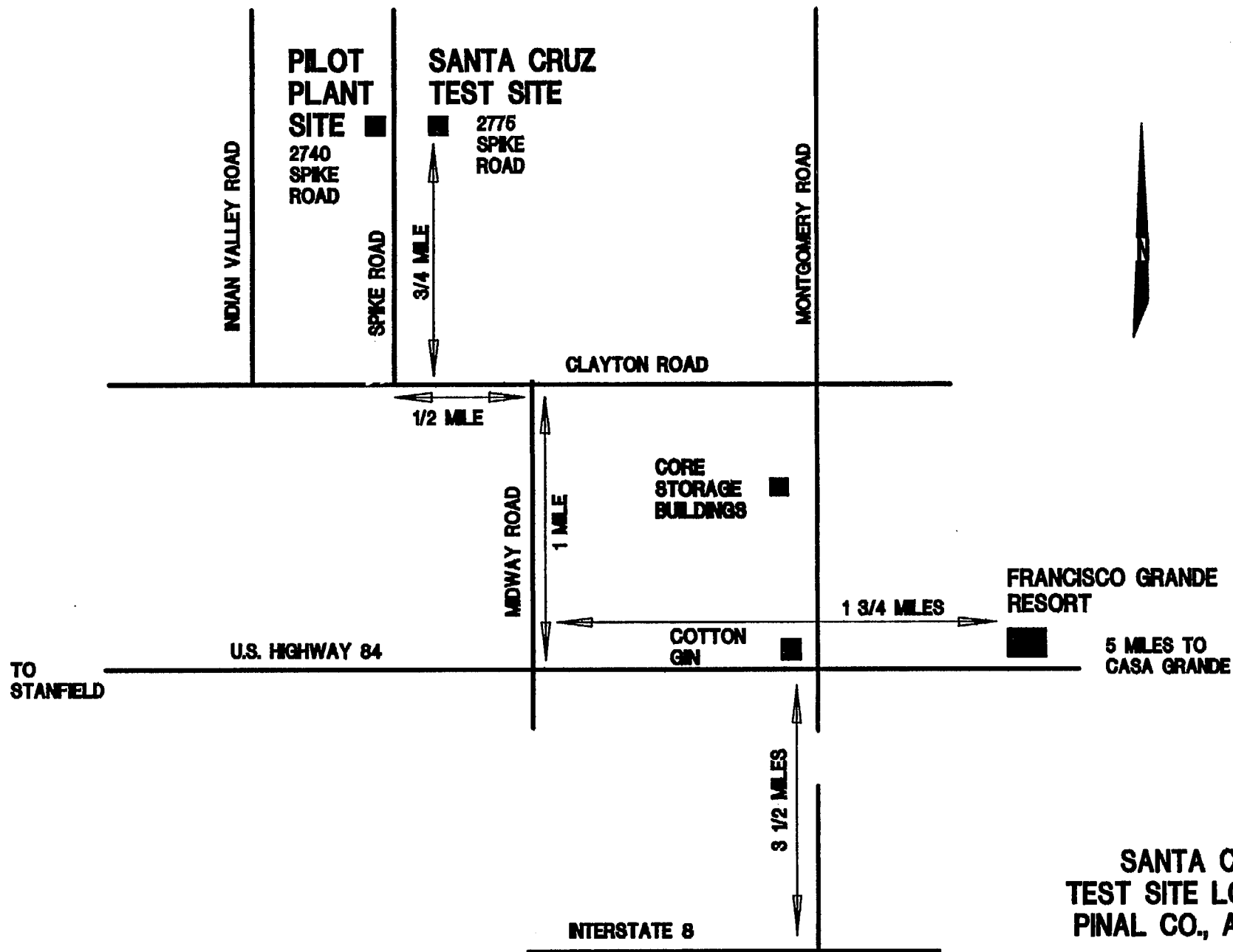
These have been entered in the Santa Cruz Document Book under Document Number 30-8-4.

WDG:mek
encs.


William D. Gay

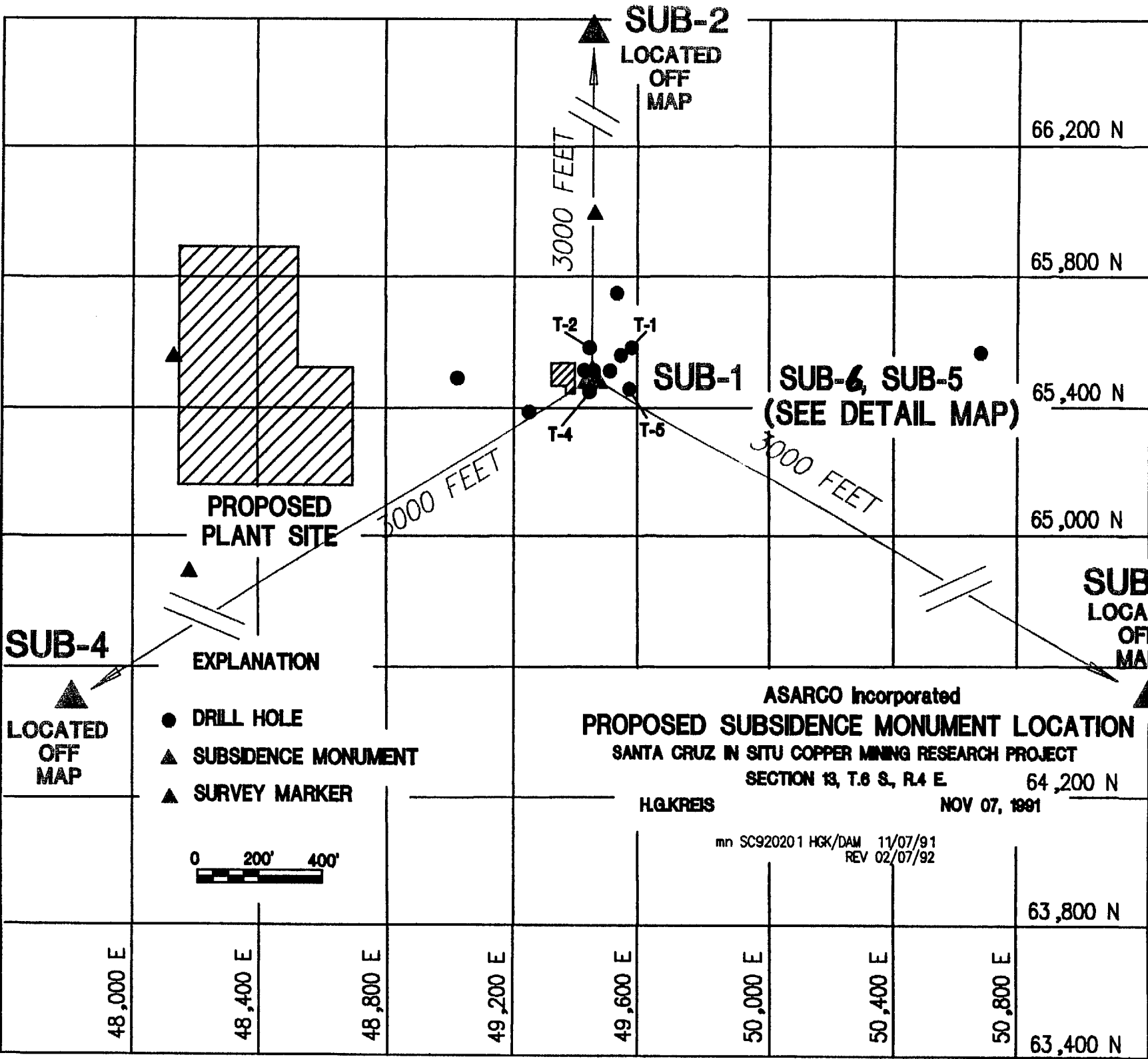
cc: G.D. Van Voorhis (w/o encs.)
W.L. Kurtz (" ")
J.D. Sell (" ")

ASARCO Incorporated P.O. Box 5747 Tucson, Az 85703-0747
1150 North 7th Avenue (602) 792-3010

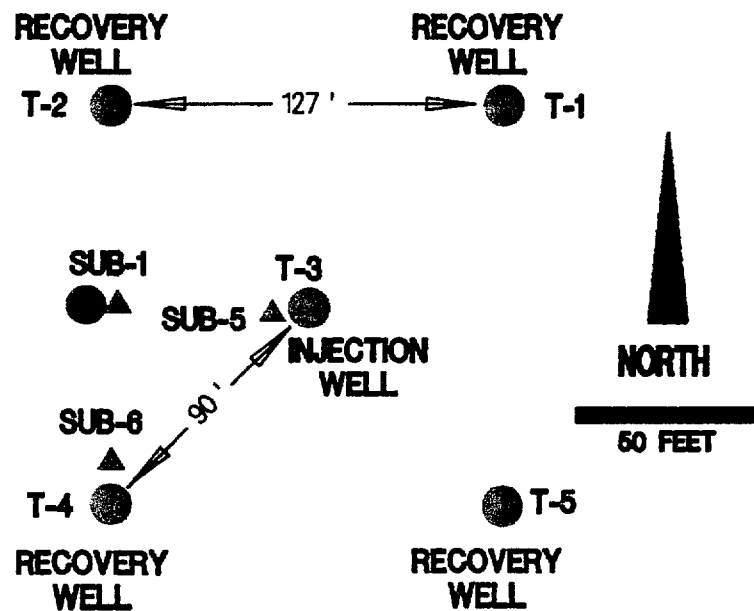


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SC9 10308 HGK/DAM TUC 03/20/91
PLOT CHG: SP5-SP7;PWO.25



SANTA CRUZ IN SITU TEST SITE



EXPLANATION

- TEST WELLS
- ▲ SUBSIDENCE MONUMENT
- HYDROLOGIC TEST WELL

H.G. Kreis
February 14, 1992

Statement of Work for Subsidence Monument Construction

A total of six monuments are to be constructed, three onsite monuments and three offsite monuments.

Location

All of the subsidence monuments will be constructed within 3000' of the Santa Cruz In Situ Copper Mining Research test site. The accompanying maps show the location of the test site and the location of the subsidence monuments about the test site. The exact ground location of the subsidence monuments will be determined and flagged by Asarco.

All of the site locations are on flat, retired agricultural fields which have easy access and no need for drill site preparation.

Ground Conditions

The drill holes used in the construction of the subsidence monuments will penetrate alluvial material consisting of weakly consolidated sand, silt, and clay.

Offsite Monument Construction Specifications

(1) All three offsite subsidence monuments (SUB-2, -3, and -4) will be constructed alike according to the following description and the accompanying figure for offsite monument construction entitled "Above Ground Subsidence Monument Construction."

(2) Drill a 6.25" diameter hole to a depth of 20'. The hole can be drilled with air (if it stays open), air and foam, or mud.

(3) Attach 2 sets of centralizers on a 20' length of 2" diameter Schedule 40 steel pipe (pipe with attached centralizers supplied to driller by Asarco Santa Cruz Inc.).

(4) Lower the 20' long, 2" diameter Schedule 40 steel pipe with centralizers into the hole to a depth of one foot above the bottom of the hole.

(5) Cement the bottom 15' of the hole using a tremie pipe or the 2" diameter pipe already in the hole.

6) Backfill the annulus between the hole and the 2" steel pipe with

drill cuttings up to a depth of three feet below the surface of the ground.

(7) Install a survey monument (supplied by Asarco Santa Cruz Inc.) on the top of the 2" pipe.

(8) Insert into the hole around the 2" pipe a 5' length of 4" diameter steel casing having a flange-like steel plate welded to the bottom (supplied by Asarco Santa Cruz Inc.). This casing should extend 2' above the surface of the ground.

(9) Backfill the annulus between the 4" casing and the walls of the hole and the annulus between the 4" casing and the 2" pipe with drill cuttings.

(10) Install a removable steel cap on the top of the 4" casing.

(11) Clean site of all materials. Cuttings can be left on the ground.

Onsite Monument Construction Specifications

(1) All three onsite subsidence monuments (SUB-1, -5, and -6) will be constructed alike according to the following description and the accompanying figure for onsite monument construction entitled "Below Ground Subsidence Monument Construction."

(2) Drill a 6.25" diameter hole to a depth of 20'. The hole can be drilled with air (if it stays open), air and foam, or mud.

(3) Attach 2 sets of centralizers on a 18' length of 2" diameter Schedule 40 steel pipe (pipe with attached centralizers supplied to driller by Asarco Santa Cruz Inc.).

(4) Lower the 18' long, 2" diameter Schedule 40 steel pipe with centralizers into the hole to a depth of one foot above the bottom of the hole.

(5) Cement the bottom 15' of the hole using a tremie pipe or the 2" diameter pipe already in the hole.

6) Backfill the annulus between the hole and the 2" steel pipe with drill cuttings up to a depth of four feet below the surface of the ground.

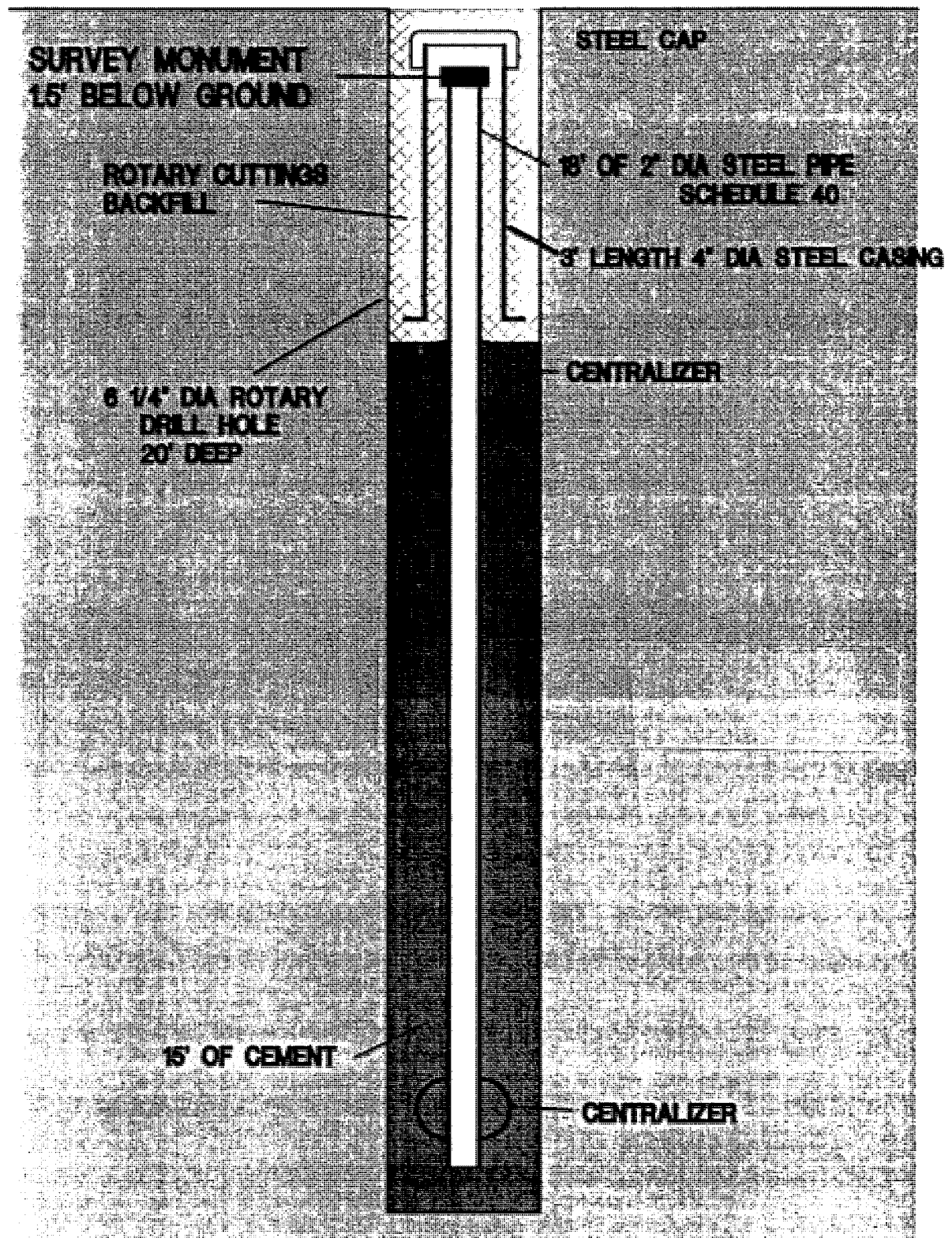
(7) Install a survey monument (supplied by Asarco Santa Cruz Inc.) on the top of the 2" pipe.

(8) Insert into the hole around the 2" pipe a 3' length of 4" diameter steel casing having a flange-like steel plate welded to the bottom (supplied by Asarco Santa Cruz Inc.). The top of this casing should be about 1' below the surface of the ground.

(9) Backfill the annulus between the 4" casing and the walls of the hole and the annulus between the 4" casing and the 2" pipe with drill cuttings.

(10) Install a removable steel cap on the top of the 4" casing.

(11) Clean site of all materials. Cuttings can be left on the ground.

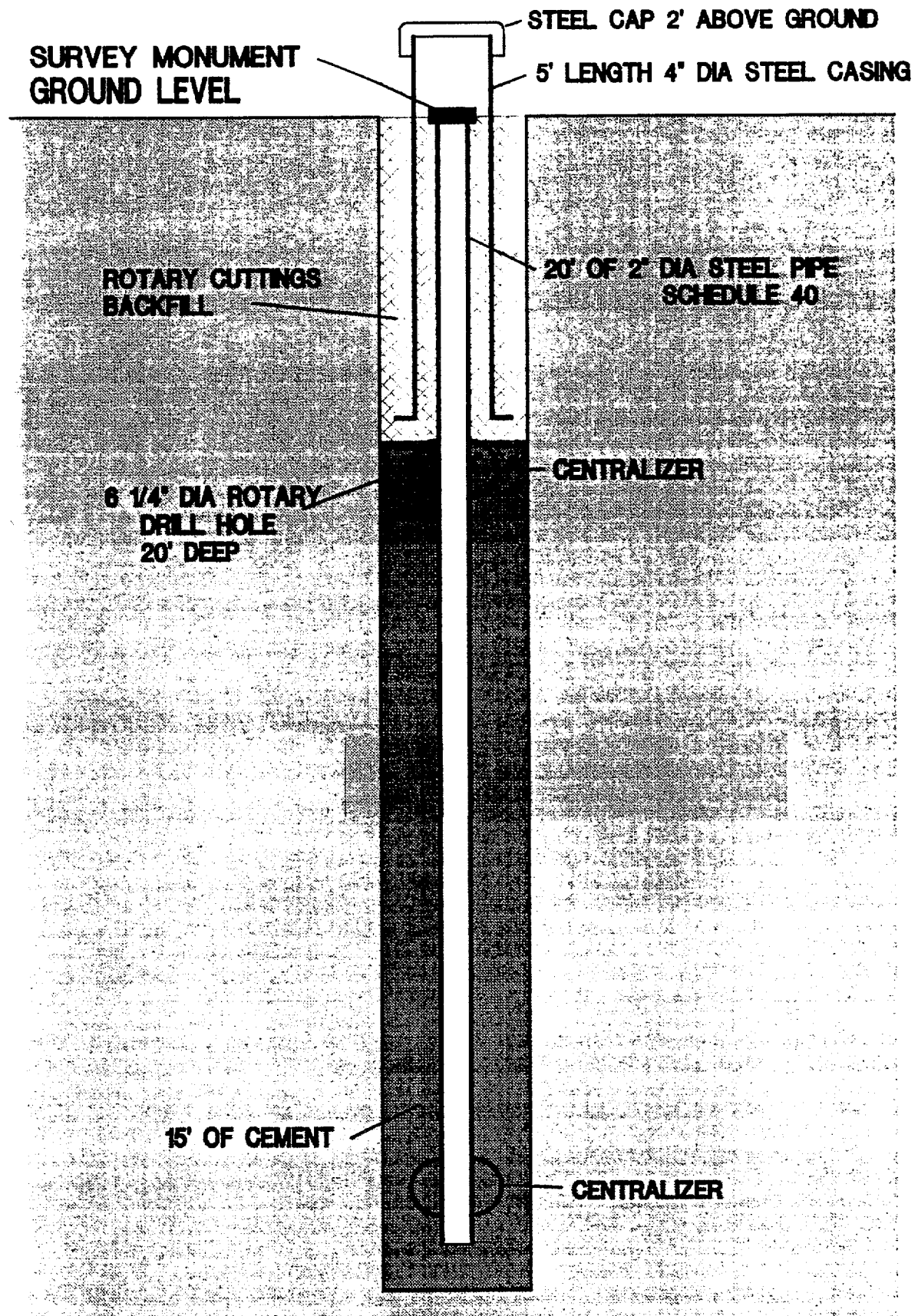


NOT TO SCALE

**FOR: SUB-1
SUB-5
SUB-6**

**ASARCO Incorporated
BELOW GROUND
SUBSIDENCE MONUMENT CONSTRUCTION
SANTA CRUZ IN SITU COPPER MINING RESEARCH PROJECT
H.G.KREIS**

mn SC920204 HGK/DAM 02/11/92



NOT TO SCALE

**FOR: SUB-2
SUB-3
SUB-4**

**ASARCO Incorporated
ABOVE GROUND
SUBSIDENCE MONUMENT CONSTRUCTION
SANTA CRUZ IN SITU COPPER MINING RESEARCH PROJECT
H.G.KREIS**

mn SC920202 HGK/DAM 02/11/92

PURCHASE ORDER

W/LK-JDS

PLANT JOB NO.

APPROPRIATION NO.

ASARCO Santa Cruz, Inc.

TUCSON OFFICE
P. O. BOX 5747

1150 NORTH 7TH AVENUE
TUCSON, ARIZONA 85703

DATE

2-14-92

ORDER NO.

SC-92-38

REQUISITION NO.

To:

Smith Pipe & Steel Co.
P.O. Box 899
Phoenix, AZ 85001
Att: Kathy Hampton
Dispatcher: Danny

DATE REQUIRED AT DESTINATION:

SHIPPING INTERVAL PROMISED

SELLER WILL SHIP BEFORE:

POINT OF SHIPMENT

TERMS:

F.O.B. POINT

FINAL DESTINATION — PLEASE NOTE CONSIGNMENT BELOW

Santa Cruz Test Site
7 miles West of Casa Grande, AZ

CONSIGNMENT — SELLER WILL SHIP TO

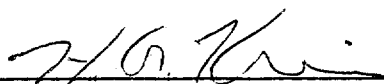
— RENDER BILLS AS PER ATTACHED SHIPPING INSTRUCTIONS —

SHIP VIA

QUANTITY	UNIT	SPECIFICATIONS	ITEM NO.	UNIT PRICE
		Order placed via phone February 14, 1992 (Telephone: 1-800-352-4596, FAX: 602-253-8770)		
		<u>DO NOT DUPLICATE</u>		
6		21' lengths, 2" diam, Sch. 40 steel pipe, threaded & coupled		\$1.34/ft.
2		21' lengths, 4" diam., Sch 40 steel pipe threaded & couples		4.44/ft.
3		20' lengths of flat band steel, ½" wide, 1/8" thick		.11/ft.
		Deliver Friday, February 21, 1992 to test site as located on attached map.		

Accounting (2)
Site
A.R. Raihl
F.T. Graybeal
W.L. Kurtz/J.D. Sell

PLEASE ENTER OUR ORDER FOR THE ITEMS SPECIFIED ABOVE. SUB-
JECT TO ALL INSTRUCTIONS AND PROVISIONS ON REVERSE SIDE.


H.G. Kreis, Site Manager

INSTRUCTIONS

INVOICE: Priced invoices in the requisite number giving the correct purchase order and requisition numbers, together with required Bills of Lading, must be forwarded on day of each shipment AS PER SPECIAL SHIPPING INSTRUCTIONS ACCOMPANYING THIS ORDER. otherwise delay in payment of account may result.

TERMS: As previously arranged or specified on this order. Care must be exercised to show cash discount, if allowed, on face of invoice.

PROVISIONS

1. **ACCEPTANCE:** Acceptance of this order constitutes acceptance of all terms herein stated. All representations and warranties by the seller relating to the subject-matter of this order or its performance shall be binding on the seller as if fully set forth herein, and shall survive inspection and acceptance of the goods ordered. No acknowledgment or acceptance of this order or any other communication by the seller shall vary or add any terms or conditions to those contained herein and any such attempted modification or addition which is not accepted in writing by the buyer, shall be void and may be disregarded without further notice or disclaimer.

2. **PRICES:** This order must not be filled at higher prices than last quoted without authority of the buyer.

3. **SHIPMENTS:** All materials must be forwarded by the route designated and seller will be held strictly accountable for any deviation therefrom.

When the material covered by this order shall aggregate a carload shipment or more, the seller must forward in carload lots, unless duly authorized in writing by the buyer to ship in less than carloads. If this order aggregates less than a minimum carload, seller must forward the entire quantity at one time unless otherwise authorized in writing by the buyer.

When blocking or dunnage, etc., not constituting a part of the car are used to protect and make shipments secure in transit, seller must show on Bills of Lading, separately, the weights of such materials, provided the lading shall aggregate a minimum carload or more, and will be held responsible for failure to comply with this rule.

Shipments will not be considered as completed until Bill of Lading, or express or mail receipt is received.

4. **PACKING AND CARTAGE CHARGES:** No charge will be allowed for packing, boxing or cartage, unless agreed upon at the time of purchase; damage to any material not properly packed to insure adequate protection in transit will be charged to the seller. All packing must conform with tariff or classification requirements so as to secure lowest possible freight rates. It is understood the buyer will receive the benefit of any decrease in freight charges between time of quotation and date of shipment, where freight enters into the price originally quoted.

5. **QUALITY AND INSPECTION:** All material furnished must be as specified and will be subject to inspection and approval of buyer after delivery. The right is reserved to reject and return at the risk and expense of the seller such portion of any shipment which may be defective or fail to comply with the specifications without invalidating the remainder of the order. If rejected it may be held for disposition at the expense and risk of the seller.

6. **QUANTITY:** The specific quantity ordered must not be changed without buyer's permission in writing.

7. **NON-PERFORMANCE:** Buyer reserves the right to cancel this order or any portion of same if delivery is not made when and as specified, time being of the essence of this order, and charge seller for any loss entailed.

8. **PATENTS:** The seller hereby guarantees the buyer against all losses of profits, damages, or both, resulting from any patent infringement by reason of purchasing or using goods covered by this order, or by reason of any loss suffered in not being able, without liability, to use such goods. This guarantee also includes the reimbursement to the buyer of all litigation costs which it may suffer as the result of any suit respecting the purchase or use of such goods, in addition to the recoveries which may be secured against it of profits and/or damages.

GENERAL:

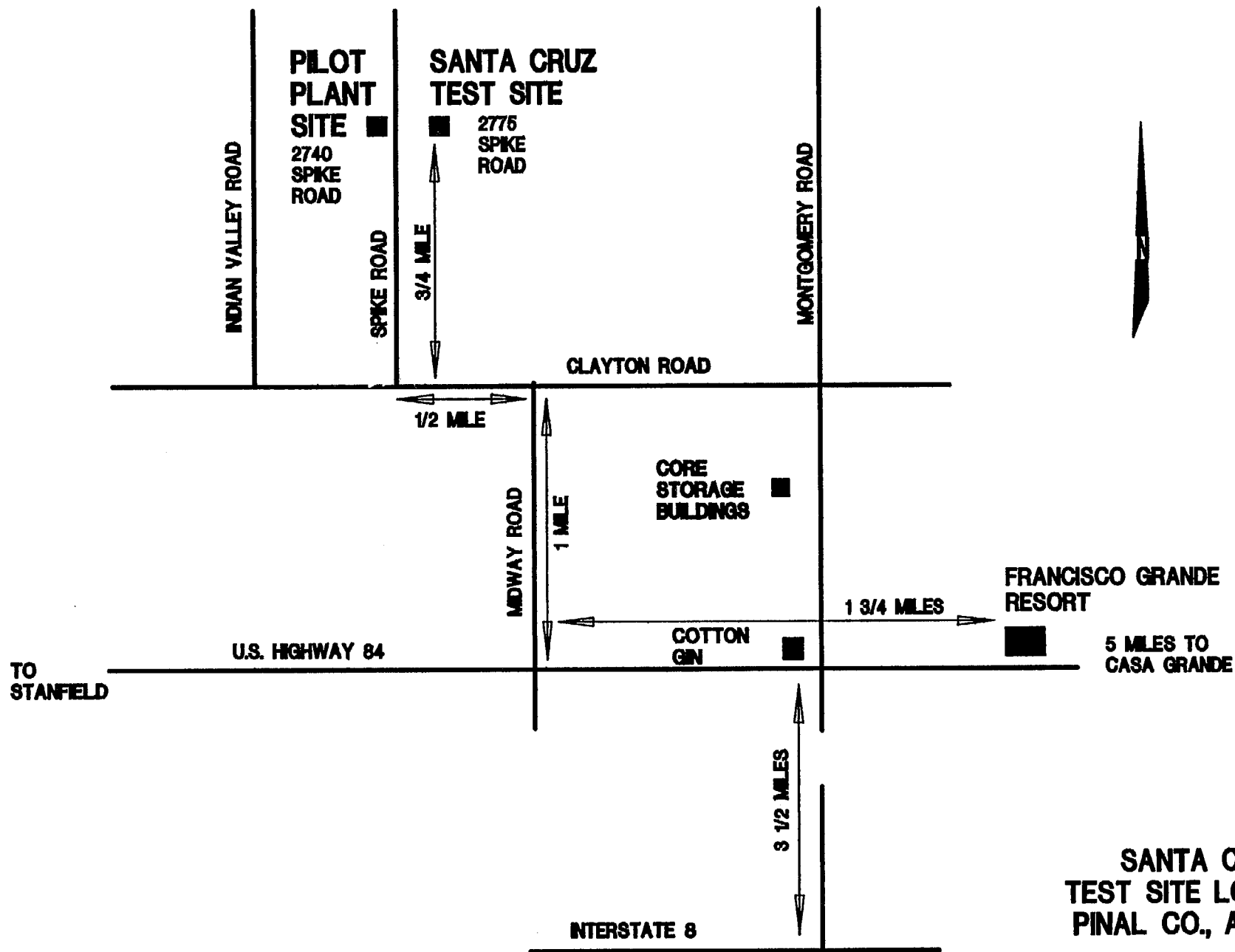
9. The material on this order must be furnished only by the person or firm to whom the order is addressed unless otherwise authorized by the buyer.

10. No drafts for purchases made will be honored unless by agreement.

11. If it becomes necessary for the seller or any agent, contractor, or employee thereof to enter upon the property of the buyer in order to construct, inspect or deliver hereunder, the seller hereby agrees to protect the buyer's property and all persons thereon from injury, damage or loss, and the seller shall save harmless and indemnify the buyer from and against any expense, loss or damage on account of any claim, demand or suit made by any person whomsoever, including any employee of the buyer, which is in any way caused by or connected with or grows out of the performance hereunder by the seller or any agent, contractor or employee thereof; provided however that the seller shall not be required to indemnify the buyer against any loss caused solely by the negligence or willful fault of the buyer or its employees. If the seller performs any work hereunder knowing it to be contrary to any local law, ordinance, rule and regulation, the seller shall bear all costs arising therefrom. Seller to carry Liability Insurance and to carry Workmen's Compensation Insurance as provided by the laws of the State in which the work is performed and further, is to obtain a certificate for same, which is to be furnished for the file of the buyer. If for any reason the seller's or any subcontractor's employees or agents may acquire a status imposing liability on the buyer for employer's contributions or taxes under the Federal Social Security Act or under any State Unemployment Insurance, Old Age Benefit, or similar Acts, the seller shall be exclusively liable for, and shall indemnify the buyer against, the same and does agree to comply with all laws and regulations so as to relieve the buyer from any and all liability therefor or the responsibility of making any reports or keeping any records with respect thereto.

12. In accepting this order the seller certified that these goods were produced in compliance with all applicable requirements of Sections 6, 7 and 12 of the Fair Labor Standards Act of 1938, as amended, and of the regulations and orders of the United States Department of Labor issued under Section 14 thereof. It will be necessary in order for us to honor your future invoices to us that the above clause or a substantial equivalent thereof appear on your invoices.

13. By acceptance of this order, seller warrants that the prices specified do not exceed the maximum prices established under any applicable United States law or regulation thereunder.



ASARCO

Exploration Department
Southwestern United States Division

February 14, 1992

Mr. Greg Knapp
Technical Services Center
ASARCO Incorporated
3422 South 700 West
Salt Lake City, Utah 84119

Re: Simmons-Devcor Land

Dear Greg:

The Santa Cruz Joint Venture (Asarco and Freeport-McMoRan) is interested in acquiring a 523 acre parcel of land which borders on the east side of the Santa Cruz Joint Venture Property (see accompanying land map). The subject property is owned by Simmons-Devcor (Cimarron Farms), and is being put up for sale by the Resolution Trust Corporation. This sale will be by auction on April 17, 1992.

We are interested in knowing the environmental liability of acquiring this property and what can be done, prior to acquisition, to reduce such liability. Consequently, we would like to have the benefit of your services in this regard.

An environmental evaluation of the subject property and certain neighboring properties was reported on in SCS Engineers' December 9, 1988 letter to J. Grossman and in Western Technologies' September 15, 1988 report, "Environmental Property Evaluation, Cimarron Pinal Holdings Inc., Casa Grande, Pinal County, Arizona," Job No. 2178J235. Copies of these reports were forwarded to you on December 3, 1991 for your evaluation of the neighboring Texaco land.

Of particular concern in these reports are: (1) the underground gasoline storage tanks (pages 13 to 15, Job No. 2178J235) and (2) the municipal incinerator site (pages 15 to 17, Job No. 2178J235). The underground gasoline storage tanks were excavated and removed from the subject property shortly after the environmental reports were written. The municipal incinerator, to the best of my knowledge, was used for disposing of trash from the Francisco Grande Resort, and it is no longer used on a regular basis, if at all.

The "above ground storage tanks" (page 17, Job No. 2178J235) are portable water storage tanks that were being stored on the property at the time of the environmental evaluation. One of the tanks was moved to the Santa Cruz test site. The other has not been moved, but is used for supplying water to the nearby buildings. Their presence, or past presence, is of no environmental concern.

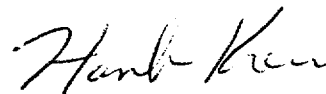
The contents of the "service buildings" (page 17 and 18, Job No. 2178J235) are chemical compounds used in exploration drilling. The "service buildings" and all the contents of these buildings, including the chemicals described on page 18 (Job No. 2178J235), are now the property of the Santa Cruz Joint Venture. Consequently, the contents of the buildings need not be considered in an environmental evaluation of the property.

Although the Santa Cruz Joint Venture owns the buildings described in the preceding paragraph, it does not own the land under the buildings. The land under these buildings is part of the subject 523 acre parcel of land and should not be excluded from your evaluation.

According to our lawyer, Mr. Bert Apker, the RTC will do some sort of an environmental evaluation of the subject land before it is put up for sale. There is no way of knowing at this time what the RTC environmental evaluation will encompass. Additional information on the RTC environmental evaluation may be obtained in mid March.

If you have any questions, or if I can be of further help, please let me know.

Sincerely,



Henry G. Kreis

HGK:mek
Attachment

cc: F.T. Graybeal
W.L. Kurtz
J.D. Sell
W.D. Gay
A.R. Raihl
W.E. McCulloch

February 7, 1992

FILE MEMO

Paper on History
Santa Cruz In Situ

On November 25, 1991, Mr. A. Raihl sent Mr. S. Swan a copy of "Santa Cruz In Situ Copper Mining Research Project - A Project History" by W.E. McCulloch, A.R. Raihl, and S.A. Swan. A copy of this paper was also sent to AIME for publication as an AIME abstract. In December, 1991, it was agreed by all parties the paper would not be published by AIME, and the paper was withdrawn from publication.

Accompanying this memo is a copy of the above paper having suggested additions/corrections by Mr. Raihl and the undersigned.

HGK:mek


H.G. Kreis

cc: A.R. Raihl
F.T. Graybeal
W.L. Kurtz
J.D. Sell
W.E. McCulloch
S.A. Swan

Copy with revisions suggested
by Asarco, Feb. 1992

Santa Cruz
In Situ Copper Mining Research Project

A Project History

Walter E. McCulloch, Jr.
Freeport Mining Company
New Orleans, LA 70161

A. R. Raihl
ASARCO Santa Cruz, Inc.
Tucson, AZ 85703

Stephen A. Swan
U.S. Bureau of Mines
Minneapolis, MN 55417

By W. McCulloch with suggested additions/revisions by A. Raihl and H. Kreis, 2-7-1992

SUMMARY

The Santa Cruz In Situ Copper Mining Research Project is a cooperative research project between the Santa Cruz Joint Venture (SCJV) and the U. S. Bureau of Mines (USBM). The test site is located approximately 7 miles west of Casa Grande, Arizona (Figure 1).

SANTA CRUZ DEPOSIT OVERVIEW

Santa Cruz is one of the worlds largest copper oxide deposits. It is a porphyry copper deposit in which deep oxidation converted former sulfide mineralization into copper oxide mineralization. The copper oxide mineralization is acid soluble and forms a geologic mineral inventory of one billion tons at 0.57% copper. The geologic mineral inventory contains a suite of copper minerals composed of 45% atacamite (a copper chloride mineral), 35% chrysocolla, and 20% chalcocite.

The deposit is concealed beneath 650' to 3000' of basin fill deposits and conglomerate, and it is underlain by lower grade chalcopryrite mineralization.

The Santa Cruz Project cannot be developed economically by conventional mining methods at today's copper prices.

SANTA CRUZ HISTORY

The sequence of events leading to the initiation of the Santa Cruz Project can be traced back 30 years to Florence, a small town located 30 miles east of the Santa Cruz deposit.

In early 1960 Asarco geologists were doing reconnaissance exploration work near the town of Florence. They found a small altered outcrop, and subsequent drilling by Asarco discovered the totally concealed Florence porphyry copper deposit. Encouraged by this discovery, Asarco geologists continued their reconnaissance exploration in the direction of the then unknown Santa Cruz deposit.

In early 1961 Asarco geologists found another altered outcrop near the town of Casa Grande. Drilling gravel covered areas near this outcrop lead to the discovery of the Sacaton porphyry copper deposit and the development of Asarco's Sacaton Mine.

Further exploration drilling of the covered area five miles southwest of the Sacaton Mine by Asarco in 1964 and again

in 1974 by Asarco and its joint venture partner Freeport-McMoRan lead to the discovery of the Santa Cruz Deposit. This discovery was made at the north end of the deposit.

A little over a year later, a competitive joint venture discovered the south end of the Santa Cruz deposit, and eventually announced the discovery of 250 million tons of 1% copper.

In 1980, copper prices began a plunge. The domestic copper industry followed suit. In Arizona, copper mining and processing employment dropped from 26,031 in 1981 to 17,182 in 1982 to 13,864 in 1983 and on down to 10,588 in 1988.

During this period of depressed copper prices, the Santa Cruz Joint Venture reduced its activity on the Santa Cruz deposit to care and maintenance.

In 1988 the Santa Cruz Joint Venture acquired the south end of the deposit from the competitive joint venture. So by the end of 1988 the Santa Cruz Joint Venture owned the entire Santa Cruz Deposit with its large reserve of soluble copper.

The economic assumptions of the late 1970's envisioned a block caving mining operation on the Santa Cruz deposit. This proved to be unrealistic during the 1980's. The Santa Cruz Joint Venture with its large soluble copper reserve saw an opportunity for developing a new mining technology - in situ leaching of an undisturbed deposit using drill holes from the surface of the ground.

IN SITU COPPER LEACHING

In situ mining of oxide copper had been attempted before by trickling leach solutions over rubblized ore in stopes or other underground workings with varied success. In the 1970's, operators had experienced copper recoveries from leaching shallow rubblized deposits by percolating diluted sulphur acid solution from the surface through the rubble and then collecting solution for copper recovery.

Also during the 1970's, in situ mining for copper using injection and recovery wells from the surface of the ground was attempted by Kennecott Copper at Safford, Arizona; Occidental Minerals at Miami, Arizona; and by Codelco in Chile. The Occidental Minerals project was reported to be technologically encouraging, but it was never carried to completion. Details from the Kennecott and Codelco tests are not publicly available. However, U.S. patents

obtained by Kennecott for their work at Safford imply a technical success for in situ copper leaching of a deep deposit using vertical injection and recovery wells.

USBM experiments indicated certain oxide copper deposits should leach well. The three basic requirements for in situ mining;

1. leach solutions must be able to contact the ore minerals,
2. the copper must be selectively dissolved by the leaching agent, and
3. the dissolved copper must be transported to the recovery wells;

were found to be controlled by the ore body's inherent natural fracturing, petrology and geochemistry. The success of an in situ mining project is dependent upon hydrological control of the injected leach solution.

In 1985, the U.S. Bureau of Mines proposed an in situ oxide copper leach research field test. Representatives of domestic copper producers and the USBM met in Phoenix, Arizona, in December 1985 and February 1986. The Bureau offered in situ leaching as a possible lower cost, environmentally sound technology for copper production from small, low-grade, and/or deep deposits. The success of in situ uranium leaching maintaining a domestic uranium production during a period of relatively low uranium prices was offered as an example of the economic potential of in situ leaching.

In situ oxide copper leaching technically appeared to be a possible means for developing the idle Santa Cruz Project. Commercial development of the technology was hampered by the lack of technical experience and by the lack of reliable economic data on which to base financial estimates for developing a commercial in situ oxide copper leaching project.

Members of the copper mining industry brought the concept of in situ leaching to the Arizona congressional delegation. The Arizona congressional delegation recognized the potential benefits of applied in situ copper mining research and sought research funding for the USBM.

In 1985 and 1986, congress appropriated funds for preliminary USBM in situ leach studies. The USBM published the "Draft Generic In Situ Copper Mine Design Manual". In 1987, congress appropriated \$2.5 million to begin in situ field research studies.

After USBM review of several potential sites, the Santa Cruz Project was selected for the test site because, as a deep, low grade deposit totally undisturbed by any previous mining activity, a "true" in situ mining research test could be conducted. In "true" in situ mining, leach solutions are forced through the ore between injection and recovery wells.

SANTA CRUZ IN SITU LEACH RESEARCH PROJECT

The USBM and Asarco Inc. as manager of the Santa Cruz Joint Venture (SCJV) signed Cooperative Agreement No. C0289001 "In Situ Copper Mining Research Project". The two principal objectives of this research project are:

1. Demonstrate in situ oxide copper mining can be operated in an environmentally acceptable manner.
2. Prepare a manual for the U.S. mining industry with reliable economic cost data.

The in situ research field test is a multi year, multi phase project. Total field test costs are currently estimated at \$22 million. Project funding is 75% USBM and 25% SCJV.

In summary the project phases are:

Phase I - Site Selection

In Phase I two core holes were drilled to help determine geologic characteristics of the test site and to obtain whole core sample for USBM laboratory studies. A hydrologic test well was drilled into the leached capping above the copper to test hydrologic conditions between the copper deposit and the overlying aquifer. The first of eventually four monitor wells was drilled into the over lying aquifer.

Phase II - In Situ Well Field Development

A commercial scale (127 ft/side) five-spot pattern well field (Figure II) was constructed using oil field technology. The four corner wells are recovery wells. The center well (90 ft. from each corner) is the injection well. The last of the four monitor wells was completed: one on the test site, one upstream, and two downstream.

During 1991 the five test wells were used in a five month long salt tracer test. The tracer test showed injected salt solution could be successfully recovered, and it demonstrated that the salt solution was

contained within the granite bedrock.

The successful results of the salt tracer test are being used in an application for an Aquifer Protection Permit. The aquifer protection permit is being submitted to the Arizona Department of Environmental Quality for the purpose of injecting a weak acid solution and recovering copper solution.

Phase III - Pilot Plant Construction

A 50 gpm solvent extraction (SX) plant and a 3 ton/day electrowinning (EW) pilot plant with anodes, cathodes and plating cell dimensions in scale with commercial operation constructed.

Phase IV - Field Test Operations

A dilute sulphuric acid solution is circulated through natural fractures in the ore between the injection well and the recovery wells. The leached copper is recovered in the SX-EW pilot plant (Figure III).

Phase V - Closure

Field test operation cease. Operations closure. Field test data interrupted. Research project report issued.

IN SITU LEACH FIELD TEST STATUS OVERVIEW

The in situ oxide copper leach research field test is currently approaching the end of Phase II. The five spot well field has been completed. To date test results are encouraging. Test data and results in greater detail will be shown in other presentations. A five month brine tracer injection/recovery pumping test has proven well to well fluid communication in the porphyry ore zone. This test also demonstrates the fluid flows can be controlled and confined in an injection/recovery operation. Test site hydrological characteristics, porosity, permeability, and dispersivity, have been determined by water injection and brine injection pumping tests. USBM laboratory examinations of and test work with drill core from the Santa Cruz Project have determined petrological and geochemical characteristics at the test site.

A computer hydrological model is being prepared incorporating the test site's hydrological data and the test site's natural rock attenuation data for dilute sulfur acid solutions. This model will demonstrate the environmental acceptability of in situ leaching of acid soluble copper can be conducted in an environmentally acceptable manner. The model will be a part of the permit application for an Aquifer Protection Permit (APP) issued by the Arizona

Department of Environmental (ADEQ) Quality.

The APP is a major permit required for the in situ leach research field test. The APP would allow the project to inject acid into the ore zone for in situ leaching. When the APP is issued, Phase II will be complete.

Phase III, construction of the SX-EW pilot plant, is anticipated to require nine months to complete. Then Phase IV, in situ leaching of acid soluble copper by injecting and recovering dilute sulphuric acid solution, will begin. The Phase IV test period will be 18 to 24 months. Upon completion of the leaching cycle, the field test data with interpreted and reported for public information and use.

REFERENCES

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- Hsueh, Limin; Hard, Robert A.; Davidson, Donald H.; and Huff, Ray V., "In Situ Mining Method and Apparatus", U. S. Patent No. 4,116,488, September 26, 1978.
- In Situ Leach Mining, Information circular 9216, U.S. Bureau of Mines
- Raihl, A. R., "Santa Cruz In Situ Copper Mining Research Project", Monthly Technical Reports, September 1988 to September 1991.
- Van Nort, S., "Santa Cruz Exploration", Inter-office memo, Freeport Exploration Company, October 16, 1991.



Southwestern Exploration Division

February 20, 1992

A.R. Raihl

Drilling Contractor
Subsidence Monuments
Santa Cruz Project
Pinal County, Arizona

The construction of the six subsidence survey monuments will be done by Cissell Drilling Company. Cissell Drilling Co. will construct the monuments at a cost of \$2,400.00. Asarco Santa Cruz Inc. will supply Cissell Drilling Company with fabricated steel components for the monuments.

Cissell Drilling Company is based in Casa Grande where its owner resides, and it has the expertise to satisfactorily complete this work.

The cost to use one of our previous out-of-town contractors is substantially more than the cost of using Cissell Drilling Company. An example of the cost of using an out-of-town contractor is attached.

Cissell Drilling Company will be contracted using a standard purchase order agreement, P.O. Number SC-92-37 (Release No. 1), as per my discussion with you and your earlier discussions with Dave Askin of the USBM.

HGK:mek
Att.

A handwritten signature in dark ink, appearing to read "H.G. Kreis", is written over a horizontal line.

H.G. Kreis

cc: F.T. Graybeal
W.L. Kurtz
J.D. Sell
Accounting

CISSELL DRILLING CO.

P O BOX 1048
Casa Grande, AZ 85222

THOMAS R. CISSELL
602/836 8141

ASARCO Incorporated

January 18, 1992

FEB 18 1992

ASARCO Incorporated
P. O. Box 5747
Tucson, Az 85703-0747

This quotation is for drilling Four Monument Holes 20 ft. depth.

Drilling 6 1/4 inch hole 20 ft. depth, installing 21 ft. of
2 inch pipe, 5 ft. of 4 inch pipe and Centralizer, and Cementing
pipe.

\$700.00 each hole

OR

\$400.00 Each HOLET. R.C

\$2,800.00 for Four holes

*ASARCO FURNISHED
PIPE AND CENTRALIZER*

Thank You,

Thomas R. Cissell

Thomas R. Cissell

January 6, 1992

Mr. Henry Kreis
ASARCO
PO Box 5747
Tucson, AZ 85703

Stewart Brothers
DRILLING CO.

Re: RFQ-Subsidence Monuments-Casa Grande, AZ

Dear Hank:

Thank you for the opportunity to provide a quote for the referenced project. Please note the following.

Mob/Demob	\$1,500.00 Lump Sum
Drill, Furnish and Install Monument	\$1,000.00/Each

Thank you again for the opportunity. Should you have any questions, please call me.

Very truly yours,

John Mabry

John Mabry
Vice President

JM:mac

ASARCO Incorporated

JAN 8 1992

SW Exploration



PURCHASE ORDER

DATE

2/14/92

ORDER NO.

SC-92-37

REQUISITION NO.

PLANT JOB NO.

APPROPRIATION NO.

ASARCO Santa Cruz, Inc.

TUCSON OFFICE
P. O. BOX 5747

1150 NORTH 7TH AVENUE
TUCSON, ARIZONA 85703

To: Cissell Drilling Company
P.O. Box 1048
Casa Grande, Arizona 85222
Contact: Tom Cissell
Telephone: 602-836-8141

DATE REQUIRED AT DESTINATION:

SHIPPING INTERVAL PROMISED

SELLER WILL SHIP BEFORE:

POINT OF SHIPMENT

TERMS:

F.O.B. POINT

FINAL DESTINATION — PLEASE NOTE CONSIGNMENT BELOW

Santa Cruz Test Site
Six miles west of Casa Grande, AZ

CONSIGNMENT — SELLER WILL SHIP TO

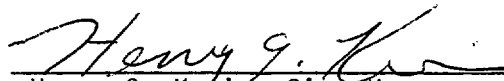
— RENDER BILLS AS PER ATTACHED SHIPPING INSTRUCTIONS —

SHIP VIA

QUANTITY	UNIT	SPECIFICATIONS	ITEM NO.	UNIT PRICE
		<p style="text-align: center;"><u>BLANKET ORDER</u></p> <p>When so requested by ASARCO Santa Cruz, Inc., Cissell Drilling Company will provide rotary drilling services at the above test site.</p> <p>Duration: January 1, 1992 to December 31, 1992</p>		

cc: Accounting (2)
A.R. Raihl
F.T. Graybeal
W.L. Kurtz
J.D. Sell

PLEASE ENTER OUR ORDER FOR THE ITEMS SPECIFIED ABOVE. SUBJECT TO ALL INSTRUCTIONS AND PROVISIONS ON REVERSE SIDE.


Henry G. Kreis, Site Manager

INSTRUCTIONS

INVOICE: Priced invoices in the requisite number giving the correct purchase order and requisition numbers, together with required Bills of Lading, must be forwarded on day of each shipment AS PER SPECIAL SHIPPING INSTRUCTIONS ACCOMPANYING THIS ORDER, otherwise delay in payment of account may result.

TERMS: As previously arranged or specified on this order. Care must be exercised to show cash discount, if allowed, on face of invoice.

PROVISIONS

1. **ACCEPTANCE:** Acceptance of this order constitutes acceptance of all terms herein stated. All representations and warranties by the seller relating to the subject-matter of this order or its performance shall be binding on the seller as if fully set forth herein, and shall survive inspection and acceptance of the goods ordered. No acknowledgment or acceptance of this order or any other communication by the seller shall vary or add any terms or conditions to those contained herein and any such attempted modification or addition which is not accepted in writing by the buyer, shall be void and may be disregarded without further notice or disclaimer.

2. **PRICES:** This order must not be filled at higher prices than last quoted without authority of the buyer.

3. **SHIPMENTS:** All materials must be forwarded by the route designated and seller will be held strictly accountable for any deviation therefrom.

When the material covered by this order shall aggregate a carload shipment or more, the seller must forward in carload lots, unless duly authorized in writing by the buyer to ship in less than carloads. If this order aggregates less than a minimum carload, seller must forward the entire quantity at one time unless otherwise authorized in writing by the buyer.

When blocking or dunnage, etc., not constituting a part of the car are used to protect and make shipments secure in transit, seller must show on Bills of Lading, separately, the weights of such materials, provided the lading shall aggregate a minimum carload or more, and will be held responsible for failure to comply with this rule.

Shipments will not be considered as completed until Bill of Lading, or express or mail receipt is received.

4. **PACKING AND CARTAGE CHARGES:** No charge will be allowed for packing, boxing or cartage, unless agreed upon at the time of purchase; damage to any material not properly packed to insure adequate protection in transit will be charged to the seller. All packing must conform with tariff or classification requirements so as to secure lowest possible freight rates. It is understood the buyer will receive the benefit of any decrease in freight charges between time of quotation and date of shipment, where freight enters into the price originally quoted.

5. **QUALITY AND INSPECTION:** All material furnished must be as specified and will be subject to inspection and approval of buyer after delivery. The right is reserved to reject and return at the risk and expense of the seller such portion of any shipment which may be defective or fail to comply with the specifications without invalidating the remainder of the order. If rejected it may be held for disposition at the expense and risk of the seller.

6. **QUANTITY:** The specific quantity ordered must not be changed without buyer's permission in writing.

7. **NON-PERFORMANCE:** Buyer reserves the right to cancel this order or any portion of same if delivery is not made when and as specified, time being of the essence of this order, and charge seller for any loss entailed.

8. **PATENTS:** The seller hereby guarantees the buyer against all losses of profits, damages, or both, resulting from any patent infringement by reason of purchasing or using goods covered by this order, or by reason of any loss suffered in not being able, without liability, to use such goods. This guarantee also includes the reimbursement to the buyer of all litigation costs which it may suffer as the result of any suit respecting the purchase or use of such goods, in addition to the recoveries which may be secured against it of profits and/or damages.

GENERAL:

9. The material on this order must be furnished only by the person or firm to whom the order is addressed unless otherwise authorized by the buyer.

10. No drafts for purchases made will be honored unless by agreement.

11. If it becomes necessary for the seller or any agent, contractor, or employee thereof to enter upon the property of the buyer in order to construct, inspect or deliver hereunder, the seller hereby agrees to protect the buyer's property and all persons thereon from injury, damage or loss, and the seller shall save harmless and indemnify the buyer from and against any expense, loss or damage on account of any claim, demand or suit made by any person whomsoever, including any employee of the buyer, which is in any way caused by or connected with or grows out of the performance hereunder by the seller or any agent, contractor or employee thereof; provided however that the seller shall not be required to indemnify the buyer against any loss caused solely by the negligence or willful fault of the buyer or its employees. If the seller performs any work hereunder knowing it to be contrary to any local law, ordinance, rule and regulation, the seller shall bear all costs arising therefrom. Seller to carry Liability Insurance and to carry Workmen's Compensation Insurance as provided by the laws of the State in which the work is performed and further, is to obtain a certificate for same, which is to be furnished for the file of the buyer. If for any reason the seller's or any subcontractor's employees or agents may acquire a status imposing liability on the buyer for employer's contributions or taxes under the Federal Social Security Act or under any State Unemployment Insurance, Old Age Benefit, or similar Acts, the seller shall be exclusively liable for, and shall indemnify the buyer against, the same and does agree to comply with all laws and regulations so as to relieve the buyer from any and all liability therefor or the responsibility of making any reports or keeping any records with respect thereto.

12. In accepting this order the seller certified that these goods were produced in compliance with all applicable requirements of Sections 6, 7 and 12 of the Fair Labor Standards Act of 1938, as amended, and of the regulations and orders of the United States Department of Labor issued under Section 14 thereof. It will be necessary in order for us to honor your future invoices to us that the above clause or a substantial equivalent thereof appear on your invoices.

13. By acceptance of this order, seller warrants that the prices specified do not exceed the maximum prices established under any applicable United States law or regulation thereunder.

PURCHASE ORDER

DATE 2/20/92

ORDER NO.
SC-92-37

PLANT JOB NO.

ASARCO Santa Cruz, Inc.

APPROPRIATION NO.

TUCSON OFFICE
P. O. BOX 5747

1150 NORTH 7TH AVENUE
TUCSON, ARIZONA 85703

REQUISITION NO.
RELEASE 1

To: Cissell Drilling Company
P.O. Box 1048
Casa Grande, Arizona 85222
Att: Tom Cissell
Telephone: 602-836-8141

FINAL DESTINATION — PLEASE NOTE CONSIGNMENT BELOW

Santa Cruz Test Site
Six miles west of Casa Grande, AZ

DATE REQUIRED AT DESTINATION:

CONSIGNMENT — SELLER WILL SHIP TO

SHIPPING INTERVAL PROMISED

SELLER WILL SHIP BEFORE:

POINT OF SHIPMENT

TERMS:

F.O.B. POINT

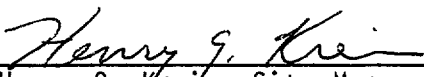
— RENDER BILLS AS PER ATTACHED SHIPPING INSTRUCTIONS —

SHIP VIA

QUANTITY	UNIT	SPECIFICATIONS	ITEM NO.	UNIT PRICE
		<p>Cissell Drilling Company, hereinafter referred to as CONTRACTOR, will initiate and complete the construction of six subsidence survey monuments at the Santa Cruz In Situ Copper Mining Research test site. Payment for work performed will be in accordance with CONTRACTOR's letter of proposal dated January 18, 1992, a copy of which is attached hereto and made a part of this order.</p> <p>CONTRACTOR will provide a drill rig complete with crew and the necessary materials with which to construct said subsidence survey monuments. The subsidence survey monuments will be constructed according to the statement of work attached hereto and made a part of this order.</p> <p>It is understood by both parties to this order that CONTRACTOR will perform all work in a diligent and workmanlike manner and in accordance with recognized working practices. ASARCO Santa Cruz, Inc. will not be charged for delays caused by failure of CONTRACTOR's equipment or personnel.</p> <p>CONTRACTOR's particular attention is called to Clause Eleven (11) on the reverse of this order. Before entering upon said property to perform this work, CONTRACTOR will submit acceptable evidence of compliance with the Workmen's Compensation Laws of the State of Arizona and acceptable evidence of other required insurance.</p> <p>CONTRACTOR will also furnish ASARCO Santa Cruz, Inc. acceptable evidence that CONTRACTOR holds appropriate and valid contractors and Dept. of Water Resources licenses issued by the State of Arizona.</p>		

Accounting (2)
Site
A.R. Raihl
F.T. Graybeal
W.L. Kurtz
J.D. Sell

PLEASE ENTER OUR ORDER FOR THE ITEMS SPECIFIED ABOVE. SUBJECT TO ALL INSTRUCTIONS AND PROVISIONS ON REVERSE SIDE.


Henry G. Kreis, Site Manager

INSTRUCTIONS

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PROVISIONS

1. **ACCEPTANCE:** Acceptance of this order constitutes acceptance of all terms herein stated. All representations and warranties by the seller relating to the subject-matter of this order or its performance shall be binding on the seller as if fully set forth herein, and shall survive inspection and acceptance of the goods ordered. No acknowledgment or acceptance of this order or any other communication by the seller shall vary or add any terms or conditions to those contained herein and any such attempted modification or addition which is not accepted in writing by the buyer, shall be void and may be disregarded without further notice or disclaimer.

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11. If it becomes necessary for the seller or any agent, contractor, or employee thereof to enter upon the property of the buyer in order to construct, inspect or deliver hereunder, the seller hereby agrees to protect the buyer's property and all persons thereon from injury, damage or loss, and the seller shall save harmless and indemnify the buyer from and against any expense, loss or damage on account of any claim, demand or suit made by any person whomsoever, including any employee of the buyer, which is in any way caused by or connected with or grows out of the performance hereunder by the seller or any agent, contractor or employee thereof; provided however that the seller shall not be required to indemnify the buyer against any loss caused solely by the negligence or willful fault of the buyer or its employees. If the seller performs any work hereunder knowing it to be contrary to any local law, ordinance, rule and regulation, the seller shall bear all costs arising therefrom. Seller to carry Liability Insurance and to carry Workmen's Compensation Insurance as provided by the laws of the State in which the work is performed and further, is to obtain a certificate for same, which is to be furnished for the file of the buyer. If for any reason the seller's or any subcontractor's employees or agents may acquire a status imposing liability on the buyer for employer's contributions or taxes under the Federal Social Security Act or under any State Unemployment Insurance, Old Age Benefit, or similar Acts, the seller shall be exclusively liable for, and shall indemnify the buyer against, the same and does agree to comply with all laws and regulations so as to relieve the buyer from any and all liability therefor or the responsibility of making any reports or keeping any records with respect thereto.

12. In accepting this order the seller certified that these goods were produced in compliance with all applicable requirements of Sections 6, 7 and 12 of the Fair Labor Standards Act of 1938, as amended, and of the regulations and orders of the United States Department of Labor issued under Section 14 thereof. It will be necessary in order for us to honor your future invoices to us that the above clause or a substantial equivalent thereof appear on your invoices.

13. By acceptance of this order, seller warrants that the prices specified do not exceed the maximum prices established under any applicable United States law or regulation thereunder.

CISSELL DRILLING CO.

P O Box 1048
Casa Grande, AZ 85222

THOMAS R. CISSELL
602/836 8141

ASARCO Incorporated

January 18, 1992

FEB 18 1992

ASARCO Incorporated
P. O. Box 5747
Tucson, Az 85703-0747

This quotation is for drilling Four Monument Holes 20 ft. depth.

Drilling 6 1/4 inch hole 20 ft. depth, installing 21 ft. of
2 inch pipe, 5 ft. of 4 inch pipe and Centralizer, and Cementing
pipe.

\$700.00 each hole OR \$400.00 Each HOLET. R.C

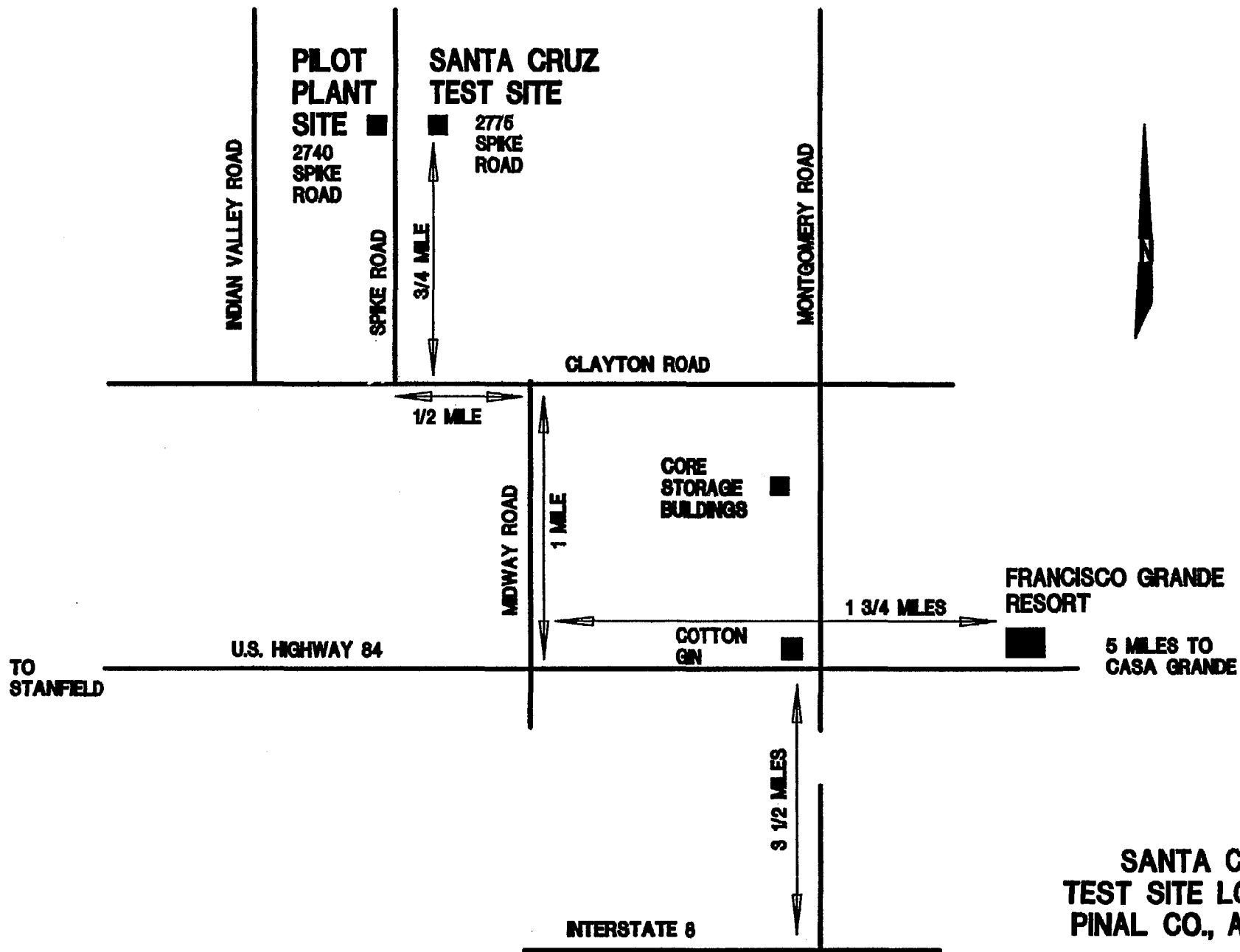
\$2,800.00 for Four holes

ASARCO FURNISHED
PIPE AND CENTRALIZER

Thank You,

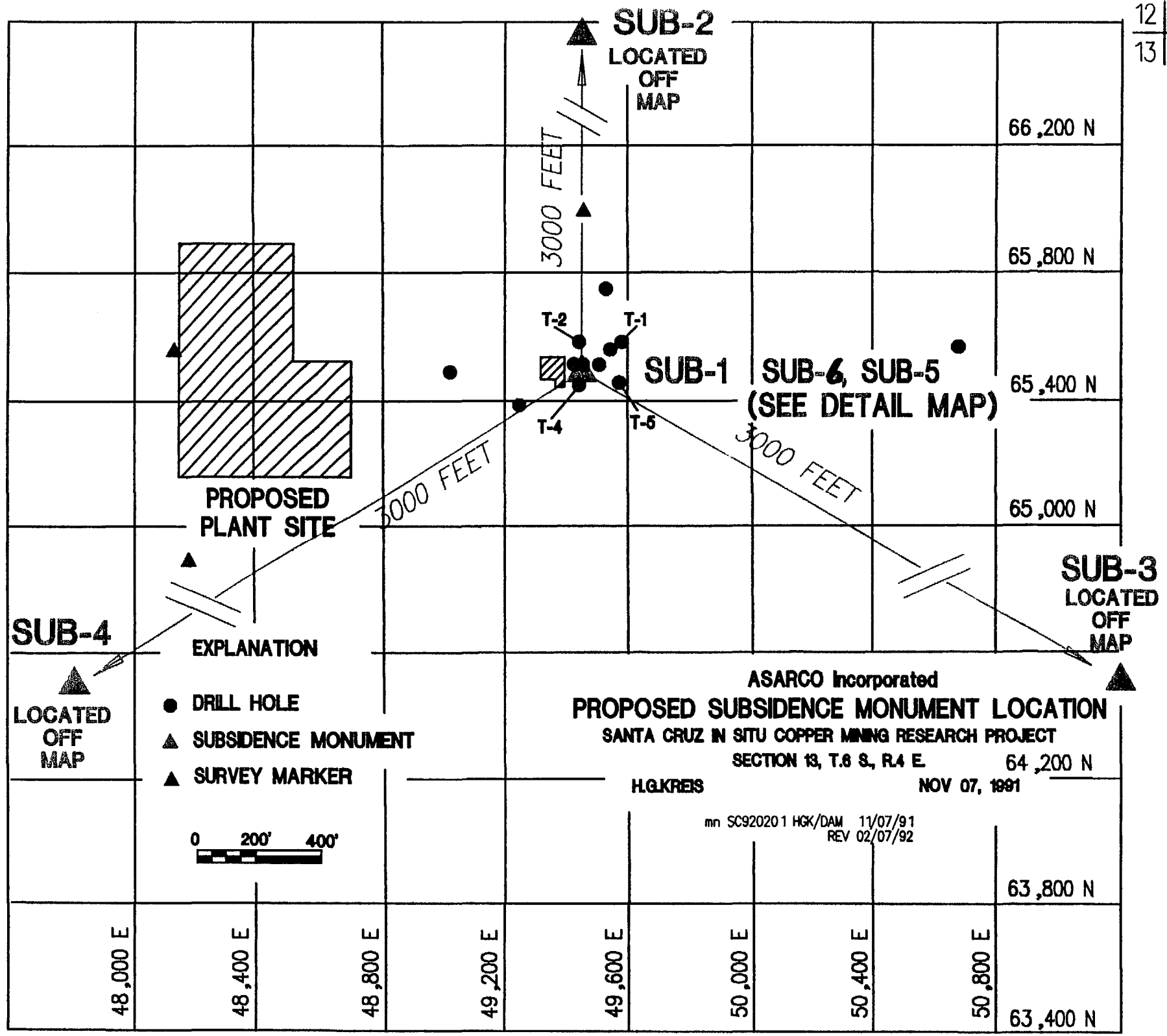
Thomas R. Cissell

Thomas R. Cissell

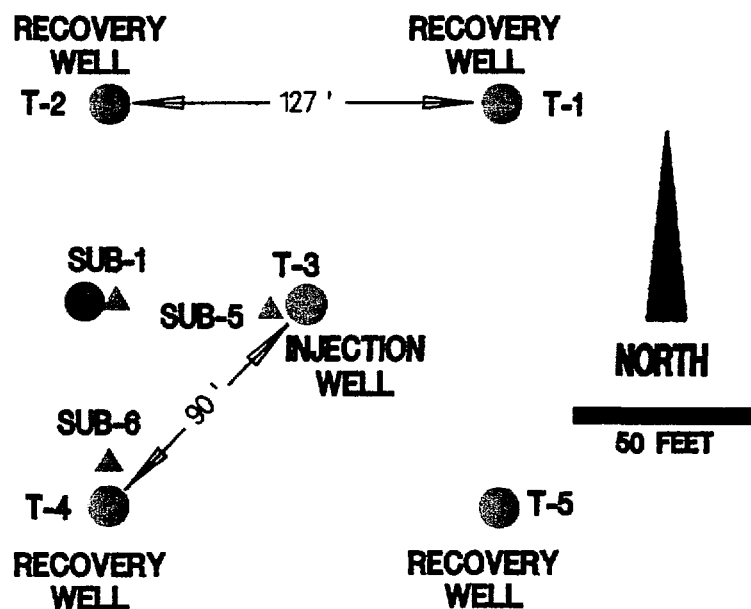


0 1/2 MILE

on SC910308 HGK/DAM TUC 03/20/91
PLOT CHG: SP5-SPT/PW0.25



SANTA CRUZ IN SITU TEST SITE



EXPLANATION

- TEST WELLS
- ▲ SUBSIDENCE MONUMENT
- HYDROLOGIC TEST WELL

H.G. Kreis
February 14, 1992

Statement of Work for Subsidence Monument Construction

A total of six monuments are to be constructed, three onsite monuments and three offsite monuments.

Location

All of the subsidence monuments will be constructed within 3000' of the Santa Cruz In Situ Copper Mining Research test site. The accompanying maps show the location of the test site and the location of the subsidence monuments about the test site. The exact ground location of the subsidence monuments will be determined and flagged by Asarco.

All of the site locations are on flat, retired agricultural fields which have easy access and no need for drill site preparation.

Ground Conditions

The drill holes used in the construction of the subsidence monuments will penetrate alluvial material consisting of weakly consolidated sand, silt, and clay.

Offsite Monument Construction Specifications

(1) All three offsite subsidence monuments (SUB-2, -3, and -4) will be constructed alike according to the following description and the accompanying figure for offsite monument construction entitled "Above Ground Subsidence Monument Construction."

(2) Drill a 6.25" diameter hole to a depth of 20'. The hole can be drilled with air (if it stays open), air and foam, or mud.

(3) Attach 2 sets of centralizers on a 20' length of 2" diameter Schedule 40 steel pipe (pipe with attached centralizers supplied to driller by Asarco Santa Cruz Inc.).

(4) Lower the 20' long, 2" diameter Schedule 40 steel pipe with centralizers into the hole to a depth of one foot above the bottom of the hole.

(5) Cement the bottom 15' of the hole using a tremie pipe or the 2" diameter pipe already in the hole.

6) Backfill the annulus between the hole and the 2" steel pipe with

drill cuttings up to a depth of three feet below the surface of the ground.

(7) Install a survey monument (supplied by Asarco Santa Cruz Inc.) on the top of the 2" pipe.

(8) Insert into the hole around the 2" pipe a 5' length of 4" diameter steel casing having a flange-like steel plate welded to the bottom (supplied by Asarco Santa Cruz Inc.). This casing should extend 2' above the surface of the ground.

(9) Backfill the annulus between the 4" casing and the walls of the hole and the annulus between the 4" casing and the 2" pipe with drill cuttings.

(10) Install a removable steel cap on the top of the 4" casing.

(11) Clean site of all materials. Cuttings can be left on the ground.

Onsite Monument Construction Specifications

(1) All three onsite subsidence monuments (SUB-1, -5, and -6) will be constructed alike according to the following description and the accompanying figure for onsite monument construction entitled "Below Ground Subsidence Monument Construction."

(2) Drill a 6.25" diameter hole to a depth of 20'. The hole can be drilled with air (if it stays open), air and foam, or mud.

(3) Attach 2 sets of centralizers on a 18' length of 2" diameter Schedule 40 steel pipe (pipe with attached centralizers supplied to driller by Asarco Santa Cruz Inc.).

(4) Lower the 18' long, 2" diameter Schedule 40 steel pipe with centralizers into the hole to a depth of one foot above the bottom of the hole.

(5) Cement the bottom 15' of the hole using a tremie pipe or the 2" diameter pipe already in the hole.

(6) Backfill the annulus between the hole and the 2" steel pipe with drill cuttings up to a depth of four feet below the surface of the ground.

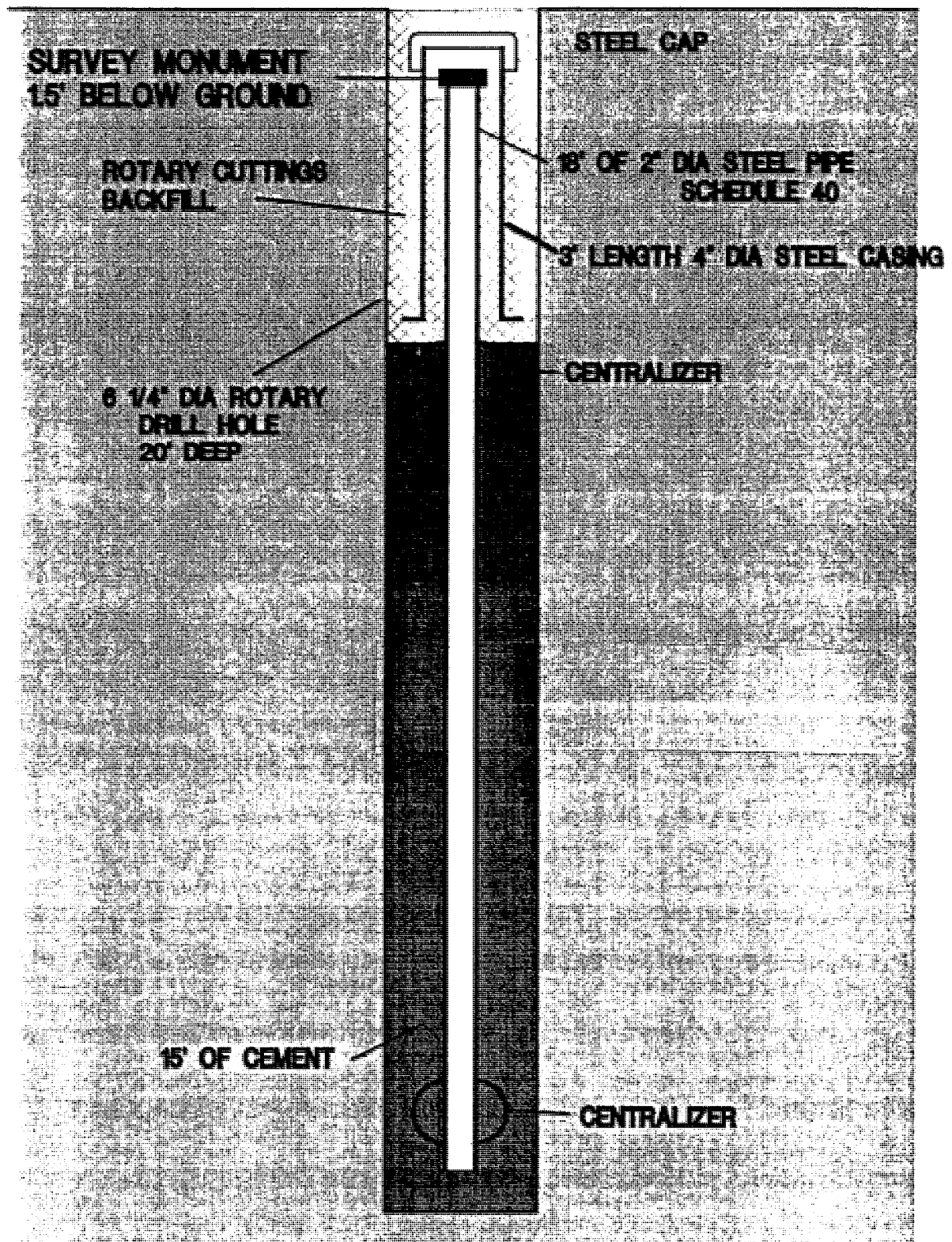
(7) Install a survey monument (supplied by Asarco Santa Cruz Inc.) on the top of the 2" pipe.

(8) Insert into the hole around the 2" pipe a 3' length of 4" diameter steel casing having a flange-like steel plate welded to the bottom (supplied by Asarco Santa Cruz Inc.). The top of this casing should be about 1' below the surface of the ground.

(9) Backfill the annulus between the 4" casing and the walls of the hole and the annulus between the 4" casing and the 2" pipe with drill cuttings.

(10) Install a removable steel cap on the top of the 4" casing.

(11) Clean site of all materials. Cuttings can be left on the ground.

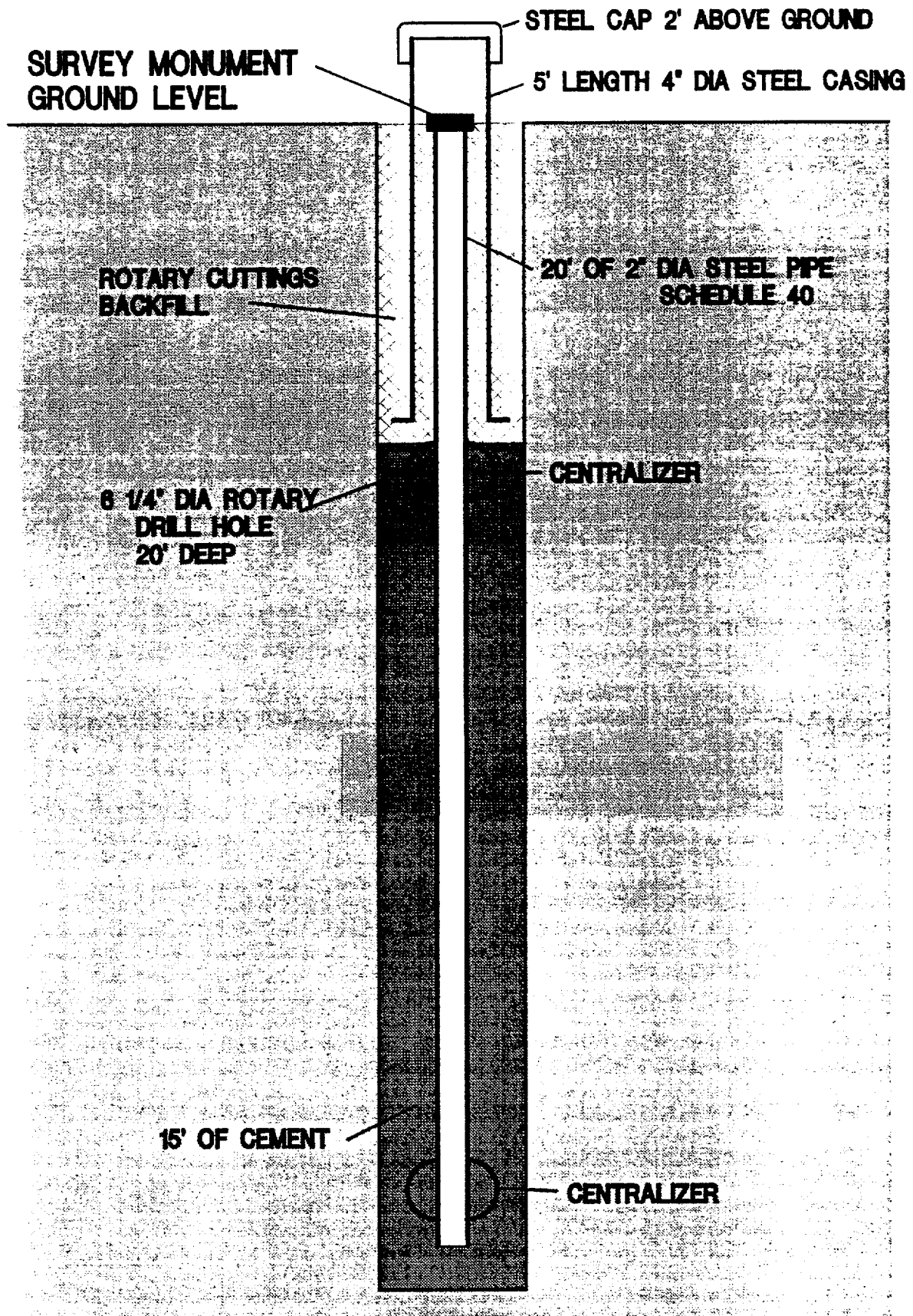


NOT TO SCALE

**FOR: SUB-1
SUB-5
SUB-6**

**ASARCO Incorporated
BELOW GROUND
SUBSIDENCE MONUMENT CONSTRUCTION
SANTA CRUZ IN SITU COPPER MINING RESEARCH PROJECT
H.G.KREIS**

mn SC920204 HGK/DAM 02/11/92



NOT TO SCALE

**FOR: SUB-2
SUB-3
SUB-4**

**ASARCO Incorporated
ABOVE GROUND
SUBSIDENCE MONUMENT CONSTRUCTION
SANTA CRUZ IN SITU COPPER MINING RESEARCH PROJECT
H.G.KREIS**

March 31, 1992

A.R. Raihl

Informal Portion of
Quarterly SCJV Meeting
March 17, 1992
Santa Cruz Project

The SCJV Quarterly Meeting for the first quarter of 1992 was held on March 17, 1992 at Asarco's Tucson Office. The formal portion of this meeting will be described in a memo by you. Topics discussed in the informal portion of the meeting are summarized below.

The items discussed in detail by you are summarized as follows:

- Status of the Aquifer Protection Permit and expectation of a May 1, 1992 submittal date.
- Air quality permit, Cyprus Mineral Park situation, and use of Amy Porter by SCJV, Cyprus, and AMA.
- Other permits including comments on 404 and 402 permits, and EPA'S satisfaction with Class V classification for the test wells.
- Surface facility engineering is 70% complete and can go no further until equipment is purchased with certified drawings of equipment specifications. Bid packages are being prepared for USBM review and holding until ready to proceed with construction.
- Lift systems are being reviewed and submersible pumps with Hastaloy components look promising event though costly.
- Lead time for equipment acquisition was discussed and supported by handout materials.
- Tracer data will be released by the USBM to DOE for the DOE to do additional fluid flow evaluations. DOE will spend an estimated \$500,000 to evaluate. Freeport-McMoRan is in agreement with this.
- Consultants to the project were identified along with their individual areas of expertise.
- SME papers presented in annual February SME meeting were discussed along with a review of questions following the presentations.

- The 1992 activity schedule for the project was reviewed.
- Site groundwater restoration and ongoing discussions.
- Survey of Casa Grande residents will check for technical knowledge and environmental concerns, and will cost \$15,000.
- Project funding for FY 1992 and FY 1993 for the cooperative agreement work and for separately funded USBM work.
- Insurance needs for SCJV are being reviewed.
- A policy on private lot acquisition should be prepared for presentation at the next SCJV meeting.

Mr. Graybeal discussed Asarco's paying for Mr. Magner's work and suggested it is time for Freeport-McMoRan to consider having SCJV pick up the costs of Mr. Magner and the salary of Mr. Raihl. Mr. Graybeal will write a letter to this effect to Freeport-McMoRan. Freeport-McMoRan will take this under consideration.

The undersigned presented the following:

- Texaco 1088 acre purchase: Purchase and Sale Agreement, future inquiries with Arizona Water Company, DC Properties and the active sewerage pond, DC Properties and the gravel pit, SCJV's environmental evaluation, CP Water Company, private lots, and work to be done during the 45 day inspection period of the Purchase and Sale Agreement.
- Simmons/RTC 523 acre parcel: RTC auction, Simmons' negotiations with Asarco, environmental work, title report, Asarco willing to pay half the cost of a SCJV bid of up to \$750 per acre, Freeport-McMoRan willing to contribute up to \$200,000 for acquisition of all or part of the 523 acres, and presence of at least six private (non SCJV) lots in Simmons land.
- Core storage facilities: 5 acre purchase offer to Simmons, and costs to move to new location.
- Video tape: \$20,000 budgeted by SCJV, \$11,600 cost to SCJV, and updated material.

The formal meeting was held following the informal meeting; and, as previously mentioned, you will write up the minutes of the formal meeting. The next quarterly meeting is scheduled for June 8th.

HGK:mek



H.G. Kreis

cc: F.T. Graybeal
W.L. Kurtz
J.D. Sell

March 31, 1992

A.R. Raihl

CANMET-USBM Visit
April 15, 1992
In Situ Test Site
Santa Cruz Project

The CANMET-USBM visit scheduled for April 15, 1992 is summarized as follows:

Visitors: Lou Wade, USBM Research Director TCRC
John Murphy, USBM Research Director, Pittsburgh
Ed Hollop, USBM Research Director, Denver
Doug Bolstad, USBM Research Director, Spokane
Phil Meikle, Chief Division of Health, Safety,
and Mining Technology, Washington
Steve Swan, USBM Technical Project Officer
CANMET, 2 people, assumed by S.Swan to be
research directors

Other Participants: A. Raihl
H. Kreis
C. Barter
P. Robinson
S. Anzalone

Meeting Schedule:
9:00AM meet at core shed, presentation, site tour,
coffee and rolls
Noon lunch at Francisco Grande, separate checks
1:30PM visit Sacaton pit and outcrop
3:00PM CANMET-USBM depart for Phoenix

Meeting Presentations:
S. Swan introduction of visiting guests;
USBM in situ research program
A. Raihl introduction of speakers
H. Kreis overview and test work
C. Barter hydrology, fluid flow, and permitting
P. Robinson community education.



H.G. Kreis

cc: F.T. Graybeal S.A. Anzalone
W.L. Kurtz S.A. Swan
J.D. Sell C.F. Barter
P. Robinson



Southwestern Exploration Division

March 31, 1992


A.R. Raihl

Suppliers to
Test Site, EA-0438
Santa Cruz Project

Great Projections of Tucson, Arizona, was chosen as a supplier of graphics services to the Santa Cruz In Situ Copper Mining Research Project. This company was chosen because of its particular graphics experience, its reputation, and its reliability in supplying Asarco in the past.

Great Projections was recently used to provide updated slides on the In Situ Copper Mining Research Project for use in presentations. Recently made slides on the geology of the Santa Cruz deposit were done at the expense of the Santa Cruz Joint Venture.

HGK:mek


H.G. Kreis

cc: Accounting
S. Swan
F.T. Graybeal
W.L. Kurtz
J.D. Sell



Southwestern Exploration Division

March 31, 1992

A.R. Raihl

Suppliers to
Test Site, EA-0438
Santa Cruz Project

Smith Pipe and Steel Co. of Phoenix, Arizona, was chosen as a supplier of steel products for the Santa Cruz In Situ Copper Mining Research Project. This company was chosen because of its particular products, its experience, its reputation, and its reliability in supplying the Santa Cruz In Situ Copper Mining Research Project in the past.

HGK:mek


H.G. Kreis

cc: Accounting
S. Swan
F.T. Graybeal
W.L. Kurtz
J.D. Sell



Southwestern Exploration Division

March 31, 1992

A.R. Raihl

Suppliers to
Test Site, EA-0438
Santa Cruz Project

Cactus Productions of Arlington, Virginia, was chosen as a supplier of video services to the Santa Cruz In Situ Copper Mining Research Project. This company was chosen because of its particular abilities, its experience, its reputation, and its reliability in supplying the Santa Cruz In Situ Copper Mining Research Project in the past.

HGK:mek

A handwritten signature in black ink, appearing to read "H.G. Kreis".

H.G. Kreis

cc: Accounting
S. Swan
F.T. Graybeal
W.L. Kurtz
J.D. Sell



Southwestern Exploration Division

April 1, 1992

A.R. Raihl

Suppliers to
Test Site, EA-0438
Santa Cruz Project

Pactel, c/o Pro-Tec in Casa Grande, was chosen as a supplier of goods and services to the Santa Cruz In Situ Copper Mining Research Project. This company was chosen because of its particular line of goods and services, its reputation, its reliability, and its proximity to the Santa Cruz test site (seven miles west of Casa Grande, Arizona.

HGK:mek

A handwritten signature in dark ink, appearing to read "H.G. Kreis".

H.G. Kreis

cc: Accounting
S. Swan
F.T. Graybeal
W.L. Kurtz
J.D. Sell

ASARCO

Exploration Department
Southwestern United States Division

March 18, 1992

Santa Cruz Session Speakers
Engineering Foundation Conference
In Situ Recovery of Minerals - II

Dear Santa Cruz Session Speakers:

On behalf of all those involved in organizing the Engineering Foundation Conference, thank you for volunteering to attend and present a paper at the In Situ Recovery of Minerals - II Conference.

As soon as the program for the conference is finalized, you and all the other speakers will receive an application form from the Engineering Foundation. You will need to complete the form and return it to the Engineering Foundation.


The attached sheets will give you an idea of what is tentatively planned for our session on the Santa Cruz In Situ Copper Mining Research Project.

Sometime after you return your application, but before August 28, 1992, I will need a brief biographical paragraph for your introduction and a paper on the topic of your talk. In the future I will give you some guidelines on the length of your paper. Your paper will be reviewed by Asarco and by the USBM. Camera ready manuscripts must be submitted to Ken Coyne by October 1st. Instructions on formatting and preparation of camera ready manuscripts will be issued to you by Ken Coyne.

Your talk should be 15 minutes long. Be sure to have plenty of backup slides and/or overhead projections to help in answering questions during the following 1.5 hour question/answer panel discussion.

If I can be of further help at this time, please let me know.

Sincerely,



Henry G. Kreis
Session Chairman

HGK:mek
Atts.

cc: F.T. Graybeal (w/atts.)
A.R. Raihl (w/o atts.)
S. Swan (" ")
W.L. Kurtz (" ")
J.D. Sell (" ")

ASARCO

Exploration Department
Southwestern United States Division

March 16, 1992

Mr. Ken Coyne
Bechtel Corporation
P.O. Box 193965
San Francisco, CA 94119-3965

Re: Engineering
Foundation
Conference

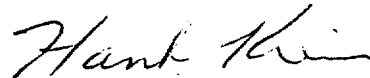
Dear Mr. Coyne:

On the attached sheets you will find all the information you requested from me in your letter of March 2, 1992.

The Co-Chairman for the Santa Cruz Project Summary has yet to be chosen. As soon as the Co-Chairman is chosen I will let you know, and I expect this to happen by March 20th.

If you need more information, please let me know.

Sincerely,



Henry G. Kreis
Session Chairman

HGK:mek
Atts.

cc: Steve Swan (w/atts.)

bl. cc: A.R. Raihl (w/atts.)
F.T. Graybeal (")
W.L. Kurtz (")
J.D. Sell (")

H.G. Kreis
March 12, 1992

IN-SITU RECOVERY OF MINERALS II

Session Title: " Santa Cruz In Situ Copper Mining Research Project"

Contents of Session: Five, brief (15 minute) presentations on various aspects of the Santa Cruz Project followed by a question-answer panel discussion.

Tentatively Scheduled Time: Thursday PM, October 29, 1992

Session Chairman: Henry G. Kreis, Asarco Inc.

Session Co-Chairman: Yet to be designated representative of Asarco or possibly of Freeport-McMoRan.

Speakers (in order of presenations):

Henry G. Kreis, Asarco Inc.
Charles F. Barter, Errol L. Montgomery & Associates, Inc.
Diane C. Marozas, USBM
Ronald B. Lantz, Intera Inc.
Priscilla Robinson, Consultant

Speaker Addresses:

Henry G. Kreis 602-792-3010
Asarco Inc.
P.O. Box 5747
Tucson, Arizona 85703

Charles F. Barter 602-881-4912
Errol L. Montgomery & Associates
1075 E. Fort Lowell Road, Suite B
Tucson, Arizona 85719

Diane C. Marozas 612-725-4674
U.S. Department of Interior
Bureau of Mines
5629 Minnehaha Ave. So.
Minneapolis, MN 55417-3099

Ronald B. Lantz 512-346-2000
Intera Inc.
6850 Austin Center Boulevard, Suite 300
Austin, Texas 78731

Priscilla Robinson 602-620-0366
P.O. Box 5591
Tucson, Arizona 85703

Co-Author Addresses:

T. Callahan
U.S. Department of Interior
Bureau of Mines
5629 Minnehaha Ave. So.
Minneapolis, MN 55417-3099

S. Paulson
U.S. Department of Interior
Bureau of Mines
5629 Minnehaha Ave. So.
Minneapolis, MN 55417-3099

W. Statham
Intera Inc.
6850 Austin Center Boulevard, Suite 300
Austin, Texas 78731

Abstracts: As follows.

ABSTRACTS OF TALKS
IN-SITU RECOVERY OF MINERALS II

OVERVIEW OF THE
SANTA CRUZ IN SITU COPPER MINING RESEARCH PROJECT
PINAL COUNTY, ARIZONA

Henry G. Kreis
Asarco Inc.

The Santa Cruz In Situ Copper Mining Research Project is a \$22 million cooperative research project between the U.S. Bureau of Mines and the Santa Cruz Joint Venture. The purpose of the project is to develop an alternative copper mining method for copper oxide deposits that can not be economically mined by conventional methods.

To date five test wells have been constructed in a five spot pattern. Each of the five wells was perforated between 1570' and 1770', and a five month long salt tracer test was conducted.

An 18 month long, in situ copper mining test is planned. A weak sulfuric acid solution will be used to leach copper from copper oxide minerals in highly fractured, but otherwise undisturbed, granite. The copper in solution will be recovered in a solvent extraction/electrowinning pilot plant (SX/EW). Construction of the SX/EW pilot plant and the initiation of the leach test will begin as soon as necessary permits are obtained.

HYDROGEOLOGIC CONDITIONS AND
GROUNDWATER RELATED PERMITTING
SANTA CRUZ IN SITU COPPER MINING RESEARCH PROJECT

Charles F. Barter
Errol L. Montgomery & Associates, Inc.

Extensive investigations have been conducted at the Santa Cruz test site to determine hydrogeologic conditions for the bedrock complex, which contains the copper oxide deposit, and for the overlying sediments, which constitute the principal aquifer. These investigations have provided data for determination of chemical quality of groundwater, for assessment of hydraulic parameters for the multilayered hydrogeologic system, and for evaluation of the environmental feasibility of the in situ mining test.

The U.S. Environmental Protection Agency, Arizona Department of Water Resources, and Arizona Department of Environmental Quality are the three regulatory agencies that have been involved with groundwater related permitting for the Santa Cruz project. Data from the hydrogeologic investigations have been used to construct conceptual and three dimensional computer models of hydrogeologic conditions at the test site. These models have been utilized to apply regulatory requirements and concepts expressed in statutes and rules for the Arizona Aquifer Protection Permit Program to the proposed in situ mining test and to predict the potential impact of the in situ mining test to the groundwater system.

THE NATURAL ATTENUATION CAPACITY OF ROCK MATERIALS
TO LIMIT THE MIGRATION OF METALS AWAY FROM IN SITU MINED SITES

D.C. Marozas and T.J. Callahan
Both of USBM

The United States Department of Interior's Bureau of Mines is conducting research on the natural attenuation capacity of rock materials to limit the migration of trace metals and other solutes away from in situ mine sites. Utilizing natural subsurface reactions in the closure of in situ leach mined sites offers economic and environmental advantages over surface restoration techniques. The capacity of natural fluid/rock interactions to attenuate major and trace elements (including all EPA MPCL elements) was determined for the Santa Cruz In Situ Mining Test Site. Results showed that natural fluid/rock interactions have a significant capacity to partition solutes from the fluid to the solid phase, thereby inhibiting their subsurface migration. Quantification of this process is essential in developing an in situ mining closure plan suitable for meeting EPA, State, and Local regulations.

MODELING FLUID MOVEMENT
SANTA CRUZ IN SITU COPPER MINING RESEARCH PROJECT

R.B. Lantz and W. Statham
Intera Inc.

Mathematical modeling was conducted for the in-situ mining research project at Santa Cruz to provide assistance in both process understanding and regulatory interaction. The model used was a fully 3-dimensional computer model, SWIFT II, that solves for both the water flow and transport of dissolved constituents.

Initially, the model was calibrated to the Santa Cruz pilot using both interference and tracer test data conducted in the 5-spot well pattern. This calibrated model was then used to predict fluid movement and constituent transport both inside and outside the 5-spot well pattern during the 2-4 year operational life of the in-situ mining research project. The model was also used to predict post-operational movement of fluids and constituents generated within the research project well pattern.

THE COMMUNITY EDUCATION PROGRAM
SANTA CRUZ IN SITU MINING RESEARCH PROJECT

Priscilla Robinson
Consultant

A program to inform the neighboring community of Casa Grande, an agricultural and manufacturing town of about 20,000, was incorporated in this multi-year research project from its initiation in the summer of 1988. The overall goal for the community education program was to anticipate the local residents' need for information about the project and to meet those needs in a timely fashion. A plan for the community education program was developed based on an analysis of the community, the technical aspects of the research program, and the regulatory process applicable to this project. Methods of communication involving two-way information exchanges were chosen to provide an on-going check on the effectiveness of the program. Careful attention was paid to identification of special audiences within the community. The program is continuing to evolve as knowledge is gained about the community and the project. Final paper will report on the overall effectiveness of the program.

ASARCO

Exploration Department
Southwestern United States Division

VIA FAX 415-768-3398

March 18, 1992

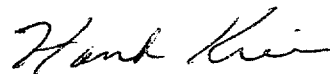
Mr. Ken Coyne
Bechtel Corporation
P.O. Box 193965
San Francisco, CA 94119-3965

Re: Engineering
Foundation
Conference

Dear Mr. Coyne:

In my letter to you March 16, 1992 I mentioned the Co-Chairman for the Santa Cruz Project Summary had yet to be chosen. Please be advised that Mr. Frederick T. Graybeal of ASARCO Incorporated has agreed to be Co-Chairman of this session. Mr. Graybeal's address is 180 Maiden Lane, New York, NY 10038, and his phone number is 212-510-1871.

Sincerely,



Henry G. Kreis
Session Chairman

HGK:mek

cc: F.T. Graybeal
S. Swan

bl. cc: A.R. Raihl
W.L. Kurtz
J.D. Sell

ASARCO

Exploration Department
Southwestern United States Division

March 20, 1992

Mr. John Stone
300 Mott Lane
Gardnerville, NV 89410

Dear John:

Please be advised that you have our consent to use the following information in your ore reserve short course:

- (1) the Birdwell Density log from CG-90 and
- (2) geologic summary data from four core holes in the center of the southern portion of Santa Cruz deposit.

It would be appreciated if you would use some other designation than the true CG-XY designation for the holes with the geology summary.

I will send a copy of your March 5, 1992, letter to Mr. F.T. Graybeal along with a note expressing your offer to give your short course to Asarco geologists.

Sincerely yours,



Henry G. Kreis

HGK:mek

bl.cc: F.T. Graybeal
W.L. Kurtz
J.D. Sell
A.R. Raihl

blind Note: To FTG:

Mr. Stone has offered to give his short course to Asarco geologists at his normal consulting fee plus an additional small override. A copy of his letter describing his short course is attached.

HGK

John Stone
300 Mott Lane
Gardnerville, NV, 89410
(702) 782-7517

ASARCO Inc. p date

MAR 9 1992

SW Exploration

March 5, 1992

Dear Hank,

As we discussed over the phone, I'm in the throes of putting together a short course in "ore reserve estimation in the real world" for the Society of Economic Geologists. I'll attach a tentative course outline to give you an idea of the sort of thing I have in mind. As I mentioned over the phone, I'd estimate that at least 90% of exploration geologists (and a large percentage of mine engineers and consultants as well) don't have the foggiest notion of how (or why) to do a reserve estimate, and judging from the papers by Prenn and Noble at the recent SME meeting, it would appear that a course like this is sorely needed! Interestingly, (and probably to the astonishment of the computer jockys) kriging is not a panacea, and may not even be appropriate as an estimation technique in many deposits!

Inasmuch as the course will focus on the "real world", I plan to use real world examples to show various techniques that I feel can help illustrate some of the important aspects of the process that are often overlooked. For example, I will use actual Pilot Knob cost sheets to illustrate how both fixed and tonnage-variable costs influence cutoff calculations, and data from Cerro Matoso to illustrate both the economic effects of selective mining and a way of estimating dilution to be expected during mining. As part of the discussion on ways to determine in-place bulk density, I'd like to use the Birdwell Density log from hole CG 90 at Casa Grande, and I'd also like to use summary data (without grades) for four holes somewhere in the center of the deposit to illustrate the concept of using intersecting sections to create a "phantom hole" that can be used to assess the predictability or projectability of a given contact.

The purpose of the course is not to re-hash old horror stories, although there are plenty around. In fact, it is so unusual for mined grades to be as good as or better than predicted, that the rare exceptions are cause for celebration. Given this fact, maybe we should be a bit careful how we use the term "proven" ore?

Regards,

John

*will use
geology of
4 drill holes*

① }
② }

PROPOSED ORE RESERVE SHORT COURSE
"ORE RESERVE ESTIMATES AND THE REAL WORLD"

1) INTRODUCTION:

- a) Purpose of estimate
- b) Types/categories of reserve estimates
(Geologic, In Situ, Mineable; Proven, Probable, Possible)
- c) Common features
(Volume, Density, Tenor, Location in space)

2) BASIC ECONOMIC CONCEPTS:

- a) Cost sheet (Pilot Knob as a typical example)
- b) Cost categories (Fixed, Variable, Sunk, etc.)
- c) Cash Flow, Present value, DCF, selective mining/scheduling
- d) Cutoff grades, development/stripping limits
- e) Lab Exercises:
 - Gold Placer cutoff/stripping limits
 - Pilot Knob cutoff (variable w/ throughput)
 - Cerro Matoso Present Value

3) PROJECTION OF DATA:

- a) Area of Influence (and variants)
- b) Inverse Distance
- c) Statistical Projection (Kriging)
- d) Use/misuse of basic statistical concepts (population statistics, grade/tonnage curves)
- e) Lab Exercises:
 - Inverse Distance in a zoned deposit
 - Population Statistics to reconcile drilling programs

4) VOLUME OF OREBODY:

- a) Geologic control/continuity of contacts
- b) Influence on mining/processing
- c) Measurement/calculation (plans, sections, block models)
- d) Lab Exercise:
 - "Phantom" drill holes to test continuity of contacts (Casa Grande)

5) DENSITY (TONNAGE FACTOR):

- a) Measurement/calculation
- b) Internal variation
- c) Double Weighting of grades
- d) Lab Exercises: (Cerro Matoso, Casa Grande)
 - Calculate tonnage factors from geophysical logs (Casa Grande)

② →

① →

6) GRADE/TENOR:

- a) Total vs. recoverable - basic metallurgical concepts (unit recovery, weight recovery)
- b) Geologic factors affecting processing/recovery and/or value/marketability
- c) Internal variability within orebody, definition of ore types

7) LOCATION IN SPACE:

- a) Influence on mining/recovery
 - b) Dilution in situ vs mill feed ("overbreak", "internal", "replacement" dilution)
- Lab Exercises:
- Develop formula for estimating dilution/recovery for a block caving operation, and apply to an example from Casa Grande
 - Calculate estimated mill feed grade for Cerro Matoso

8) MAPPING/SAMPLING/TESTING:

- a) Objective (project stage)
- b) Drilling, logging, geophysical/geotechnical techniques
- c) Bulk sampling/"pilot" testing

9) MINE GRADE CONTROL:

- a) Objective
- b) Theory vs reality

As noted, "laboratory" exercises would consist of use of actual data from the following deposits to illustrate the theoretical concepts discussed:

Pilot Knob, Missouri - Underground magmatic/replacement magnetite deposit. No longer in operation

Cerro Matoso, Colombia - Open pit nickel laterite deposit with smelter. In operation

Casa Grande, Arizona - Underground porphyry copper deposit. Presently undeveloped

San Juan, California - Placer gold deposit. Presently undeveloped

March 4, 1992

F.T. Graybeal

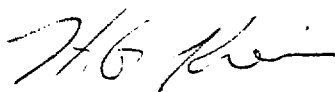
Environmental Assessment
Simmons 528 Acre Parcel
Santa Cruz Project
Pinal County, Arizona

Mr. Gregory Knapp has completed his environmental assessment of the 528 acre Simmons parcel of land which borders the east side of the SCJV property. A copy of his report accompanies this memo.

Mr. Knapp has concluded, and I concur, there are no environmental concerns that would require additional work prior to the proposed SCJV acquisition of this property. His conclusion is based on his review of environmental reports covering this property and on his evaluation of the property in the field.

The Resolution Trust Corporation has yet to disclose its plans for an environmental assessment of this property. Mr. Apker alerted the RTC lawyer of environmental concerns with the property, namely, the existence of the trash pit. So, it is possible the RTC environmental assessment may be more detailed than it would have been if not alerted to the presence of the trash pit. If the RTC's environmental assessment is more detailed than any of the environmental assessments to date, there may be some new information to evaluate and the above conclusion could be subject to change.

By copy of this letter, I am forwarding a copy of Mr. Knapp's report to Freeport-McMoRan for review and comment.



H.G. Kreis

HGK:mek
Accompaniment

cc: W.L. Kurtz
J.D. Sell
W.D. Gay
A.R. Raihl
G. Knapp (w/o accompaniment)
W.E. McCulloch

ASARCO

March 2, 1992

Technical Services Center

M.O. Varner
Director

D.E. Holt
Engineering Manager

D.A. Robbins
Environmental Sciences Manager

M.G. King
Research Manager

ASARCO Incorporated

MAR 4 1992

SW EXPEDITION

Mr. Hank Kreis
Tucson Office

RE: Environmental Assessment Simmons-Devcor Land

Pursuant to your request I visited the Simmons-Devcor land on February 25, 1992 and performed a visual inspection relating to possible environmental concerns. The subject property is illustrated in Figure 1. This property is adjacent to property owned by the Santa Cruz Joint Venture (SCJV).

The previous environmental assessments by Western Technologies (Job No. 2178J235 September 1988) and Woodward-Clyde (WCC File No. 88H1062C January 1989) were reviewed as well.

Summary results of the site visit are as follows:

The property in Sections 17, 18, and 30 appear to have no environmental impacts. The land in Sections 17 & 18 appears to be largely undisturbed desert terrain. The land in Section 30 appears to be fallow agricultural land.

The property in Section 19, other than where the old airfield facilities and the incinerator/ash pit are located (Figure 2), seems to be similar to the Section 17 & 18 land.

The old airfield facilities, now occupied by the SCJV, appear to have no environmental impacts from past use of the land. The underground tanks were removed and previous soil testing indicated no detectable petroleum hydrocarbons. There appear to be no other environmental concerns.

No further evaluation work is recommended for any of the above land.

The incinerator and adjacent ash/trash pit do not appear to have any significant environmental impacts. However, there is a sizable accumulation of domestic-type trash in the pit (approximately 1100 cubic yards) and surrounding area. This trash is mostly glass, tin cans, appliances, a few tires, a few rusted-out 55 gallon drums, and other debris. There were no obvious signs of soil contamination observed other than some small lube oil stains around the abandoned water well adjacent to the incinerator. Past soil boring and sampling performed by Western Technologies in the pit showed no detectable organic solvent compounds or metals. Hazardous waste characterizations indicated the soils were non-hazardous.

Future use of this property should include the closure of this trash pit. The existing trash should be hauled to an appropriate landfill and the pit backfilled with clean soil. A closure plan including post-excavation samples would likely be required by the regulating authority (County or State).

If desired, additional evaluation sampling could be performed in the next several weeks. Two additional borings to an approximate depth of 30 feet could be performed. Soil samples from five foot intervals could be gathered for organic solvent and TCLP analyses. Proposed boring locations are provided in Figure 3. A cost estimate for this work is provided below.

Soil Borings

Rig - 1 day @ \$ 900.00/day	\$	900.00
Mobilization @ \$ 400.00/day	\$	400.00
Steam cleaner @ \$ 45.00/day	\$	45.00

Sample Analyses

Soils EPA 8260 - 14 samples @ \$ 240.00 each	\$	3360.00
Soils Total Metals 14 samples @ \$ 100.00 each	\$	1400.00
Soils TCLP Organics - 1 sample	\$	865.00
Soils TCLP Metals - 1 sample	\$	200.00
Sampling Materials	\$	200.00
Total Estimated External Costs	\$	7370.00



Gregory A. Knapp
Senior Environmental Scientist

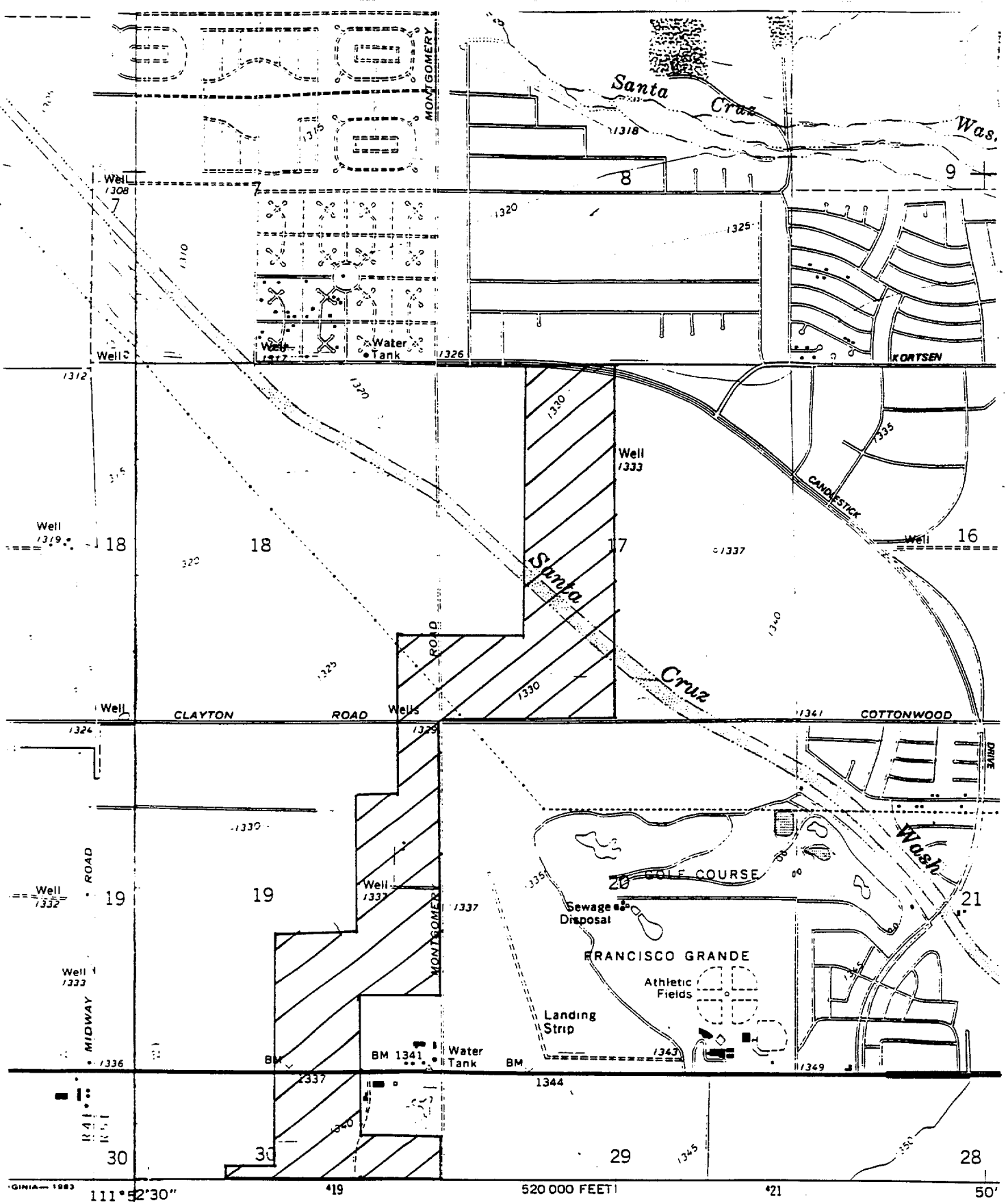


Figure 1
Simmons-Devcor Land

Scale: 1" = 1970'

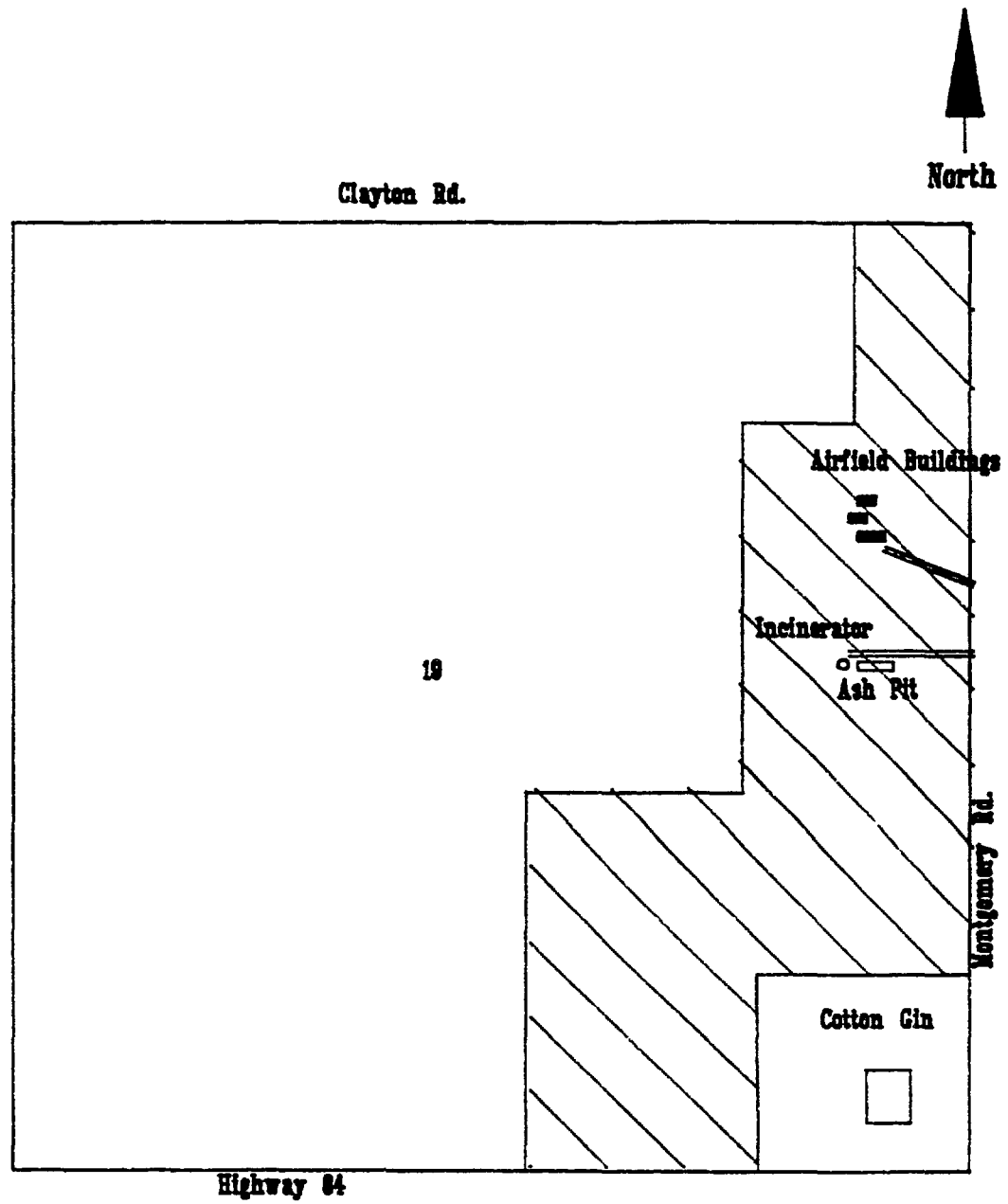
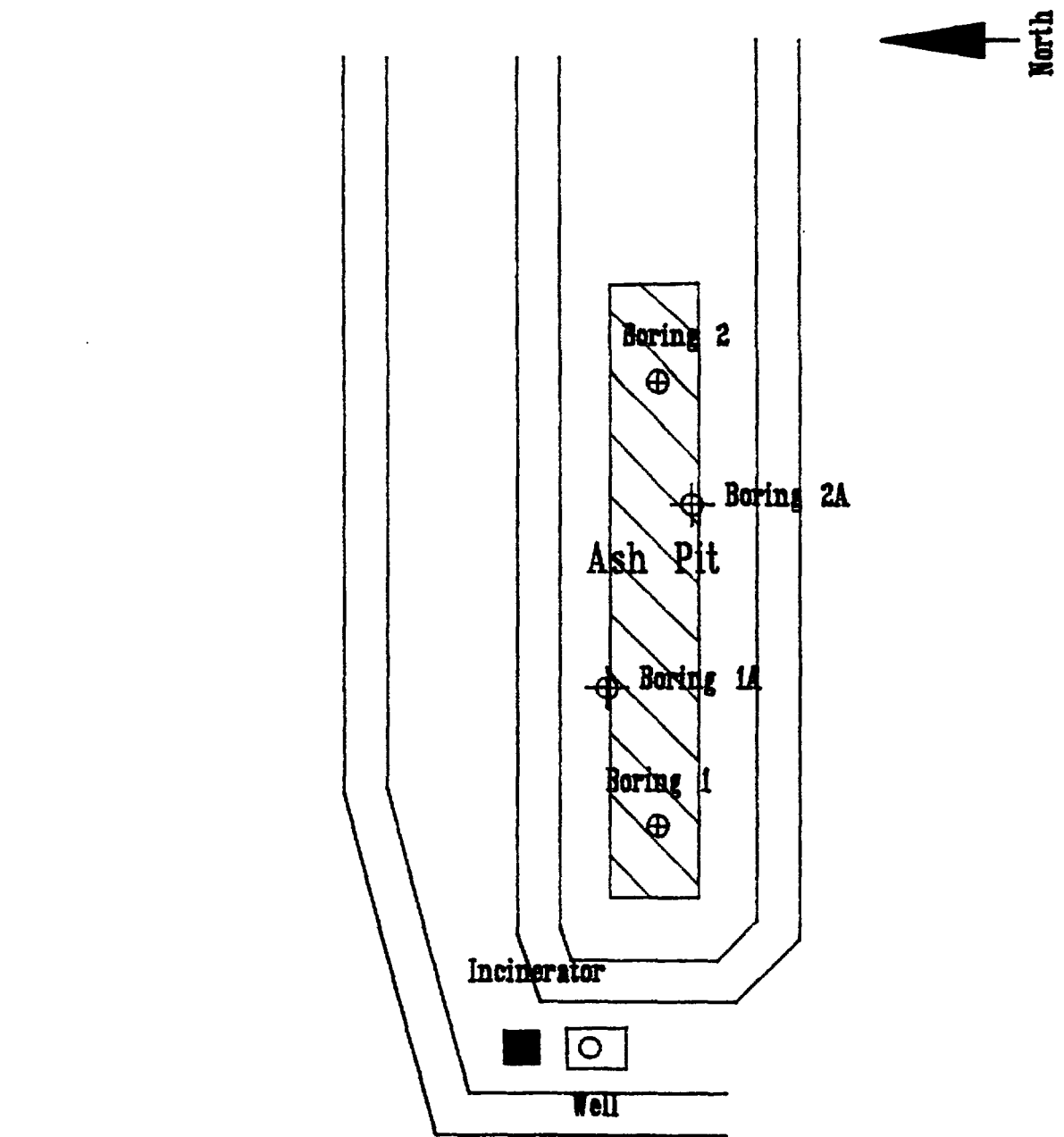


Figure 2

Simmons Devoor Land
Section 19

Scale: 1" = 1000'



⊕ Previous Boring Location

⊗ Proposed Boring Location

Figure 3
Incinerator / Ash Pit
Scale: 1" = 50'



Southwestern Exploration Division

March 20, 1992

F.T. Graybeal
New York Office

Purchase and Sale Agreement
Texaco Land
Santa Cruz Project
Pinal County, Arizona

On March 13, 1992 a copy of the Purchase and Sale Agreement ("Agreement") for the 1088 acre parcel of Texaco land arrived at the Tucson Office. It was sent by Mr. Apker who told Mr. Kurtz this Agreement is Texaco's modification of the original Agreement sent to Texaco by Mr. Apker.

Both Mr. Kurtz and I have reviewed this Agreement and have told Mr. Apker of our comments. More recently I spoke with you and Mr. Woods about this Agreement.

In summary of my comments, the following is offered:

- Is a clause needed to relieve Santa Cruz of any liability of acquiring the Property without fully disclosing our knowledge of the mineral potential to Texaco?
- Texaco has land in Section 17 that needs to be added to the Agreement. For some reason this land was overlooked in a couple of the old title insurance reports on the property.
- I want to be sure we can inspect and acquire all the land files relating to the CP area, not just the Property, that are in Texaco's possession. This should include files on correspondence with lot owners, the bankruptcy court, DC Properties, NAAC, royalty owners, CP Water Co., etc.
- Section 7, page 3, excludes Personal Property (excepting capital stock and well equipment) from being included in the sale of the property. What exactly is being excluded from the sale? Are maps, land files, etc. considered personal property? If so, this section needs to be modified.
- The present Agreement requires Texaco to make certain documents, as described on page 8,, available to Santa Cruz on or before 30 days after signing the agreement. This could leave as little as 15 days to review the documents before the 45 day rescind clause (page 6) expires. The documents should be available within 5 days after the date of signing this Agreement to allow sufficient time for inspection.

F.T. Graybeal

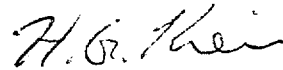
March 30, 1992

- Section 8.a, page 4, refers to a clubhouse on the property. This clubhouse is not on the Property of this Agreement, and reference to it should be deleted.
- Section 8.d, page 6, allows a 45 day inspection period. Does this give Santa Cruz the right to enter the property and drill holes for environmental purposes, or do we need to specifically establish this right in the Agreement?

I would like to draw your attention to another matter, one which has been discussed several times in the past. As you will recall, Texaco holds a 5% NSR royalty, in addition to the underlying 2.5% royalties, on the land Texaco sold to Simmons and Simmons sold to SCJV in late 1988. This is a combined royalty of 7.5% on approximately 200 SCJV acres consisting of the SE/4 (less approx. 177 lots) Section 7, T6S, R5E; the W/2, NW/4 (less 5 lots) Section 17, T6S, R5E; and five small well sites in Section 13, T6S, R4E, and Section 18, T6S, R5E. Although the documentation is not available in this office, I believe these combined 7.5% royalties also apply to the 75 acres of land (E/2, NW/4 Section 17, T6S, R5E) sold to and presently owned by Simmons (subject to RTC auction in May, 1992). All of this land was once part of the CP Area acquired by Texaco.

These 7.5% combined royalties are unduly high and could be troublesome in the future. Consideration should be given to acquiring or reducing Texaco's 5% NSR royalty on both the SCJV land and Simmons Land. Perhaps this could be negotiated on the premise SCJV wants all of Texaco 5% NSR royalties along with the CP Water Co. which is currently serving customers -- not on the Property of this Agreement -- but internal to the SCJV 200 acres with the 7.5% NSR royalty. I suspect Texaco will relinquish its 5% royalties on these properties, just as readily as it dropped its demand for a royalty on the 1088 acres.

If I can be of further help, please let me know.



H.G. Kreis

HGK:mek

cc: J.L. Woods
B.M. Apker
W.L. Kurtz
J.D. Sell
A.R. Raihl



Southwestern Exploration Division

March 19, 1992

Mr. F.T. Graybeal
New York Office

Cover Letter
Phase I and II Report
Santa Cruz Project

Enclosed for review by you and others in the New York Office is a rough draft copy of the cover letter that will be used to transmit the "Phase I and II Technical Report" to the U.S. Bureau of Mines. This draft has been reviewed by Mr. Raihl.

HGK:mek
enc.


H.G. Kreis

cc: A.R. Raihl
W.L. Kurtz
J.D. Sell

ROUGH DRAFT FOR ASARCO REVIEW

April ____, 1992

Mr. Steven Swan
U.S. Bureau of Mines
Twin Cities Research Center
5629 Minnehaha Avenue South
Minneapolis, Minnesota 55417

Re: Phase I and II Technical Report

Dear Mr. Swan:

Fifteen copies of "Phase I and II Technical Report" are being delivered to the U.S. Bureau of Mines in satisfaction of the terms of Cooperative Agreement C0289001 and Modification 5. Three copies of this report with appendices and ten copies without appendices accompany this letter. By copy of this letter, a copy of this report without appendices is being sent to each of the following USBM recipients: Mr. David Askin, Contracting Officer in Denver, Colorado; and Mr. Michael F. Jenkins in Washington, D.C.

The report describes all the work and results of Phase I and II of the In Situ Copper Mining Research Project up to December 31, 1991. It is a compilation by SAIC of text material and appendix material written by SAIC, Montgomery and Associates, Intera Inc., KD Engineering, USBM, Asarco Inc., Zonge Engineering, Woodward-Clyde, and Priscilla Robinson.

The report was written with the understanding it will be used only for internal USBM purposes. Although the report itself will not be published, its contents will be used as source material for USBM interim report publications.

The quality of the organization, technical writing, and editing of the enclosed report is as we agreed, and our agreement is summarized in my December 12, 1991 letter to you, a copy of which is enclosed for your convenience.

As discussed in our telephone conversation of March 18, 1992, the oral presentation to the USBM on Phase I and II will be scheduled by you within two weeks after receiving this report.

If you or anyone else in the U.S. Bureau of Mines has any questions about this report, please feel free to contact me or any of the authors involved in its writing.

Sincerely yours,

Henry G. Kreis

Enclosures

cc: DAskin	(1 text)
MJenkins	(1 text)
ARRaihl	(1 text, 1 appendix)
FTGraybeal	(4 text, 1 appendix)
WEMcCulloch	(2 text, 1 appendix)
CBarter	(1 text)
FBazanella	(1 text)
HCothran	(4 text, 2 appendix)
WLK/JDS/LIBRARY	(1 text, 1 appendix)
HGKreis	(1 text, 1 appendix)

ASARCO

Exploration Department
Southwestern United States Division

December 12, 1991

Mr. S. Swan
U.S. Bureau of Mines
Twin Cities Research Center
5629 Minnehaha Avenue South
Minneapolis, Minnesota 55417

Re: Phase I and II Report

Dear Steve:

In our December 5th telephone conference call between you, me, John Nicol, John Pendleton, and Chris Manikas, we discussed the writing of the Phase I and II report. I would like to take a moment to summarize my understanding of the quality of the organization, technical writing, and editing of the Phase I and II report.

The Phase I and II report will be used only for internal USBM purposes and will not be made public. The USBM will use the Phase I and II report as source material for writing USBM interim report publications.

The quality of the organization, technical writing, and editing of the Phase I and II report is to be the same as that exhibited in the Phase I and II draft report of May 15, 1991. Such quality is adequate for the USBM's purposes, and the cost of upgrading the quality is not justified.

Three rough draft copies of the Phase I and II report will be given to the USBM in early 1991. If the USBM wishes to make changes, they can be requested at that time. Such changes will be incorporated into the final Phase I and II report.

Sincerely,



Henry G. Kreis

HGK:mek

cc: A.R. Raihl
F.T. Graybeal
W.L. Kurtz
J.D. Sell
J. Nicol
W.E. McCulloch

DELIVERY OF REPORTS TO USBM

One copy w/o appendix:

U.S. Department of the Interior
Bureau of Mines
Branch of Procurement, Denver
Bldg. 20, Denver Federal Center
Denver, Colorado 80225

Attention: Mr. David Askin
Contracting Officer 2043
Agreement No. C0289001

One copy w/o appendix:

U.S. Department of the Interior
Bureau of Mines
810 7th Street NW
Washington, D.C. 20241

Attention: Mr. Micheal F. Jenkins
Agreement No. C0289001

Ten copies w/o appendices and three copies with appendices:

U.S. Department of the Interior
Bureau of Mines
Twin Cities Research Center
5629 Minnehaha Avenue South
Minneapolis, Minnesota 55417

Attention: Mr. Steven A. Swan
Agreement No. C0289001

ASARCO

Exploration Department
Southwestern United States Division

March 20, 1992

Mr. W.E. McCulloch, Jr.
Freeport Mining Company
P.O. Box 61520
New Orleans, Louisiana 70161

Re: Texaco Purchase
and Sale Agreement

Dear Walt:

Enclosed for your review is a draft copy of the Purchase and Sale Agreement ("Agreement") for the purchase of Texaco's 1088 parcel of land and the CP Water Company. This Agreement was prepared by Mr. Apker, sent to Texaco, and returned with modifications from Texaco.

As you will find, the general terms of this Agreement are in agreement with previous negotiations. I don't expect any major changes; however, there are a number of details in the Agreement that are being addressed and are likely to be changed.

Also enclosed are copies of the following items forwarded to us by Mr. Apker:

- (1) Agreement for Operation of Water System dated October 22, 1985
- (2) December 15, 1988 letter from R.J. Kennedy to P. Darrow about CP Water Company
- (3) Memorandum of Settlement dated April 9, 1984.

If you have any questions, please feel free to call me.

Sincerely,



Henry G. Kreis

HGK:mek
Encs.

cc: F.T. Graybeal (w/o encs.)
W.L. Kurtz (" ")
J.D. Sell (" ")
A.R. Raihl (" ")



Southwestern Exploration Division

March 31, 1992

FILES

Santa Cruz Petrography
USBM Open File Report
Santa Cruz Project
Pinal County, Arizona

A USBM manuscript for an Open File Report entitled "Petrology of Copper-Oxide-Bearing Host Rocks from the Santa Cruz In Situ Leach Mining Demonstration Project, Arizona" by Susan Brink and Drummond Earley III was submitted to the undersigned for technical review. A copy of this manuscript with comments, corrections, etc. by the undersigned is attached.

HGK:mek
Attachment

A handwritten signature in black ink, appearing to read "H.G. Kreis".

H.G. Kreis

cc: A.R. Raihl (previously given copy of att.)
F.T. Graybeal (w/att.)
W.L. Kurtz (file copy)
J.D. Sell (" ")

April 6, 1992

A.R. Raihl

Presentation for
CANMET-USBM Visit
April 15, 1992
Santa Cruz Project

The presentations that will be given to CANMET-USBM on April 15, 1992, will be technically orientated talks. They will not be the same presentations that will be given in the future as part of our community education program for non-technically orientated audiences.

where

The presentations are scheduled, beginning at 9 AM on April 15th, as follows:

<u>Speaker</u>	<u>Topic</u>	<u>Time</u>
S. Swan	Introduction of visitors, USBM program	As needed
A. Raihl	Welcome and introduction of speakers and video	As needed
Video tape	S.C. In Situ Copper Mining Research Project	10 minutes
H. Kreis	Santa Cruz deposit, objectives, phases, design, facilities, test work, commercial production	20 minutes
C. Barter	Hydrology, attenuation, fluid flow, permitting	20 minutes
P. Robinson	Community education	10 minutes

HGK:mek


H.G. Kreis

cc: F.T. Graybeal
W.L. Kurtz
J.D. Sell
P. Robinson
S.A. Swan (via FAX)
C.F. Barter

PURCHASE ORDER

DATE

5/4/92

ORDER NO.

SC-92-40

REQUISITION NO.

PLANT JOB NO.

ASARCO Santa Cruz, Inc.

TUCSON OFFICE
P. O. BOX 5747

1150 NORTH 7TH AVENUE
TUCSON, ARIZONA 85703

APPROPRIATION NO.

To: Thompson Safe Lock and Key
201 E. 4th Street
Casa Grande, AZ 85222
Tel.: 602-836-7662

FINAL DESTINATION — PLEASE NOTE CONSIGNMENT BELOW

Santa Cruz Test Site
7 miles west of Casa Grande, AZ

DATE REQUIRED AT DESTINATION:

CONSIGNMENT — SELLER WILL SHIP TO

SHIPPING INTERVAL PROMISED

SELLER WILL SHIP BEFORE:

POINT OF SHIPMENT

TERMS:

F.O.B. POINT

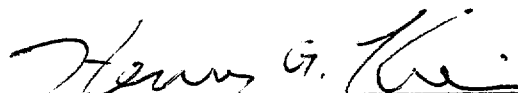
— RENDER BILLS AS PER ATTACHED SHIPPING INSTRUCTIONS —

SHIP VIA

QUANTITY	UNIT	SPECIFICATIONS	ITEM NO.	UNIT PRICE
		<p style="text-align: center;"><u>BLANKET ORDER</u></p> <p>When requested, Thompson Safe Lock and Key will supply locks, keys, and lock and key service for the above described test site.</p> <p>Duration: April 28, 1992 to December 31, 1992</p>		

cc: Accounting (2)
A.R. Raihl
F.T. Graybeal
W.L. Kurtz
J.D. Sell
Test Site

PLEASE ENTER OUR ORDER FOR THE ITEMS SPECIFIED ABOVE. SUBJECT TO ALL INSTRUCTIONS AND PROVISIONS ON REVERSE SIDE.


Henry G. Kreiß, Site Manager

INSTRUCTIONS

INVOICE: Priced invoices in the requisite number giving the correct purchase order and requisition numbers, together with required Bills of Lading, must be forwarded on day of each shipment AS PER SPECIAL SHIPPING INSTRUCTIONS ACCOMPANYING THIS ORDER, otherwise delay in payment of account may result.

TERMS: As previously arranged or specified on this order. Care must be exercised to show cash discount, if allowed, on face of invoice.

PROVISIONS

1. **ACCEPTANCE:** Acceptance of this order constitutes acceptance of all terms herein stated. All representations and warranties by the seller relating to the subject-matter of this order or its performance shall be binding on the seller as if fully set forth herein, and shall survive inspection and acceptance of the goods ordered. No acknowledgment or acceptance of this order or any other communication by the seller shall vary or add any terms or conditions to those contained herein and any such attempted modification or addition which is not accepted in writing by the buyer, shall be void and may be disregarded without further notice or disclaimer.

2. **PRICES:** This order must not be filled at higher prices than last quoted without authority of the buyer.

3. **SHIPMENTS:** All materials must be forwarded by the route designated and seller will be held strictly accountable for any deviation therefrom.

When the material covered by this order shall aggregate a carload shipment or more, the seller must forward in carload lots, unless duly authorized in writing by the buyer to ship in less than carloads. If this order aggregates less than a minimum carload, seller must forward the entire quantity at one time unless otherwise authorized in writing by the buyer.

When blocking or dunnage, etc., not constituting a part of the car are used to protect and make shipments secure in transit, seller must show on Bills of Lading, separately, the weights of such materials, provided the lading shall aggregate a minimum carload or more, and will be held responsible for failure to comply with this rule.

Shipments will not be considered as completed until Bill of Lading, or express or mail receipt is received.

4. **PACKING AND CARTAGE CHARGES:** No charge will be allowed for packing, boxing or cartage, unless agreed upon at the time of purchase; damage to any material not properly packed to insure adequate protection in transit will be charged to the seller. All packing must conform with tariff or classification requirements so as to secure lowest possible freight rates. It is understood the buyer will receive the benefit of any decrease in freight charges between time of quotation and date of shipment, where freight enters into the price originally quoted.

5. **QUALITY AND INSPECTION:** All material furnished must be as specified and will be subject to inspection and approval of buyer after delivery. The right is reserved to reject and return at the risk and expense of the seller such portion of any shipment which may be defective or fail to comply with the specifications without invalidating the remainder of the order. If rejected it may be held for disposition at the expense and risk of the seller.

6. **QUANTITY:** The specific quantity ordered must not be changed without buyer's permission in writing.

7. **NON-PERFORMANCE:** Buyer reserves the right to cancel this order or any portion of same if delivery is not made when and as specified, time being of the essence of this order, and charge seller for any loss entailed.

8. **PATENTS:** The seller hereby guarantees the buyer against all losses of profits, damages, or both, resulting from any patent infringement by reason of purchasing or using goods covered by this order, or by reason of any loss suffered in not being able, without liability, to use such goods. This guarantee also includes the reimbursement to the buyer of all litigation costs which it may suffer as the result of any suit respecting the purchase or use of such goods, in addition to the recoveries which may be secured against it of profits and/or damages.

GENERAL:

9. The material on this order must be furnished only by the person or firm to whom the order is addressed unless otherwise authorized by the buyer.

10. No drafts for purchases made will be honored unless by agreement.

11. If it becomes necessary for the seller or any agent, contractor, or employee thereof to enter upon the property of the buyer in order to construct, inspect or deliver hereunder, the seller hereby agrees to protect the buyer's property and all persons thereon from injury, damage or loss, and the seller shall save harmless and indemnify the buyer from and against any expense, loss or damage on account of any claim, demand or suit made by any person whomsoever, including any employee of the buyer, which is in any way caused by or connected with or grows out of the performance hereunder by the seller or any agent, contractor or employee thereof; provided however that the seller shall not be required to indemnify the buyer against any loss caused solely by the negligence or willful fault of the buyer or its employees. If the seller performs any work hereunder knowing it to be contrary to any local law, ordinance, rule and regulation, the seller shall bear all costs arising therefrom. Seller to carry Liability Insurance and to carry Workmen's Compensation Insurance as provided by the laws of the State in which the work is performed and further, is to obtain a certificate for same, which is to be furnished for the file of the buyer. If for any reason the seller's or any subcontractor's employees or agents may acquire a status imposing liability on the buyer for employer's contributions or taxes under the Federal Social Security Act or under any State Unemployment Insurance, Old Age Benefit, or similar Acts, the seller shall be exclusively liable for, and shall indemnify the buyer against, the same and does agree to comply with all laws and regulations so as to relieve the buyer from any and all liability therefor or the responsibility of making any reports or keeping any records with respect thereto.

12. In accepting this order the seller certified that these goods were produced in compliance with all applicable requirements of Sections 6, 7 and 12 of the Fair Labor Standards Act of 1938, as amended, and of the regulations and orders of the United States Department of Labor issued under Section 14 thereof. It will be necessary in order for us to honor your future invoices to us that the above clause or a substantial equivalent thereof appear on your invoices.

13. By acceptance of this order, seller warrants that the prices specified do not exceed the maximum prices established under any applicable United States law or regulation thereunder.



Southwestern Exploration Division

April 23, 1992

Files

On Site Subsidence
Monument Locations
Santa Cruz Project

The on site subsidence survey monuments are being buried a foot below the ground surface to avoid interfering with surface operations.

To find the location of the buried monuments follow these directions:

Monument SUB-1, approx. 18' east of SM-1:

On a straight line between the center of SM-1 and the center of T-3, go 17.7' from SM-1 towards T-3. At that point go 1.5' due south to SUB-1.

Monument SUB-5, approx. 13' west of T-3:

On a straight line between the center of T-3 and the center of SM-1, go 12.6' from T-3 towards SM-1. At that point go 0.6' south to SUB-5. (Note: SUB-5 is on a line between the electric power box and the conduit box.)

Monument SUB-6, approx. 7' north of T-4:

SUB-6 is located 7' due north of T-4 on a straight line connecting the east edge of the 10" steel casing in T-4 with the east edge of the 10" steel casing in T-2.

A handwritten signature in dark ink, appearing to read "H.G. Kreis".

H.G. Kreis

HGK:mek

cc: A.R. Raihl
Test Site
F.T. Graybeal
W.L. Kurtz
J.D. Sell

ASARCO

Exploration Department
Southwestern United States Division

May 11, 1992

Ms. Diane Marozas
U.S. Bureau of Mines
E. 58th Street & Mississippi River
Minneapolis, MN 55417

Dear Diane:

In this box are the following samples that you requested:

- C-1 1030' to 1035' (core)
- T-2 1250' to 1260' (assay reject of rotary cuttings)
- T-2 1680' to 1690' (D) (duplicate rotary cuttings)
- T-2 1720' to 1730' (D) (duplicate rotary cuttings).

The geology of these samples are described on the geologic logs.

If you have any questions, please feel free to call.

Sincerely,



Henry G. Kreis

HGK:mek
Encs.

cc: A.R. Raihl
F.T. Graybeal
W.L. Kurtz
J.D. Sell
S.A. Swan

5/20/92

WLK/JDS/WDG/ARR

The RTC auction
of Simon's ± 500 ac
parcel scheduled for
May 29th has be
canceled. It has
been rescheduled for
1:30PM June 26th.

H.G.K.



Southwestern Exploration Division

June 4, 1992

A.R. Raihl

Subsidence Monuments
Santa Cruz Project

Construction of the subsidence survey monuments has been completed. The location and the "as built" construction of each monument is described in the attachments.

The monuments have not been surveyed, and there are no plans to survey them until just prior to the start of the in situ copper mining test. To facilitate finding the off site monuments, their approximate coordinates are: SUB-2, 68510N and 49420E; SUB-3, 64010N and 52018E; and SUB-4, 64010N and 46820E. The locations of the on site monuments are described in the attached April 23, 1992 file memo.

A handwritten signature in cursive script that reads "H.G. Kreis".

HGK:mek

H.G. Kreis

cc: Test Site
F.T. Graybeal
W.L. Kurtz
J.D. Sell
J. Ahlness
W.E. McCulloch



Southwestern Exploration Division

April 23, 1992

Files

On Site Subsidence
Monument Locations
Santa Cruz Project

The on site subsidence survey monuments are being buried a foot below the ground surface to avoid interfering with surface operations.

To find the location of the buried monuments follow these directions:

Monument SUB-1, approx. 18' east of SM-1:

On a straight line between the center of SM-1 and the center of T-3, go 17.7' from SM-1 towards T-3. At that point go 1.5' due south to SUB-1.

Monument SUB-5, approx. 13' west of T-3:

On a straight line between the center of T-3 and the center of SM-1, go 12.6' from T-3 towards SM-1. At that point go 0.6' south to SUB-5. (Note: SUB-5 is on a line between the electric power box and the conduit box.)

Monument SUB-6, approx. 7' north of T-4:

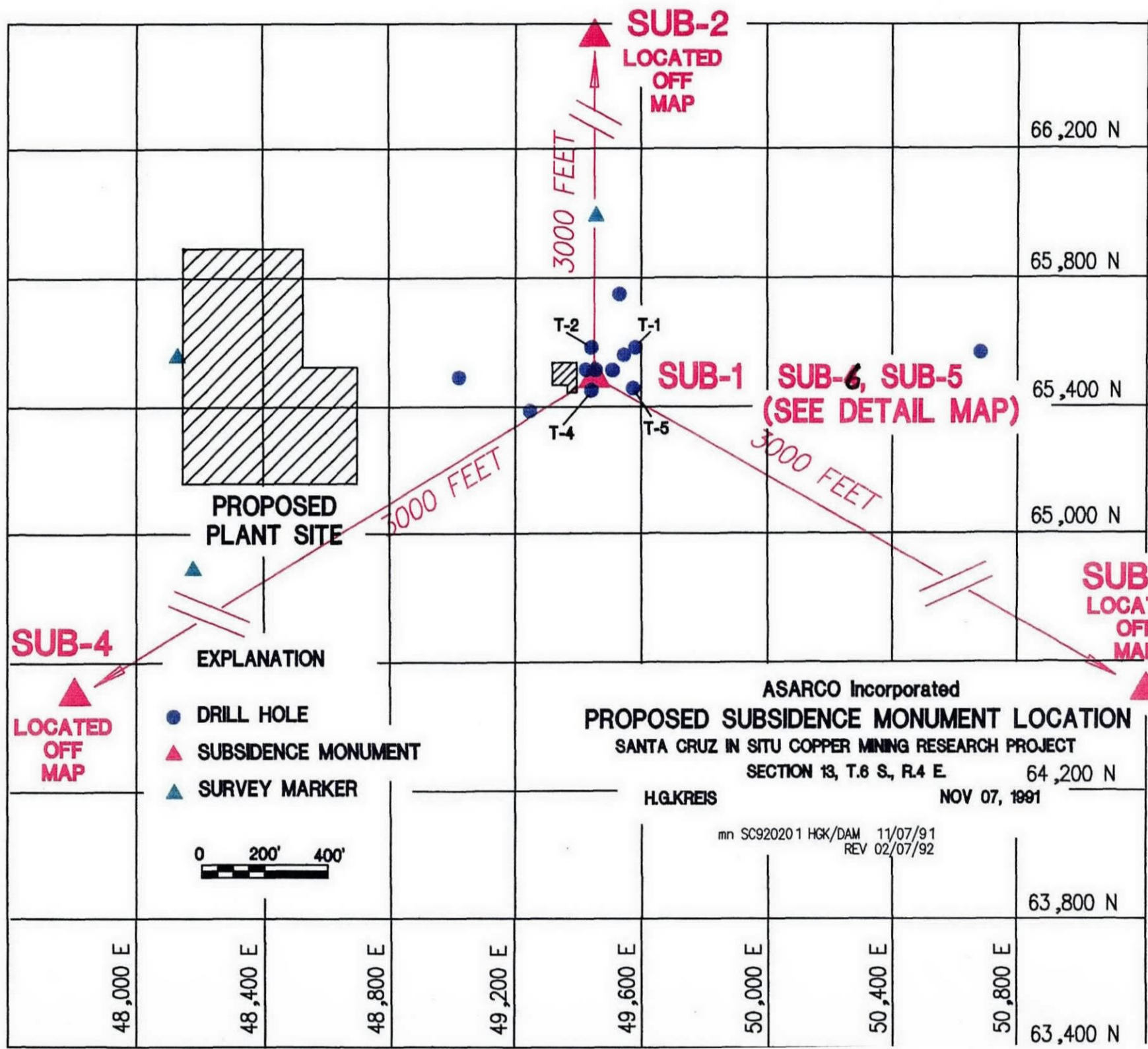
SUB-6 is located 7' due north of T-4 on a straight line connecting the east edge of the 10" steel casing in T-4 with the east edge of the 10" steel casing in T-2.

HGK:mek

A handwritten signature in cursive script, appearing to read "H.G. Kreis".

H.G. Kreis

cc: A.R. Raihl
Test Site
F.T. Graybeal
W.L. Kurtz
J.D. Sell



SUB-4
 LOCATED
 OFF
 MAP

SUB-2
 LOCATED
 OFF
 MAP

3000 FEET

SUB-1 **SUB-6, SUB-5**
 (SEE DETAIL MAP)

SUB-3
 LOCATED
 OFF
 MAP

66,200 N

65,800 N

65,400 N

65,000 N

64,200 N

63,800 N

63,400 N

48,000 E

48,400 E

48,800 E

49,200 E

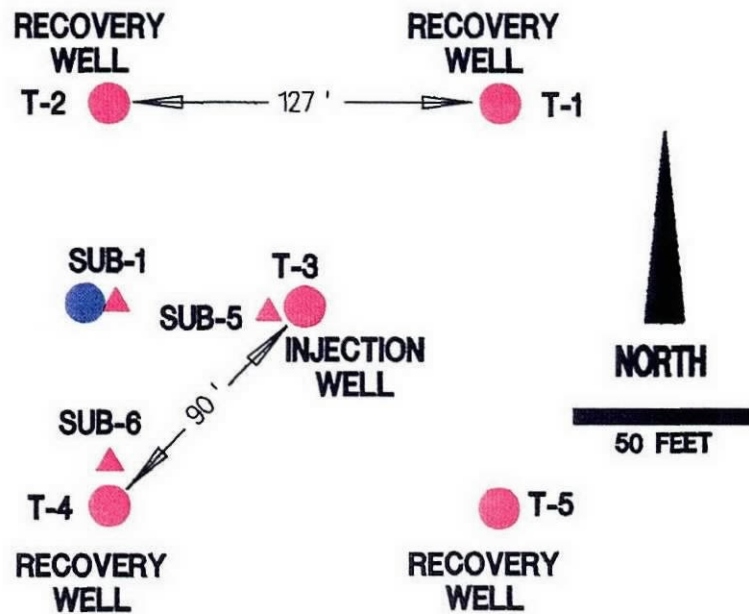
49,600 E

50,000 E




50,400 E

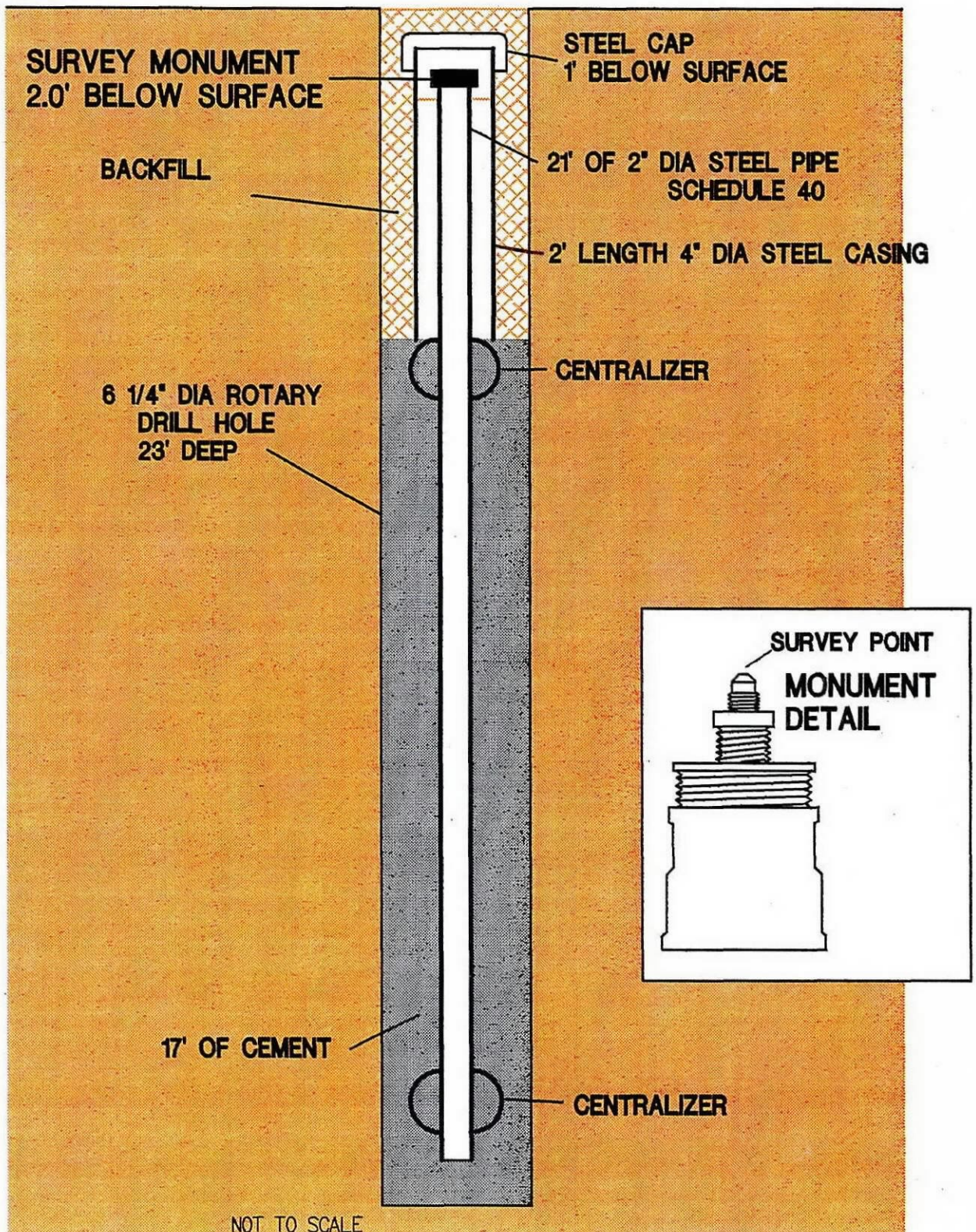
50,800 E

SANTA CRUZ IN SITU TEST SITE



EXPLANATION

-  TEST WELLS
-  SUBSIDENCE MONUMENT
-  HYDROLOGIC TEST WELL

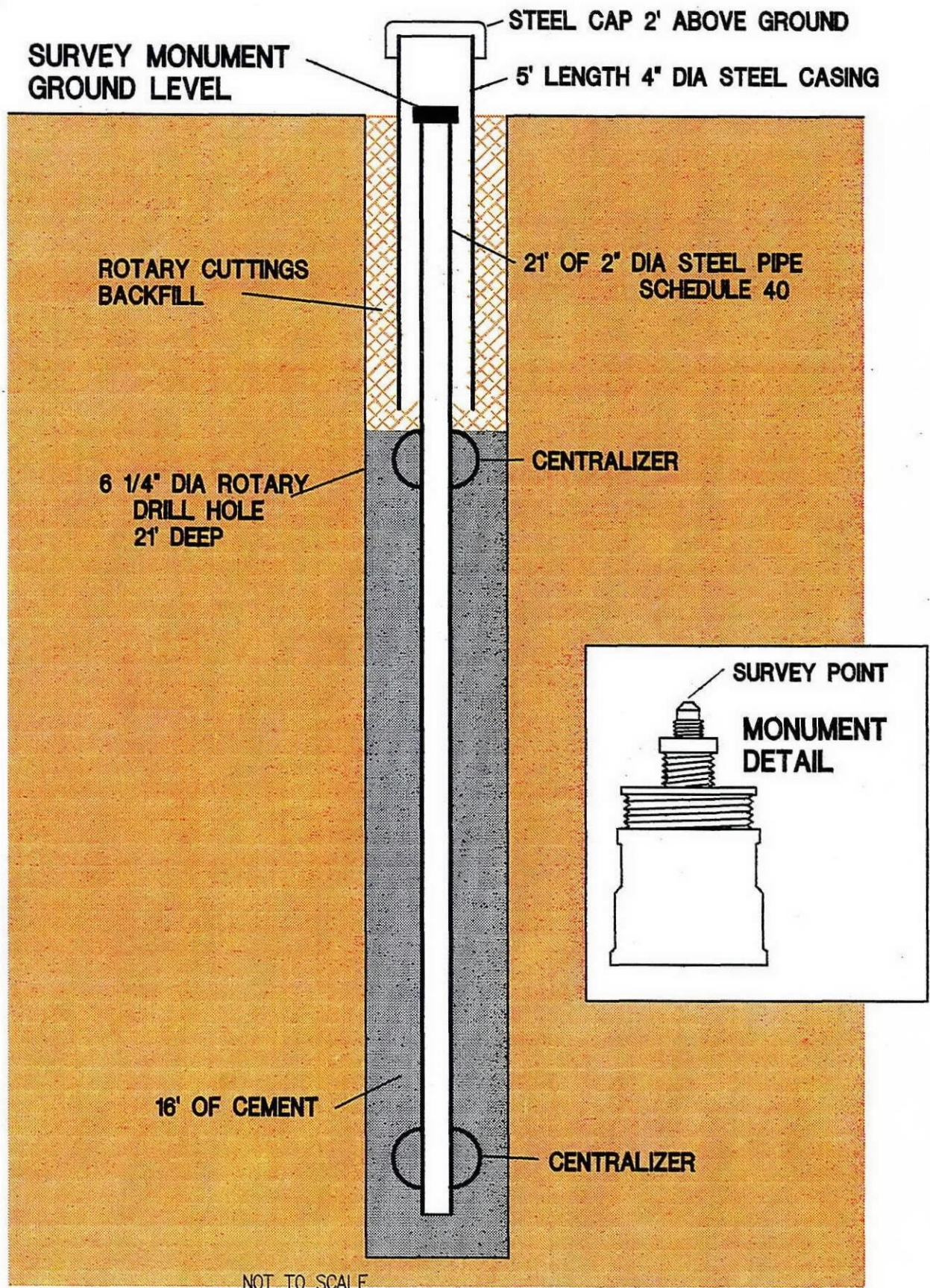


AS BUILT
FOR: SUB-1
SUB-4 ⁶
SUB-5

ASARCO Incorporated
ON SITE BELOW GROUND
SUBSIDENCE MONUMENT CONSTRUCTION
SANTA CRUZ IN SITU COPPER MINING RESEARCH PROJECT
H.G.KREIS

MAY 22, 1992

min SC920204 HGK/DAM 02/11/92
05/22/92



NOT TO SCALE

**AS BUILT
FOR: SUB-2
SUB-3
SUB-4**

**ASARCO Incorporated
OFF SITE ABOVE GROUND
SUBSIDENCE MONUMENT CONSTRUCTION
SANTA CRUZ IN SITU COPPER MINING RESEARCH PROJECT
H.G.KREIS**

MAY 22, 1992

mn SC920202 HGK/DAM 02/11/92
05/22/92

ASARCO

Exploration Department
Southwestern United States Division

June 5, 1992

Mr. Charles F. Barter
Errol L. Montgomery & Associates, Inc.
1075 East Fort Lowell Road, Suite B
Tucson, Arizona 85719

Re: Preliminary Draft
Executive Summary
Phase I and II Report
Santa Cruz Project

Dear Charlie:

Enclosed is a preliminary rough draft of the "Executive Summary, Phase I and II Technical Report." Please review and comment on those sections of the report that are covered by your field of expertise.

Sincerely yours,



Henry G. Kreis

HGK:mek
Enc.

cc: A.R. Raihl (w/o enc.)
F.T. Graybeal (w/o enc.)
W.L. Kurtz (w/o enc.)
J.D. Sell (w/o enc.)

ASARCO

Exploration Department
Southwestern United States Division

June 5, 1992

Mr. Ron Lantz
INTERA Inc.
6850 Austin Center Blvd., Suite #300
Austin, Texas 78731

Re: Preliminary Draft
Executive Summary
Phase I and II Report
Santa Cruz Project

Dear Ron:

Enclosed is a preliminary rough draft of the "Executive Summary, Phase I and II Technical Report." Please review and comment on those sections of the report that are covered by your field of expertise.

Sincerely yours,



Henry G. Kreis

HGK:mek
Enc.

cc: A.R. Raihl (w/o enc.)
F.T. Graybeal (w/o enc.)
W.L. Kurtz (w/o enc.)
J.D. Sell (w/o enc.)

ASARCO

Exploration Department
Southwestern United States Division

June 5, 1992

Ms. Priscilla Robinson
P.O. Box 5591
Tucson, AZ 85703

Re: Preliminary Draft
Executive Summary
Phase I and II Report
Santa Cruz Project

Dear Priscilla:

Enclosed is a preliminary rough draft of the "Executive Summary, Phase I and II Technical Report." Please review and comment on those sections of the report that are covered by your field of expertise.

Sincerely yours,



Henry G. Kreis

HGK:mek
Enc.

cc: A.R. Raihl (w/o enc.)
F.T. Graybeal (w/o enc.)
W.L. Kurtz (w/o enc.)
J.D. Sell (w/o enc.)

FROM: J. D. SELL

6-5-92

TO: H G Kreis

June 4, 1992 memo
Subsidence Movement
Santa Cruz Project

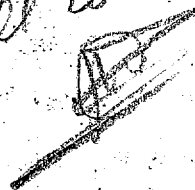
Sub-1 in area sect.... 204
Sub-2 off map sec... 202
Sub-3 off map sec... 202
Sub-4 off map sect... 204 & sect... 202
Sub-5 in area sect... 204
Sub-6 in area

not on any section
should be... 204

you entered ^{on the} ~~map~~ ^{plan} & change 4 to 6

Jim

6-5
Sent to Don
He will correct



ASARCO

Southwestern Exploration Division

June 15, 1992

A.R. Raihl

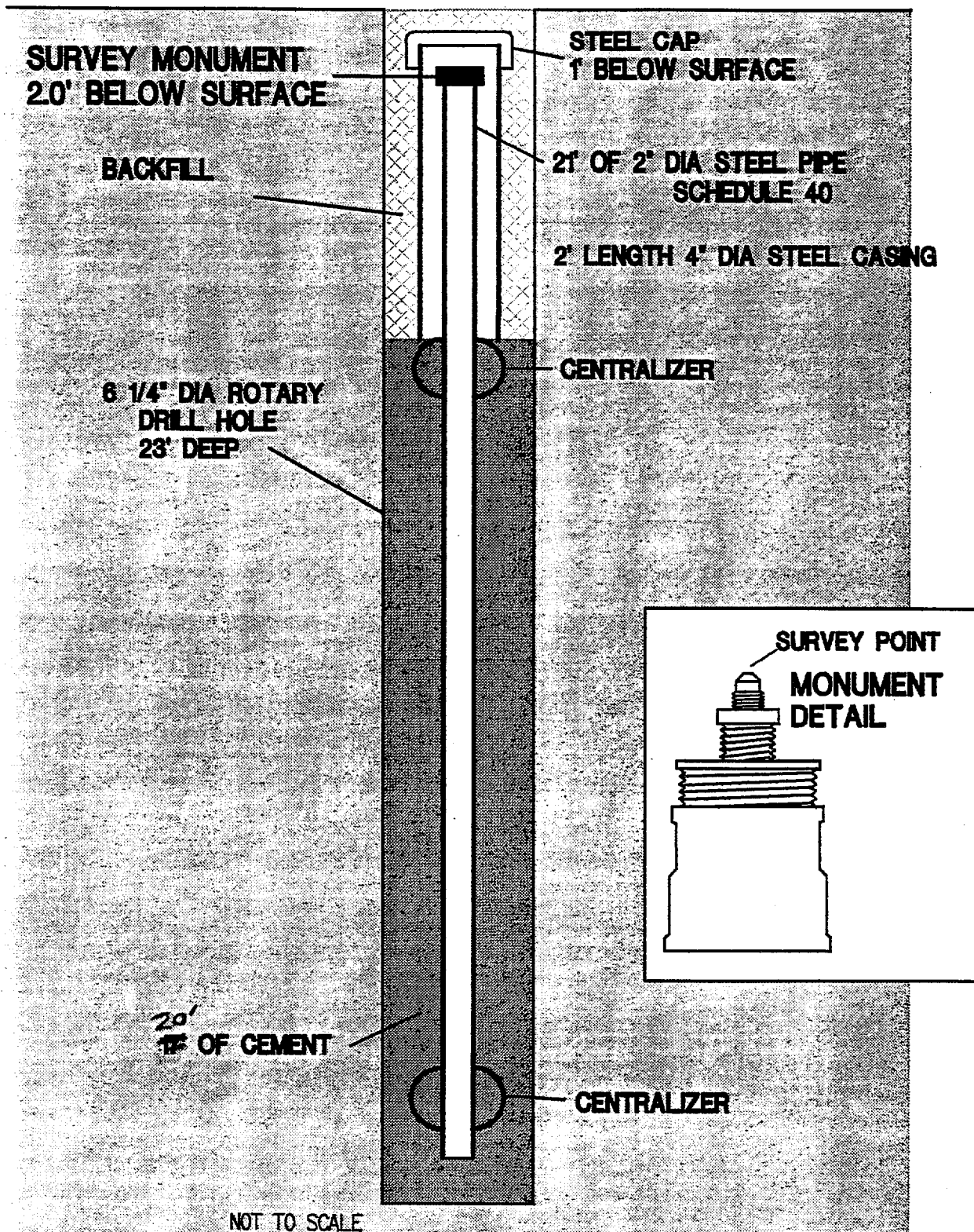
Subsidence Monuments
Santa Cruz Project

Enclosed is a revised drawing of the on site, below ground subsidence monument construction. Please use it to replace the same drawing in my June 4, 1992 memo to you.

HGK:mek
Enc.


H.G. Kreis

cc: Test Site
F.T. Graybeal
W.L. Kurtz
J.D. Sell
J.K. Ahlness
W.E. McCulloch



AS BUILT
FOR: SUB-1
SUB-5
SUB-6

ASARCO Incorporated
ON SITE BELOW GROUND
SUBSIDENCE MONUMENT CONSTRUCTION
SANTA CRUZ IN SITU COPPER MINING RESEARCH PROJECT
H.G.KREIS

MAY 22, 1992

JDS

ASARCO

Exploration Department
Southwestern United States Division

June 26, 1992

Mr. Richard McCarthy
US West Communications
Distribution Services
13333 W. Selma Highway
Casa Grande, AZ 85222

Dear Mr. McCarthy:

In March and April 1991 US West installed a buried telephone line between our test site (Section 13, T6S, R4E) and Route 84. During trenching operations, US West's contractor severed and repaired an irrigation water line on our property at a location on Clayton Road approximately 1300 feet west of Midway Road.

This location is now the site of standing water, saturated ground, and some plant life supported by the water. It is obvious the water line is leaking where it was repaired by US West. It appears, without the benefit of visual inspection of the pipe, the repair work did not hold.

The water line is currently being used to irrigate farm land leased from us by Dave Clayton (602-421-1149). Mr. Clayton has informed me the water needs of his crops are in a critical stage; and, because of this, he can not shut off the irrigation pump to allow repair of the water line at this time. It may not be until September or later that the irrigation pump can be shut off.

It appears clear that US West or its contractor did not adequately repair the irrigation water line. Consequently, US West remains liable for satisfactory repair of the line and for any damage which is caused if the situation worsens.

Please contact me and let me know how this matter will be handled by US West.

Sincerely yours,



Henry G. Kreis
Site Manager

HGK:mek

cc: Dave Clayton
D & M Farms

24978 W. Boone Dr.
Casa Grande, AZ 85222

ASARCO Incorporated P.O. Box 5747 Tucson, Az 85703-0747
1150 North 7th Avenue (602) 792-3010

Blind Note: Mr. B. Apker reviewed a draft copy of the above, 6-26-92.

Blind copies: F.T. Graybeal
W.L. Kurtz
J.D. Sell
W.D. Gay
A.R. Raihl

ASARCO

Exploration Department
Southwestern United States Division

July 20, 1992

Ms. Diane Marozas
U.S. Bureau of Mines
E. 58th Street & Mississippi River
Minneapolis, MN 55417

Dear Diane:

In this box is the following sample that you requested:

T-2 1670' to 1680' (assay reject of rotary cuttings).

The geology of this sample is described on the geologic log.

If you have any questions, please feel free to call.

Sincerely,



Henry G. Kreis

HGK:mek
Encs.

cc: A.R. Raihl
F.T. Graybeal
W.L. Kurtz
J.D. Sell
S.A. Swan

ASARCO

Exploration Department
Southwestern United States Division

July 22, 1992

Mr. R. Lantz
INTERA Inc.
6850 Austin Center Blvd.
Suite #300
Austin, Texas 78731

Dear Ron:

Here is a rough draft of Executive Summary, Phase I and II
Technical Report.

Kindly review those sections of the Executive Summary that
pertain to your area of expertise.

Sincerely,



Henry G. Kreis

HGK:mek
enc.

cc: A.R. Raihl
F.T. Graybeal
W.L. Kurtz
J.D. Sell



Southwestern Exploration Division

July 14, 1992

F.T. Graybeal
New York Office

Foreclosure Sale
RTC/Simmons Land
Santa Cruz Project

On July 10, 1992 Speedie and Associates, a Phoenix environmental evaluation firm, had two environmental engineers on the RTC/Simmons land. Speedie and Associates recently received a bid-type package from AM&G Asset Management, a Phoenix land management firm, requesting a bid proposal for an environmental evaluation of the RTC/Simmons land. Other environmental firms were likewise invited to make bid proposals for the work.

AM&G Asset Management is managing the RTC/Simmons land for the RTC. An AM&G representative said the foreclosure sale (not an auction, I was told) of the RTC/Simmons land may be delayed because the RTC may choose to do more environmental work. The representative will not know until two days before July 31st, the foreclosure sale date, if the foreclosure sale will be delayed.

The RTC could become the owner of the RTC/Simmons land at the foreclosure sale. If the RTC does become the owner, the RTC could sell the land as a separate parcel or by packaging it with other properties. The RTC has not made a decision, in the event it becomes the owner, on how to sell the land.

HGK:mek


H.G. Kreis

cc: W.L. Kurtz
J.D. Sell
W.D. Gay
A.R. Raihl
W.E. McCulloch
B.M. Apker



Southwestern Exploration Division

January 4, 1993

A.R. Raihl

Keys to Test Site
Santa Cruz Project

Enclosed for your use are the following keys to the Santa Cruz test site:

- main fence gate and fence gates about field office
- field office
- test wells
- south core storage building
- middle core storage building
- large ocean container.

HGK:mek
encs.


H.G. Kreis

cc: F.T. Graybeal (w/o encs.)
W.L. Kurtz (" ")
J.D. Sell (" ")

JDS

FROM: F. T. GRAYBEAL

TO: AR Dainl
Tucson Office

In Situ
Santa Cruz

The attached shows you the
extent and level of interest
in in situ.

2/23/88

~~Attach~~
cc: WLK/JDS with attach
RLB w. attach.

RECEIVED

FEB 26 1988

EXPLORATION DEPARTMENT

Richard de J. Osborne
Chairman and President

February 12, 1988

The Honorable Dennis DeConcini
United States Senate
SH 328 Hart Senate Office Building
Washington, D. C. 20510-0302

Dear Senator DeConcini:

We at Asarco are enthused about the in situ mining project at Casa Grande that you and Patty Lynch have been so instrumental in getting started. I regret that our efforts to meet on February 2, did not work out. I will try again on my next trip to Washington but in the meantime want to express the thanks of all of us for your leadership on this project.

The history of copper production in the United States from the earliest days is one of increasing production at lower and lower real costs from copper deposits of diminishing ore grade. Those who tend to count us out because of lowering ore grades and supposed lack of technological sophistication, simply do not know the industry.

The current rebirth of the copper industry in Arizona has surprised many observers. It is, however, not unlike what has happened in the past in this industry. This time the shift in technology involves heap leaching and solvent extraction - electrowinning. This is where we are today. The next logical step if we can master the technology is in situ leaching coupled with electrowinning, and that is what we are setting out to do for the first time at Casa Grande.

I look forward to meeting with you in Washington when we can arrange a visit and to welcoming you on site in Arizona once we are organized and underway.

Sincerely,


Richard de J. Osborne

January 20, 1988

H.G. Kreis
Tucson Office


Santa Cruz Joint Venture/USBM
In Situ Project

Mr. Brown informs me that the In Situ Project will be handled by the Mining Department with Al Raihl the Project Manager.

Mr. Brown has offer your services for a very specific phase of the project. During the drilling you will log the core and/or cuttings, and plot the data and assays on the appropriate Santa Cruz Sections. You will be present only when the drilling occurs and you will treat the data just like these were additional exploration holes. You will not be involved with any other phase of the In Situ Project.

Any deviation from the above will require direct permission from your manager, Mr. Sell.

WLK:mek


W. L. Kurtz

cc: R.L. Brown
J.D. Sell
A.R. Raihl
S.A. Anzalone

August 12, 1988


Mr. R. L. Brown, V.P.
Exploration Department
NEW YORK OFFICE

Santa Cruz Project
Applications for Exploration Appropriation

Attached are five (5) copies each of two Applications for Exploration Appropriation for ASARCO Santa Cruz, Inc., totalling \$350,000 to cover the projected costs for Phase 1 of the In Situ Copper Mining Research Project which will be conducted near Casa Grande, Arizona. Dividing the expenditure into two appropriations is done at the request of the Tucson Office accounting staff.

Total expenditures for Phase 1 of the research Project are estimated at \$2,813,658. The U.S. Bureau of Mines will fund approximately \$2,300,000 of the expenditure. The Santa Cruz Joint Venture will fund \$375,000 which in turn will be billed equally (\$187,500 each) to ASARCO Santa Cruz, Inc., and Freeport Copper Company. The remaining \$138,658 plus a contingency of \$23,842, will be charged directly to ASARCO Santa Cruz, Inc.

Because of the way the books for ASARCO Santa Cruz, Inc. and the Santa Cruz Joint Venture were developed and the Tucson Office accounting methods, it would be very difficult to differentiate and correctly allocate costs unless two appropriations are used. Therefore, one of the appropriations will be used to cover those costs which are chargeable to the Santa Cruz Joint Venture. The other appropriation will cover the remaining costs not chargeable by agreement to the Joint Venture.



A. R. Raihl

ARR:brw

Attachment

cc: W. L. Kurtz w/att.
G. H. Myers "
C. L. Snow "
R. J. Kupsch "

SANTA CRUZ PROJECT

APPLICATION FOR EXPLORATION APPROPRIATION

Two Applications for Exploration Appropriations are submitted by ASARCO Santa Cruz, Inc., totalling \$350,000.00. This amount is the estimated expenditure that ASARCO Santa Cruz, Inc., proposes to make on Phase 1 of the In Situ Copper Mining Research Project at the Santa Cruz Project near Casa Grande, Arizona. Two appropriations are submitted at the request of the Tucson Office accounting staff because of the method of accounting for the Santa Cruz Joint Venture, ASARCO Santa Cruz, Inc., and the accounting procedures used.

ASARCO Santa Cruz, Inc., proposes to execute a cost sharing agreement with the United States Bureau of Mines to conduct Phase 1 of the In Situ Copper Mining Research Project; however, the Project is expected to continue after Phase 1 is completed. ASARCO Santa Cruz, Inc., will be committed to share 25% of the total Project costs at some time during the Project. However, Asarco has opted not to meet its full obligation for Phase 1 but is proposing to pay certain described costs which total \$513,658.00.

The Santa Cruz Project is a 50-50 Joint Venture between ASARCO Santa Cruz, Inc., and Freeport Copper Company. Asarco has opted not to charge the Joint Venture specific costs and has limited the amount to be charged to the Joint Venture for Phase 1 work to \$375,000. The items not charged to the Joint Venture are:

1. Asarco management costs.
2. Costs associated with the Asarco Field Manager.
3. New York and Tucson Office general and administrative costs.

One of the appropriation requests is for the costs directly chargeable to ASARCO Santa Cruz, Inc. The other appropriation is for half of those costs which are chargeable to the Santa Cruz Joint Venture. The other half of these costs is chargeable to Freeport Copper Company.

The estimated costs for the Phase 1 expenditures and the costs that are allocated to the Joint Venture associates are as follows. A more detailed cost estimate is attached.

	Total Costs	Directly Chargeable to ASARCO Santa Cruz	Chargeable to		
			Santa Cruz Joint Venture	Freeport Copper Co.	ASARCO Santa Cruz
Labor	\$316,246	\$125,677	\$190,569	\$ 95,284	\$ 95,285
Other Direct Costs	<u>\$197,412</u>	<u>12,981</u>	<u>184,431</u>	<u>92,215</u>	<u>92,215</u>
Total	\$513,658	\$138,658	\$375,000	\$187,500	\$187,500

The Application for Exploration Appropriation for the costs of the Project directly chargeable to ASARCO Santa Cruz, Inc., totals as follows:

Costs directly chargeable	\$138,658
Contingency	<u>23,842</u>
Total	\$162,500

The Application for Appropriation for the costs of the Project chargeable to ASARCO Santa Cruz, Inc., through the Santa Cruz Joint Venture totals \$187,500.

ASARCO Santa Cruz, Inc., is proposing to the USBM that all work included in Phase 1 will be completed within 14 months after the execution of the agreement. It is presently estimated that the agreement will be signed on September 1, 1988.

ARR:brw
August 12, 1988

SANTA CRUZ PROJECT
PHASE I LABOR COST ESTIMATE

	<u>Hours</u>	<u>Direct</u>	<u>Fringe</u>	<u>G&A (2)</u>	<u>Total</u>
Program Management (1)	552	\$ 15,777	\$10,444	\$ 6,231	\$ 32,452
Legal Support	80	16,000	-0-	-0-	16,000
A. R. Raihl (1)	880	25,151	16,650	9,934	51,735
H. G. Kreis	1,380	30,928	20,474	12,216	63,618
V. C. Martz	552	13,055	8,643	5,157	26,855
G. H. Myers	288	7,943	5,258	3,137	16,338
Sr. Accountant	576	11,400	7,546	4,503	23,449
Clerical	576	5,592	3,702	2,209	11,503
Process Eng.	192	5,077	3,361	2,005	10,443
Production Eng.	-0-	-0-	-0-	-0-	-0-
Geological Technician	2,400	28,795	19,062	11,375	59,232
Draftsman	160	<u>2,246</u>	<u>1,487</u>	<u>888</u>	<u>4,621</u>
Total		\$161,964	\$96,627	\$57,655	\$316,246

Total Labor Costs \$316,246

Labor Costs Charged Directly to
ASARCO Santa Cruz, Inc. \$125,677

Labor Costs Charged to
Santa Cruz Joint Venture \$190,569

Labor Costs Charged to
Freeport Copper Company from
Santa Cruz Joint Venture \$ 95,284

Labor Costs Charged to
ASARCO Santa Cruz, Inc., from
Santa Cruz Joint Venture \$ 95,284

(1) Costs of Project Management and A. R. Raihl (Field Supervisor) not charged to Santa Cruz Joint Venture. Total - \$84,187.

(2) Tucson Office G&A not charged to Santa Cruz Joint Venture.
Total - \$41,490.

ARR:brw
August 12, 1988

SANTA CRUZ PROJECT
PHASE I OTHER DIRECT COST ESTIMATE

<u>Cost Item</u>	<u>Total Estimated Cost</u>	<u>Chargeable to Santa Cruz Joint Venture</u>	<u>Directly Chargeable to ASARCO Santa Cruz</u>	<u>Chargeable to Freeport Copper Co.</u>	<u>ASARCO Santa Cruz</u>
Travel	\$ 33,683	\$ 25,000(1)	\$ 8,683	\$12,500	\$ 12,500
Telephone	1,050	1,050	-0-	5,025	5,025
Postage	2,125(2)	2,125(2)	-0-	1,062	1,062
Computer Use	(3)	(3)	-0-	-0-	-0-
Pre-Contract Costs	55,000	55,000	-0-	27,500	27,500
Short Radius Well Fracturing	<u>105,554</u>	<u>101,256(4)</u>	<u>4,298</u>	<u>50,628</u>	<u>50,628</u>
Total	\$197,412	\$184,431	\$12,891	\$96,715	\$ 96,715

Total Other Direct Costs \$197,412

Other Direct Costs Charged Directly to
ASARCO Santa Cruz, Inc.

\$ 12,981

Other Direct Costs Charged to
Santa Cruz Joint Venture

\$184,431

Other Direct Costs Charged to
Freeport Copper Company from
Santa Cruz Joint Venture

\$ 92,216

Other Direct Costs Charged to
ASARCO Santa Cruz, Inc. from
Santa Cruz Joint Venture

\$ 92,216

- (1) Travel expenses of Project Management and A. R. Raihl are not chargeable to the Santa Cruz Joint Venture.
- (2) Estimated cost of postage in proposal to USBM was \$2,125; however, only costs of Facsimile, Federal Express, UPS, etc., are directly allocated. Other postage costs are considered overhead.
- (3) Computer use costs in proposal to USBM were estimated at \$4,582. However, these costs are not directly allocated but are considered as overhead.
- (4) A maximum of \$375,000 has been set as the amount of expenditures to perform Phase I work that is chargeable to the Santa Cruz Joint Venture.

ARR:brw
August 12, 1988

APPLICATION FOR EXPLORATION APPROPRIATION

August 12 19.88

Originating Office Tucson

DESCRIPTION:

LOCATION OF PROSPECT/PROJECT: Santa Cruz Project
Casa Grande, Arizona

PARTNERS:

Partner's Per Cent 50% with special consideration

COMPANY: ☐ ASARCO

☒ Subsidiary. Specify ASARCO Santa Cruz, Inc.

WORK CONTEMPLATED:

ASARCO Santa Cruz, Inc., is planning to execute an agreement with the United States Bureau of Mines for Phase 1 of an In Situ Copper Mining Research Project on a cost share basis (25% Asarco, 75% USBM). Asarco, in conjunction with the Santa Cruz Joint Venture, has proposed to spend \$513,658 for Phase 1 work as part of its 25% commitment. Of this amount, \$375,000 will be charged to the Santa Cruz Joint Venture with the remaining \$138,658 plus a contingency of \$23,842 to be charged directly to ASARCO Santa Cruz, Inc. This appropriation is for this directly charged amount. Work contemplated during Phase 1 is to drill one geological characterization hole, one hydrological characterization hole, three test wells, and at least one monitor well and initiate the obtaining of the required permits for the Program.

Total estimated cost (FORM 302-MA ATTACHED)

\$ 162,500

Reviewed by
Acct. Mgr. or Chief Acct.

Approved by
Vice President

Recommended by
Supervisor

Approved by
Comptroller

Account Chargeable to
To be designated by Comptroller

Approved by Advisory Committee
.....19 ...

Approved by Board of Directors
.....19

Secretary

APPLICATION FOR EXPLORATION APPROPRIATION

August 12 19.88

Originating Office Tucson

DESCRIPTION:

LOCATION OF PROSPECT/PROJECT: Santa Cruz Project
Casa Grande, Arizona

PARTNERS:

Partner's Per Cent .50% with special considerations

COMPANY: ☐ ASARCO

☒ Subsidiary. Specify ASARCO Santa Cruz, Inc.

WORK CONTEMPLATED:

ASARCO Santa Cruz, Inc., is planning to execute an agreement with the United States Bureau of Mines for Phase 1 of an In Situ Copper Mining Research Project on a cost share basis (25% Asarco, 75% USBM). Asarco, in conjunction with the Santa Cruz Joint Venture, has proposed to spend \$513,658 for Phase 1 work as part of its 25% commitment. Of this amount, \$375,000 will be charged to the Santa Cruz Joint Venture and then \$187,500 will be back charged to ASARCO Santa Cruz, Inc. This appropriation will be used for this amount. Work contemplated during Phase 1 is to drill one geological characterization hole, one hydrological characterization hole, three test wells, and at least one monitor well and initiate the obtaining of the required permits for the Program.

Total estimated cost (FORM 302-MA ATTACHED)

\$ 187,500

Reviewed by [Signature]
Acct. Mgr. or Chief Acct.

Approved by
Vice President

Recommended by [Signature]
Supervisor

Approved by
Comptroller

Account Chargeable to
To be designated by Comptroller

Approved by Advisory Committee
.....19 ...

Approved by Board of Directors
.....19

.....
Secretary

ASARCO

T-4.19
ASC-4.19

In Situ

Southwestern Mining Department

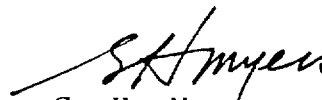
November 9, 1988

MEMORANDUM

TUCSON OFFICE
Santa Cruz Project Reports


Heretofore, cost reports for Santa Cruz Joint Venture's Exploration Authorizations have been exclusive of Freeport Copper Company's participation.

Effective October, 1988, these cost reports will include the total expenditures under each cost center and expense number. Freeport Copper Company's share of the total costs will be indicated under cost center 650 partners' Share. The grand total of each report will still reflect Asarco Santa Cruz Incorporated's net share of total cost.



G. H. Myers
Accounting Manager

GHM/CLS/kh

cc: Controller
RLBrown
TEScartaccini
JDSell 
ARRaihl
File

ASARCO Incorporated

NOV 11 1988

SW Exploration

MINE EXAMINATION AND DEVELOPMENT EXPENSEDATE: NOVEMBER 09, 1988MONTH: OCTOBER, 1988

438.00 SANTA CRUZ IN SITU RESEARCH PROJECT

	MONTH	YEAR	TO-DATE
620 ADMIN., GENERAL			
100 SALARIES	10390.37	10390.37	10390.37
210 OVERHEAD FROM GENERAL	6878.42	6878.42	6878.42
211 DEPARTMENTAL OVERHEAD	5062.08	5062.08	5062.08
400 MATERIALS AND SUPPLIES	5172.37	5172.37	5172.37
500 COMMUNICATIONS	95.28	85.28	85.28
550 FREIGHT AND EXPRESS	48.25	48.25	48.25
600 TRAVELING EXPENSE	42.00	42.00	42.00
754 OUTSIDE PROFESSIONAL SERVICES	2425.00	2425.00	2425.00
755 SUB-CONTRACTORS	86906.02	86906.02	86906.02
801 TAXES - STATE & CITY SALES	412.40	412.40	412.40
641 DISTRIB. ACCOUNTS - AUTOS			
400 MATERIALS AND SUPPLIES	43.81	43.81	43.81
801 TAXES - STATE & CITY SALES	1.54	1.54	1.54
649 REIMBURSABLE EXPENSES			
755 SUB-CONTRACTORS	-21906.02	-21906.02	-21906.02
650 PARTNER'S SHARE			
950 OTHER	-40311.54	-40311.54	-40311.54

TOTALS: 55249.98 55249.98 55249.98

AUTHOR. NUMBER	AMOUNT AUTHORIZED	MONTH	YEAR TO-DATE	TOTAL TO-DATE	BALANCE UNEXPENDED
438.00	600000.00	55249.98	55249.98	55249.98	544750.02

ORIG: RLBROWN

CC: RJO, RJK, ADC,

TES, JDS, ARR, GHM, FILE

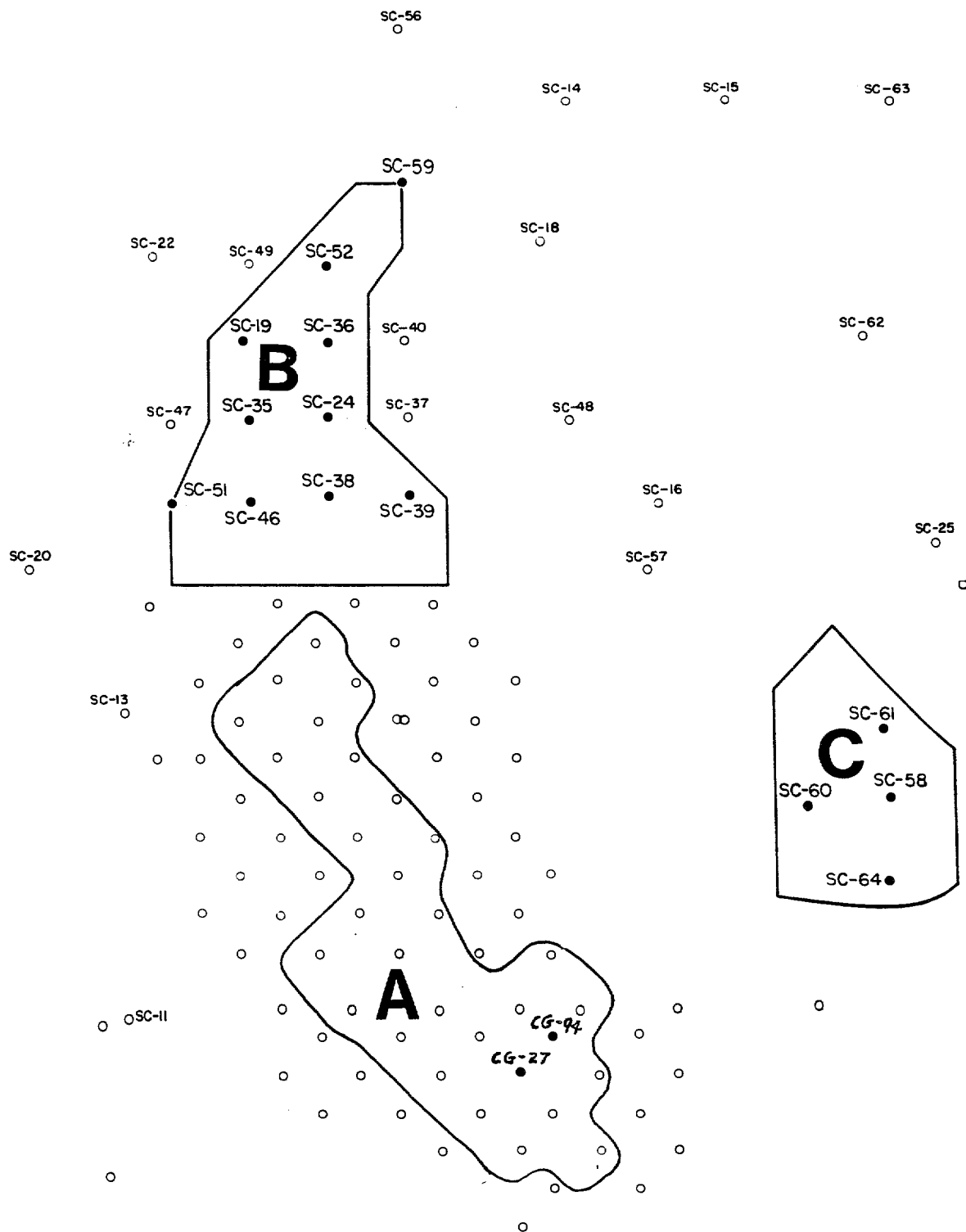
APPROVED BY:

Original Signed By
C. L. Snow

ASARCO Incorporated

NOV 11 1988

SW Exploration



SANTA CRUZ PROJECT
PINAL COUNTY, ARIZONA
ASARCO-FREEPORT
COPPER RESERVE

H.G.K. Jan. 1989

H.G. Kreis
Jan. 27, 1989

COMPARISON OF THREE COPPER OXIDE DEPOSITS

<u>Deposit</u>	<u>CuOx Reserve (Tons @ %T.Cu)</u>	<u>Lbs. Cu (Billion)</u>	<u>Class. of Reserve</u>	<u>No. of D.H.'s In Reserve</u>	<u>To Devel. into Probable Res. (D.H.'s and \$)</u>	<u>Av.Depth to Base CuOx</u>	<u>Area of Res. (mm sq.ft.)</u>	<u>Continuity</u>	<u>Amenability of Continuity To In Situ</u>	<u>Remarks</u>
A	150mm @ 1.20%	3.6	Probable	30 (350' ctrs)	-0-	2500'	3.7	Very Good	Good	-Twice as high Cu grade and lbs. Cu. -Best continuity of all CuOx deposits. -Additional devel. drill holes not needed at this time. -Substantial margin for adverse situation because of high grade and high total pounds of copper. -Morale booster for when test work doesn't go well.
B	150mm* @ 0.50%	1.5*	Possible	9 (500' ctrs)	≥50 holes ≥\$2.8 million	2150'	3.0	Highly erratic for thicknesses <500'.	Fair	-Large, expensive drilling pro- gram needed to develop reserve to probable classification; possibility exists for a decrease in tonnage and/or grade. -Erratic nature of mineraliza- tion may not be readily amen- able to in situ leaching-- particularly to a thin leach test interval.
C	50mm @ 0.56%	0.5	Possible	4 (500' ctrs)	32 holes \$2.3 million	2400'	1.5	Good	Good	-Low tonnage-grade leaves little margin for error. -Low grade version of deposit "A".

*Maximum: USBM and SAIC reserve of 52mm tons at 0.85% Cu (0.9 billion lbs. Cu)
and 73mm tons at 0.67% Cu (1.0 billion lbs. Cu) respectively.

DEC 11 1989

December 11, 1989

SW Exploration

Mr. R. L. Brown, V.P.
Exploration Department
NEW YORK OFFICE

Santa Cruz Project
Supplemental Appropriation Request

Attached are the original and five (5) of Application for Supplemental Exploration Appropriation No. EA0075 in the amount of \$20,000 to be used for ASARCO Santa Cruz, Inc.'s (ASCI) share of the Santa Cruz Joint Venture's (SCJV) costs of producing a video describing the Santa Cruz In Situ Copper Mining Research Project (Project); the costs associated with a reception planned for early January 1990 in Casa Grande for members of Congress and staff (and others); and other public relations items. By regulation, the above-described expenditures are not allowed as part of the cost share program under the USBM/SCJV agreement.

The production of the video and the reception have been discussed with you, R. Kupsch, R. Muth, and/or D. Noyes, and verbal approval has been given. Mr. Kupsch recommended that these items be funded by a capital appropriation request passed through his office. However, the Tucson Office accounting staff has advised that it would be more appropriate to submit a supplemental appropriation request through your office.

Also attached is a copy of Cactus Productions Inc.'s proposal to J. Magner for the production of the video. The estimated cost was about \$20,000; however, I see total costs of considerably more. Not only will the scope of the video be expanded but also both P. Robinson and J. Magner will be required to focus and coordinate efforts.

Freeport Copper Company has approved the expenditure of \$17,000 for their 50% share of these costs.


A. R. Raihl

ARR:brw

Attachments

cc:	R. J. Kupsch	w/att.
	W. L. Kurtz	"
	J. D. Sell	"
	G. H. Myers	"

APPLICATION FOR SUPPLEMENTAL EXPLORATION APPROPRIATION

..... December 4 19 89.

Originating Office Tucson

Application is hereby made for supplemental Appropriation to cover cost, in excess of original estimate, of work authorized by New York.

No. EA. 0075

Present total Estimated Cost (Form 302-MA attached) \$ 1,789,000

Amount previously authorized (date) \$ 1,769,000


Balance for which Authorization is now requested \$ 20,000

ADDITIONAL WORK CONTEMPLATED:

Production of a video to describe the Santa Cruz In Situ Copper Mining Research Project and other public relations costs which are not allowed under the USBM/Asarco Cooperative Agreement C0289001. Total costs are estimated as: Video, \$30,000; Reception following field tour planned for January 1990, \$4,000; and public relations miscellaneous costs, \$6,000. The Santa Cruz Joint Venture Operating Committee has approved the \$34,000 expenditure for the video and reception. Freeport Copper Company will fund half of this amount, or \$17,000.

EXPLANATION OF INCREASED COST:

Maintaining a good public relations program in Arizona and especially the Casa Grande area is critical for the In Situ Leach Project. Most of these costs are funded under the USBM/Asarco Cooperative Agreement C0289001 (EA 00438); however, some costs are not. The items above fall into this category and were not anticipated.

Reviewed by 
ACCT. MGR. OR CHIEF ACCT.Recommended by 
A. R. Raihi SUPERVISORApproved by
CONTROLLERAccount Chargeable to
TO BE FILLED IN BY CONTROLLERApproved by
VICE PRESIDENT

Approved by Advisory Committee

Approved by Board of Directors

..... 19.....

..... 19.....

SECRETARY

Cactus Productions inc.

A Full Service Video Production Company



Mr. Jim Wagner
Lachelli, Waller & Wagner
600 Maryland Avenue
Suite 302-West Wing
Washington, D.C. 20024

Dear Mr. Wagner:

Here is the proposal you asked for on producing a videotape for the Santa Cruz In Situ Mining Project.

I met with the computer graphics artist and editor that I will use on this project. After discussing this at great length we decided it would be best to use 3-D Computer Graphics and Paintbox technology. With these tools we can dissolve from a real shot of the desert floor to a computer drawing of the same picture. We then can turn the land sideways and look beneath the surface and see the many layers of groundwater, bedrock, copper, etc. You then will actually see the wells being drilled down to the copper deposits. You will see a colored solution being pumped into these deposits and then extracted. By using 3-D and Paintbox technology we will be able to give you a very effective visual tool.

It is always a challenge, and a lot of fun, to produce a video with these types of graphics. I'm excited about the project and confident you will be pleased with the final product.

If there is any possible way to speed up the production decision on this project I would greatly appreciate it. This would be much easier to do in September than it would be in October or November.

For what it is worth you can let these people know I was born and raised in Blythe, CA, just a few hours drive from Casa Grande. I'm very familiar with the area and as strange as it may sound I'm actually looking forward to the chance to see that part of the desert again.

Please call with any questions. I really want to work on this project so I'm willing to negotiate the price but I think a fee in the high teens or 20 is very fair considering the type of video you'll be getting.

Sincerely,



Carl Rutan



PROPOSAL FOR USING A VIDEOTAPE AS PART OF A PUBLIC AWARENESS
CAMPAIGN FOR THE SANTA CRUZ IN SITU MINING PROJECT

A 12 to 15 minute videotape could be produced explaining how the project will work, its benefits and economic and environmental impact on the Southern Arizona community. This tape could then be shown to citizens groups, business associations and local, state and federal elected officials. The computer generated graphics included in the video will give people a very clear picture of exactly what will be happening beneath the desert surface. I believe a videotape of this type will be considerably more effective than sending out a spokesperson with a series of graphs and charts.

This videotape could be used for several different purposes.

1. A representative of ASARCO or the Bureau of Mines could play this tape for community leaders and business groups. They could then follow up with a question and answer session. Kiwanis, Rotary, Chamber of Commerce, Lions, etc. would be the types of groups you'd want to speak with.
2. Show this tape to elected officials in the city of Casa Grande, state legislature as well as Congress. This tape would give officials in Phoenix and Washington a look at exactly what will be happening beneath the Southern Arizona Desert floor. These officials are much more likely to understand your point if they see something they can understand.
3. This tape could be played for high school or college students.
4. A tape of this nature could be played continuously at the mining projects visitors center.
5. You could use this tape to educate the news media. I would use state of the art computer generated graphics to visually demonstrate how the project will work. If TV stations were given a broadcast quality tape of this kind they probably would incorporate the graphics portion into their news stories. If they use your tape you have a better chance of having your story told correctly.
6. The same videotape used to make this tape could be saved and used again later for another purpose. Use it to produce a video annual report for the Bureau of Mines or ASARCO. Use it for a video news release when the project actually starts.

- MORE -

VIDEOTAPE PROPOSAL
IN SITU MINING PROJECT

PRODUCTION STYLE

Everything would be taped with broadcast quality equipment and recorded on BetaCam broadcast quality tape.

To produce this video I would include interviews with Sen. DeConcini, Rep. Kolbe, the Mayor of Casa Grande as well as Representatives of the Bureau of Mines and one or two engineers or geologists working on the project. I would let the players and pictures tell the story.

I would spend several days videotaping at the project site and in the Casa Grande area. We would want to use plenty of cover footage from the site, research laboratories and surrounding areas. A heavy emphasis would be placed on making the video interesting by using plenty of high quality cover video and graphics.

I would rely extensively on computer generated graphics and special effects to show what will be happening beneath the surface. I would use 3-D Computer Graphics to show the layers of bedrock, groundwater, copper deposits and their relationship to each other. I would then use special effects to show the wells being drilled, the solution being pumped in and finally recovered. The key portion of this tape will be demonstrating, visually, how this type of mining can be completed without harming the groundwater. Moving graphics, or animation, will effectively present this point.

I would use Digital Mastering and D-2, or Digital tape for the editing. By using this type tape and editing facilities you will have the option later to change portions of the final product without adding a large expense. Digital tape also saves you generation loss of video. With standard video each generation, or duplication, loses some video. With Digital tape you don't lose any quality at all in the editing process or when making duplicates. Most importantly it means you will be able to make changes in the future without adding a lot of cost.

PRODUCTION COST AND SCHEDULE

I believe it would take 2 to 3 weeks to complete production of this video. This would include shooting in Arizona and Washington, D.C. and conducting interviews in both places. It would take about a week to produce the graphics and edit the tape and a few more days to make VHS copies.

You should assume this project will cost between \$16,000 and \$22,000. Using Digital Mastering and tape it will cost about \$1,000 to make changes and update the video. It will cost \$10 to \$20 for VHS duplicates. The more duplicates you make at one time the lower the cost. If you make 500 copies at once the price goes to about \$7.50 per copy.



Southwestern Exploration Division

January 28, 1991

A.R. Raihl

USBM SLCRC
Metallurgical Results
Santa Cruz Project
Pinal County, AZ

Lorin Redden and Alan Isaacson, both from the USBM's Salt Lake City Research Center, will give a presentation at 9 AM on March 12th at Asarco's Tucson Office. Their presentation will cover the results of their column leach test work on samples from the Santa Cruz test wells.

A handwritten signature in black ink, appearing to read "H.G. Kreis", is written above the typed name.

H.G. Kreis

HGK:mek

cc: F.T. Graybeal
W.L. Kurtz
J.D. Sell
F. Bazanella (KD Eng.)

ASARCO

Exploration Department
Southwestern United States Division

February 15, 1991

Dr. Donald H. Davidson
SAIC
1710 Goodridge Drive
Mail Stop T-2-2-1
McLean, Virginia 22102

CIPRA


Dear Dr. Davidson:

Pursuant to our meetings and telephone conversations, CIPRA is interested in using the services of SAIC. As you know, CIPRA is the name of a research organization being formed by ASARCO Incorporated, Magma Copper Company, and Cyprus Copper Corporation. CIPRA is being formed for the sole purpose of submitting a copper mining research proposal to the U.S. Department of Energy (DOE). The proposal is entitled "In Situ Leach Mining of Copper Sulfides." CIPRA would be using your services in implementing the research work being proposed to the DOE.

At this time, CIPRA would like to obtain a proposal for work by SAIC during the first year of the DOE contract. If you have any questions, please feel free to call.

Thank you for giving this matter your consideration.

Sincerely yours,



Henry G. Kreis

HGK:mek

cc: F.T. Graybeal
W.L. Kurtz
J.D. Sell
A.R. Raihl

February 15, 1991

F. T. Graybeal

USBM-CIPRA
DOE Proposal

A substantial amount of progress has been made on the preparation of the DOE proposal and on the USBM-CIPRA management structure of the DOE proposal. This progress was made during the joint USBM-CIPRA-UofA meeting on February 12th and during the USBM-CIPRA meeting on February 13th. The progress resulted from satisfying a joint CIPRA-USBM need for a proposal and a management structure aimed at industrialization. The following describes the present state of the DOE proposal.

The DOE proposal is being revised and will be available at the end of February. The work in the DOE proposal is being restructured according to the attached tables: Table 1, Summary of Expenditures; Table 2, DOE-CIPRA Contributions; and Table 3, Expenditure Distribution. These tables were prepared by the undersigned; modified after review by A. Raihl, D. Crowell, S. Young (Magma), and J. Dobson (Cyprus); and presented to the USBM. The USBM representatives, W. Larson, P. Chamberlain, and T. Phillips, found the contents of these tables to be acceptable and agreed to incorporate them into the DOE proposal. It was further agreed by all parties that the proposal would be submitted by CIPRA to the DOE.

A management structure for the proposal has been agreed to by representatives of CIPRA and USBM, but remains subject to review by management, lawyers, and contracting specialists. The management of the work specified in the proposal will remain a joint CIPRA-USBM effort by means of an advisory committee. The prime contractor to the DOE will be CIPRA, as shown in the attached figure. CIPRA will pay for the research work of the USBM through a CRDA type agreement.

According to what we were told by the USBM, CRDA agreements are relatively new to the USBM, and only a few have been put into existence. The basic function of the CRDA agreement is to allow industry to fund USBM research programs. The CRDA agreement allows flexibility in the assignment of patent rights. It allows the granting of patent rights to industry or, in our case, to CIPRA and/or DOE. In the USBM, CRDA agreements are handled by technology transfer people rather than the procurement people, like D. Askin, who do the customary memorandums of agreement.

Undoubtedly, work done under the DOE proposal will generate patents and other intellectual data. The ownership of these patents, the

forming of a holding company to hold these patents, and the amount of patent royalty and licensing fees have yet to be addressed by CIPRA, USBM, and DOE. When these matters are addressed, they will be found to be legally complex and time consuming to negotiate. Therefore, these matters will not be addressed until some more appropriate time in the future.

This completes my update on the DOE proposal for now. There is more to discuss the next time we have an opportunity to talk. A copy of the revised DOE proposal will be mailed to you as soon as it becomes available.

HGK;mek



H. G. Kreis

cc: A. R. Raihl
W. L. Kurtz
J. D. Sell

Table 1. SUMMARY OF EXPENDITURES

YEAR	Lix. Development			Const.	Field Test		Decom.	TOTAL
	1	2	3	4	5	6	7	
Geology	\$ 60,000	\$ 30,000	\$ 300,000	\$ 200,000	\$ 20,000	\$ 10,000	\$ 10,000	\$ 630,000
Lixiviant	630,000	1,380,000	1,500,000	100,000	-0-	-0-	10,000	3,620,000
Metal Recov.	20,000	30,000	200,000	20,000	-0-	-0-	10,000	280,000
Econ. Eval.	20,000	10,000	50,000	10,000	10,000	-0-	300,000	400,000
Hydrology	10,000	30,000	550,000	100,000	200,000	200,000	230,000	1,320,000
Environment	10,000	20,000	200,000	500,000	150,000	150,000	1,340,000	2,370,000
Field Test Work	-0-	-0-	2,000,000	4,800,000	4,420,000	4,000,000	2,100,000	17,320,000
TOTAL	\$750,000	\$1,500,000	\$4,800,000	\$5,730,000	\$4,800,000	\$4,360,000	\$4,000,000	\$25,940,000

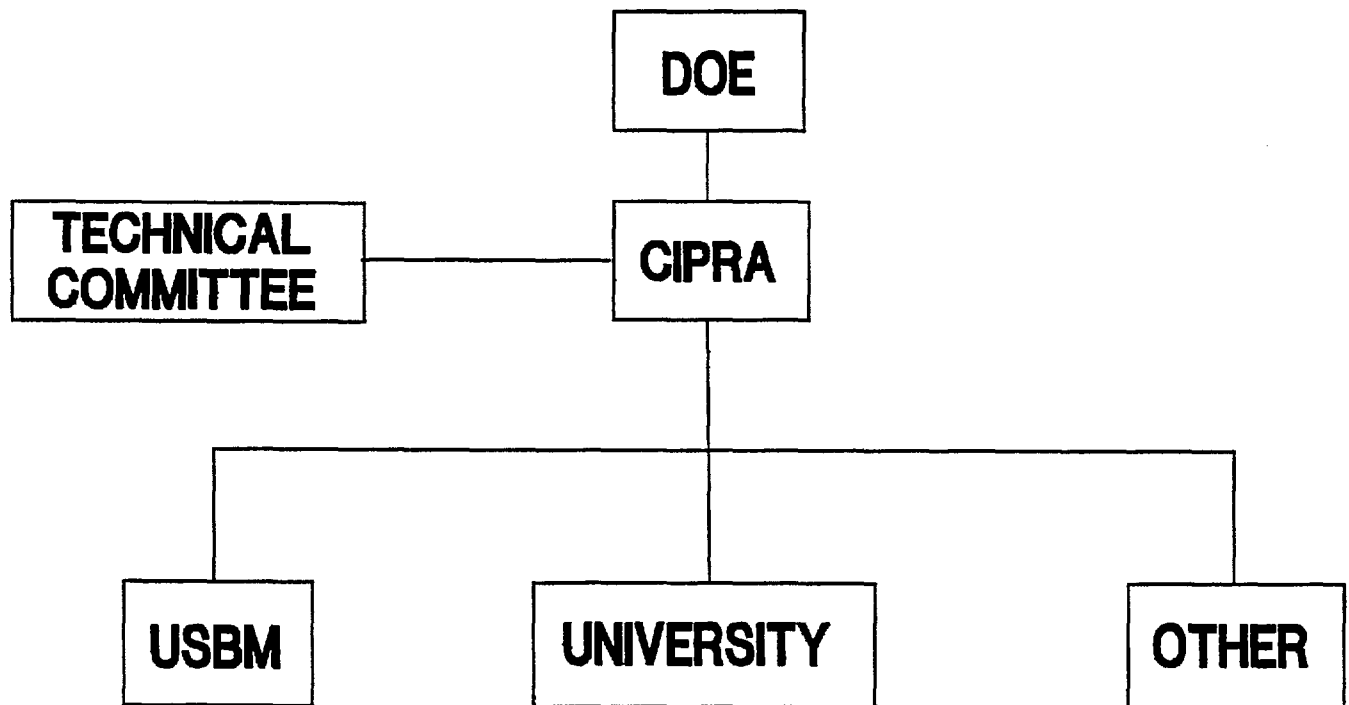
Table 2. DOE-CIPRA CONTRIBUTIONS

YEAR	1	2	3	4	5	6	7	TOTAL
DOE	\$525,000	\$1,050,000	\$3,360,000	\$4,011,000	\$3,360,000	\$3,052,000	\$2,800,000	\$18,158,000
CIPRA	225,000	450,000	1,440,000	1,719,000	1,440,000	1,308,000	1,200,000	7,782,000
TOTAL	\$750,000	\$1,500,000	\$4,800,000	\$5,730,000	\$4,800,000	\$4,360,000	\$4,000,000	\$25,940,000

Table 3. EXPENDITURE DISTRIBUTION

	USBM	UNIV.	OTHER	TOTAL
Year 1	\$ 550,000	\$100,000	\$ 100,000	\$ 750,000
Year 2	1,120,000	200,000	180,000	1,500,000
Year 3	2,100,000	200,000	2,500,000	4,800,000
Year 4	550,000	-0-	5,180,000	5,730,000
Year 5	310,000	-0-	4,490,000	4,800,000
Year 6	300,000	-0-	4,060,000	4,360,000
Year 7	300,000	-0-	3,700,000	4,000,000
TOTAL	\$5,230,000	\$500,000	\$20,210,000	\$25,940,000

MANAGEMENT STRUCTURE



Santa Cruz In Situ Copper Mining Research Project Drill Holes and Wells				
Well No.	Registration No.	File No.	Location	Remarks
HC-1	55-522887	D(6-4)13abd	T6S, R4E, 13 SE NW NE	Abandoned 11/9/90
C-1	55-522892 55-522893	D(6-4)13abd	T6S, R4E, 13 SE NW NE	Abandoned 1/17/89
C-2	55-522896	D(6-4)13abd	T6S, R4E, 13 SE NW NE	Abandoned 12/15/89
SM-1	55-523172	D(6-4)13abc	T6S, R4E, 13 SW NW NE	
SM-2	55-525827	D(6-4)13abc	T6S, R4E, 13 SW NW NE	
SM-3	55-525828	D(6-4)13abc	T6S, R4E, 13 SW NW NE	
SM-4	55-525829	D(6-4)13aac	T6S, R4E, 13 SW NE NE	
T-1	55-523899	D(6-4)13abd	T6S, R4E, 13 SE NW NE	
T-2	55-523900	D(6-4)13abd	T6S, R4E, 13 SE NW NE	
T-3	55-523901	D(6-4)13abd	T6S, R4E, 13 SE NW NE	
T-4	55-525309	D(6-4)13abd	T6S, R4E, 13 SW NE NE	
T-5	55-525310	D(6-4)13abd	T6S, R4E, 13 SE NW NE	
PW-1	55-528249	D(6-4)13bcb	T6S, R4E, 13 NW SW NW	
HC - Hydrological Characterization C - Core Hole SM - Site Monitor T - Test Well PW - Process Water				

ARR:brw
 February 12, 1991
 cc: W. D. Gay
 H. G. Kreis
 J. D. Sell

ASARCO Inc.

FEB 13 1991

SW Exploration

ASARCO

Exploration Department
Southwestern United States Division

February 25, 1991

Mrs. Sharon Young
Manager of Metallurgical Services
Magma Copper Company
P.O. Box M
San Manuel, AZ 85631

Re: Cyprus Participation
CIPRA Association
Sulfide In Situ

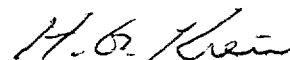
Dear Mrs. Young:

Jerry Dobson, Cyprus' representative to CIPRA, called today with the following information about Cyprus' participation in CIPRA. On February 20th Cyprus management reviewed their participation in CIPRA, and the review concluded with Cyprus deciding to withdraw from participation in CIPRA. Apparently, the review was prompted by Mr. Dobson expressing concerns about the low dollar level of Cyprus participation in the first year of the sulfide in situ leach proposal.

As you know, on February 13th Cyprus had reduced the dollar level of Cyprus' first year participation to \$35,000. As explained by Mr. Dobson, the reduction was made in order for Cyprus to fund participation in an EPRI research program to solve the problem of crud buildup in SX-EW plants. Mr. Dobson went on to say that he wasn't given a reason for Cyprus dropping out, but there had been an apparent erosion of support in management for some time.

Mr. Dobson and I agreed to talk after the proposal has been written and the funding levels are clearly established. At that time, Mr. Dobson will decide if it would be appropriate for him to approach his management with the idea of rejoining CIPRA.

Sincerely yours,



H. G. Kreis

HGK:mek

cc: W.C. Larson	D.H. Davidson
F.T. Graybeal	W.L. Kurtz
A.R. Raihl	J.D. Sell

ASARCO Incorporated P. O. Box 5747 Tucson, Az 85703-0747
1150 North 7th Avenue (602) 792-3010



Southwestern Exploration Division

February 25, 1991

F.T. Graybeal

Dr. Wadsworth
Sulfide In Situ Leach

Dr. Milton Wadsworth has informed me that he is not available to consult on the sulfide in situ leach program. He has a heavy work load as Dean of the College of Mines, University of Utah, and as the new president of AIME. Because of his work load and age, he will give up his position as Dean in June 1991 and enter into retirement with a three year phased retirement program offered by the University of Utah.

HGK:mek


H.G. Kreis

cc: Sharon Young - Magma
W.C. Larson - USBM
A.R. Raihl
D.H. Davidson - SAIC
W.L. Kurtz
J.D. Sell



Southwestern Exploration Division

February 26, 1991

F.T. Graybeal
New York Office

Pinal Fault
Santa Cruz Project

In response to your Pinal Fault memo of January 3, 1991 and our Pinal Fault discussions of February 22, 1991, I have revised the discussion of the Pinal Fault in the Phase I and II final report. A rough draft copy of this discussion is enclosed for your review. Also enclosed is the cross section with planned revisions.

Please let me know if these revisions are satisfactory to you.

HGK:mek
encs.

A handwritten signature in dark ink, appearing to read "H.G. Kreis", is written above the printed name.

H.G. Kreis

cc: A.R. Raihl
W.L. Kurtz
J.D. Sell

shown in the cross sections of Figures 4-3 and 4-4. In C-2 there is: 1,361 ft to 1,391 ft, a fault zone with strong breakage of the rock, local gouge, and weak evidence of a moderate to steep dip; 1,420 ft to 1,472 ft, a fault zone with strong breakage of the rock, local gouge, and 45° to 60° dipping structure; and 1,497 ft to 1,506 ft, a fault zone with a total of 12 inches of gouge and 40° to 60° dipping structure. In SC-19 from 1,320 ft to 1,360 ft, 1,460 ft to 1,520 ft, and 1,580 ft to 1,610 ft, the rock is moderately to strongly broken with local minor gouge. The attitudes of these structures are not determinable from the present data base, but future geophysical log interpretations may help to determine their attitudes.

Within the immediate boundaries of the test site there is no core above a depth of 1,200 ft so the only nearby core above 1,200 ft is in C-1. In C-1 between the top of bedrock at 627 ft and a depth of 1,246 ft the rock, granite and porphyry, is strongly faulted and weathered. The core was so strongly broken that the RQD for most of the interval was zero and the remainder was low (Figure 4-12).

The weathered and broken rock in C-1 from 627 ft to 1,246 ft is bottomed by a 10° to 40° dipping fault zone seen in C-1 from 1,212 ft to 1,246 ft. Other than the apparent dip seen in the core, the attitude of the fault is not determinable from the present data base.

INSERT (A)

A fault, herein named the Pinal Fault, was intercepted in T-4 from 730 ft to 760 ft (see Figure 4-2). As interpreted from the geology of widely spaced (500-ft centers) exploration drill holes, the Pinal Fault strikes N65°W and dips 65° to 90° to the southwest. The Pinal Fault is a normal fault of post-conglomerate age. It down drops the top of bedrock 200 ft to 350 ft. The Pinal Fault zone caused lost circulation drilling problems by taking up to 300 gpm, the rate of circulating drilling mud at the time. *in T-4*

The attitude of the Pinal Fault is such that it passes within 50 ft of the perforations in monitor well SM-1. At the 1,570 ft to 1,770 ft depth of perforations in the test wells, the Pinal Fault is estimated to be within 300 ft of T-4, the closest well to the Pinal Fault, at the depth of the perforations.

The orientation of fractures in the general area of the test site is known from orientated core that was obtained during the drilling of C-1. Orientated core was cut in C-1 from 1,259 ft to 1,306 ft, 1,695 ft to 1,705 ft, and 1,722 ft to 1,760 ft (Dahl, 1989).

The attitudes of the fractures are summarized in Table 4-4 according to the type of mineralization occurring in the fracture. All of the attitudes of the copper oxide mineralized fractures were measured in the 1,259 ft to 1,306 ft interval which is in the upper zone of the copper oxide mineralization.

4.7 COPPER RESERVES

The geologic copper reserves in the in situ leach test site are known from the copper intercepts in core holes, C-2 and SC-19, and rotary holes, T-1 to T-5. The exact locations of these copper intercepts are known from surveys of drill hole collars and from down hole directional surveys. The locations of the

(A) FOR INSERTION

(ROUGH DRAFT)
2-26-91

The Pinal Fault, a fault herein so named and shown in Figure 4-2, is interpreted to be a normal fault with 250 ft to 350 ft of displacement. It is post conglomerate in age, and it is interpreted to strike N65W and dip somewhere between 65° and 90° to the southwest.

The existence of the Pinal Fault is based on the interpretation of drill hole results. The results of about a dozen exploration drill holes on 500 ft centers show a 250 ft to 350 ft displacement in the top of bedrock along a N65W line. This displacement is interpreted to be the result of a post conglomerate age fault, the Pinal Fault. Further evidence of the fault was experienced during the drilling of the test well T-4. In test well T-4 the top of bedrock was 100 ft lower than in neighboring test wells, abundant gouge-like clay was found at the apparent fault contact between the conglomerate and the top of bedrock, and total lost circulation of 300 gpm drilling mud was experienced immediately above the gouge-like clay. All of these features in T-4 are interpreted to be evidence of the Pinal Fault.

The Pinal Fault, like most faults in the Santa Cruz Deposit, probably consists of brecciated rock and fault gouge. A physical description of the fault zone can not be made from rotary cuttings, the drilling of which destroys the fault characteristics of the rock. Furthermore there are no known core intercepts of the Pinal Fault from which ~~structural~~ description could be made.
a physical

The attitude of the Pinal Fault is interpreted from drill hole results. The N65W strike was determined from the above described exploration drill hole results. The dip was interpreted to be 65° or more steeply dipping, up to 90°, because the fault was intercepted in T-4 but not in any of the other test wells.

The attitude of the Pinal Fault is such that it is estimated to pass within 50 ft of the perforations in monitor well SM-1. Deep in the granite bedrock, at the 1,570 ft to 1,770 ft depth of perforations in the test wells, the Pinal Fault is estimated to be within 300 ft of T-4, the closest well at this depth to the Pinal Fault.

It is not known if the Pinal Fault is more permeable or less permeable than the rock through which it cuts. It probably has various combinations of relatively higher permeability and impermeability along the course of the fault. Indirect evidence of such characteristics are the permeable appearing breccia and impermeable appearing fault gouge seen in many of the Santa Cruz deposit faults. However, the hydrologic characteristics of these faults can not be determined by visual examination.

LOOKING EAST

T-2 T-3 T-4

Don
2-26-91

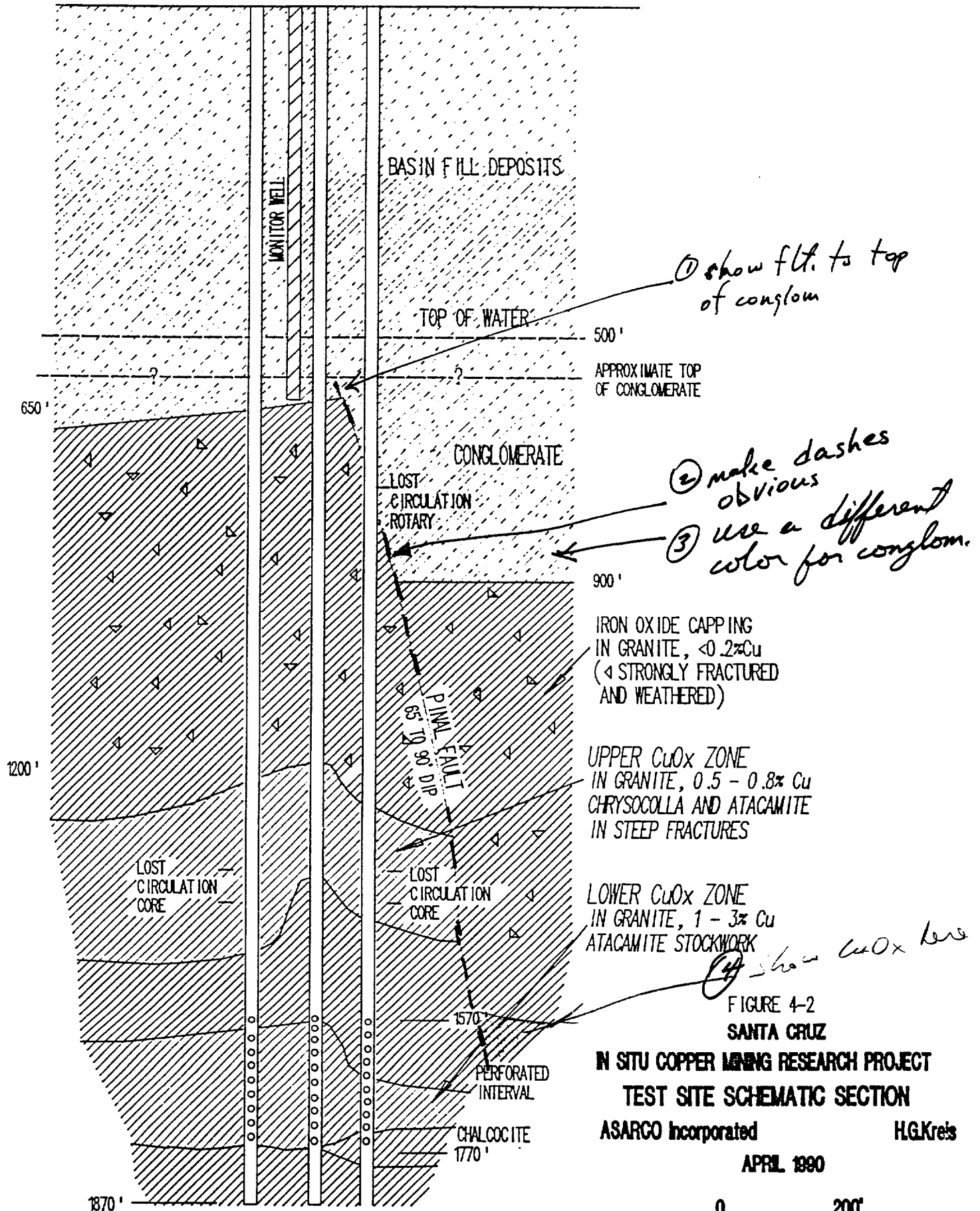


FIGURE 4-2
SANTA CRUZ
IN SITU COPPER MINING RESEARCH PROJECT
TEST SITE SCHEMATIC SECTION

ASARCO Incorporated H.G.Kretz

APRIL 1990



ASARCO

Exploration Department
Southwestern United States Division

March 11, 1991

Ms. Sharon K. Young
Manager of Metallurgical Services
Magma Copper Company
P.O. Box M
San Manuel, AZ 85631

Dear Sharon:

Please find enclosed a copy of SAIC's proposal for work on the CIPRA sulfide in situ leach proposal.

Sincerely,



Henry G. Kreis

HGK:mek
enc.

cc: W. Larson (w/encs.)
F.T. Graybeal (w/encs.)
W.L. Kurtz (w/encs.)
J.D. Sell (w/encs.)
A.R. Raihl (w/encs.)

Rec 3-7-91



Science Applications International Corporation
An Employee-Owned Company

KM91-032

March 6, 1991

Mr. Henry G. Kreis
ASARCO Incorporated
1150 North 7th Avenue
Tucson, AZ 85703-0747

Subject: SAIC Proposal No. 1-279-71-920-00 for
In Situ Leach Mining of Copper Sulfides

Dear Mr. Kreis:

Science Applications International Corporation (SAIC), in response to your letter of February 15, 1991, is pleased to submit this Technical and Cost Proposal to CIPRA to support the first year of work pertaining to the proposed CIPRA cost-shared project with the U. S. Department of Energy (DOE) for In Situ Leach Mining of Copper Sulfides.

Please address all technical questions to Dr. Donald Davidson at (703) 749-8729. Questions of a cost or contractual nature should be addressed to the undersigned at (703) 448-6322.

Sincerely,

SCIENCE APPLICATIONS
INTERNATIONAL CORPORATION

A handwritten signature in cursive script that reads "Karen Murphy". The signature is written in black ink and is positioned above the printed name and title.

Karen Murphy
Contracts Representative

1710 Goodridge Drive, P.O. Box 1303, McLean, Virginia 22102 (703) 821-4300

Other SAIC Offices: Albuquerque, Boston, Colorado Springs, Dayton, Huntsville, Las Vegas, Los Angeles, Oak Ridge, Orlando, Palo Alto, San Diego, Seattle, and Tucson

PROPOSAL FOR TECHNICAL AND ADMINISTRATIVE SUPPORT
FOR IN SITU LEACH MINING OF COPPER SULFIDES

Submitted to:

COPPER INDUSTRY PRODUCERS RESEARCH ASSOCIATION (CIPRA)
c/o ASARCO Incorporated
1150 North 7th Street
Tucson, AZ 85703-0747

Submitted by:

Science Applications International Corporation
1710 Goodridge Drive
McLean, Virginia 22102

March 6, 1991

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Attachment II - Letter request for proposal to CIPRA	
Attachment III - Cost Proposal	
Attachment IV - Resumes	

1.0 Background

Science Applications International Corporation (SAIC), is submitting this proposal to provide technical and administrative support to the Copper Industry Producers Research Association (CIPRA). This submission is in response to a CIPRA request dated February 15, 1991 (Attachment I). This work will support CIPRA's cost shared proposal to the U.S. Department of Energy (DOE) for In Situ Leach Mining of Copper Sulfides. The specific work and level of effort for the first year of the project proposed to CIPRA by SAIC is based on a meeting held in Tucson, Arizona on February 12 and 13, 1991 (Attachment II), during which time CIPRA members and the U.S. Bureau of Mines (USBM) discussed the technical work and time frame required to develop a commercial process to in situ mine copper sulfides. Dr. Davidson of SAIC attended this meeting and provided input based on his experiences with in situ mining of copper sulfide at Kennecott Copper from 1971 to 1978.

SAIC is a diversified, high technology research and development company whose activities encompass a broad range of scientific, engineering, systems, and other professional services to government and commercial clients. Major business areas include Energy and Space, National Security and Defense Systems, Environmental Sciences, and Health Care Services. Corporate headquarters are located in La Jolla, California. In 1990 SAIC revenues were \$1 Billion. This proposed work would be administered within the Energy and Space Sector, in which Dr. Donald Davidson the SAIC project manager is located in McLean, Virginia.

SAIC and its staff have extensive experience with the development of in situ copper and uranium mining. SAIC is currently supporting the Santa Cruz Joint Venture (SCJV) copper oxide cost shared In Situ Copper Mining Research Project with the U.S. Bureau of Mines (USBM). This work includes: design, installation, testing of the wells and well pattern; analysis of hydrologic and solute transport data; design and analysis acid leach testing; and providing administrative support to SCJV with regard to meeting government requirements in contract and sub-contract administration. SAIC was the prime contractor to the USBM in support of its program to develop a generic design manual for commercial scale in situ copper mining operations and to develop engineering designs for

pilot scale testing at two sites in Casa Grande, Arizona. SAIC previously provided technical support to: ASARCO with regard to describing methods of evaluating in situ copper mining for the Poston Butte and Santa Cruz deposits; Occidental Minerals with regard to the analysis of field leach testing of copper oxides at the Van Dyke deposit; and to Rocky Mountain Energy and Wyoming Minerals with regard to design and testing of oxygen gas injection for in situ uranium mining. Dr. Donald Davidson, Manager of Technology Development at SAIC has served as SAIC project manager for each of these projects. Prior to joining SAIC he was a Group Leader on the Kennecott Copper in situ mining project from 1971 to 1978, during which time he developed a process and equipment for oxygen/lixiviant injection into a copper sulfide orebody, and is named on U.S. patents pertaining to this process. Dr. Davidson also served as a Kennecott representative to the joint Kennecott/Lawrence Livermore Laboratory program on the nuclear rubblization and oxygen leaching of a copper sulfide orebody.

2.0 Statement of Work

The technical discussions held during the February 12 -13, 1991 meeting in Tucson addressed a multi-year project consisting of seven tasks.

1. Task I - Geologic Characterization
2. Task II - Lixiviant System
3. Task III - Hydrologic Characterization
4. Task IV - Metal Recovery Research
5. Task V - Economic Evaluation
6. Task VI - Environmental Evaluation
7. Task VII - Field Test Work.

The major effort of work for the first year focused on Tasks I and II with regard to: identifying ranges of pyrite - to - chalcopyrite ratios of CIPRA member copper resources; demonstrating that copper can be extracted from the chalcopyrite in laboratory test using lixiviant systems such as oxygen/acid, oxygen/alkaline, and ferric iron/acid, over a range of process conditions associated with the depth of burial and composition of the chalcopyrite and host rock in CIPRA member deposits; and identifying initial engineering designs for field testing the most promising process conditions resulting from the laboratory

tests. Prior work on the lixiviant systems described above have shown that these are most likely to provide the best technical and economic conditions for in situ mining chalcopyrite. The oxygen system is likely to involve free oxygen gas in order to develop high pregnant liquor copper concentrations. Laboratory testing will be conducted by the USBM and University of Arizona Copper Research Center.

SAIC has structured its proposed work activities for the first year of the project to support the work described above under Tasks I and II. In addition, SAIC, is proposing an eighth task (Task VIII - Project Management) under which SAIC would support CIPRA with: administrative functions pertaining to cost accounting, and contracting and sub-contracting for U.S. Government contracts; technical support relating to Task III through VII; and the management and storage of data resulting from work conducted under Tasks I through VII. Task I, II, and VIII are described below, and the level of effort by staff member and task in Table I.

2.1 Task I - Geologic Characterization

- o Assist CIPRA identify the geologic parameters of CIPRA member copper sulfide deposits that impact copper recovery using in situ mining methods.
- o Assist CIPRA to identify literature sources pertaining to previous in situ copper mining projects or research work that address rock and mineral properties that affect fluid flow and chemical reactivity and transport in copper sulfide ore.
- o Review factors and methods used in field tests to assess the in situ fluid flow and leach properties of copper sulfide ore.
- o Assist CIPRA with review and assessment of laboratory methods being researched by other CIPRA sub-contractors, such as USBM and University of Arizona Copper Research Center, that measure fluid flow and leach properties in copper sulfide ore. Some of these methods include permeability and porosity measurements and

microscopy, X-ray analysis, and spectroscopic methods.

2.2 Task II - Lixiviant Systems

- o Assist CIPRA to identify literature sources pertaining to previous in situ mining projects or research that describe the chemical systems and leaching conditions used to extract copper from sulfide minerals and from ore. Chemical systems would include: oxidants; acids and bases for pH control; and chemicals to inhibit copper loss from solution. Leaching conditions would include: temperature; pressure; time; and chemical concentration.
- o Based on results of the literature survey conducted by CIPRA and the University of Arizona Copper Research Center and the USBM, support these organizations with the development of a prioritized list of laboratory experiments to test the chemical systems and leaching conditions that are most likely to be associated with a commercial operation.
- o Consult with the University of Arizona Copper Research Center and the USBM with regard to developing experimental methods and procedures for use in the laboratory to demonstrate that copper can be extracted from sulfide minerals and from the ore. These methods include batch leaching of pure sulfide minerals and ore, and column and core leaching of sulfide ore.
- o Support CIPRA in the evaluation of laboratory chemical leach tests conducted by the University of Arizona Copper Research Center and the USBM with regard to: selection of chemical systems for field testing; identifying the well completion system required for use with specific chemical system; and selection of materials of construction for use in a given well completion system.

2.3 Task VIII - Project Management

Work under this task consists of (1) reporting of SAIC work and (2) providing management and technical support to CIPRA to plan, define, report, and monitor the overall conduct of the program. Specific activities are:

- o Prepare SAIC monthly technical financial reports.
- o Provide administrative support to CIPRA with regard to CIPRA activities pertaining to the development and review of cost accounting and contracts and sub-contracts procedures required for expenditure of government funds.
- o Support CIPRA with the integration of the results of technical work conducted in Tasks I through VII, and in the preparation of briefings to CIPRA member management and the DOE.
- o Support CIPRA with the process of reviewing and up-dating program plans, objectives, and goals, and in developing work plans and budgets for the subsequent years of the program.
- o Support CIPRA with development and operation of a data management system to collect and store technical information generated by work under Task I through VII.
- o Provide technical input to tasks III through VII when required.

3.0 SAIC Project Organization Level of Effort

Dr. Davidson will act as the SAIC project manager and provide technical support with regard to geologic, lixiviant systems, hydrologic characterization, metal recovery, economic evaluation, environmental evaluation, and field testing. Ms. Hema Virmani, an SAIC contracts and sub-contracts specialist, will provide the support to CIPRA regarding administrative functions relating to the expenditure of government funds. Mr. John Pendleton, an SAIC geologist, will

support CIPRA with the development and operation of a data management system. Each of these SAIC staff members are currently supporting the SCJV copper oxide cost shared project. The level of effort for the first year of work is shown in Table 1 below, and cost in Table 2.

Table 1

Staff	Hours Per Task		
	Task I	Task II	Task VIII
D. Davidson	40	140	80
H. Virmani	0	0	120
J. Pendleton	0	0	100
clerical	0	0	40

TASK	TRAVEL DESCRIPTION
I	No Travel
II	One trip, 4 days/Washington DC to Salt Lake to Reno One trip, 2 days/Washington DC to Minneapolis
VIII	2 trips, 3 days/Washington DC to Tucson

ASARCO

Exploration Department
Southwestern United States Division

January 18, 1991

Dr. Donald H. Davidson
SAIC
1710 Goodridge Drive
Mail Stop T-2-2-1
McLean, Virginia 22102

Dear Don:

You are invited to participate in the USBM-industry meeting on sulfide in situ leaching. As you know, the meeting will be held February 12th and 13th in Tucson.

Details of the agenda are being prepared, and I will send them to you as soon as they become available.

Sincerely,



Henry G. Kreis

HGK:mek

cc: F.T. Graybeal
W.L. Kurtz
J.D. Sell
A.R. Raihl

ATTACHMENT II

ASARCO

Exploration Department
Southwestern United States Division

February 15, 1991

Dr. Donald H. Davidson
SAIC
1710 Goodridge Drive
Mail Stop T-2-2-1
McLean, Virginia 22102

CIPRA

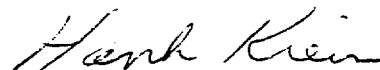
Dear Dr. Davidson:

Pursuant to our meetings and telephone conversations, CIPRA is interested in using the services of SAIC. As you know, CIPRA is the name of a research organization being formed by ASARCO Incorporated, Magma Copper Company, and Cyprus Copper Corporation. CIPRA is being formed for the sole purpose of submitting a copper mining research proposal to the U.S. Department of Energy (DOE). The proposal is entitled "In Situ Leach Mining of Copper Sulfides." CIPRA would be using your services in implementing the research work being proposed to the DOE.

At this time, CIPRA would like to obtain a proposal for work by SAIC during the first year of the DOE contract. If you have any questions, please feel free to call.

Thank you for giving this matter your consideration.

Sincerely yours,



Henry G. Kreis

HGK:mek

ATTACHMENT III

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

Proposal No. 1-279-71-920-00

Terms & Conditions, Assumptions & Other Statements

Science Applications International Corporation (SAIC) is pleased to submit its cost proposal in accordance with your request dated February 15, 1991. This proposal has been prepared on the basis of the following understandings and assumptions:

I. General

1. Our proposal is firm for a period of sixty (60) days from the date of the proposal.
2. The cost estimates contained in this proposal are based upon a Cost-Plus-Fixed-Fee (CPFF) type contract.

II. Administrative

1. Invoices will be submitted on a monthly basis. Payment terms are net 30 days. A 1.5% per month late charge will be imposed on all unpaid balances 30 days after the invoice date. The remittance address is as follows:

Science Applications International Corporation
File No. 2570
Los Angeles, CA 90074

2. The following individuals are authorized to negotiate on behalf of SAIC:

Karen Murphy (703) 448-6322
Contracts Representative

Stuart L. Phillips (615) 481-2116
Contract Manager

Any additional terms and conditions of any future contract are subject to negotiation and acceptance by SAIC.

IN SITU LEACH MINING OF COPPER SULFIDES

SAIC Cost Proposal No. 1-279-71-920-00

DIRECT LABOR

	<u>Hours</u>	
Scientist Level 434 (D. Davidson)	260	
Scientist Level 212 (H. Virmani)	120	
Scientist Level 211 (J. Pendleton)	100	
Level 62 (clerical)	40	
	<hr/>	
	520	
TOTAL DIRECT LABOR COSTS		\$45,011

OTHER DIRECT COSTS

Travel and Miscellaneous Costs	\$ 9,820
	<hr/>
TOTAL ESTIMATED COSTS	\$54,831

ATTACHMENT IV

DONALD H. DAVIDSON, P.E.

Position with Company: Manager,
Technology Development and Analysis

Education:

New York University: Ph.D., Chemical Engineering, 1967.

New York University: M.Ch.E., Chemical Engineering, 1962.

Rensselaer Polytechnic Institute: B.Ch.E., Chemical Engineering, 1959.

Experience: Dr. Davidson is responsible for managing projects and developing new technology for in situ treatment of hazardous waste and in situ leaching (ISL) of minerals. He has over 31 years of industrial experience, 21 years of which are in developing new technology from bench scale to demonstration of commercial feasibility for minerals, oil and gas recovery, and hazardous waste. This experience includes both private industry and government supported projects exceeding \$30 million.

Dr. Davidson's major accomplishments with regard to in situ technology development include:

- Development of an overall program plan, schedule, and budget for three major projects.
- Development of a cash flow model to assess economic sensitivity to process, geologic, and cost parameters. This model is used to evaluate economic performance, establish priorities for laboratory and field testing, rank candidate deposits, and identify deposit characteristics for exploration programs.
- Development of environmental data gathering and permitting programs and integration of these with mining plans.
- Design, construction, and operation of a high-pressure laboratory using rock cores and solvents to evaluate in situ fluid flow and minerals extraction. This facility had the capability of handling both acidic and alkaline solutions in combination with oxygen gas, hydrogen peroxide, and other oxidants at pressures up to 2,000 psi.
- Development of mathematical models describing the behavior of gaseous oxygen/liquid mixtures in fractured mineralized rock. These models were incorporated into a multi-well computer simulator to predict and analyze the movement of fluid and chemical plumes in subsurface environments.
- Planning, designing, sizing, and costing of well systems and surface facilities for field testing single well, 2-well, and 5-well operations. This includes: well logging; pressure and chemical tracer communication tests; leaching with acidic, ammoniacal, and liquid and gaseous oxidants in copper oxide and sulfide ore; and hydraulic and explosive fracturing of rock. The objective was to determine flow and extraction characteristics for ISL, and establish a baseline of operability and cost for scale-up to a production facility design. The field test period was 6 years.

- Design, construction, costing, and operation of a well system and hardware to safely transport stable dispersions of gas, hydrogen peroxide, and other oxidants and corrosive liquids to depths of 5,000 feet below the surface.

Dr. Davidson also has extensive experience in oil and gas production research and development. He has participated in laboratory and field projects relating to the use of chemicals and hydraulic fracturing for both the stimulation and impairment of well productivity. Specific activities were:

- Participated in a \$50 million proposal to the Department of Energy (DOE) to assess the feasibility of producing methane from geopressed aquifers along the Gulf Coast. Developed a plan to acquire sufficient data in 1- to 2-year testing to scale-up long-term reservoir performance. This plan contained environmental data gathering and permitting, drilling and completion of wells, design and operation of surface facilities, laboratory testing, short-term and long-term field testing, data analysis, and reporting.
- Developed a method of relating surface water quality requirements to mechanisms and rates of injection well damage by solids. This technique, referred to as Barkman/Davidson analysis, has been used by the industry to assess water treatment needs in North Sea injection, reinjection of salt cavity fluids in the Strategic Petroleum Reserve (SPR) program, and reinjection of spent geothermal brines.
- Used statistical analysis to determine criticality of numerous parameters associated with well completions and workovers for hundreds of Gulf Coast wells.
- Evaluated chemical and hydraulic systems used to increase productivity of producing oil and gas wells. Specific studies involving laboratory and field testing, mathematical modeling, and computer simulation included:
 - Chemical stimulation of sandstone and carbonate reservoirs using hydrochloric-hydrofluoric and hydrochloric acid systems;
 - Use of polymers and foams to control profile of injected and produced fluids; and
 - Evaluation of formation damage related to gypsum and calcite precipitation in wells.
- Developed model and computer simulation of gas production from low permeability fracture/matrix reservoirs, including mechanisms of fluid flow in fractures, adsorption, and diffusion of gas in matrix rock. A comparison of analysis with field production histories indicates the shape of production decline reflects limiting recovery mechanism.
- Developed mathematical model describing the movement and filtration of micron size particles in rock pores. This model was used to construct a computer simulation of well permeability damage by drilling mud particles, for the purpose of predicting mud filtrate invasion.

Dr. Davidson's technical background also includes:

- Use of experimental design and statistical analysis to evaluate the performance of complex systems involving large data sets and many variables. Specific applications to quality control for tire manufacturing and optimization of oil production from Gulf of Mexico wells.
- Development of a mathematical model and method of analyzing stress-strain behavior of composite structures with specific application to the design, construction, and testing of a prototype polyurethane/fiber cast tire and a fiberglass/epoxy torsion bar for automobiles.

Employment History: Manager of Technology Development, Systems Engineering and Analysis Division, Science Applications International Corporation (SAIC). 1985 to present. Dr. Davidson manages SAIC's contract with ASARCO (a major U.S. copper producer) to provide management and technical support for ASARCO's cost share program with the U.S. Bureau of Mines to field test in situ copper mining. This is a 4 year program involving installation and testing of: ten injection and production wells (to circulate acid and leach copper); a solvent extraction/electrowinning plant (to obtain copper cathode); and a system of environmental monitoring wells. Technical work on the project includes: design of 2,000-foot wells; hydrologic and chemical tracer testing in well patterns completed in fractured rock; design of mineral extraction tests for operation of the well pattern; design of well equipment for operation in corrosive fluids; and design and analysis of laboratory extraction tests. Dr. Davidson supports ASARCO with development and management of the cost share program. SAIC is responsible for installation and testing of the wells and well system, and for the integration and analysis of data.

Dr. Davidson managed SAIC's Superfund Innovative Technology Evaluation (SITE) program with the Environmental Protection Agency (EPA) for testing and evaluation of CF Systems' extraction technology for contaminated water and sludges using high measure carbon dioxide and propane. This work developed cost and performance data to determine whether this technology could be considered in the Superfund decisionmaking. Specific activities included: providing technical support for gathering and evaluating technology and site data for site selection, site preparation, and test planning; preparation of the demonstration test plan, including operating conditions, schedule, procedures, and methodology for test evaluation; preparation of a sampling and analysis plan; preparation of a health and safety plan; preparation of a quality assurance project plan; conducting sampling and analysis during testing; and technical and cost evaluation of the test data for scale-up to commercial operation. Technical Evaluation and Application Analysis Reports were written.

Dr. Davidson also managed SAIC's project to develop a generic design manual for in situ copper mining for the U.S. Bureau of Mines. Phase I work involved: construction of a generic design manual that provides procedures for developing specifications and costs for well systems, surface processing facilities, and environmental permitting and monitoring; development of a cash flow computer program to conduct discounted-cash-flow/rate-of-return of investment (DCF/ROR)

analysis utilizing all capital and operating costs associated with the well system, surface plant, and environmental activities; development of a method to estimate the best of 42 possible mining scenarios; and creation of test procedures for obtaining site-specific data required for the commercial design and economic analysis. The test procedures include permeability testing of wells, tracer and chemical leaching of well patterns including modeling of plumes, laboratory leaching of core material, and identification and description of the permit application process for in situ copper mining. Phase II work consisted of design and execution of field tests to obtain hydrologic engineering design data at two field sites in Arizona for use in conducting a commercial design and analysis of data using hydrologic modeling; calculation of the best commercial design specifications and costs for the two sites, and scale down of this design to a pilot scale operation; and development of a program plan, a schedule, and budget for pilot plant operations at the two sites.

Dr. Davidson provided technical support to SAIC's field program at Kelly Air Force Base to test in situ biodegradation of soils containing organic and metal waste. In this process, groundwater that is mixed with hydrogen peroxide and nutrients is circulated through the soil using a series of injection and production wells. Dr. Davidson directed field testing, analyzed movement of the chemical plume and its interaction with the soil and contaminants, and developed procedures for engineering scale-up and a generic cost model.

Dr. Davidson provided hydrologic and geochemical support to SAIC's String-fellow project by analyzing organic and metal concentrations data obtained from well fluids to determine the impacts of acid/rock reactions and pH changes on the transport and precipitation of organics and metals along the plume.

Private Consulting. 1981 to 1985. Dr. Davidson provided technical support to Ray V. Huff and Associates' ISL project in Chile with regard to design and analysis of laboratory core leaching and field well pattern leaching. Consulted to NL Industries with regard to mud invasion in oil wells.

Manager Special Projects, Northrop Services, Inc. (NSI). 1982 to 1985. Dr. Davidson managed NSI's Library of Congress project to develop a government-owned, contractor-operated production facility for mass book preservation. The process utilized a hazardous chemical to deacidify paper. Dr. Davidson was the project manager for the \$16 million Library of Congress program to develop and test a process, then design, construct, and activate a production facility to deacidify large volumes of books. Project activities included development of a program plan, schedule, and budget; design of a chemical plant for distillation/condensation/recycling; design of large thermal-vacuum chambers to achieve optimum gas-paper contact; development of instrumentation to measure gas compositions; development of operating and system safety procedures; mathematical modeling of system performance and process control; and writing equipment specifications and procurement of equipment.

Manager, Special Projects, Energy Systems Group, TRW. 1980 to 1982. Dr. Davidson supported DOE's in situ technology for fossil energy. In addition, he developed a program plan for Allied Chemical on trona solution mining and one for Conoco minerals on in situ copper leaching.

Manager, Petroleum Engineering and Solution Mining of Minerals, SAIC. 1978 to 1979. Dr. Davidson provided technical support for in situ technology: permeability testing; well and wellfield design; laboratory and field leaching; and economic analysis. Clients included Occidental Minerals, Occidental Research, ASARCO, Wyoming Minerals, Rocky Mountain Energy, General Crude Minerals, U.S. Bureau of Mines, DoD, and EPA.

Group Leader, Kennecott Copper Corporate. 1971 to 1978. Dr. Davidson was involved in all aspects of the in situ copper mining program. He supported program planning; economic analysis; high pressure core leaching; modeling and computer simulation of in situ flow and leaching inwell patterns; design, testing, and analysis of 5 years of field testing; integration and analysis of 5 years of field testing; and integration and analysis of project data and presentation to corporate management. Dr. Davidson was Kennecott's fluid flow representative on the joint Kennecott/Lawrence Livermore Laboratory/USERDA Project for Nuclear Rubblization of Copper Ore Bodies.

Research Engineer, Shell Development Company. 1967 to 1971. Dr. Davidson was a research engineer with numerous projects in oil and gas production R&D. This included chemical and hydraulic stimulation and formation damage by chemical precipitates and solid particles. His work involved laboratory and field testing, mathematical modeling, and computer simulation.

Professional Licenses and Memberships

Dr. Davidson was a member of the Solution Mining Committee of the Society of Mining Engineers and in 1979 served on the Society of Petroleum Engineers Committee on Emerging Technology. He served as the chemistry session chairman for the 1987 seminar on in situ minerals leaching sponsored by the Engineering Foundation.

American Chemical Society
American Institute of Chemical Engineers
Society of Petroleum Engineers
Certified Professional Engineer, Texas Certificate Number 31693
U.S. EPA Office of Emergency and Remedial Response Hazardous Materials
Incident Response Operations (165.5) Training Course

Patents

U.S. patent 3,917,345, Well Stimulation for Solution Mining.
U.S. patent 4,045,084, In Situ Mining of Copper and Nickel.
U.S. patent 4,116,488, In Situ Mining Method and Apparatus.
U.S. patent 4,125,289, Method for In Situ Minefields.

Publications and Presentations

Generic In Situ Copper Design Manual, Mining Research Contract Report for U.S. Bureau of Mines, April 1988.

Effectiveness of In Situ Biological Treatment of Contaminated Groundwater and Soils at Kelly Air Force Base, Texas, Oak Ridge Model Conference, Oak Ridge, Tennessee, Oct. 13-16, 1987.

Treatment In Your Own Backyard, Civil Engineering, February 1986.
Technical and Economic Factors Involved in the Evaluation of In Situ Leaching (ISL), Society of Mining Engineers Fall meeting, Albuquerque, New Mexico, October 16, 1985.

Paper presented March 29 - April 1, 1982 American Chemical Society Meeting, Las Vegas, Nevada, "Chemical Technology Associated with In Situ Copper Leaching."

In Situ Leaching Mining of Deep Ore Bodies Through Multiple Branched Holes, paper presented at Energy-Sources Technology Conference and Exhibition, Houston, Texas, January 1981.

Technology for In Situ Uranium Leaching, Mining Engineering, February 1980.

In Situ Leaching of Nonferrous Metals, paper presented at the American Mining Congress Annual Meeting, San Francisco, California, 1979.

In Situ Leaching Materials of Construction, SPE 8320, Society of Petroleum Engineers Annual Meeting, 1979, Las Vegas, Nevada.

Invasion and Impairment of Formations by Particulates, SPE, 8210, Society of Petroleum Engineers Annual Meeting, 1979, Las Vegas, Nevada.

Economic Optimization of In Situ Minerals Leaching, paper presented March 17, 1979, Pacific Southwest Minerals Conference, San Francisco, California.

Measurement and Control in Solution Mining of Copper and Uranium, Proceedings of the 7th Annual Mining and Metallurgy Division Symposium and Exhibit, Instrument Society of America, November 1, 1978, Denver, Colorado.

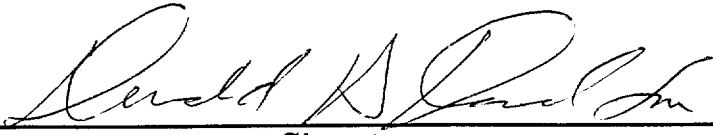
Water Quality and Well Impairment in Geothermal Reinjection Wells, Talk presented October 1978 meeting of Geothermal Resource Council of San Diego.

Water Quality and Well Impairment, Journal of Petroleum Technology, July 1972.

Heat Transfer in Pulsating Flow, Journal of the Franklin Institute, Vol. 291, No. 1, January 1971.

Solids Transport in a Horizontal Tube, Ind. Eng. Chem., Process Design and Development, Vol. 10, No. 2, 1971. 1968 ACS Convention, Atlantic City, New Jersey, Paper on Heat Transfer in Pulsating Flow.

I certify that, to the best of my knowledge, the information in this resume is accurate.


Signature

3/6/91
Date

JOHN D. PENDLETON

EDUCATION

Virginia Polytechnic Institute and State University: B.S., Geology (1988)

SUMMARY OF EXPERIENCE

Mr. Pendleton is a staff geologist within the Environmental Technology Group (ETG) of Science Applications International Corporation (SAIC). Since joining SAIC, he has provided technical support and field management for an in situ copper leaching field experiment at the Santa Cruz Joint Venture site as well as for projects under the Department of Defense (DOD) Installation Restoration Program (IRP). He has also been involved in the investigation of geologic and hydrogeologic characteristics conducted at the U.S. Ecology Sheffield Facility in Sheffield Illinois. Additionally, Mr. Pendleton has assisted in performing various industrial hygiene surveys and also provides support in the management and operation of SAIC's Equipment Service Center which is responsible for the allocation, tracking, and maintenance of all equipment for ETG field projects.

EMPLOYMENT HISTORY

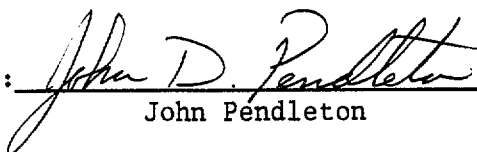
ASARCO - Santa Cruz Joint Venture Copper Leaching Field Experiment

Currently, Mr. Pendleton is playing an active role in an in situ copper leaching field experiment at the Santa Cruz Joint Venture, site in Casa Grande, Arizona. His responsibilities include supporting the installation of downhole pumps, implementation of the test procedures associated with water injection, pressure transient, flow profile and pressure communication tests and data analysis of the above test data.

Department of Defense Installation Restoration Program

Mr. Pendleton has been involved in various aspects of the Installation Restoration Program (IRP). This program determines the degree and extent of environmental degradation associated with past waste handling practices. Most recently, he served on the field crew conducting Site Investigation (SI) activities at General Mitchell AFB, Milwaukee, WI. He was responsible for the installation and development of all monitoring wells and was involved in the collection of groundwater, soil, surface water and sediment samples.

Verified for accuracy by:


John Pendleton

Date:

3/5/91

U.S. Ecology Sheffield Facility

Mr. Pendleton has also served as a supervisory geologist during the installation of groundwater monitoring wells at the U.S. Ecology Sheffield Facility, Sheffield, Illinois. This position required supervision of the soil sampling and installation which occurred at the site.

Mr. Pendleton has also gained the following skills from his field work experience:

Supervision of hollow stem auger, mud, and air rotary drilling operations and soil borings

Installation of shallow/deep groundwater monitoring wells, subsurface sampling using a standard split-spoon, shelby tube and California ring samples and monitoring well development and purging.

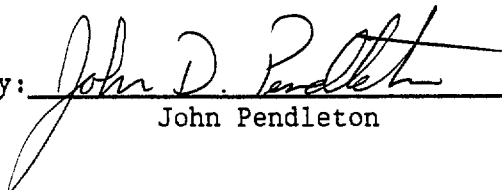
He has also participated in the sampling of soils, surface water, sediments and groundwater and their handling and shipment.

Mr. Pendleton was also involved in various projects associated with the Industrial Hygiene Section of the Applied Technology Division of SAIC. He conducted air and bulk sampling surveys for asbestos, monitored work practices for many government agencies and asbestos removal contractors, and contributed to the writing of various industrial hygiene reports. He has also participated in several federal government sampling projects which involved chemical hazards such as formaldehyde, formic acid, sodium hydroxide and polychlorobiphenols and has participated in comprehensive industrial hygiene surveys at several U.S. Air Force facilities. These surveys include performing such duties as occupational hazard assessments, illumination evaluations, hazardous noise exposure tests, ventilation system assessments, radon exposure tests, and various health and safety evaluations.

May 1988 to September 1988: Terradynamics Corporation

Prior to joining SAIC, Mr. Pendleton worked as an environmental geologist at Terradynamics Corporation. His primary responsibilities included site feasibility studies, laboratory soils testing, and soil radon measurements and mapping. In addition, he has been a site field manager in charge of work crews conducting soil radon measurements and has also participated in various geochemical sampling projects.

Verified for accuracy by:


John Pendleton

Date:

3/5/91

HEMA VIRMANI

Position With Company: Project/
Subcontract Administrator

Education:

University of Virginia: Continuing Education, 1988 to Present
Contracts and Procurement Certificate Program to be completed by Spring 1991.
St. Joseph's College: B.S., Mathematics

Experience:

Employment History: Project/Subcontract Administrator, Science Applications International Corporation, October 1988 to present. Ms. Virmani is the Project/Subcontractor Administrator for SAIC's Santa Cruz Joint Venture In Situ Copper Mining Research Project. In this role, Ms. Virmani assists the Project Manager with contractual, financial, preparation of cost proposal, and administrative issues related to this project. She is responsible for fulfilling financial and all contractual requirements for a budget of more than \$6 million. About 75% of the contract funding is subcontracted. She also assists the prime contractor in meeting contractual requirements with their subcontractors and in submitting cost proposal to USBM for Phases II and III for an additional \$10 million dollars. Ms. Virmani is also a Subcontract Administrator for Larry Peck's Group and Bob Kennedy's Group in Denver and provides all subcontract support for the groups. She is knowledgeable in FAR and in the administration of FFP, CPFF, and Time and Materials contract in both the Government and private sectors. In addition, Ms. Virmani will also prepare all financial reports for Division 279.

Contract Specialist, ICF Incorporated, April 1985 to October 1988. Before joining SAIC, Ms. Virmani worked as a Contract Specialist at ICF. Her primary responsibilities included monitoring of more than \$10 million of EPA, DOE, and various other private contracts to oversee financial and contractual obligations, as well as performing monthly budget analyses. She worked directly with the technical vice-president to coordinate and ensure integrity of the monthly financial reports and invoicing. She also acted as a liaison with various client officers for contract compliance and coordinated internal information between ICF corporate and regional offices. In addition, Ms. Virmani also performed close out of contracts.

Affiliations:

The National Contract Management Association

I certify that, to the best of my knowledge , the information in this resume is accurate.

Hema Virmani
Signature

3/5/91
Date

SAIC
Science Applications
International Corporation

March 19, 1991

A.R. Raihl

1991 McKelvey Forum
Santa Cruz Project

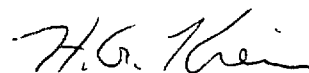
At the recent McKelvey Forum, Phil Nelson of the USGS displayed a poster on the Santa Cruz Project geophysical results. The poster incorrectly mentioned anomalously high uranium concentrations in the upper copper oxide zone.

Nelson's interpretation of the geophysical results shows 9 to 15 ppm uranium in the upper zone and 6 to 8 ppm uranium in the lower zone. A copy of Nelson's work is attached. Although the uranium content in the upper zone is slightly elevated, it is not anomalous for a granitic rock. Granitic rocks average 4 ppm uranium and have a common range of 1 to 10 ppm uranium.

During a telephone conversation with Mr. Nelson on January 29th, prior to the McKelvey Forum, he mentioned finding anomalous uranium in the upper copper oxide zone. Upon mentioning this, Mr. Nelson was advised that (a) his findings had to be technically correct, and (b) the consequences of being technically incorrect with an emotional, controversial element like uranium; and (c), if technically correct, the need to talk to those managing the project before publicizing the data.

Immediately following the telephone conversation, Mr. Nelson reviewed his work on the uranium content. After making this review, he realized the uranium values were not anomalous, and this conclusion was reflected in the attached note dated February 1st. Apparently Mr. Nelson neglected to delete this from his poster.

HGK:mek



H. G. Kreis

cc: F.T. Graybeal
W.L. Kurtz
J.D. Sell



United States Department of the Interior



GEOLOGICAL SURVEY
BOX 25046 M.S. 967
DENVER FEDERAL CENTER
DENVER, COLORADO 80225

IN REPLY REFER TO:

1 Feb 91

ASARCO INC.

FEB 7 1991

SW Exploration

*Hank —
thanks for the loan of the slides — site aerial
here they are. site x-section*

*The uranium level in the upper ore zone
is only 10 ppm and much lower in the lower ore
zone.*

Phil Nelson

OPEN HOLE LOGS FROM T-HOLES *From: P. NELSON, USGS*

3-4-91 p. 1 of 3

The openhole logs are presented in two formats: well by well and log by log. The well by well format (figures w1-w5) displays a selected set of logs for each well. The log by log format (figures L1-L7) displays one or two logs, such as density and photoelectric logs, for all five wells. In these plots the five-spot geometry is arrayed in the shape of a capital "N", with the southwest well T-4, at the left, and the northeast well T-1, at the right. Keep in mind that the two eastern wells T-1 and T-5 appearing on the right side of the plots have very little copper whereas the three wells T-4, T-2, and T-3 appearing on the left contain appreciable copper oxide mineralization.

Rather than discuss each plot individually, we discuss geological and mineralogical features that can be discerned in the logs, referring to pertinent figures to illustrate the features.

Diabase Sill. A near-horizontal diabase sill varying in thickness from 3 to 16 feet can be discerned in four of the T-holes. In three of the T-holes, the intercept is unambiguous with the same characteristics as seen in cored hole C-1: gamma-ray and resistivity decrease while neutron porosity increases. The depth intervals are 1446-1456 in T-1, 1436-1451 in T-2 and 1410-1426 in T-4. In T-5 the diabase is much thinner, occurring at 1416-1419 feet, and the pick is less certain; "diabase dikelets" were diagnosed from the cuttings.

Curiously, the characteristic diabase signature is not present in the central hole T-3. Instead, over the interval 1414-1434, the gamma-ray log is high instead of low and resistivity does not change much. Neutron porosity is high. Observation of cuttings at this depth in T-5 indicated high iron oxide content and very little diabase. Better information comes from cored hole C-2 which lies within 30 feet of T-3 at this depth. The geological description for C-2 notes that diabase and diabase breccia are present from 1439 to 1449 feet within a fault zone extending from 1420 to 1472 feet, described as "strongly broken and crushed with local soft and hard gouge". Faulting within the region penetrated by T-3 and C-2 has altered the physical properties of the diabase. However, on the basis of the neutron response, we believe the diabase is present at a depth of 1414-1434 in T-3.

*→ **Uranium distribution.** The Schlumberger natural gamma spectrometry log provides abundances of potassium, uranium, and thorium. Shown in figure Wx are uranium logs in five T-holes and the location of the diabase sill. Above the sill and within a zone more or less coincident with the upper copper oxide zone, uranium content is around 10 ppm. Note that the diabase sill coincides with the lower boundary of the upper zone where uranium content is higher than below the sill. Arithmetic means are tabulated in table Wz for three zones in each hole. Uranium content is around 2 to 4 ppm below the sill and 5 to 8 ppm near the bottom of the holes. Because of the magnitude of environmental corrections for the NGT tool, the uncertainty in uranium concentration may be several ppm. Nevertheless, Table Wx and figure Wx provide valid comparisons of the uranium distribution with depth.

ASACCO

MAR 4 1991

SW Exploration

Table Wx. Uranium content (ppm) averaged from spectral gamma-ray logs over three depth zones (feet) in each hole.

T-1	T-2	T-3	T-4	T-5
1268-1464 10.7	1255-1455 13.0	1245-1438 9.4	1220-1426 8.5	1250-1435 14.9
1464-1730 3.4	1455-1706 2.6	1438-1708 2.4	1426-1668 3.5	1435-1700 4.2
1730-1870 5.8	1706-1820 5.7	1708-1872 8.0	1668-1796 5.7	1700-1830 6.0

Uranium concentration in silicic igneous rocks is generally within the range 1 to 10 ppm (Clark et al., 1966). Based on a large number of samples from sites throughout the world, Clark et al. (1966) report a mean value of 4.7 ppm and a median of 3.9 ppm. Uranium can be highly mobile in oxidizing environments; its anomalous presence in fractured rock is sometimes used to infer transport and deposition by circulating groundwaters (Fertl et al. 1980, West and Laughlin, 1976). Given the excellent correlation of uranium distribution with the diabase sill and with the copper oxide distribution (figure Wp), it is quite likely that the pattern of uranium distribution in the T-holes is the result of dissolution and precipitation rather than primary distribution.

ELEMENTS AND MINERALOGY FROM GEOCHEMICAL LOGS
FLOW LOGS
CONCLUSIONS
REFERENCES

Clark, S.P., Jr., Z. E. Peterman, and K. S. Heir, 1966, Abundances of uranium, thorium, and potassium, in Handbook of Physical Constants, S.P. Clark, Jr., ed., Geol. Soc. of America Memoir 97, pp 521-541.

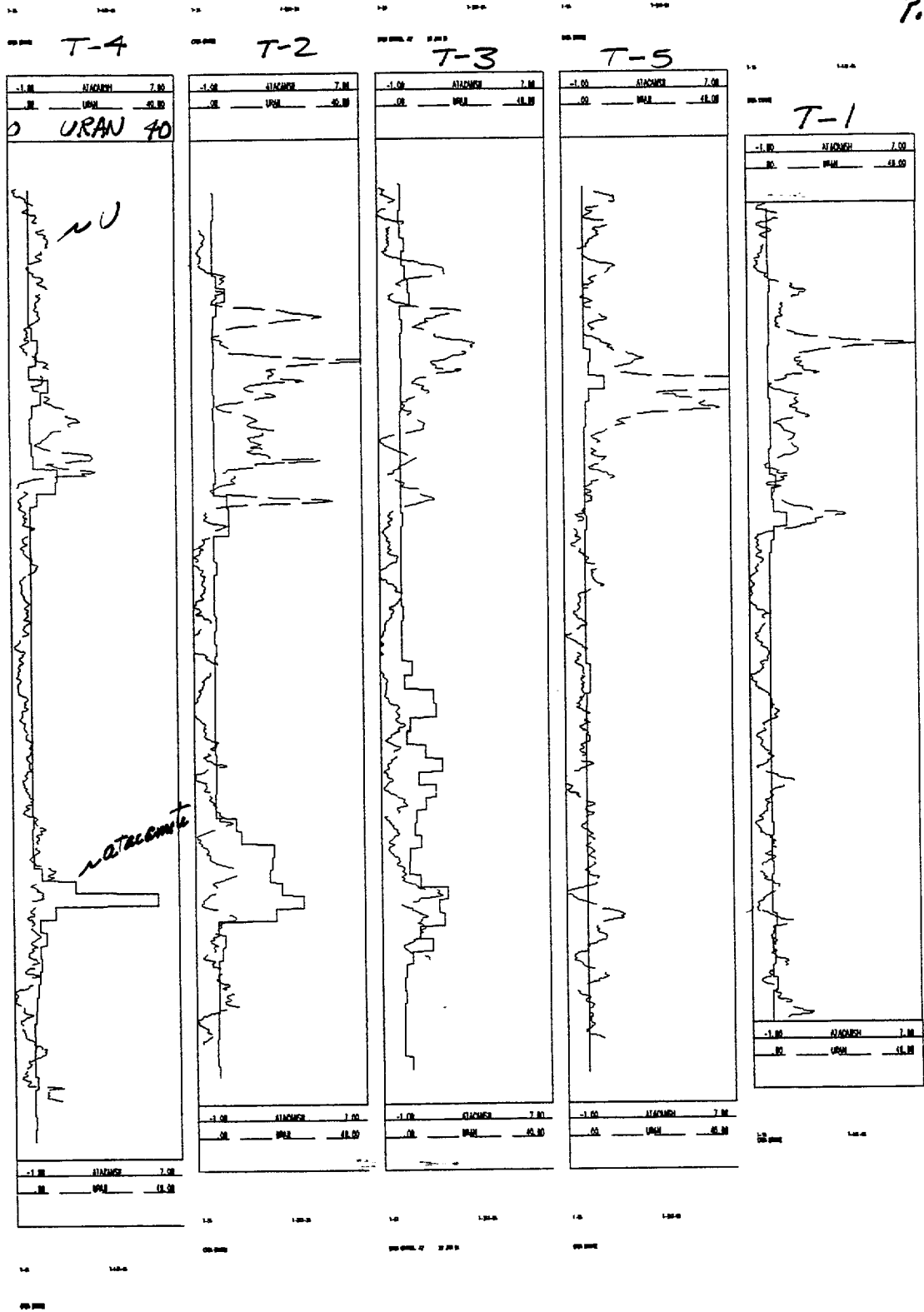
Fertl, W. H., W. L. Stapp, D. B. Vaello, and W. C. Vercellino, 1980, Spectral gamma-ray logging in the Texas Austin Chalk Trend, J. of Petr. Tech. pp 481-488.

Melzer, L. Stephen, 1990, Review of borehole video camera images performed in the T-wells on 7 July 1990, memo to A. Raihl of Asarco, 16 pp.

Montgomery and Associates, Inc., 1990, Summary of results of laboratory chemical analyses for routine constituents for groundwater samples obtained from injection and recovery test wells T-1, T-2, T-3, and T-5, four data sheets, Tucson, Az.

Nelson, Philip H., 1988, Well logs from Shads No. 4 (Amoco), Catoosa, Oklahoma, U. S. Geological Survey Open-File Report 88-584, 11 p.

From -
P. Nelson
USGS



To _____

Date _____ Time _____

WHILE YOU WERE OUT

M _____

of _____

Phone _____

Area Code	Number	Extension
TELEPHONED		PLEASE CALL
CALLED TO SEE YOU		WILL CALL AGAIN
WANTS TO SEE YOU		URGENT

RETURNED YOUR CALL

Message 5 in water
pumped from wells 3/1/91
near to the Rain & Windy
2,752, 123 gallons

Operator _____



AMPAD
EFFICIENCY®

23-000 50 SHT. PAD

23-001 250 SHT. DISPENSER BOX

March 25, 1991

F. T. Graybeal
New York Office

Cipra Meeting
March 22, 1991

On March 22nd Sharon Young of Magma, Don Davidson of SAIC, and the undersigned met at Asarco's Tucson Office. The following describes the outcome of this meeting.

Ms. Young explained in greater detail Magma's back peddling on the sulfide in situ proposal. The groundwork for the back peddling was laid at the February AIME annual meeting in Denver. The groundwork consisted of concerns about the environmental requirements of working with a Government Agency (such as the environmental assessment process imposed by NEPA requirements), the possibility of excessive regulatory thinking by a Government Agency, and the credibility of ideas proposed by a Government Agency.

In view of these concerns, it was realized that working with a Government Agency on a research project next to an important mining operation, such as the San Manuel in situ leach operation, could have some less than desirable consequences. Recognizing the possibility of undesirable consequences, Magma took a closer look at its relationship with the USBM and the Government's role in the sulfide in situ leach proposal.

Magma has a good working relationship with the USBM, and Magma does not want to compromise this working relationship in any way. With this in mind, Magma decided, since the AIME annual meeting, not to proceed with the Government's proposed sulfide in situ leach program, but this decision remained only temporarily. Ms. Young and Mr. Chris Burt were able to convince Magma to soften its position sufficiently to keep Magma's interest in the Government's proposed sulfide in situ leach program alive, at least for a little longer.

It appears doubtful that Magma would ever be interested in hosting a Government sponsored sulfide in situ mining research project at one of Magma's operating properties. None-the-less, Magma is still very much interested in the in situ leaching of chalcopyrite. Apparently sufficiently interested to consider a sulfide in situ leaching program without the direct involvement of a Government Agency.

Cipra Meeting

March 25, 1991

Ms. Young and the undersigned discussed various ways to make the sulfide in situ leach proposal appealing to industry. As a point of beginning, it was decided to construct a sulfide in situ leach program as if it were solely an industry program. With this as a beginning point, a review would then be made to see how the USBM and university research organizations would fit into the program. Fitting the USBM and university research organizations into the program would have to be done in a way that would benefit the program and be acceptable to management.

There is no certainty where this will take the sulfide in situ leach program. Wherever the program goes, the program should be such as to maintain a good working relationship with the USBM.

A handwritten signature in cursive script, appearing to read "H. G. Kreis / mek".

H. G. Kreis

cc: W.L. Kurtz
J.D. Sell ✓
A.R. Raihl
D.H. Davidson (SAIC)



United States Department of the Interior

BUREAU OF MINES
SALT LAKE CITY RESEARCH CENTER
729 ARAPEEN DRIVE
SALT LAKE CITY, UTAH 84108-1283



March 22, 1991

ASARCO LETTER

Mr. Henry G. Kreis
Geologist
Southwestern Exploration Division
ASARCO, Incorporated
P. O. Box 5747
Tucson, AZ 85703

MAR 25 1991

SW Exploration

Dear Mr. Kreis:

Lorin D. Redden and myself would like to thank you for allowing us to present our research relating to the Santa Cruz Field Experiment.

We have enjoyed working with ASARCO on this matter, and look forward to continuing this research.

If you feel that we may be of any help to you in the future, please feel free to contact me at (801) 524-6160.

Sincerely,

Alan Isaacson
Alan E. Isaacson

*Copy to: F.T.G.
A.R.R.
WLK
JDS*

APKER, APKER, HAGGARD & KURTZ, P.C.
P. O. Box 10280
Phoenix, Arizona 85064-0280
(602) 381-0085

ASARCO Santa Cruz
c/o Mr. George H. Myers
P. O. Box 5747
Tucson, AZ 85703-0747

January 1, 1991
Page 1
Client: 111-6
Matter: 1

SC

Matter: In Situ Leach Project

Date	Professional Services Rendered		
12/06/90	Prepare correspondence to Mr. Garcia; telephone conference with Mr. Gay; telephone conference with Mr. Gay; review Clayton lease; telephone conference with Mr. Gay's office.		
12/07/90	Telephone conference with Mr. Gay; draft form of 1991 loan for D&M Farms (Clayton); prepare correspondence to Pinal County Recorder.		
12/10/90	Telephone conference with Mr. Gay's office; review correspondence from Pinal County Recorder; prepare correspondence to Mr. Gay; prepare correspondence to Pinal County Recorder.		
12/12/90	Telephone conference with Mr. Gay.		
12/18/90	Review correspondence and map of pipeline; review copy of Desert Carmel LOA newsletter.		
		Total Services	441.00
		Disbursements	
	Long distance telephone	5.75	

	Total Disbursements		5.75
		Current Charges	446.75

87-12

ASARCO Inc., p. 111-6

MAY 1 1991

SW Exploration

APKER, APKER, HAGGARD & KURTZ, P.C.
P. O. Box 10280
Phoenix, Arizona 85064-0280
(602) 381-0085

ASARCO Santa Cruz
c/o Mr. George H. Myers
P. O. Box 5747
Tucson, AZ 85703-0747

February 1, 1991
Page 1
Client: 111-6
Matter: 1

Matter: In-Situ ^{SC} Leach Project

EAC087-12

Date	Professional Services Rendered
01/04/91	Telephone conference with Mr. Gay re new use reports, tax assessments, etc.
01/07/91	Telephone conference with Messrs. Myers and Gay; prepare correspondence to Mr. Myers re tax delinquency; prepare correspondence to Mr. Garcia; prepare correspondence to Mr. Gay.
01/09/91	Telephone conference with Mr. Gay.
01/12/91	Telephone conference with Fennemore, Craig re general adjudication.
01/14/91	Travel to Tucson; conference with Mr. Gay re new uses filings; conference with Mr. Myers re tax valuation protests; conference with Pinal County Assessor; travel to Florence and Phoenix.
01/15/91	Review correspondence re statements of claimant.
01/17/91	Office conference re tax assessment protests; telephone conference with Phil Darrow re general adjudication filings; conference at assessor's office.
01/18/91	Telephone conference with Mr. Brown; telephone conference with Mr. Gay's office; telephone conference with RTC.
01/19/91	Prepare assignment of statements of claimant; prepare correspondence to Mr. Gay; review Pinal County Assessor's 1991 notices of tax valuations.
01/21/91	Telephone conference with Mr. Gay; telephone conference with Arizona Title; telephone conference with Mr. Myers; telephone conference with Transamerica Title; telephone conference with Transamerica Title.
01/22/91	Telephone conference with Mr. Gay; prepare trust instruction; telephone conference with Transamerica Title in Casa Grande; telephone conference with Mr. Kurtz; prepare correspondence to ADWR re new uses filings; telephone conference with Transamerica Title; conference at Transamerica Title in Casa Grande; conference with Mr. Gay and Mr. Kurtz; travel to Phoenix.

ASARCO Inc.

MAY 1 1991

SW Exploration

APKER, APKER, HAGGARD & KURTZ, P.C.
P. O. Box 10280
Phoenix, Arizona 85064-0280
(602) 381-0085

ASARCO Santa Cruz
c/o Mr. George H. Myers
P. O. Box 5747
Tucson, AZ 85703-0747

February 1, 1991
Page 2
Client: 111-6
Matter: 1

Matter: ^{SC} ~~In Situ Leach~~ Project
(Cont.)

Date	Professional Services Rendered	
01/23/91	Telephone conference with Fidelity Title in Casa Grande; telephone conference with RTC re Simmons Devcor loan; conference at Lawyers Title re assignment of statements of claimant.	
01/24/91	Prepare Pinal County tax protests; telephone conference with Mr. Myers' office; review Cimarron deed re Section 11, etc.; telephone conference with Mr. Gay; telecopy to Mr. Gay; telephone conference with Laura Kozell's office at RTC; telephone conference with Lawyers Title; telephone conference with Ron Serasbayer at RTC; telephone conference with Mr. Brown; telephone conference with Mr. Gay.	
01/25/91	Telephone conference with Mr. Myers; telephone conferences with Pinal County title companies re ownership; telephone conference with Mr. Myers; review water rights records; prepare correspondence to ADWR; telephone conference with Mr. Gay; prepare correspondence to Mr. Gay.	
01/26/91	Draft 1991 tax assessment protests.	
01/28/91	Draft protests; telephone conference with Mr. Myers; telephone conference with Mr. Myers; telephone conference with Mr. Gay; revise paragraph 7 of protest statements.	
01/29/91	Travel to Tucson; conference with Mr. Myers re tax protests; telephone conference with John Amato and Brainerd Montgomery re Casa Grande Copper Co. property.	
01/30/91	Review notice of change of well ownership on well 55-609655; telephone conference with Pinal County Assessor's office; assemble tax appeal petitions; prepare correspondence to Pinal County Assessor; prepare correspondence to Mr. Myers.	
	Total Services	4,914.00

ASARCO IN

MAY 1 1991

SW EXPLORE

APKER, APKER, HAGGARD & KURTZ, P.C.
P. O. Box 10280
Phoenix, Arizona 85064-0280
(602) 381-0085

ASARCO Santa Cruz
c/o Mr. George H. Myers
P. O. Box 5747
Tucson, AZ 85703-0747

February 1, 1991
Page 3
Client: 111-6
Matter: 1

SC
Matter: ~~In-Situ Leach~~ Project
(Cont.)

Disbursements

01/18/91	Travel expenses	28.57	
	Travel to Tucson on 1/14/91.		
01/22/91	Miscellaneous costs advanced	120.00	
	Fee to file new uses statements of claimant.		
01/31/91	Travel expenses	12.94	
	Travel to Tucson on 1/22/91.		
01/31/91	Travel expenses	25.87	
	Travel to Tucson on 1/29/91.		
	Long distance telephone	8.68	
	Excess photocopying charges	180.00	

	Total Disbursements		376.06
	Current Charges		5,290.06

87-12

ASARCO INC.
MAY 1 1991
SW EXPENDITURE

ASARCO

Exploration Department
Southwestern United States Division

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

May 28, 1991

Ms. Phyllis Donato
Contract Administrator
ASARCO Incorporated
180 Maiden Lane
New York, NY 10038

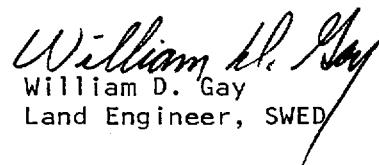
Santa Cruz Project
Document Book Entry

Dear Ms. Donato:

Enclosed is a copy of the Federal Aviation Administration Lease No. DTFA08-91-L-13253, covering the Restricted Area for the VORTAC Facility at Casa Grande, Arizona. This has been entered in the Santa Cruz Document Book under Document No. 30-7.

Sincerely yours,

WDG:mek
enc.


William D. Gay
Land Engineer, SWED

cc: R.L. Brown (w/o enc.)
W.L. Kurtz (w/o enc.)
J.D. Sell (w/o enc.)

ASARCO

Exploration Department
Southwestern United States Division

May 29, 1991

Department of Water Resources
15 South 15th Avenue
Phoenix, Arizona 85007

Santa Cruz JV
Notices of Intention to
Drill Exploration Wells

Gentlemen:

Enclosed are three (3) "Notice of Intention to Drill Exploration Well" forms for three wells. Asarco's check of \$30.00 for the filing fees is also enclosed.

Sincerely yours,



Henry G. Kreis
Field Manager

HGK:mek
Encs. (3 in duplicate)
(check)

cc: J.D. Sell
W.L. Kurtz
W.D. Gay

EXPLORATION WELL(S)
FILING FEE \$10.00

DEPARTMENT OF WATER RESOURCES (DWR)
NOTICE OF INTENTION TO DRILL
EXPLORATION WELL(S)

EXPLORATION WELL(S)

Section 45-596, Arizona Revised Statutes and Rule R12-15-817 provide: Prior to drilling one or more exploration wells, the well owner, lessee or exploration firm shall file a Notice of Intention to Drill on a form provided by the Department.

WELL/LAND LOCATION

1. Township 6S N/S
Range 4E E/W
Section 12

7. Number of wells 1
(See Condition 3 on reverse)

11. Drilling firm:

Cissell Drilling

Name

P.O. Box 1048

Address

Casa Grande, AZ 85222

City State Zip

317

DWR License Number

In the case of a single well,
list 10-acre subdivision

SW 1/4, SW 1/4, NE 1/4

2. County Pinal

3. Applicant:
ASARCO Incorporated
Name

P.O. Box 5747

Address

Tucson AZ 85703

City State Zip

4. Henry G. Kreis
NAME OF CONTACT PERSON
Phone 792-3010

5. Owner of well:
Santa Cruz JV

Name

P.O. Box 5747

Address

Tucson AZ 85703

City State Zip

6. Purpose of well(s) drilled
pursuant to this Notice:

Mineral Exploration X
Geotechnical _____
Cathodic Protection _____
Grounding _____

8. Owner of land:

Santa Cruz JV

Name

P.O. Box 5747

Address

Tucson AZ 85703

City State Zip

9. DESCRIPTION OF WELL:

Diameter 5 inches

Depth Approx. 190 feet

Type of casing None
(If none, so state)

10. Construction will start:

After June 1 1991
Month Day Year

and be completed before 8-31-1991

DO NOT WRITE IN THIS SPACE
OFFICE RECORD

File No. _____

Filed _____ By _____

Input _____ By _____

Duplicate _____

Mailed _____ By _____

Registration _____

AMA/INA _____

W/S _____ S/B _____

12. Period well will remain
in use None months.

13. Proposed method of
abandonment of well(s)
after project is
completed:

Back fill with rotary
cuttings immediately
after drilling, and
cement top 20' of hole.

14. Is the proposed wellsite within 100 feet of a septic tank system, sewage disposal area, landfill, hazardous waste facility or storage area of hazardous materials? Yes ___ No X
If yes, a request for a variance must accompany this application pursuant to R12-15-820.

GENERAL INSTRUCTIONS

1. Fill out this form in duplicate and mail to Department of Water Resources, 15 South 15th Ave. Phoenix, Arizona 85007
2. Proper filing fee of \$10.00 must accompany Notice.

I state that this Notice is filed in compliance with Rule R12-15-809 and is complete and correct to the best of my knowledge and belief and that I understand the conditions set forth on the reverse side of this form.

DATE May 28, 1991

DWR 55-40-10/88 (Revised)

Henry G. Kreis
Signature of Applicant

EXPLORATION WELL(S)
FILING FEE \$10.00

DEPARTMENT OF WATER RESOURCES (DWR)
NOTICE OF INTENTION TO DRILL
EXPLORATION WELL(S)

EXPLORATION WELL(S)

Section 45-596, Arizona Revised Statutes and Rule R12-15-817 provide: Prior to drilling one or more exploration wells, the well owner, lessee or exploration firm shall file a Notice of Intention to Drill on a form provided by the Department.

WELL/LAND LOCATION

1. Township 6S ~~X/S~~
Range 4E ~~E/W~~
Section 23

In the case of a single well,
list 10-acre subdivision

NE 1/4, NE 1/4, NW 1/4

2. County Pinal

3. Applicant:
ASARCO Incorporated
Name

P.O. Box 5747
Address
Tucson AZ 85703
City State Zip

4. Henry G. Kreis
NAME OF CONTACT PERSON
Phone 792-3010

5. Owner of well:
Santa Cruz JV
Name
P.O. Box 5747
Address
Tucson AZ 85703
City State Zip

6. Purpose of well(s) drilled
pursuant to this Notice:

Mineral Exploration X
Geotechnical _____
Cathodic Protection _____
Grounding _____

7. Number of wells 1
(See Condition 3 on reverse)

8. Owner of land:

Santa Cruz JV
Name
P.O. Box 5747
Address
Tucson AZ 85703
City State Zip

9. DESCRIPTION OF WELL:

Diameter 5 inches
Deepen an old hole 130'
Depth approx. 900 feet total

Type of casing 20' steel
(If none, so state)

10. Construction will start:
After June 1 1991
Month Day Year
and be completed before 8-31-1991

DO NOT WRITE IN THIS SPACE OFFICE RECORD	
File No. _____	
Filed _____	By _____
Input _____	By _____
Duplicate _____	
Mailed _____	By _____
Registration _____	
AMA/INA _____	
W/S _____	S/B _____

11. Drilling firm:

Cissell Drilling
Name
P.O. Box 1048
Address
Casa Grande, AZ 85222
City State Zip
317
DWR License Number

12. Period well will remain
in use None months.

13. Proposed method of
abandonment of well(s)
after project is
completed:

Weld cap on steel
casing leaving hole
open for reentry next
year.

14. Is the proposed wellsite within 100 feet of a septic tank system, sewage disposal area, landfill, hazardous waste facility or storage area of hazardous materials? Yes ___ No X
If yes, a request for a variance must accompany this application pursuant to R12-15-820.

GENERAL INSTRUCTIONS

- Fill out this form in duplicate and mail to Department of Water Resources, 15 South 15th Ave. Phoenix, Arizona 85007
- Proper filing fee of \$10.00 must accompany Notice.

I state that this Notice is filed in compliance with Rule R12-15-809 and is complete and correct to the best of my knowledge and belief and that I understand the conditions set forth on the reverse side of this form.

DATE May 28, 1991

DWR 55-40-10/88 (Revised)

H. G. Kreis
Signature of Applicant

Section 45-596, Arizona Revised Statutes and Rule R12-15-817 provide: Prior to drilling one or more exploration wells, the well owner, lessee or exploration firm shall file a Notice of Intention to Drill on a form provided by the Department.

WELL/LAND LOCATION

1. Township 6S N/S
Range 4E E/W
Section 24

In the case of a single well,
list 10-acre subdivision

NW 1/4, NW 1/4, NW 1/4

2. County Pinal

3. Applicant:

ASARCO Incorporated

Name

P.O. Box 5747

Address

Tucson AZ 85703

City State Zip

4. Henry G. Kreis

NAME OF CONTACT PERSON

Phone 792-3010

5. Owner of well:

Santa Cruz JV

Name

P.O. Box 5747

Address

Tucson AZ 85703

City State Zip

6. Purpose of well(s) drilled
pursuant to this Notice:

Mineral Exploration X

Geotechnical

Cathodic Protection

Grounding

7. Number of wells 1
(See Condition 3 on reverse)

8. Owner of land:

Santa Cruz JV

Name

P.O. Box 5747

Address

Tucson AZ 85703

City State Zip

9. DESCRIPTION OF WELL:

Diameter 5 inches

Depth Approx. 190 feet

Type of casing None
(If none, so state)

10. Construction will start:
After June 1 1991
Month Day Year
and be completed before 8-31-1991

DO NOT WRITE IN THIS SPACE
OFFICE RECORD

File No.

Filed By

Input By

Duplicate

Mailed By

Registration

AMA/INA

W/S S/B

11. Drilling firm:

Cissell Drilling

Name

P.O. Box 1048

Address

Casa Grande, AZ 85222

City State Zip

317

DWR License Number

12. Period well will remain
in use None months.

13. Proposed method of
abandonment of well(s)
after project is
completed:

Back fill with rotary

cuttings immediately

after drilling, and

cement top 20' of hole.

14. Is the proposed wellsite within 100 feet of a septic tank system, sewage disposal area, landfill, hazardous waste facility or storage area of hazardous materials? Yes No X

If yes, a request for a variance must accompany this application pursuant to R12-15-820.

GENERAL INSTRUCTIONS

1. Fill out this form in duplicate and mail to Department of Water Resources, 15 South 15th Ave. Phoenix, Arizona 85007
2. Proper filing fee of \$10.00 must accompany Notice.

I state that this Notice is filed in compliance with Rule R12-15-809 and is complete and correct to the best of my knowledge and belief and that I understand the conditions set forth on the reverse side of this form.

DATE May 28, 1991

DWR 55-40-10/88 (Revised)

H. G. Kreis
Signature of Applicant



Southwestern Exploration Division

May 10, 1991

F.T. Graybeal
New York Office

Environmental Report
Texaco Land
Santa Cruz Project

Western Technologies Inc. (WTI) reported the results of its environmental evaluation of Texaco's Land in 1988 (Job No. 2178J235, Environmental Property Evaluation, Cimarron Pinal Holdings, Inc.). In this report it was stated bore hole samples from the landfill and sewerage oxidation pond in Section N (both in NE/4 Section 8, T6S, R5E) showed "no presence of hazardous wastes." However, the laboratory reports used to support this conclusion show detectable 1,4-diethylene dioxide (Dioxane). According to Pat Maley this compound is on the EPA's list of hazardous compounds.

If it is decided to proceed with the acquisition of the Texaco land, the significance of the presence of Dioxane will have to be evaluated.

Freeport McMoRan, having brought the analytical results to my attention, is aware of the situation.

HGK:mek
Att.


H. G. Kreis

cc: W.L. Kurtz
J.D. Sell
A.R. Raihl
W.D. Gay
P.J. Maley

ENVIRONMENTAL PROPERTY EVALUATION
CIMARRON PINAL HOLDINGS, INC.
CASA GRANDE, PINAL COUNTY,
ARIZONA

JOB NO. 2178J235



**WESTERN
TECHNOLOGIES
INC.**
The Quality People

ARIZONA

Phoenix
3737 East Broadway Road
P.O. Box 21387
Phoenix, Arizona 85036
(602) 437-3737

Mesa
952 East Baseline Road, No. 104
Mesa, Arizona 85204
(602) 926-2113

Sun City
17200 North Dysart Road, No. 13
P.O. Box 2431
Sun City, Arizona 85372
(602) 975-2154

Flagstaff
2400 East Huntington Drive
Flagstaff, Arizona 86001
(602) 774-8708

Lakeside
Route 1, Box 1030
Lakeside, Arizona 85929
(602) 368-5568

Tucson
3480 South Dodge Boulevard
Tucson, Arizona 85713
(602) 748-2262

Sierra Vista
1827 South Paseo San Luis
Sierra Vista, Arizona 85635
(602) 458-0364

Laughlin / Bullhead City
1610 Riverview Drive, No. 5
Bullhead City, Arizona 86442
(602) 758-8378

NEW MEXICO

Albuquerque
8305 Washington Place, N.E.
Albuquerque, New Mexico 87113
(505) 823-4488

Farmington
400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966

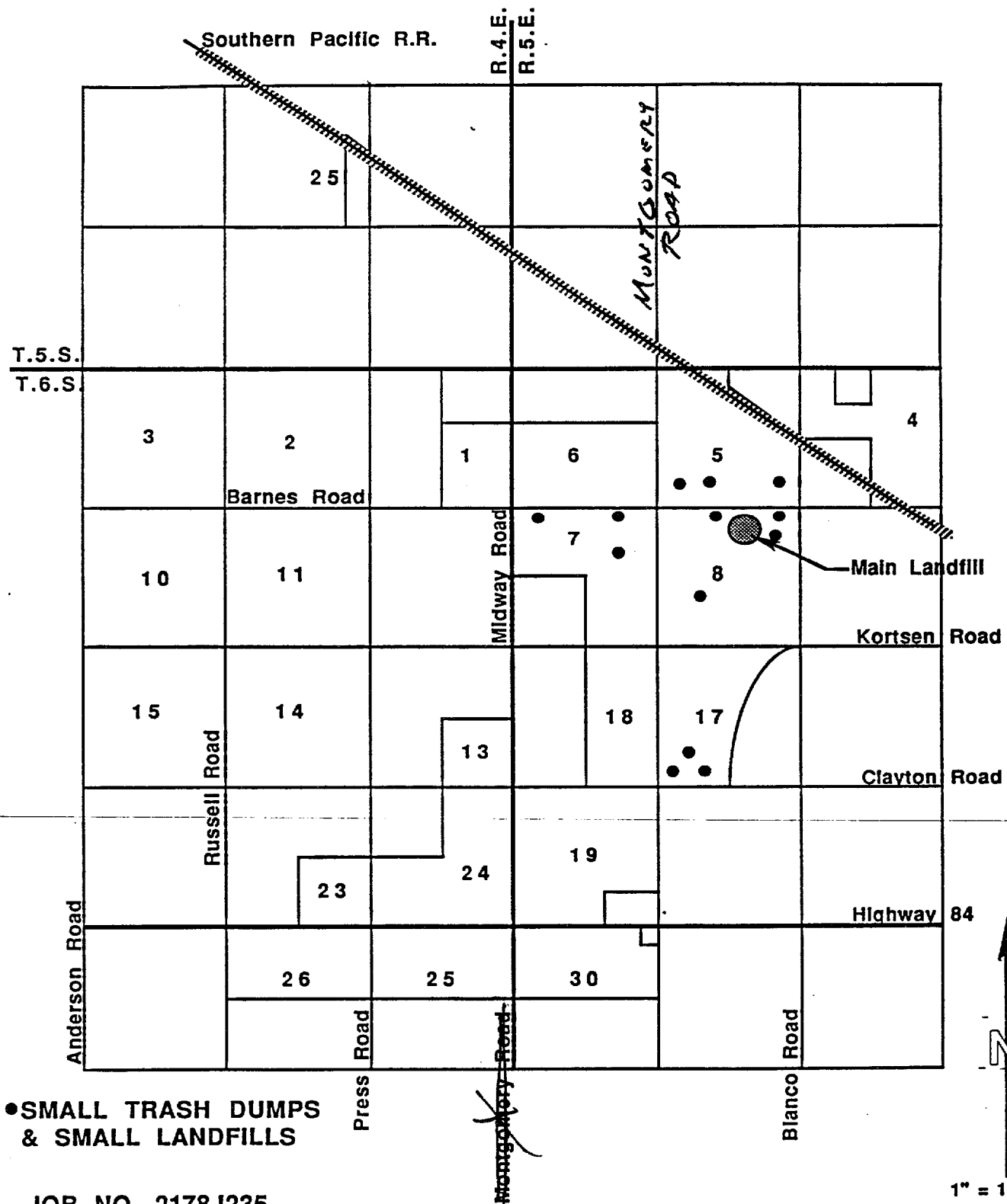
NEVADA

Las Vegas
3611 West Tompkins Avenue
Las Vegas, Nevada 89103
(702) 798-8050

Cimarron Pinal Holdings Inc.

Landfills & Small Trash Dumps

Figure 2B



JOB NO. 2178J235

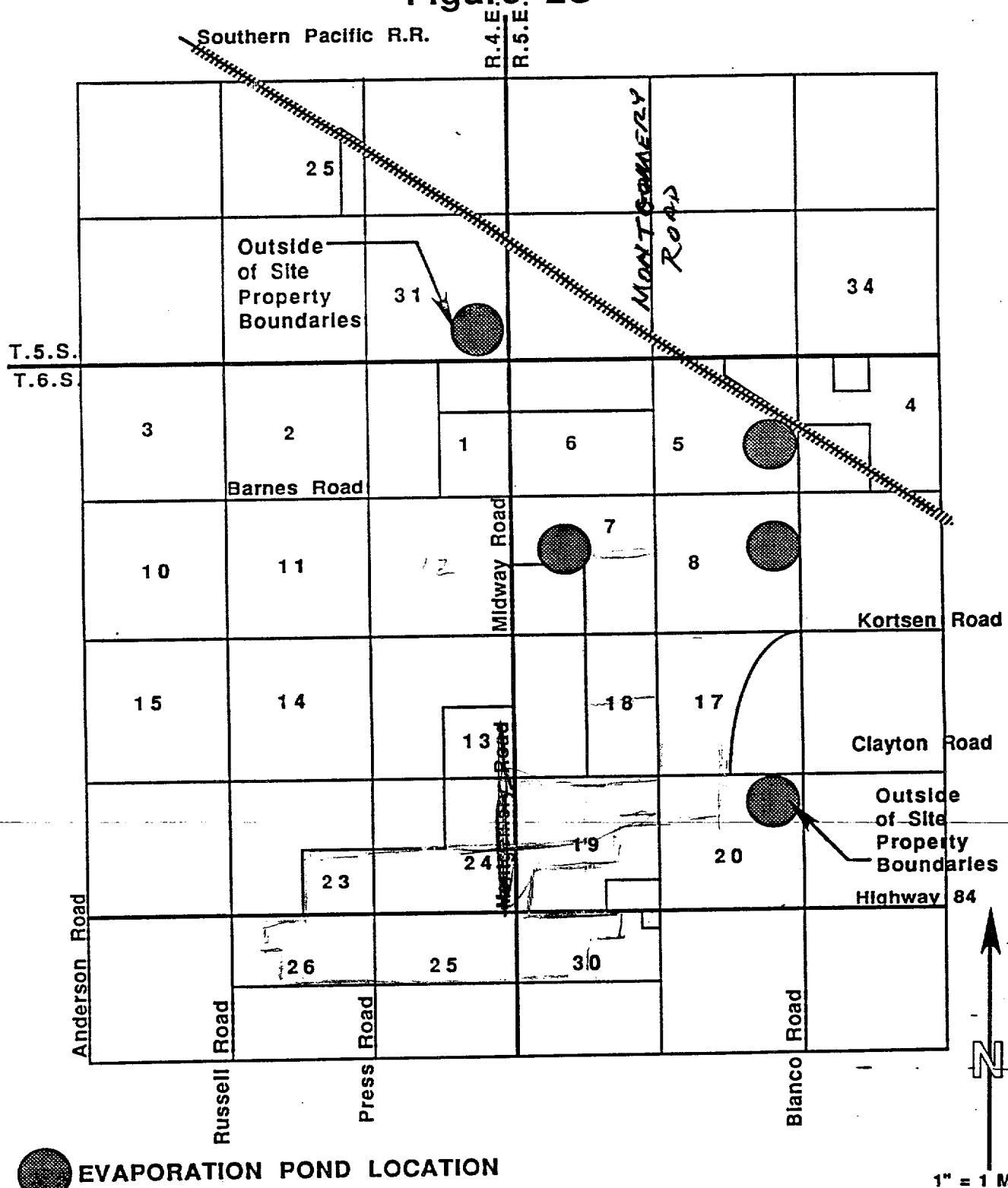
REVIEWED
W. SHONERD, P.E.
PREPARED
MAXWELL

WESTERN TECHNOLOGIES INC.
The Quality People

Cimarron Pinal Holdings Inc.

Evaporation Ponds

Figure 2C



JOB NO. 2178J235

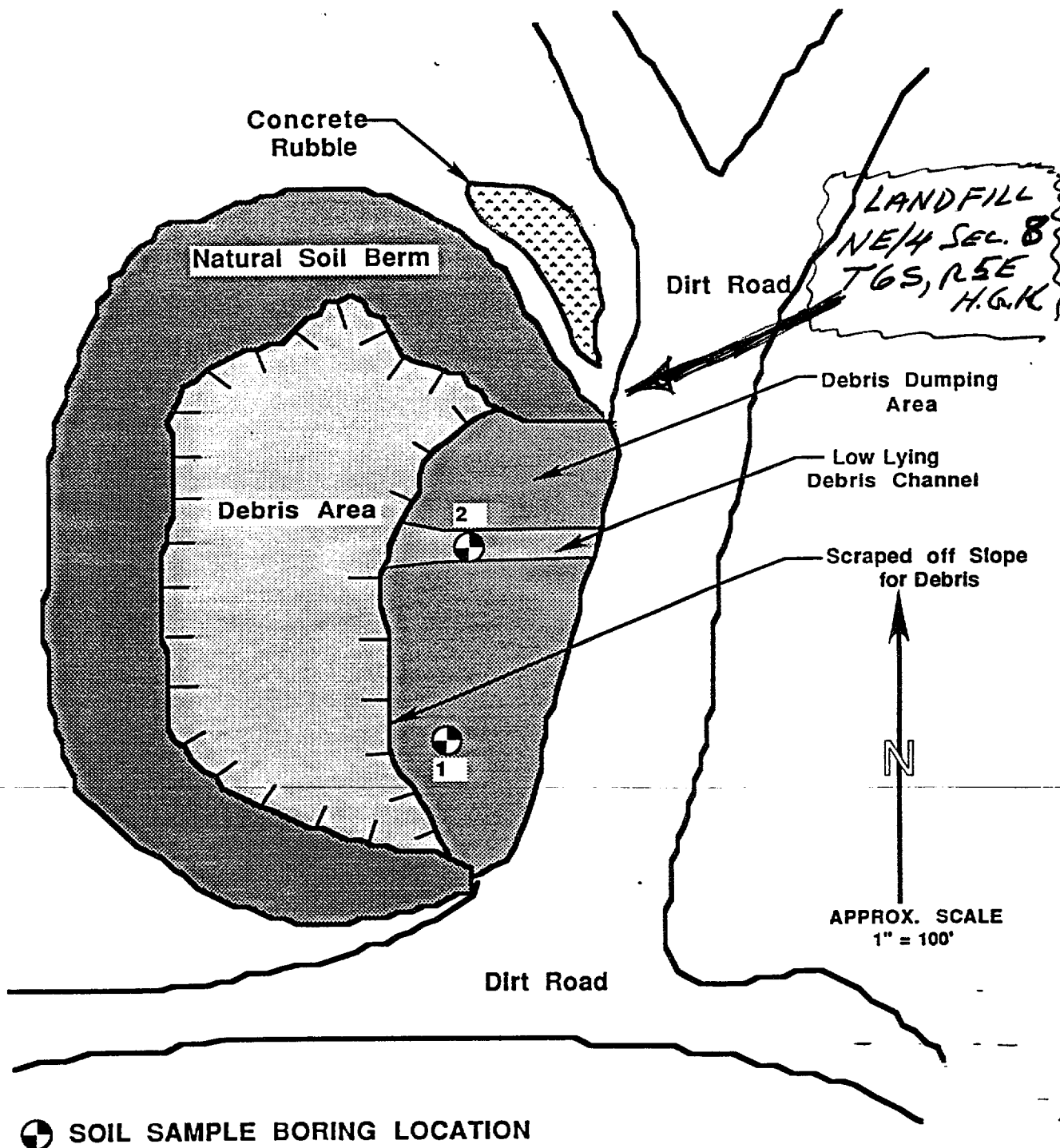
REVIEWED W. SHONERD, P.E.
PREPARED MAXWELL

WESTERN TECHNOLOGIES INC.
The Quality People

Cimarron Pinal Holdings Inc.

Main Landfill

Figure 5



SOIL SAMPLE BORING LOCATION

JOB NO. 2178J235

REVIEWED W. SHONERD, P.E.
PREPARED MAXWELL

WESTERN TECHNOLOGIES INC.
The Quality People

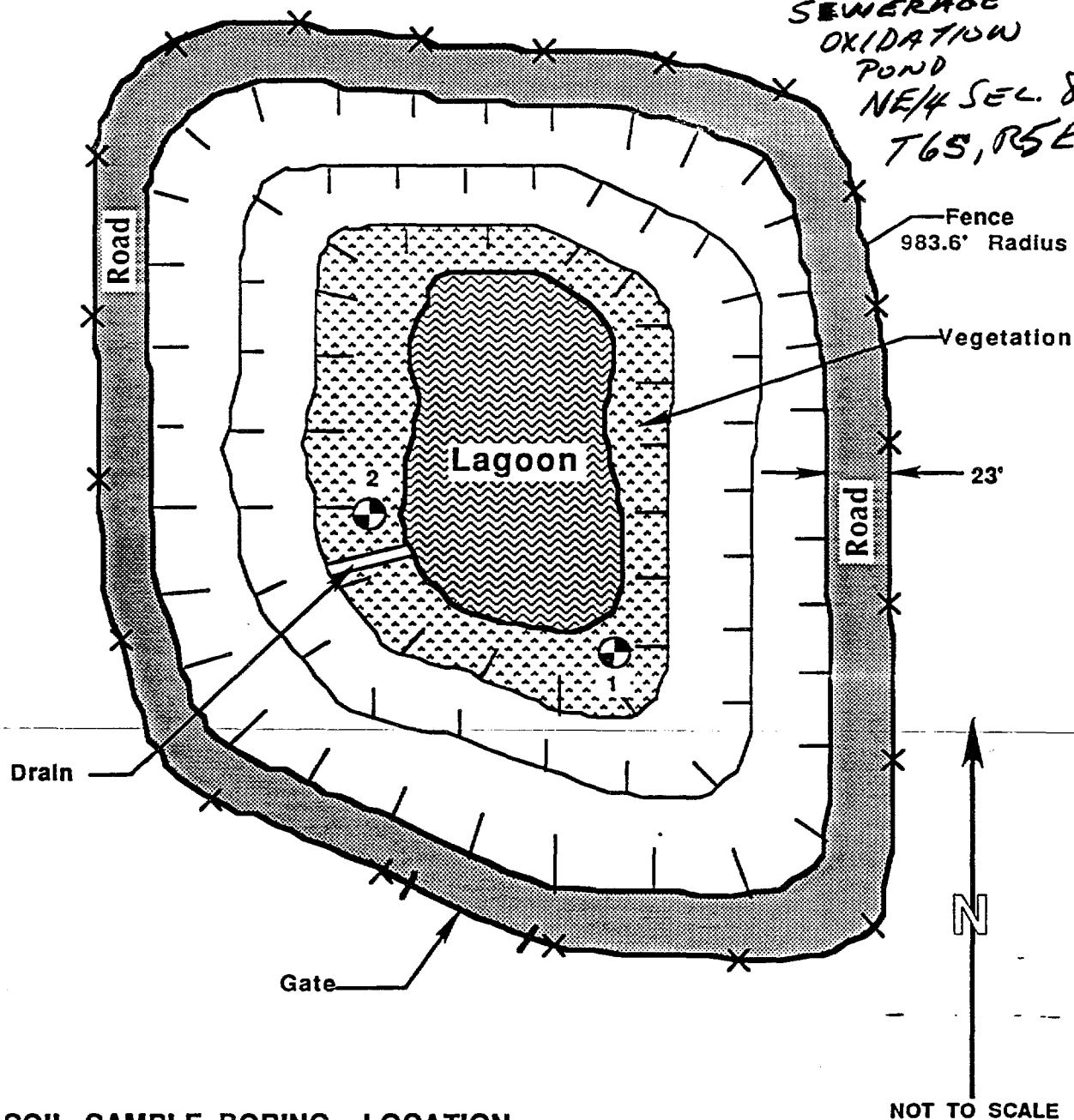
Cimarron Pinal Holdings Inc.

Waste Water Evaporation Pond

Figure 6

THIS IS POND
NEXT TO LANDFILL

SEWERAGE
OXIDATION
POND
NE 1/4 SEC. 8
T6S, R5E



SOIL SAMPLE BORING LOCATION

JOB NO. 2178J235

REVIEWED	W. SHONERD, P.E.
PREPARED	MAXWELL

WESTERN TECHNOLOGIES INC.
The Quality People

CHAIN OF CUSTODY RECORD

JOB NO.		PROJECT NAME				NUMBER OF CONTAINERS	SAMPLING METHOD					REMARKS (PHYSICAL APPEARANCE, etc.)	LAB I.D.
SAMPLERS: (SIGNATURE)							VACUUM	SOIL SCOOP	SOIL AUGER	SPLIT SPOON			
SAMPLE IDENT.	DATE	TIME	COMP	GRAB	SAMPLE LOCATION								
TD-1-0	8-3-88	6:45			Sanitary Landfill / Trash Dump	1				✓		Powder Sand & Gravel	8812289
TD-1-5	8-3-88	7:15			" " "	1				✓		Soft Brown Soil	8812289
TD-1-10	8-3-88	7:40			" " "	1				✓		Sandy Silt & Gravel	8812295
TD-1-15	8-3-88	8:05			" " "	1				✓		Sand & Crystal gravel	
TD-1-20	8-3-88	8:30			" " "	1				✓		Sand & fine Gravel	
TD-1-25	8-3-88	8:55			" " "	1				✓		Sand	
TD-1-30	8-3-88	9:35			" " "	1				✓		Clay & Soil Brown/white	
TD-2-0	8-3-88	10:20			Sanitary Landfill / Trash Dump	1				✓		Sand	8812290
TD-2-5	8-3-88	10:40			" " "	1				✓		Sand	8812290
TD-2-10	8-3-88	11:00			" " "	1				✓		Sand & fine gravel	8812296
TD-2-15	8-3-88	11:20			" " "	1				✓		Sand and gravel	
TD-2-20	8-3-88	11:50			" " "	1				✓		Sand, Soil, med Gravel	
TD-2-25	8-3-88	12:15			" " "	1				✓		Sand & fine gravel	
TD-2-27	8-3-88	12:45			" " "	1				✓		Coarse Sand	
RECEIVED BY (SIGNATURE)		DATE / TIME		RECEIVED BY (SIGNATURE)		RECEIVED BY (SIGNATURE)		DATE / TIME		RECEIVED BY (SIGNATURE)			
<i>Sam Houston</i>		8/4/88 2:38											
RECEIVED BY (SIGNATURE)		DATE / TIME		RECEIVED BY (SIGNATURE)		RECEIVED BY (SIGNATURE)		DATE / TIME		RECEIVED BY (SIGNATURE)			
RECEIVED BY (SIGNATURE)		DATE / TIME		RECEIVED BY (SIGNATURE)		RECEIVED BY (SIGNATURE)		DATE / TIME		RECEIVED BY (SIGNATURE)			
				<i>J. Webb</i>				8/4/88 2:38					
REMARKS													
<div style="border: 1px solid black; padding: 10px; display: inline-block;"> <p>LANDFILL NE 1/4 SECTION 8 T6S, R5E H&K.</p> </div>													



**WESTERN
TECHNOLOGIES**

3737 East Broadway Road
P.O. Box 21387
Phoenix, Arizona 85066

CHAIN OF CUSTODY RECORD

pond in NE/4 Sec. 8

JOB NO. 21785235		PROJECT NAME Cimarron FINAL				NUMBER OF CONTAINERS	SAMPLING METHOD					REMARKS (PHYSICAL APPEARANCE, etc.)	LAB I.D.
SAMPLERS: (SIGNATURE) <i>Sam Houston</i>							V/C SAM	SOIL SCOOP	SOIL AUGER	SPLIT SPOON			
SAMPLE IDENT.	DATE	TIME	COMP	GRAB	SAMPLE LOCATION								
WWP-1-0	8-2-88	11:15			NE end marsh area						fine gravel & soil	8812271	
WWP-1-5	8-2-88	11:35			" " " "						Sand & fine gravel	8812271	
WWP-1-10	8-2-88	12:15			" " " "						Sand & gravel	8812293	
WWP-1-75	8-2-88	12:50			" " " "						Sand & fine gravel		
WWP-1-30	8-2-88	1:40			" " " "						Soil & Clay		
WWP-2-0	8-2-88	2:15			South Central end ^{By Inlet Pipe}						Soil & fine gravel	8812288	
WWP-2-5	8-2-88	2:45			" " " "						Soil & fine gravel	8812288	
WWP-2-10	8-2-88	3:20			" " " "						Sand & fine gravel	8812294	
WWP-2-15	8-2-88	3:40			" " " "						Soil & fine gravel & sand		
WWP-2-20	8-2-88	4:05			" " " "						Hard Brown Clay		
WWP-2-25	8-2-88	4:30			" " " "						Hard Brown Clay		
WWP-Sludge	8-2-88	2:26			Directly at Inlet Pipe						Black Sludge	8812288	
WWP-Liquid	8-2-88	3:40			" " " "						Green Liquid	8812288	
RECEIVED BY (SIGNATURE)		DATE / TIME		RECEIVED BY (SIGNATURE)		RECEIVED BY (SIGNATURE)		DATE / TIME		RECEIVED BY (SIGNATURE)			
<i>Sam Houston</i>		8-2-88 11:00 AM											
		8-2-88 11:30 AM											
RECEIVED BY (SIGNATURE)		DATE / TIME		RECEIVED BY (SIGNATURE)		RECEIVED BY (SIGNATURE)		DATE / TIME		RECEIVED BY (SIGNATURE)			
RECEIVED BY (SIGNATURE)		DATE / TIME		RECEIVED BY (SIGNATURE)		RECEIVED BY (SIGNATURE)		DATE / TIME		RECEIVED BY (SIGNATURE)			
				<i>J. Hall</i>				8/4/88 2:38					
REMARKS													
SEWERAGE EVAPORATION POND													
NE/4 SECTION 8 T6S, R5E													
H.G.K.													



**WESTERN
TECHNOLOGIES**
INC.

3737 East Broadway Road
P.O. Box 21387
Phoenix, Arizona 85016

Cimarron Pinal Holdings, Inc.
Job No. 2178J235

ANALYTICAL RESULTS
Summary and Sample Codes

The analytical results from all areas of sampling (i.e., the incinerator ash pit, the waste water evaporation pond and the solid waste landfill) show no evidence of any hazardous waste contamination with respect to the limited but specific areas tested. The laboratory report sample codes for each site may be interpreted as follows:

The prefix TD indicates trash dump or landfill. AP indicates ash pit. WWP indicates waste water pond. AP-1-0 and AP-1-5 means, for example, Ash pit sample from Boring No. 1 and 0 feet and ash pit sample from Boring 1 at 5 feet, respectively.

Analytical laboratory data is attached.



**WESTERN
TECHNOLOGIES
INC.**

3737 East Broadway Road
P.O. Box 21387
Phoenix, Arizona 85036
(602) 437-3737

LABORATORY REPORT

CLIENT Cimarron Pinal
Casa Grande, AZ 00000

SAMPLE NO. : 8812271
INVOICE NO.: 2178W235
DATE : 08-25-88
REVIEWED BY: ~~FOR~~
PAGE : 1 OF 2

CLIENT SAMPLE ID : WWP-1-0 & WWP-1-5
SAMPLE TYPE: Soil
SAMPLE SOURCE: --
SAMPLED BY: WTI/S. Houston
SUBMITTED BY: WTI/S. Houston

AUTHORIZED BY: CP/Personnel
CLIENT P.O. : --
SAMPLE DATE .: 08-02-88
SUBMITTED ON : 08-05-88

REMARKS -

GC/MS SOLVENT SCREEN

* DATA TABLE *

[----- PARAMETER -----]	[- RESULT -]	[- UNIT -]
Benzene	<10.	mg/kg
1-Butanol (N-Butyl Alcohol)	<10.	mg/kg
2-Butanone (Methyl Ethyl Ketone)	<10.	mg/kg
2-Butoxyethanol (Butyl Cellosolve) ...	<10.	mg/kg
2-(2-Butoxyethanol) Ethanol	<10.	mg/kg
(Butyl Carbitol)		
Butyl Ester Acetic Acid	<10.	mg/kg
(Butyl Acetate)		
Carbon Tetrachloride	<10.	mg/kg
1,1-Dichloroethane(1,1-DCA)	<10.	mg/kg
1,2-Dichloroethane(1,2-DCA)	<10.	mg/kg
1,1-Dichloroethene(1,1-DCE)	<10.	mg/kg
1,2-Dichloroethene(1,2-DCE)	<10.	mg/kg
Dichloromethane(Methylene Chloride)...	<10.	mg/kg
Dimethylbenzene(Xylene)	<10.	mg/kg
*1,4-Diethylene Dioxide(Dioxane)	50.	mg/kg *
1,2-Ethanidiol(Ethylene Glycol)	<10.	mg/kg
Ethanol(Ethyl Alcohol)	<10.	mg/kg
2-Ethoxyethanol(Cellosolve)	<10.	mg/kg
2-Ethoxyethyl Acetate	<10.	mg/kg-
(Cellosolve Acetate)		
Ethylbenzene	<10.	mg/kg
Ethyl Ester Acetic Acid	<10.	mg/kg
(Ethyl Acetate)		
2-Methoxyethanol(Methyl Cellosolve)...	<10.	mg/kg
Methylbenzene(Toluene)	<10.	mg/kg

SEWERAGE
OXIDATION
POND
NE/4 SEC 8
T6S, R5E



**WESTERN
TECHNOLOGIES
INC.**

3737 East Broadway Road
P.O. Box 21387
Phoenix, Arizona 85036
(602) 437-3737

LABORATORY REPORT

CLIENT Cimarron Pinal
Casa Grande, AZ 00000

SAMPLE NO. : 8812296
INVOICE NO.: 2178W235
DATE : 08-25-88
REVIEWED BY: **FJR**
PAGE : 1 OF 2

CLIENT SAMPLE ID : TD-2-10
SAMPLE TYPE: Soil
SAMPLE SOURCE: --
SAMPLED BY: WTI/S. Houston
SUBMITTED BY: WTI/S. Houston

AUTHORIZED BY: CP/Personnel
CLIENT P.O. : --

SAMPLE DATE .: 08-03-88
SUBMITTED ON : 08-05-88

REMARKS -

GC/MS SOLVENT SCREEN

* DATA TABLE *

[----- PARAMETER -----] [- RESULT -] [- UNIT -]

Benzene	<10.	mg/kg
1-Butanol (N-Butyl Alcohol)	<10.	mg/kg
2-Butanone (Methyl Ethyl Ketone)	<10.	mg/kg
2-Butoxyethanol (Butyl Cellosolve) ...	<10.	mg/kg
2-(2-Butoxyethanol) Ethanol	<10.	mg/kg
(Butyl Carbitol)		
Butyl Ester Acetic Acid	<10.	mg/kg
(Butyl Acetate)		
Carbon Tetrachloride	<10.	mg/kg
1,1-Dichloroethane(1,1-DCA)	<10.	mg/kg
1,2-Dichloroethane(1,2-DCA)	<10.	mg/kg
1,1-Dichloroethene(1,1-DCE)	<10.	mg/kg
1,2-Dichloroethene(1,2-DCE)	<10.	mg/kg
Dichloromethane(Methylene Chloride)...	<10.	mg/kg
Dimethylbenzene(Xylene)	<10.	mg/kg
* 1,4-Diethylene Dioxide(Dioxane)	50.	mg/kg *
1,2-Ethanidiol(Ethylene Glycol)	<10.	mg/kg
Ethanol(Ethyl Alcohol)	<10.	mg/kg
2-Ethoxyethanol(Cellosolve)	<10.	mg/kg
2-Ethoxyethyl Acetate	<10.	mg/kg -
(Cellosolve Acetate)		
Ethylbenzene	<10.	mg/kg
Ethyl Ester Acetic Acid	<10.	mg/kg
(Ethyl Acetate)		
2-Methoxyethanol(Methyl Cellosolve)...	<10.	mg/kg
Methylbenzene(Toluene)	<10.	mg/kg

LANDFILL
NE/4 SEC. 8
T65, R5E



**WESTERN
TECHNOLOGIES
INC.**

3737 East Broadway Road
P.O. Box 21387
Phoenix, Arizona 85036
(602) 437-3737

LABORATORY REPORT

CLIENT Cimarron Pinal
Casa Grande, AZ 00000

SAMPLE NO. : 8812288
INVOICE NO.: 2178W235
DATE : 08-25-88
REVIEWED BY: **FSK**
PAGE : 1 OF 2

CLIENT SAMPLE ID : WWP-2-0 & WWP-2-5
SAMPLE TYPE: Soil/Liquid
SAMPLE SOURCE: WWP Sludge, WWP Liquid
SAMPLED BY: WTI/S. Houston
SUBMITTED BY: WTI/S. Houston

AUTHORIZED BY: CP/Personnel
CLIENT P.O. : --
SAMPLE DATE .: 08-02-88
SUBMITTED ON : 08-05-88

REMARKS -

GC/MS SOLVENT SCREEN

* DATA TABLE *

[----- PARAMETER -----] [- RESULT -] [- UNIT -]

Benzene	<10.	mg/kg
1-Butanol (N-Butyl Alcohol)	<10.	mg/kg
2-Butanone (Methyl Ethyl Ketone)	<10.	mg/kg
2-Butoxyethanol (Butyl Cellosolve) ...	<10.	mg/kg
2-(2-Butoxyethanol) Ethanol	<10.	mg/kg
(Butyl Carbitol)		
Butyl Ester Acetic Acid	<10.	mg/kg
(Butyl Acetate)		
Carbon Tetrachloride	<10.	mg/kg
1,1-Dichloroethane(1,1-DCA)	<10.	mg/kg
1,2-Dichloroethane(1,2-DCA)	<10.	mg/kg
1,1-Dichloroethene(1,1-DCE)	<10.	mg/kg
1,2-Dichloroethene(1,2-DCE)	<10.	mg/kg
Dichloromethane(Methylene Chloride)...	<10.	mg/kg
Dimethylbenzene(Xylene)	<10.	mg/kg
* 1,4-Diethylene Dioxide(Dioxane)	32.	mg/kg *
1,2-Ethanidiol(Ethylene Glycol)	<10.	mg/kg
Ethanol(Ethyl Alcohol)	<10.	mg/kg
2-Ethoxyethanol(Cellosolve)	<10.	mg/kg
2-Ethoxyethyl Acetate	<10.	mg/kg-
(Cellosolve Acetate)		
Ethylbenzene	<10.	mg/kg
Ethyl Ester Acetic Acid	<10.	mg/kg
(Ethyl Acetate)		
2-Methoxyethanol(Methyl Cellosolve)...	<10.	mg/kg
Methylbenzene(Toluene)	<10.	mg/kg

SEWERAGE
OXIDATION
POND
NE 1/4 SEC 8
T6S, R5E

ASARCO

Exploration Department
Southwestern United States Division


June 24, 1991

Mr. William C. Larson
U.S. Bureau of Mines
Twin Cities Research Center
5629 Minnehaha Avenue South
Minneapolis, Minnesota 55417

Dear Bill:

Enclosed please find a copy of the videotape on the Salt Tracer Test, Santa Cruz In Situ Copper Mining Research Project. This video tape contains raw footage with no time scale.

Sincerely,

A handwritten signature in cursive script that reads "Henry G. Kreis". To the right of the signature, there is a small, handwritten mark that appears to be "mek".

Henry G. Kreis

HGK:mek
Enc.

cc: F.T. Graybeal
W.L. Kurtz
J.D. Sell
A.R. Raihl
S. Swan - USBM

ASARCO

Exploration Department
Southwestern United States Division

June 24, 1991

Mr. William A. Obenchain
Program Manager
Office of Industrial Processes, CE-231
Conservation and Renewable Energy
Department of Energy
Washington, D.C. 20585

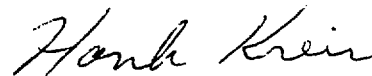
Dear Bill:

I have received your letter requesting energy and material flow data on copper production. I forwarded your letter to Robert J. Kupsch, Vice President of Mining for ASARCO Inc., and I trust you will hear from him in the near future.

As previously promised, I have enclosed some ASARCO Inc. annual reports, and some brochures on our cooperative copper mining research program with the U.S. Bureau of Mines.

If I can be of any further help, please let me know.

Sincerely yours,



H.G. Kreis

HGK:mek
Enc.

bl.cc: R.J. Kupsch
F.T. Graybeal
W.L. Kurtz
J.D. Sell
A.R. Raihl

ASARCO

Southwestern Exploration Division

June 24, 1991

Robert Kupsch
New York Office

Bill Obenchain, Program Manager for the DOE, has made a request for energy and material flow information in the production of copper. The details of his request are described in his letter to me of June 21, 1991, a copy of which is attached.

I would appreciate any help you can give Mr. Obenchain. As you may know, the copper industry (mainly Asarco, Magma, and Cyprus) and the USBM worked with Mr. Obenchain in the recent past on a copper mining research proposal.

HGK:mek
Encs.


H.G. Kreis

cc: F.T. Graybeal
W.L. Kurtz/J.D. Sell
A.R. Raihl



Department of Energy
Washington, DC 20585

June 21, 1991

ASARCO Incorporated

Mr. Henry G. Kreis, Site Manager
ASARCO Incorporated
P.O. Box 5747
Tucson, AZ 85703

JUN 24 1991

SW EXP-100000

Dear Hank:

I have spoken to you previously of the DOE's Metals Initiative research program. It is important for us to have an accurate data describing the energy and material flows for the copper industry. Only in this way can we identify those areas in which to direct our research efforts.

Enclosed you will find two charts. The first is a hand drawn diagram entitled "Copper Industry Flowsheet - 1989". In it we have tried to identify the amount of copper produced and the energy consumed in each unit operation. The numbers in parenthesis are in millions of BTUs per short ton. The other numbers are the millions of short tons passing through each unit operation. The overall tonnages are taken from the Copper Development Association's "Annual Data 1990". The mass flows through the various unit operations are derived from there. The energy figures are from a variety of sources, some rather old. The second chart is a Lotus Spreadsheet with the same information plus the Bureau of Mines estimate of the operating costs for various smelter operations.

DOE would appreciate it if you would take a look at these numbers and give us any nonproprietary information which might help us improve upon them.

Thank you.

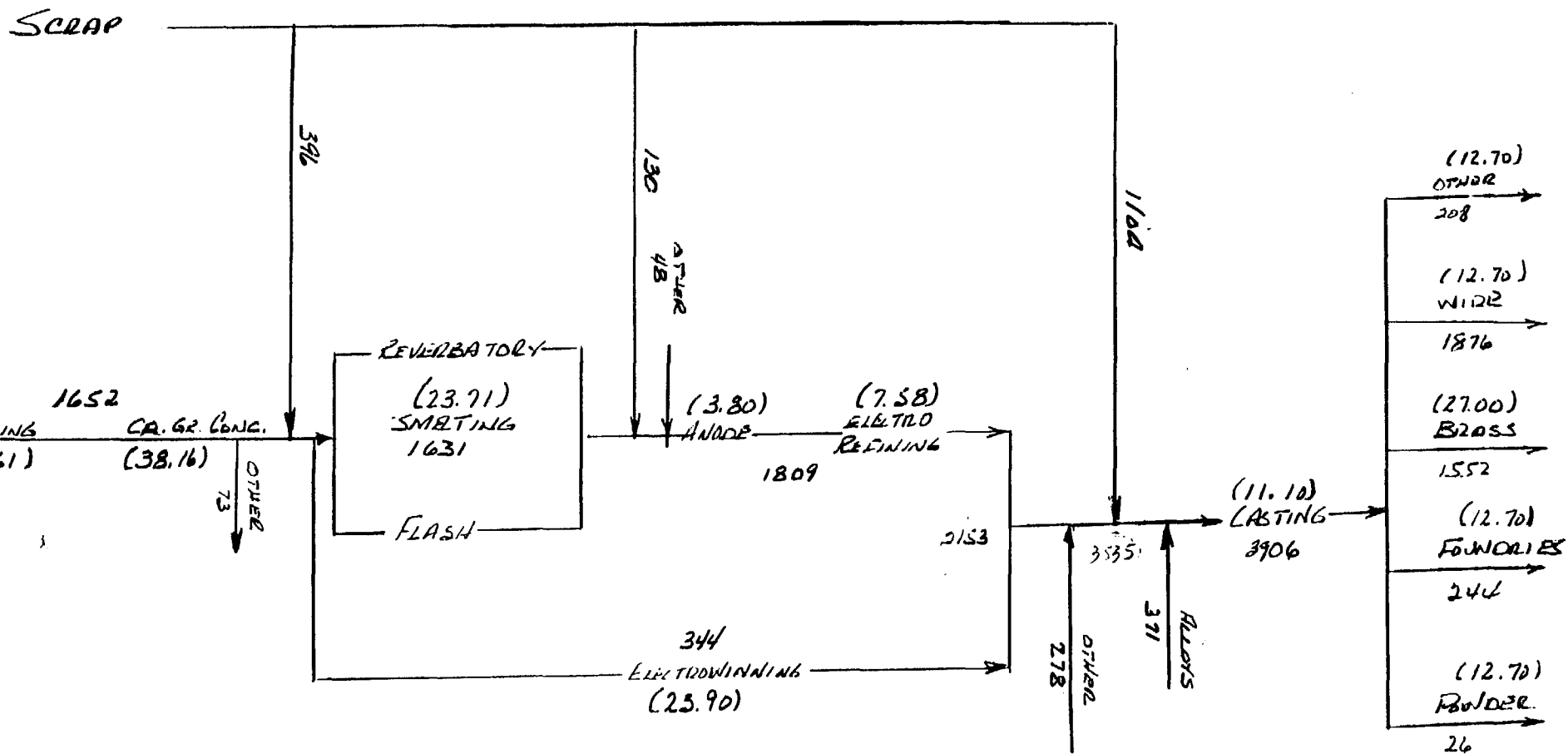
Sincerely,

A handwritten signature in black ink, appearing to read "Bill O", is written over the typed name.

William A. Obenchain, Program Manager
Office of Industrial Processes, CE--231
Conservation and Renewable Energy

Enclsoure

COVER INDUSTRY FLOW SHEET ~ 1989
(5/13/91)



() 10^6 BTU/TON

COPPER FLOWSHEET, 1989

UNIT OPERATION	1000's shrt tons	10E6 BTU/ton	BTU	refer- ence	COSTS \$/lb.
MINING	1652	21.61	35699.72		0.17 MINING
CRUSHING/GRINDING	1652	25.92	42819.84		0.28 C/G/CONC
FLOTATION	1652	12.24	20220.48		
SMELTING	1235	15.30	18895.50		0.18 SMELT&REF
CONVERTING	1235	5.87	7249.45		-0.11 BY PROD
POLLUTION/ACID PLANT	1235	2.54	3136.90		
ANODE	1283	3.80	4875.40	4p24	0.52 NET COST
ELECTROREFINING	1283	7.58	9725.14	BuMines Prop	
ELECTROWINNING	344	23.90	8221.60	4p72	0.02 TAXES
CASTING	1627	11.10	18059.70	4p75	
LOW GRADE SCRAP	396	42.42	16798.32	4p83	0.06 CAP RECOV
NO. 2 SCRAP	130	17.27	2245.10	4p82	
HIGH GRADE SCRAP	1104	3.81	4206.24	4p81	
WIRE MILLS	1876	12.70	23825.20	4p75	
BRASS MILLS	1552	27.00	41904.00	4p75	
FOUNDRIES	244	12.70	3098.80	est	
POWDER MILLS	26	12.70	330.20	est	
OTHER PRODUCTS	208	12.70	2641.60	est	
TOTAL			263953.19		0.60 TOTAL COST

TOTAL (quads/year) 263953.19 XE3XE6/C15 =0.264 QUAD

Selling Price (cents/lb 130.045 cathode

Selling Price (cents/lb 136.028 wirebar

filename: CUflows

5/15/91

ASARCO

Exploration Department
Southwestern United States Division

June 26, 1991

Mr. Philip H. Nelson
United States Geological Survey
Box 25046 MS 964
Denver Federal Center
Denver, Colorado 80225

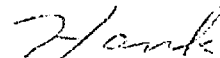
Dear Phil,

Here is a copy of your 102 page draft copy of "Geophysical Logs from a Copper Oxide Deposit, Santa Cruz Project, Casa Grande, Arizona," Open File Report 91-XXX.

You did a commendable job of compiling and interpreting the abundance of data. I made a few comments, but no comments of any major consequence.

If you have any questions you can reach me at the test site, (602) 836-6249.

Sincerely,



Henry G. Kreis

HGK:dma
Enclosure

Blind copy: F.T.G. (w:enc.)
A.R.R. (w/o:enc.)
W.L.K. (w/o:enc.)
J.D.S. (w/o:enc.)

ASARCO Incorporated

JUL 1 1991

SW Exploration

PURCHASE ORDER

DATE 1-13-92

PLANT JOB NO.

ASARCO Santa Cruz, Inc.

ORDER NO.
SC-92-1

APPROPRIATION NO.

TUCSON OFFICE
P. O. BOX 5747

1150 NORTH 7TH AVENUE
TUCSON, ARIZONA 85703

REQUISITION NO.

To: Great Projections Inc.
1955 W. Grant Rd., Suite 150
Tucson, AZ 85745
Contact: Tim Miller
FAX 602-620-6679 Tele: 602-620-6677

FINAL DESTINATION — PLEASE NOTE CONSIGNMENT BELOW
Santa Cruz Test Site
7 miles West of Casa Grande, AZ

DATE REQUIRED AT DESTINATION:

CONSIGNMENT — SELLER WILL SHIP TO

SHIPPING INTERVAL PROMISED

SELLER WILL SHIP BEFORE:

POINT OF SHIPMENT

TERMS:

F.O.B. POINT

— RENDER BILLS AS PER ATTACHED SHIPPING INSTRUCTIONS —
SHIP VIA

QUANTITY	UNIT	SPECIFICATIONS	ITEM NO.	UNIT PRICE
		<p style="text-align: center;"><u>BLANKET ORDER</u></p> <p>When requested to do so, Great Projections Inc. will provide computer graphics and slide services for the benefit of the Santa Cruz In Situ Copper Mining research project.</p> <p>Duration: January 13, 1992 to December 31, 1992</p>		

cc: Accounting (2)
A.R. Raihl
F.T. Graybeal
W.L. Kurtz/J.D. Sell

PLEASE ENTER OUR ORDER FOR THE ITEMS SPECIFIED ABOVE. SUBJECT TO ALL INSTRUCTIONS AND PROVISIONS ON REVERSE SIDE.


H.G. Kreis, Site Manager

INSTRUCTIONS

INVOICE: Priced invoices in the requisite number giving the correct purchase order and requisition numbers, together with required Bills of Lading, must be forwarded on day of each shipment AS PER SPECIAL SHIPPING INSTRUCTIONS ACCOMPANYING THIS ORDER, otherwise delay in payment of account may result.

TERMS: As previously arranged or specified on this order. Care must be exercised to show cash discount, if allowed, on face of invoice.

PROVISIONS

1. **ACCEPTANCE:** Acceptance of this order constitutes acceptance of all terms herein stated. All representations and warranties by the seller relating to the subject-matter of this order or its performance shall be binding on the seller as if fully set forth herein, and shall survive inspection and acceptance of the goods ordered. No acknowledgment or acceptance of this order or any other communication by the seller shall vary or add any terms or conditions to those contained herein and any such attempted modification or addition which is not accepted in writing by the buyer, shall be void and may be disregarded without further notice or disclaimer.

2. **PRICES:** This order must not be filled at higher prices than last quoted without authority of the buyer.

3. **SHIPMENTS:** All materials must be forwarded by the route designated and seller will be held strictly accountable for any deviation therefrom.

When the material covered by this order shall aggregate a carload shipment or more, the seller must forward in carload lots, unless duly authorized in writing by the buyer to ship in less than carloads. If this order aggregates less than a minimum carload, seller must forward the entire quantity at one time unless otherwise authorized in writing by the buyer.

When blocking or dunnage, etc., not constituting a part of the car are used to protect and make shipments secure in transit, seller must show on Bills of Lading, separately, the weights of such materials, provided the lading shall aggregate a minimum carload or more, and will be held responsible for failure to comply with this rule.

Shipments will not be considered as completed until Bill of Lading, or express or mail receipt is received.

4. **PACKING AND CARTAGE CHARGES:** No charge will be allowed for packing, boxing or cartage, unless agreed upon at the time of purchase; damage to any material not properly packed to insure adequate protection in transit will be charged to the seller. All packing must conform with tariff or classification requirements so as to secure lowest possible freight rates. It is understood the buyer will receive the benefit of any decrease in freight charges between time of quotation and date of shipment, where freight enters into the price originally quoted.

5. **QUALITY AND INSPECTION:** All material furnished must be as specified and will be subject to inspection and approval of buyer after delivery. The right is reserved to reject and return at the risk and expense of the seller such portion of any shipment which may be defective or fail to comply with the specifications without invalidating the remainder of the order. If rejected it may be held for disposition at the expense and risk of the seller.

6. **QUANTITY:** The specific quantity ordered must not be changed without buyer's permission in writing.

7. **NON-PERFORMANCE:** Buyer reserves the right to cancel this order or any portion of same if delivery is not made when and as specified, time being of the essence of this order, and charge seller for any loss entailed.

8. **PATENTS:** The seller hereby guarantees the buyer against all losses of profits, damages, or both, resulting from any patent infringement by reason of purchasing or using goods covered by this order, or by reason of any loss suffered in not being able, without liability, to use such goods. This guarantee also includes the reimbursement to the buyer of all litigation costs which it may suffer as the result of any suit respecting the purchase or use of such goods, in addition to the recoveries which may be secured against it of profits and/or damages.

GENERAL:

9. The material on this order must be furnished only by the person or firm to whom the order is addressed unless otherwise authorized by the buyer.

10. No drafts for purchases made will be honored unless by agreement.

11. If it becomes necessary for the seller or any agent, contractor, or employee thereof to enter upon the property of the buyer in order to construct, inspect or deliver hereunder, the seller hereby agrees to protect the buyer's property and all persons thereon from injury, damage or loss, and the seller shall save harmless and indemnify the buyer from and against any expense, loss or damage on account of any claim, demand or suit made by any person whomsoever, including any employee of the buyer, which is in any way caused by or connected with or grows out of the performance hereunder by the seller or any agent, contractor or employee thereof; provided however that the seller shall not be required to indemnify the buyer against any loss caused solely by the negligence or willful fault of the buyer or its employees. If the seller performs any work hereunder knowing it to be contrary to any local law, ordinance, rule and regulation, the seller shall bear all costs arising therefrom. Seller to carry Liability Insurance and to carry Workmen's Compensation Insurance as provided by the laws of the State in which the work is performed and further, is to obtain a certificate for same, which is to be furnished for the file of the buyer. If for any reason the seller's or any subcontractor's employees or agents may acquire a status imposing liability on the buyer for employer's contributions or taxes under the Federal Social Security Act or under any State Unemployment Insurance, Old Age Benefit, or similar Acts, the seller shall be exclusively liable for, and shall indemnify the buyer against, the same and does agree to comply with all laws and regulations so as to relieve the buyer from any and all liability therefor or the responsibility of making any reports or keeping any records with respect thereto.

12. In accepting this order the seller certified that these goods were produced in compliance with all applicable requirements of Sections 6, 7 and 12 of the Fair Labor Standards Act of 1938, as amended, and of the regulations and orders of the United States Department of Labor issued under Section 14 thereof. It will be necessary in order for us to honor your future invoices to us that the above clause or a substantial equivalent thereof appear on your invoices.

13. By acceptance of this order, seller warrants that the prices specified do not exceed the maximum prices established under any applicable United States law or regulation thereunder.



Southwestern Exploration Division

July 28, 1992

G.D. Van Voorhis
New York Office

H.G. Kreis
Monthly Report
July 1992

Santa Cruz Joint Venture

Land work associated with the Simmons Devcor parcel of land continued during the month. Mr. Apker and I met with a representative of First American Title to review First American Title's title report on the Simmons Devcor parcel. (A number of the title aspects of the Simmons Devcor parcel also apply to the neighboring Texaco property since parts of both parcels were once in the Desert Carmel subdivision.) A quarter section of land in the Simmons Devcor parcel has a clouded title which First American Title thought could be easily cleared up. The RTC foreclosure sale of the Simmons Devcor 528 acre parcel was changed from July 31st to August 28th.

Arrangements are being made for Cissell Drilling of Casa Grande to do the annual SCJV assessment work on SCJV unpatented mining claims.

On June 27th a tour of the Santa Cruz Deposit geology and the Santa Cruz In Situ Copper Mining Research Project was given to Barry Gillies, a Freeport Indonesia geologist.

Santa Cruz In Situ Mining Project

A rough draft of the executive summary of the "Phase I and II Technical Report" has been technically reviewed and has been submitted for review by Asarco, Freeport-McMoRan, and USBM management.

The USBM is combining into one Open File Report the previous Open File Report drafts of "Fracture Systems of the Santa Cruz Porphyry Copper Deposit as they relate to the In Situ Copper Mining Research Project" by Linda Dahl and "Geology of the Santa Cruz In Situ Copper Mining Research Project" by Linda Dahl and Henry Kreis.

As usual, several trips were made to the Santa Cruz test site to check on security and maintenance and repair work.

General Exploration

A quick reconnaissance of advances in the leaching of chalcopyrite-chalcocite concentrates was made. The most promising commercial process appears to have been developed by BHP Minerals and RTZ. BHP and RTZ have done extensive research and pilot plant testing using ammonia leaching and SX/EW copper recovery. A feasibility study, scheduled for completion in mid-1992, will determine if the process is commercially viable at Escondida.

HGK:mek


H.G. Kreis

cc: F.T. Graybeal W.L. Kurtz
J.D. Sell A.R. Raihl

ASARCO

Exploration Department
Southwestern United States Division

November 25, 1991

Mr. John Nicol
SAIC
1710 Goodridge Drive
Mail Stop T-2-2-1
McLean, Virginia 22102

Re: CSAMT Summary Report

Dear John:

Here is the CSAMT summary report for the Phase I and II report. It was written by Zonge Engineering, and slightly edited by Asarco.

Sincerely yours,



H.G. Kreis

HGK:mek
Enclosure: typed text
 computer disk text
 in WP 5.1

cc: A.R. Raihl (w/o disk)
 F.T. Graybeal (" ")
 W.L. Kurtz (" ")
 J.D. Sell (" ")
 S. Swan (" ")
 W.E. McCulloch (" ")
 C.O. Windels (" ")

CSAMT Monitoring of the
Santa Cruz In-Situ Test Site
for
ASARCO, Incorporated

Summary

Zonge Engineering and Research Organization has performed a series of geophysical tests at the Santa Cruz In-situ Test Site. The tests are directed towards refining methods for non-intrusive monitoring of the leachate solution. The goal of the tests is to develop a surface technique for mapping the drop in rock resistivity caused by the leachate.

Controlled Source Audio-frequency Magnetotellurics, CSAMT, was picked as the method of choice because of its great depth of investigation, relatively high resolution and resistance to background electrical noise. Tests of an alternative method, Transient Electro-Magnetic (TEM), have also been conducted. Both methods provide information about the vertical variation of resistivity under each sounding point, but CSAMT has better lateral resolution.

Two phases of a three-phase CSAMT survey program have been completed. The goal of Phase I was to provide a three-dimensional grid of background resistivity values before any conductive fluids were injected into the test site. Two Phase I surveys established the resistivity pattern of the background geology, as well as data repeatability. Phase II followed with a repeat survey after the

injection of a salt-water tracer. Phase III surveys will monitor changes in the background resistivity pattern due to the leaching operation.

All three CSAMT surveys to date have been conducted over a closely spaced grid (see the CSAMT Line Location Map). A total of 107 stations are spaced at 30 foot intervals along eleven lines. A three-person crew requires three to four days to complete measurements over the entire grid.

The first Phase I survey was conducted in late April, 1990. The crew established the survey grid and made a complete set of CSAMT measurements using a N45E transmitter antenna orientation. This original survey established that good quality data could be obtained in the geological and cultural environment present at the test site. The effects of well casing, pipelines and powerlines were minimal. The results also showed very good correlation with the known geology.

The CSAMT data show the alluvial fill as a low-resistivity surface layer. The basement rocks are apparent as an underlying zone of high resistivity. An offset in the resistive basement response marks the location of the Pinal fault, which runs through the survey area near well T-4.

The encouraging results prompted an immediate extension of the first survey. The crew returned to the site in early May, 1990 and made a set of measurements to extend the grid coverage and to obtain some comparison soundings using a transmitter antenna orientation of N45W. Data obtained using the second transmitter site were consistent with data obtained using the first transmitter site. There were no strong distortions due to the particular locations of the transmitter antennas. Data repeatability was very good. The data were consistent from line to line and from station to station.

A second Phase I survey, called Phase I(B), was performed in February, 1991. The Phase I(B) survey updated the information about the pattern of background resistivity prior to the injection of a salt-water tracer. In general the results were very encouraging. There was very good correlation between the Phase I and Phase I(B) data sets, however, there were some changes in the background resistivity pattern between May, 1990 and February, 1991 due to ground-water circulation tests and changes in surface cultural features.

The field crew also made TEM measurements during the Phase I (B) survey. Although a TEM monitoring system would be faster than CSAMT, the TEM results did not show resolution obtainable with CSAMT.

A smooth-model resistivity cross-section along Line 1 SE is shown as Figure 2. The contoured values are the result of inverting apparent resistivity and impedance phase from the February 1991 survey to a smooth-model profile under each CSAMT sounding point. Model resistivities are constrained to vary smoothly with depth along each vertical profile. The alluvium is visible in Figure 2 as a conductive surface layer. The underlying basement rocks are resistive. There is an offset in the depth to basement between station -45 and -15, showing the offset across the Pinal fault.

The Phase II CSAMT survey was in June of 1991. The survey was performed after several months of salt-water injection. The injection and recovery pumps were not operating during the Phase II survey, but electrical power to the site office and lab trailer was on.

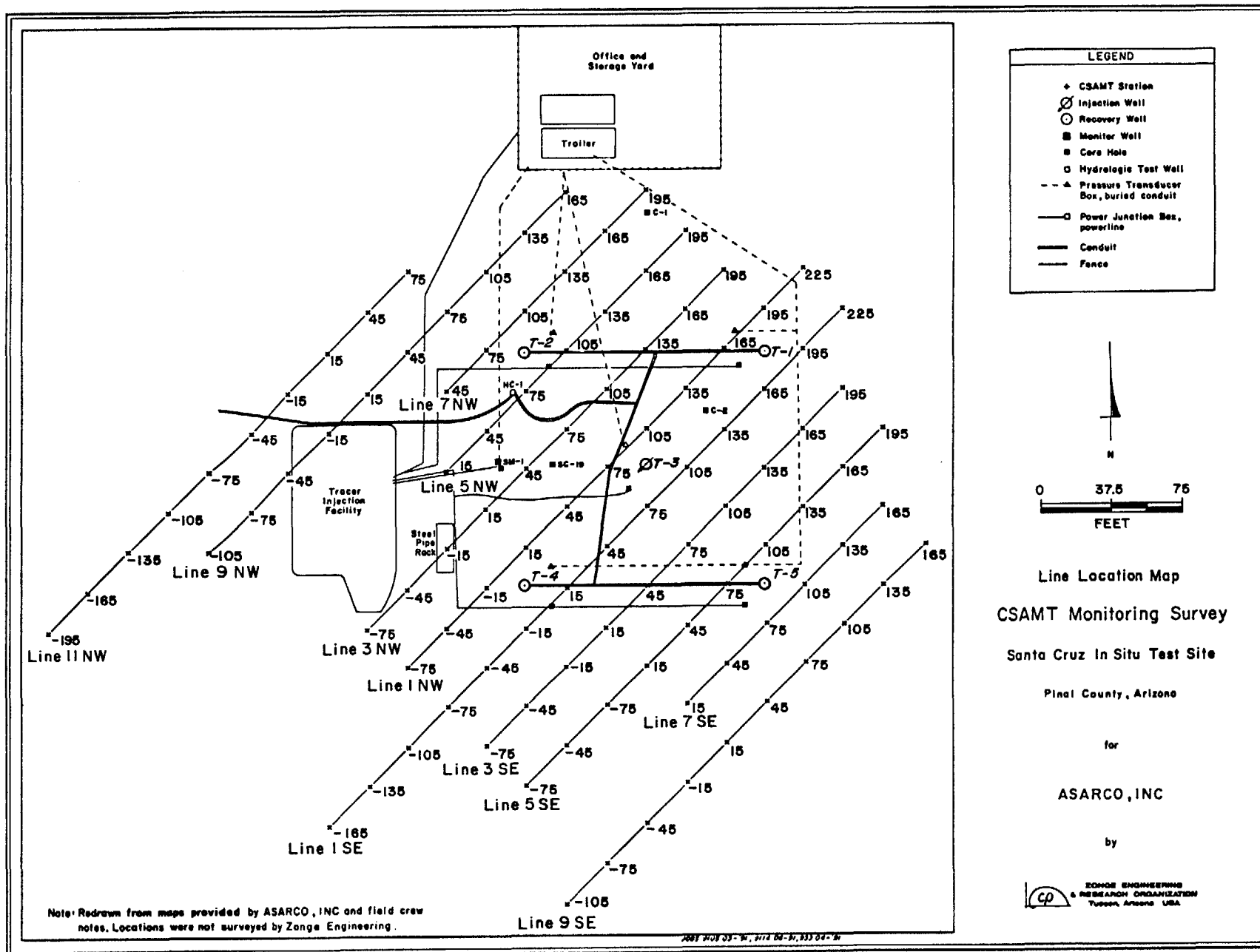
The cross-sections for each line can be combined into plan maps showing smooth-model resistivity at a constant depth. Figure 3 shows in plan view the smooth-model resistivity maps at a depth of 1700 feet for the survey performed in May of 1990 (top), February of 1991 (middle), and June of 1991 (bottom). In Figure 3 lower resistivity values are shown in yellow and green shades and higher resistivity values are shown in darker shades of blue. A good comparison is seen between the Phase I and Phase I(B) data, with most values consistently between 60 and 100 ohm-meters. The

Phase II data, gathered after several months of salt water injection, show more variation, but no strong changes are seen centered around the injection well.

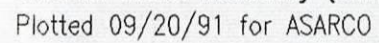
The results of the Phase II survey were encouraging, but not conclusive. The background noise created by new powerlines may have obscured a weak pattern of resistivity change at the injection depth. Background powerline noise affected the data quality at 64, 512, and 2048 hertz. All three frequencies are close to harmonics of 60 hertz, the frequency used for power distribution. Collecting more closely spaced frequency data using harmonic-frequency CSAMT should reduce the problem of power line noise interference.

The absence of a substantial change in resistivity is most likely due to the relatively low concentration of salt in the tracer (three to four grams per liter at injection and one gram per liter or less at recovery.) The changes in resistivity expected from the leachate should be detectable based upon the data repeatability observed to date at the Santa Cruz Site and upon results from surveys over leachate at other sites.

No logistical changes are envisioned for the Phase III CSAMT work. Grid stations will be re-occupied and data will be measured using the same transmitter location and frequencies. Harmonic-frequency CSAMT data will be collected to reduce the effects of powerline noise.

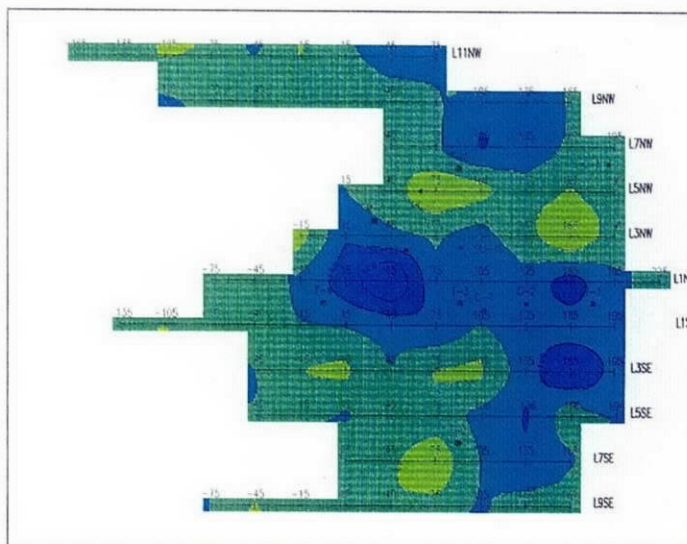


February 1991 Survey

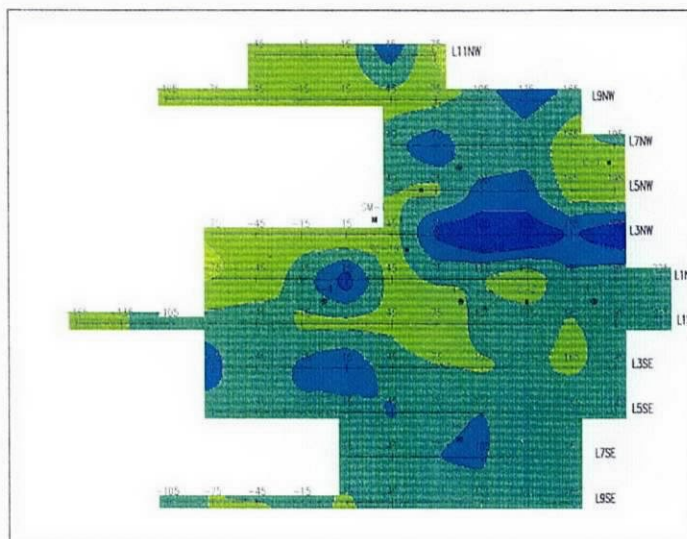


Zonge

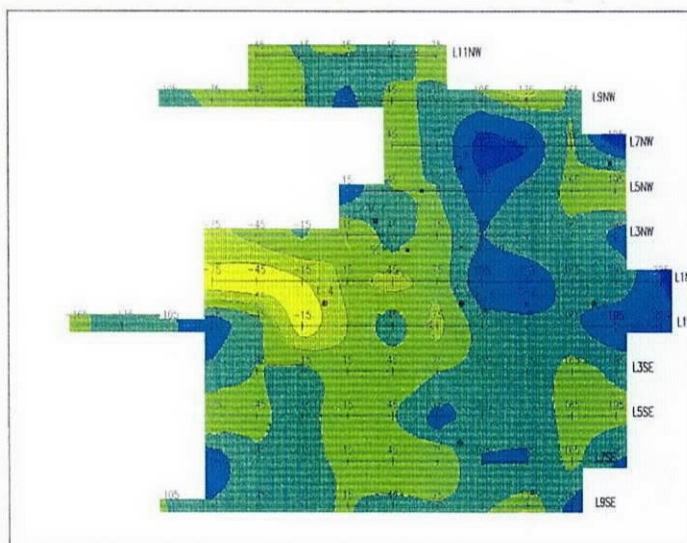
PLAN VIEWS OF RESISTIVITY AT 1700' DEPTH



PHASE I
May 1990



PHASE I (B)
February 1991



PHASE II
June 1991

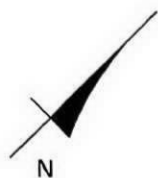


Figure 3