received with letter dtd 2/5/91

YMP/91-6

YMP/91-6

U.S. DEPARTMENT OF ENERGY

OCRWM

YUCCA MOUNTAIN

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

RECORD MEMORANDUM

RISK/BENEFIT ANALYSIS OF ALTERNATIVE STRATEGIES FOR CHARACTERIZING THE CALICO HILLS UNIT AT YUCCA MOUNTAIN

REVISION 0

VOLUME 2

102.8

JANUARY 1991

UNITED STATES DEPARTMENT OF ENERGY

APPENDIX A

FINAL CONCURRENCE STATEMENTS

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with Sections 2.1-2.6, and Appendices B-F, as finalized on January 14, 1991. I have reviewed the sections and found that they accurately represent the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Sections 2.1-2.6 and Appendices B-F in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ✓ No ___

HOLLIS J. CALL
Name (print)

DECISION ANALYSIS
Technical Specialty

[signature]
Signature

1-22-91
Date

My concurrence with Sections 2.1 - 2.6 and Appendices B - F applies only to the VOI portions of the report. My repsonsibilities did not include review of the MUA.

I also have reservations about the presentation of Section 2.6.1.8 (VOI Model Results and Sensitivity). The material contained in this section is accurate and is at least a minimum representation of this part of the study. Given more time, additional detail and a better presentation of this important section would give the reader a better understanding of the results and, importantly, why these results emerged from our analysis.

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with Sections 2.1-2.6, and Appendices B-F, as finalized on January 14, 1991. I have reviewed the sections and found that they accurately represent the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Sections 2.1-2.6 and Appendices B-F in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ____ No X

BRUCE CROWE
Name (print)

Geologist
Technical Specialty

Bruce Crowe
Signature

1/22/91
Date

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with Sections 2.1-2.6, and Appendices B-F, as finalized on January 14, 1991. I have reviewed the sections and found that they accurately represent the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Sections 2.1-2.6 and Appendices B-F in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ____ No ✓

Errol M. Gardiner
Name (print)

MINING ENGINEER
Technical Specialty

[signature]
Signature

1-15-90
Date

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with Sections 2.1-2.6, and Appendices B-F, as finalized on January 14, 1991. I have reviewed the sections and found that they accurately represent the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Sections 2.1-2.6 and Appendices B-F in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ____ No X

ERNEST HARDIN
Name (print)

GEOPHYSICIST & TASK LEADER
Technical Specialty

E. L. Hardin
Signature

1.16.91
Date

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with Sections 2.1-2.6, and Appendices B-F, as finalized on January 14, 1991. I have reviewed the sections and found that they accurately represent the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Sections 2.1-2.6 and Appendices B-F in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ____ No ✓

C.C. HERRINGTON
Name (print)

REGULATORY SPECIALIST
Technical Specialty

[signature]
Signature

1/17/91
Date

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with Sections 2.1-2.6, and Appendices B-F, as finalized on January 14, 1991. I have reviewed the sections and found that they accurately represent the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Sections 2.1-2.6 and Appendices B-F in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ____ No ✓

Jerry L. King
Name (print)

Regulatory/Management
Technical Specialty

[signature]
Signature

1/20/91
Date

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with Sections 2.1-2.6, and Appendices B-F, as finalized on January 14, 1991. I have reviewed the sections and found that they accurately represent the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Sections 2.1-2.6 and Appendices B-F in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ____ No X

John Fargo Lathrop
Name (print)

Principal Decision Analyst
Technical Specialty

John Fargo Lathrop
Signature

1/18/91
Date

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

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Written comments provided? Yes ____ No X

BARNEY D. Lewis
Name (print)

Hydrologist
Technical Specialty

Barney D. Lewis
Signature

Jan 16, 1991
Date

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with Sections 2.1-2.6, and Appendices B-F, as finalized on January 14, 1991. I have reviewed the sections and found that they accurately represent the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Sections 2.1-2.6 and Appendices B-F in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ____ No _y_

ROBERT C. MURRAY

Name (print)

GEOLOGY

Technical Specialty

[signature]

Signature

1/16/91

Date

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with Sections 2.1-2.6, and Appendices B-F, as finalized on January 14, 1991. I have reviewed the sections and found that they accurately represent the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Sections 2.1-2.6 and Appendices B-F in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ____ No ✓

Russell A. Paige
Name (print)

Geologist
Technical Specialty

R. A. Paige
Signature

18 Jan. 91
Date

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with Sections 2.1-2.6, and Appendices B-F, as finalized on January 14, 1991. I have reviewed the sections and found that they accurately represent the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Sections 2.1-2.6 and Appendices B-F in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ____ No ✓

MARTHA PENDLETON
Name (print)

GEOLOGIST / REGULATORY / MANAGEMENT
Technical Specialty

Martha W. Pendleton
Signature

1/18/91
Date

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with Sections 2.1-2.6, and Appendices B-F, as finalized on January 14, 1991. I have reviewed the sections and found that they accurately represent the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Sections 2.1-2.6 and Appendices B-F in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes X* No ___

John B. Robertson
Name (print)

Hydrology/Hydrogeology
Technical Specialty

John B. Robertson — 1/24/91
Signature — Date

* informal handwritten comments were previously provided to the Chairman. None of those comments required mandatory changes in the report for my concurrence. I am satisfied that all of my comments have recieved appropriate consideration and are adequately accounted for in the final revisions of the report.

J B Robertson

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with Sections 2.1-2.6, and Appendices B-F, as finalized on January 14, 1991. I have reviewed the sections and found that they accurately represent the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Sections 2.1-2.6 and Appendices B-F in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ____ No X

VICTOR J. ROHRER
Name (print)

COST/SCHEDULE
Technical Specialty

Victor J Rohrer
Signature

1/17/91
Date

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with Sections 2.1-2.6, and Appendices B-F, as finalized on January 14, 1991. I have reviewed the sections and found that they accurately represent the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Sections 2.1-2.6 and Appendices B-F in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ✓ No __

Scott Sinnock
Name (print)

Performance Assessment / Performance Evaluation
Technical Specialty

[signature]
Signature

Date 1/18/91

The VOI portion of the analysis evaluated requirements for technical information provided by testing in terms of an absolute measure (R) whereas the "scientific confidence" portion evaluated the relative merits of alternative strategies. The VOI, within the limits of the assumptions used, indicated little to no net value of any of the testing strategies. The confidence assessment indicates greater relative benefit of extensive drifting strategies but did not establish the need for any of the strategies. Therefore, I personally believe that the CHRBA analysis leads to a conclusion that testing is not necessary, but that, if done, the recommended strategies will better increase confidence than the other strategies. The need for such increased confidence has not been established by the CHRBA. I believe further decision-aided analysis of the reasons for and levels of "sufficient confidence" is appropriate before a conclusion can be supported that the recommended strategies are necessary for project success

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with Sections 2.1-2.6, and Appendices B-F, as finalized on January 14, 1991. I have reviewed the sections and found that they accurately represent the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Sections 2.1-2.6 and Appendices B-F in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ____ No ✓

Michael D. Voegele
Name (print)

REGULATORY SPECIALIST
Technical Specialty

Michael D Voegele
Signature

Jan 16, 1991
Date

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with Sections 2.1-2.6, and Appendices B-F, as finalized on January 14, 1991. I have reviewed the sections and found that they accurately represent the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Sections 2.1-2.6 and Appendices B-F in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ____ No ✓

Charles F. Voss

Name (print)

Geotechnical engineering and Performance Assessment

Technical Specialty

[signature]

Signature

1/18/91

Date

CONCURRENCE STATEMENT FOR SECTIONS 2.1 THROUGH 2.6 AND APPENDICES B THROUGH F, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with Sections 2.1-2.6, and Appendices B-F, as finalized on January 14, 1991. I have reviewed the sections and found that they accurately represent the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Sections 2.1-2.6 and Appendices B-F in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ____ No X

DAVID M. WONDERLY
Name (print)

SURFACE BASED DRILLING
Technical Specialty

[signature]
Signature

1-15-91
Date

CONCURRENCE STATEMENT FOR SECTION 2.7,
RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with the recommendations and conclusions documented in Section 2.7, as finalized on January 8th, 1991. I have reviewed the section and find that it accurately represents the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Section 2.7 in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ✓ No ___

HOLLIS J. CALL
Name (print)

DECISION ANALYSIS
Technical specialty

[signature]
Signature

1-11-91
Date

My concurrence is with the recommendations and conclusions of Section 2.7 that are based <u>only</u> on the value-of-information study. My responsibilities did not include review of the study design or conclusions of the MUA.

CONCURRENCE STATEMENT FOR SECTION 2.7,
RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with the recommendations and conclusions documented in section 2.7, as it is finalized on January 8th, 1991. I have reviewed the section and find that it accurately represents the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express dissenting opinion in writing, for inclusion with this statement in the CHRBA documentation.

Dissenting opinion? Yes ___ No X

BRUCE CROWE
Name (print)

Geologist
Technical specialty

Bruce Crowe
Signature

January 8, 1991
Date

CONCURRENCE STATEMENT FOR SECTION 2.7,
RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with the recommendations and conclusions documented in Section 2.7, as finalized on January 8th, 1991. I have reviewed the section and find that it accurately represents the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Section 2.7 in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ___ No ✓

David C Dobson
Name (print)

Geologist/Regulatory Specialist
Technical specialty

David C Dobson
Signature

1/8/91
Date

CONCURRENCE STATEMENT FOR SECTION 2.7,
RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with the recommendations and conclusions documented in section 2.7, as ~~it is~~ finalized on January 8th, 1991. I have reviewed the section and find that it accurately represents the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express dissenting opinion in writing, for inclusion with this statement in the CHRBA documentation.

Dissenting opinion? Yes ___ No ✓

ERROL M GARDINER
Name (print)

MINING ENGINEER
Technical specialty

[signature]
Signature

1/8/91
Date

CONCURRENCE STATEMENT FOR SECTION 2.7,
RECOMMENDATIONS AND CONCLUSIONS

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Written comments provided? Yes ___ No ✓

ERNEST HARDIN

Name (print)

GEOPHYSICIST

Technical specialty

E.L. Hardin

Signature

08 JAN 91

Date

CONCURRENCE STATEMENT FOR SECTION 2.7,
RECOMMENDATIONS AND CONCLUSIONS

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Written comments provided? Yes ___ No X

C. C HERRINGTON
Name (print)

REGULATORY SPECIALIST
Technical specialty

CCHerrington
Signature

1/9/91
Date

CONCURRENCE STATEMENT FOR SECTION 2.7,
RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with the recommendations and conclusions documented in Section 2.7, as finalized on January 8th, 1991. I have reviewed the section and find that it accurately represents the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Section 2.7 in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ___ No X

JERRY L. KING

Name (print)

Regulatory / Management

Technical specialty

[signature]

Signature

January 11, 1991

Date

CONCURRENCE STATEMENT FOR SECTION 2.7,
RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with the recommendations and conclusions documented in Section 2.7, as finalized on January 8th, 1991. I have reviewed the section and find that it accurately represents the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Section 2.7 in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ___ No _✓_

John Lathrop
Name (print)

Principal Decision Analyst
Technical specialty

John Lathrop
Signature

1/8/91
Date

CONCURRENCE STATEMENT FOR SECTION 2.7,
RECOMMENDATIONS AND CONCLUSIONS

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Written comments provided? Yes ___ No X

BARNEY D. LEWIS
Name (print)

Hydrologist
Technical specialty

Barney D. Lewis
Signature

January 8, 1991
Date

CONCURRENCE STATEMENT FOR SECTION 2.7,
RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with the recommendations and conclusions documented in Section 2.7, as finalized on January 8th, 1991. I have reviewed the section and find that it accurately represents the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Section 2.7 in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ___ No X

ROBERT C. MURRAY
Name (print)

GEOLOGIST
Technical specialty

[signature]
Signature

1/8/91
Date

CONCURRENCE STATEMENT FOR SECTION 2.7,
RECOMMENDATIONS AND CONCLUSIONS

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Dissenting opinion? Yes ___ No ✓

Russell A. Paige
Name (print)

Geologist
Technical specialty

R. A. Paige
Signature

8 Jan 91
Date

CONCURRENCE STATEMENT FOR SECTION 2.7,
RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with the recommendations and conclusions documented in Section 2.7, as finalized on January 8th, 1991. I have reviewed the section and find that it accurately represents the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Section 2.7 in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ___ No ✓

MARTHA W. PENDLETON
Name (print)

GEOLOGIST / REGULATORY SPECIALIST
Technical specialty

Martha W. Pendleton
Signature

1/9/91
Date

CONCURRENCE STATEMENT FOR SECTION 2.7,
RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with the recommendations and conclusions documented in Section 2.7, as finalized on January 8th, 1991. I have reviewed the section and find that it accurately represents the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Section 2.7 in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ___ No ✓

John B Robertson
Name (print)

[illegible]
Technical specialty

John B Robertson
Signature

Jan 8, 1991
Date

CONCURRENCE STATEMENT FOR SECTION 2.7,
RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with the recommendations and conclusions documented in Section 2.7, as finalized on January 8th, 1991. I have reviewed the section and find that it accurately represents the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Section 2.7 in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ___ No X

VICTOR J. ROHRER
Name (print)

Cost and Schedule
Technical specialty

Victor J Rohrer
Signature

Jan 9, 1991
Date

CONCURRENCE STATEMENT FOR SECTION 2.7, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with the recommendations and conclusions documented in Section 2.7, as finalized on January 8th, 1991. I have reviewed the section and find that it accurately represents the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Section 2.7 in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ✓ No ___

Scott Sinnock
Name (print)

Performance Evaluation / Assessment
Technical specialty

[signature]
Signature

1/8/90
Date

My personal opinion is that the value-of-information analysis is sufficiently reliable to seriously challenge the recommendation for the desirability of extensive drifting or per strategies 2 & 5. I also believe the MUA for scientific confidence artificially separates the value-of-information from confidence. Therefore, I recommend more formal performance assessment and reconsideration of needed confidence in terms of impacts on performance and accuracy of proposed testing.

CONCURRENCE STATEMENT FOR SECTION 2.7,
RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with the recommendations and conclusions documented in Section 2.7, as finalized on January 8th, 1991. I have reviewed the section and find that it accurately represents the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Section 2.7 in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ___ No X per telecon MD Voegele w/J. Hall of Jan 14, 1991, 2 pm

MICHAEL D. VOEGELE
Name (print)

REGULATORY
Technical specialty

[signature]
Signature

Jan. 14, 1991
Date

CONCURRENCE STATEMENT FOR SECTION 2.7, RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with the recommendations and conclusions documented in Section 2.7, as finalized on January 8th, 1991. I have reviewed the section and find that it accurately represents the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Section 2.7 in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ___ No ✓

CHARLES F. VOSS
Name (print)

GEOTECHNICAL ENGINEERING & PERF. ASSESSMENT
Technical specialty

Charles F. Voss
Signature

1/11/91
Date

CONCURRENCE STATEMENT FOR SECTION 2.7,
RECOMMENDATIONS AND CONCLUSIONS

I hereby concur with the recommendations and conclusions documented in Section 2.7, as finalized on January 8th, 1991. I have reviewed the section and find that it accurately represents the results of the Calico Hills Risk/Benefit Analysis from the perspective of my technical specialty. I have been given the opportunity to express any comments relative to Section 2.7 in writing, for inclusion with this statement in the CHRBA documentation.

Written comments provided? Yes ___ No X

DAVID M. WONDERLY
Name (print)

SURFACE BASED DRILLING
Technical specialty

[signature]
Signature

1-10-91
Date

APPENDIX B

COST AND SCHEDULE ESTIMATES FOR ALTERNATIVES STRATEGIES

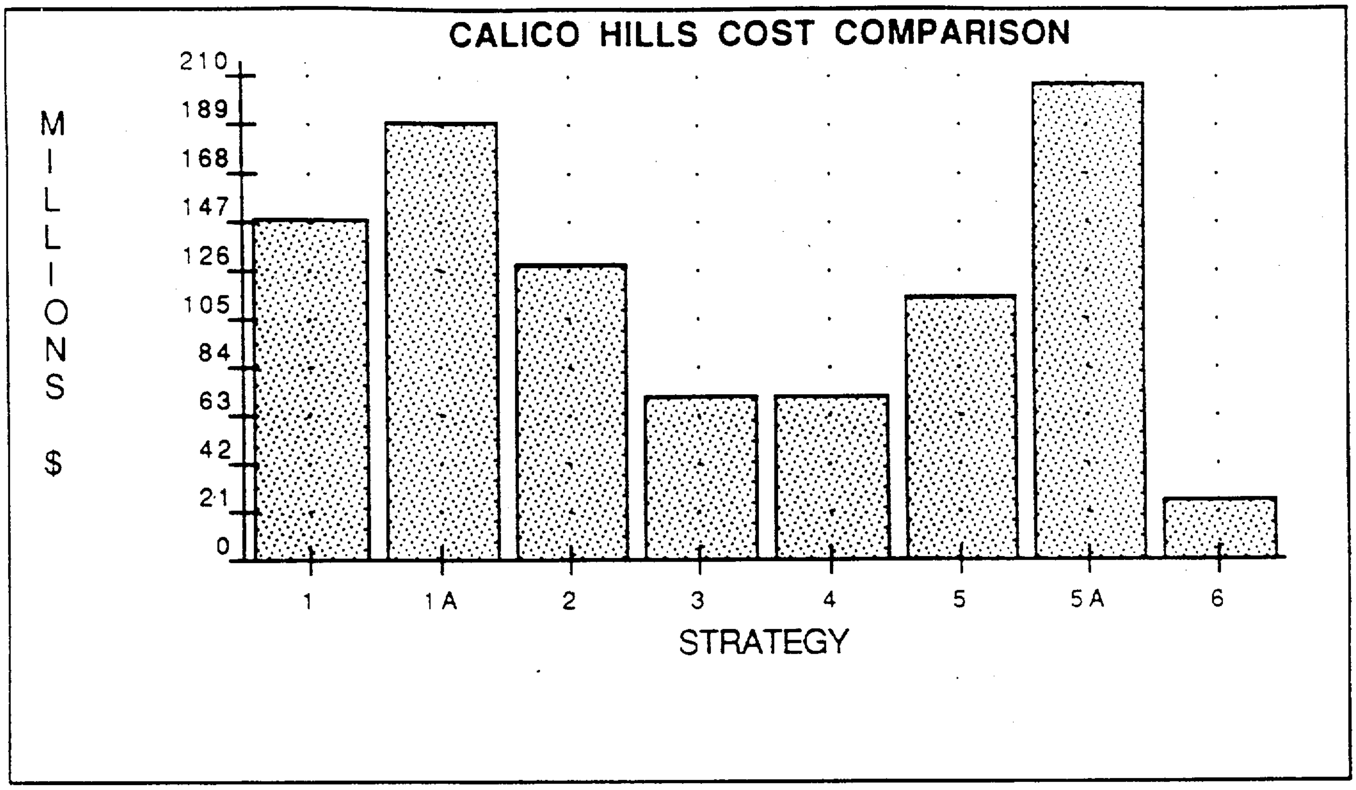
CALICO HILLS STUDY

COST AND SCHEDULE INFORMATION

MAY 2, 1990

CALICO HILLS STRATEGIES
COST AND SCHEDULE AGENDA

1. GRAPHIC COMPARISON OF COST BY STRATEGY
2. COMPARISON OF SUMMARY COST AMOUNTS BY STRATEGY
3. COST AND SCHEDULE GUIDANCE AND ASSUMPTIONS
4. SUMMARY OF TESTING COST BY STRATEGY
5. SUMMARY OF DECOMMISSIONING COST BY STRATEGY
6. COST AND SCHEDULE DATA FOR EACH STRATEGY
7. DETAIL COST BREAKOUT OF STRATEGY # 5



CALICO HILLS COST COMPARISON
MILLIONS $
210
189
168
147
126
105
84
63
42
21
0
1
1A
2
3
4
5
5A
6
STRATEGY

CALICO HILLS - COST AND SCHEDULE
GUIDANCE AND ASSUMPTIONS

1. LOWEST COST ALTERNATIVES - SHAFTS NOT RAMPS

2. SHORT PERIOD OF TIME TO COMPLETE THEREFORE BEST ESTIMATES AVAILABLE

3. CONSISTENCY BETWEEN EACH STRATEGY IMPORTANT

4. ALL COST IN PRESENT VALUE AND NO CONTINGENCY ADDED

5. MOST CONSTRUCTION COST ESTIMATES BASED ON ESF COST

6. OTHER COST AND SCHEDULE VALUES:

   A. 5,000 FT. OF DRIFTING FOR LIMITED FACILITY

   B. 12,000 FT. OF DRIFTING FOR EXTENDED FACILITY

   C. 1,650 FT. SHAFT DEPTH FOR NEW SHAFTS

   D. 600 FT. SHAFT CONNECTIONS TO ESF MTL

   E. DRIFTING COST AT $2,000 PER FT., 18 FT. PER DAY

   F. SHAFT SINKING AT $3,000 PER FT., 8 FT. PER DAY

   G. TESTING TIME: 3 YRS FOR EXTENDED FACILITY
      2 YRS FOR LIMITED FACILITY

7. TESTING COST HAVE LEAST BASIS SINCE ESF TESTING IS DIFFERENT

8. DECOMMISSIONING COST ADDED WITH NO ESF EQUIVALENT DECOM COST BASED ON A PERCENT OF CONSTRUCTION COST

9. CALICO HILLS STRATEGIES BEGIN AFTER 2 YEARS OF SURFACE BASED TESTING 1/93

CALICO HILLS COST COMPARISON

02-MAY-1990		TOTAL ESTIMATED COST	PERCENT OVER STRATEGY #6	DATE TESTING COMPLETE
STRATEGY # 6		$25,460,000		08/30/95
STRATEGY # 3		$69,646,443	274%	05/30/97
STRATEGY # 4		$69,646,443	274%	05/30/97
STRATEGY # 5	INITIAL	$112,639,008	442%	10/30/95
STRATEGY # 2		$126,557,880	497%	12/31/98
STRATEGY # 1	INITIAL	$147,281,745	578%	03/30/97
STRATEGY # 1	WITH OPTION	$189,256,027	743%	08/30/98
STRATEGY # 5	WITH OPTION	$204,970,631	805%	10/30/98

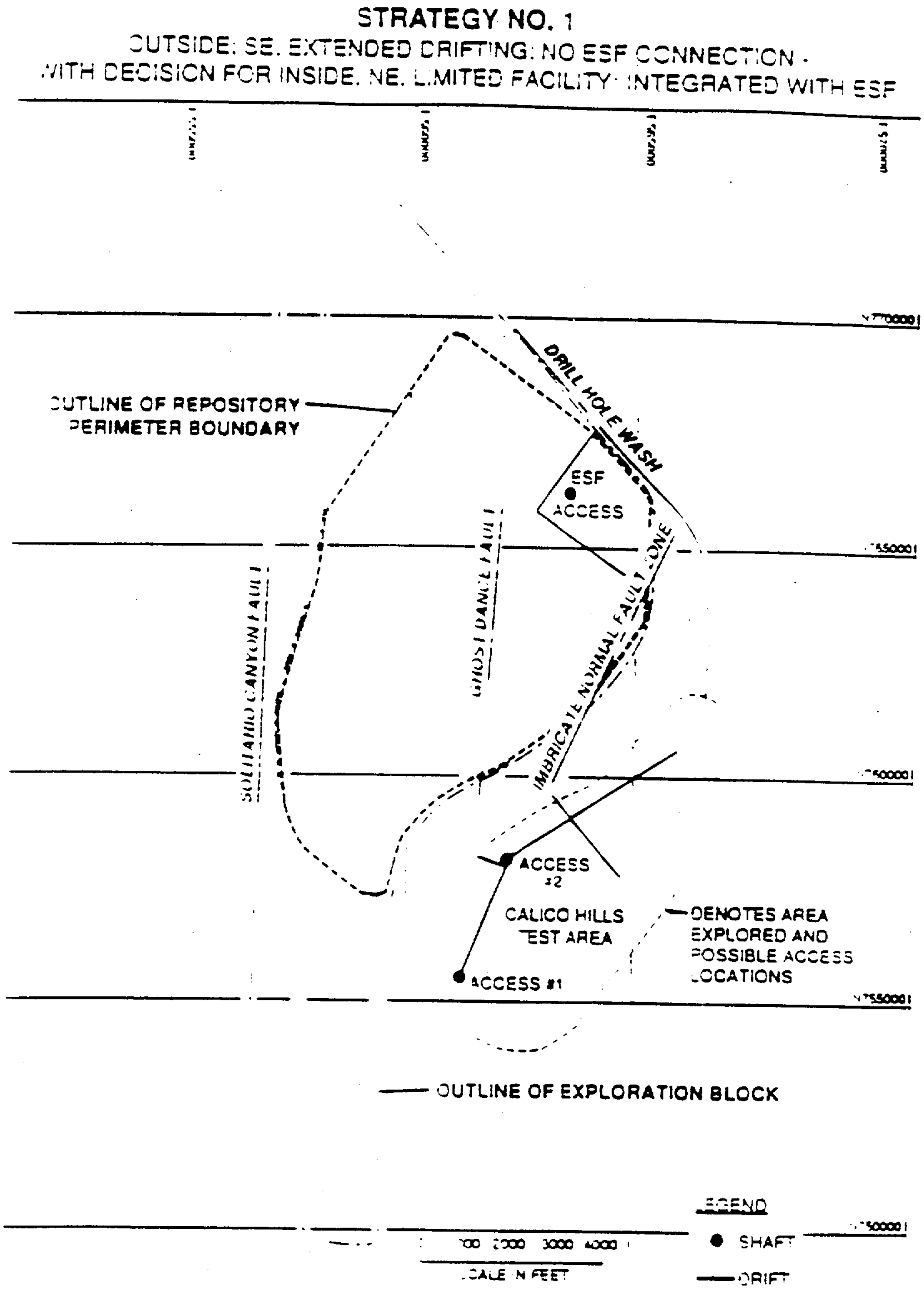
CALICO HILLS COST COMPARISON
TESTING COST

02-MAY-1990	TOTAL ESTIMATED COST	PERCENT OVER STRAT. #6	TESTING COST	TESTING % OF TOTAL
STRATEGY # 1 INITIAL	$147,281,745	578%	$30,300,000	20.6%
STRATEGY # 1 WITH OPTION	$189,256,027	743%	$41,508,000	21.9%
STRATEGY # 2	$126,557,880	497%	$30,300,000	23.9%
STRATEGY # 3	$69,646,443	274%	$21,600,000	31.0%
STRATEGY # 4	$69,646,443	274%	$21,600,000	31.0%
STRATEGY # 5 INITIAL	$112,639,008	442%	$37,000,000	32.8%
STRATEGY # 5 WITH OPTION	$204,970,631	805%	$60,500,000	29.5%
STRATEGY # 6	$25,460,000		$18,020,000	70.8%

CALICO HILLS COST COMPARISON
TESTING COST LESS DECOMM COST

02-MAY-1990	TOTAL ESTIMATED COST	ESTIMATED DECOMM COST	DECOM %	TESTING COST	TESTING % OF TOTAL LESS DECOM
STRATEGY # 1 INITIAL	$147,281,745	$34,234,945	23%	$30,300,000	26.8%
STRATEGY # 1 WITH OPTION	$189,256,027	$48,104,320	25%	$41,508,000	29.4%
STRATEGY # 2	$126,557,880	$34,919,250	28%	$30,300,000	33.1%
STRATEGY # 3	$69,646,443	$18,554,313	27%	$21,600,000	42.3%
STRATEGY # 4	$69,646,443	$18,554,313	27%	$21,600,000	42.3%
STRATEGY # 5 INITIAL	$112,639,008	$22,564,568	20%	$37,000,000	41.1%
STRATEGY # 5 WITH OPTION	$204,970,631	$44,813,146	22%	$60,500,000	37.8%
STRATEGY # 6	$25,460,000	$1,689,650	7%	$18,020,000	75.8%

Figure 1.4-6 Sketch depicting Calico Hills characterization Strategy No. 1.



Calico Hills Stategy # 1
Cost Estimate

02-MAY-1990
Cost Elements

			Total Cost
INITIAL PROGRAM			
Design Cost, Mgt and Integation, QA:	Construction		$13,838,400
	Decommissioning		$13,169,375
Construction Cost:			
Site Preparation		$2,654,900	
Surface Facilities		$1,610,800	
First Shaft		$5,565,400	
Second Shaft		$3,982,100	
Subsurface Excavation		$24,000,000	
Underground Services		$7,292,500	
Construction Operations		$6,851,400	
Construction Management		$3,011,400	
Capital Equipment		$13,939,900	

Subtotal			$68,908,400
Testing Program			$30,300,000
Decommissioning		$18,065,570	
Capital Equipment		$3,000,000	
		------------	$21,065,570
Contingency			0

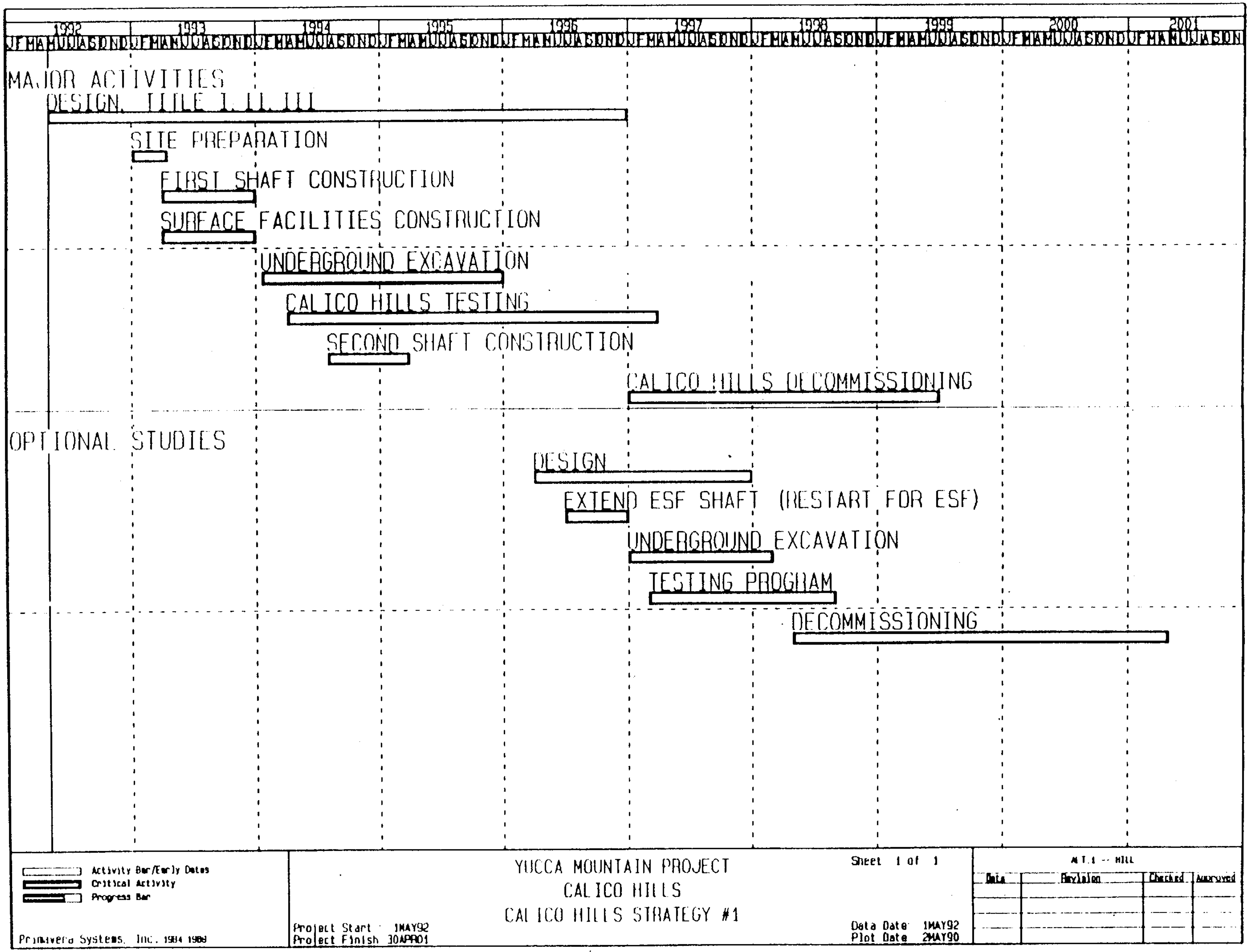
Total Estimated Cost - Initial Program			$147,281,745
OPTIONAL CONFIRMATORY PROGRAM			
Design Cost, Mgt and Integation, QA:	Construction		$1,608,295
	Decommissioning		$5,609,375
Construction Cost:			
Site Preparation		0	
Surface Facilities		0	
Shaft Connection to ESF		$1,830,700	
Subsurface Excavation		$10,000,000	
Underground Services		$1,823,125	
Construction Management		$90,342	
Construction Operations		$685,140	
Capital Equipment		$860,050	

Subtotal			$15,289,357
Testing Program			$11,208,000
Decommissioning			$8,260,000
Contingency			0

Total Estimated Cost of Option			$41,975,027
Grand Total - Initial Program and Option			$189,256,772

01-MAY-1990

JOR ACTIVITIES	ESF SCHEDULE START	ESF SCHEDULE FINISH	CALICO HILLS STRATEGY # 1 SCHEDULE START	CALICO HILLS STRATEGY # 1 SCHEDULE FINISH	DUR.
SIGN, TITLE I, II, III	03/29/91	03/31/93	05/01/92	12/30/96	
SITE PREPARATIONS	06/30/92	11/25/92	01/02/93	04/15/93	3.5
FIRST SHAFT CONSTRUCTION	11/30/92	11/08/95	04/01/93	12/30/93	9
SURFACE FACILITIES CONSTRUCTION	01/08/93	04/18/94	04/01/93	12/30/93	9
SECOND SHAFT CONSTRUCTION	01/04/93	08/19/94	08/01/94	03/30/95	8
UNDERGROUND EXCAVATION	08/22/94	03/07/95	01/15/94	12/30/95	23.5
TO ES1/ES2 CONNECTION		11/09/95	CONNECTION	07/30/94	
CALICO HILLS TESTING	N/A		04/01/94	03/30/97	36
DECOMMISSIONING	N/A		01/01/97	06/30/99	30
OPTIONAL CONFIRMATORY STUDIES					
DECISION POINT			03/30/96		
SIGN			04/01/96	12/30/97	
EXTEND ESF SHAFT (RESTART FOR ESF)			07/01/96	12/30/96	6
UNDERGROUND EXCAVATION			01/01/97	02/28/98	14
TESTING PROGRAM			03/01/97	08/30/98	18
DECOMMISSIONING			05/01/98	04/30/01	36


1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
MAJOR ACTIVITIES
DESIGN, TITLE I, II, III
SITE PREPARATION
FIRST SHAFT CONSTRUCTION
SURFACE FACILITIES CONSTRUCTION
UNDERGROUND EXCAVATION
CALICO HILLS TESTING
SECOND SHAFT CONSTRUCTION
CALICO HILLS DECOMMISSIONING
OPTIONAL STUDIES
DESIGN
EXTEND ESF SHAFT (RESTART FOR ESF)
UNDERGROUND EXCAVATION
TESTING PROGRAM
DECOMMISSIONING
Activity Bar/Early Dates
Critical Activity
Progress Bar
Primavera Systems, Inc. 1984 1989
Project Start 1MAY92
Project Finish 30APR01
YUCCA MOUNTAIN PROJECT
CALICO HILLS
CALICO HILLS STRATEGY #1
Sheet 1 of 1
Data Date 1MAY92
Plot Date 2MAY90
Date
Revision
Checked
Approved

CHARACTERIZING CALICO HILLS
STRATEGY # 1

SCRIPTION:

SE location, outside the site, 2 accesses, extended drifting, no ESF Integration Option to set up confirmatory underground facility inside the block near the Coyote Wash site. This optional facility would be integrated with the ESF.

		ESF COST	PERCENT OF	AMOUNT
Design: Initial	Title I, II, & III Mgt & Integration QA Health & Safety	$17,153,000	30%	$5,145,900
Design: Optional	Title I, II, & III Mgt & Integration QA Health & Safety	5145900	5%	$257,295
Construction Mgt		4302000	70%	$3,011,400
Optional Const. Mgt.		3011400	3%	$90,342
Site Preparation		ESF Cost	percent of	
	Design	2261000	40%	$904,400
	Roads & pads	4286000	30%	$1,285,800
	Electric	1794000	50%	$897,000
	Water	1109000	30%	$332,700
	Communications	304000	20%	$60,800
	Sewage	157000	30%	$47,100
	Mobilization	63000	50%	$31,500
	Capital Equip.	8333000	40%	$3,333,200
	Total			$6,892,500
Surface Facilities:		ESF	percent of	
	Design	$3,300,000	30%	$990,000
	Adm. Bldg	4833000	Trailers 2	$200,000
	Change Bldg.		2	$200,000
	Warehouse		1	$300,000
	Communications Bldg.		1	$100,000
	Generator Bldg	553000	40%	$221,200
	Hoist house	241000	80%	$192,800
	Instrumentation Data Bldg			$200,000
	Shaft collar	246000	80%	$196,800
	Capital Equip.	940000	100%	$940,000
	Total			$3,540,800
Primary Shaft		Drill and blast		
	Design	$2,315,000	40%	$926,000
	Mob/Demob	307000	60%	$184,200
	Sink/line	3000	1650	$4,950,000
	Hoist	423000	80%	$338,400
	Headframe	116000	80%	$92,800
	Capital Equip.	1908000	80%	$1,526,400
	Total			$8,017,800

Instr & Supplies, IDS, Bore holes			$15,000,000
	-----		------------
Total	55		$30,300,000
Optional Extended Testing	Personnel		
SNL	5	18	$900,000
LANL	5	18	$900,000
USGS	5	18	$900,000
Installation	12	14	$1,008,000
Instr & Suppli	15000000	50%	$7,500,000
TOTAL	OPTION		$11,208,000
Construction Operations & Maintenance:			
Maintenance	6113000	60%	$3,667,800
Operations	5306000	60%	$3,183,600
Electric	included above		
Sanitation	included above		
Water	included above		
Capital Equip	2129000	50%	$1,064,500

	Total		$7,915,900
Optional Operations and Maint	7915900	10%	$791,590
Decommisioning: (initial)	Original excavation Cost	percent of	
Design and Seal Development	6898750	50%	$3,449,375
Backfill drifts	24000000	50%	$12,000,000
Fill and seal Shaft #1	4950000	40%	$1,980,000
Fill and seal Shaft #2	4950000	40%	$1,980,000
Remove Surf Facilities	3540800	40%	$1,416,320
Site Restoration	6892500	10%	$689,250
Capital Equip			$3,000,000
Rate	$9,000	Months	
Management/Integration/QA	30 personnel	36	$9,720,000

Total			$34,234,945
Optional drifting Decom:			
Backfill drifts	10000000	70%	$7,000,000
Fill and seal Shaft	1800000	70%	$1,260,000
Design and Seal Development	3449375	100%	$3,449,375
Management/Integration/QA	10	24	$2,160,000
Total	OPTION		$13,869,375
	Grand total-Initial		$147,281,745
04:23:10 PM Total Option			$41,975,027

Secondary Access

Shaft:	Raised bore Rate $3,000 per ft.		
Design	$2,315,000	30%	$694,500
Mob/Demob	307000	50%	$153,500
Sink and line	above	1650	$4,950,000
Hoist	423000	80%	$338,400
Headframe	116000	80%	$92,800
Capital Equip.	2218000	70%	$1,552,600
Total			$6,229,200

Optional Connection to ESF

Mob/Demob	153500	20%	$30,700
Sink and line	$3,000	600	$1,800,000
Hoist	Headframe N/A		
Total	OPTION		$1,830,700

Underground Drifting

		Rate	
Length in feet	12,000	$2,000	$24,000,000
Size	12 X 14 FT.		
Design	1415000	80%	$1,132,000
Capital Equip.:			
Mining Machine	3136000	80%	$2,508,800
Hauling Machine	included above		0
Total			$27,640,800

Option for drifting inside the block 12 x14

Length in ft.	5000	$2,000	$10,000,000
Design	1132000	30%	$339,600
Total			$10,339,600

Underground Services

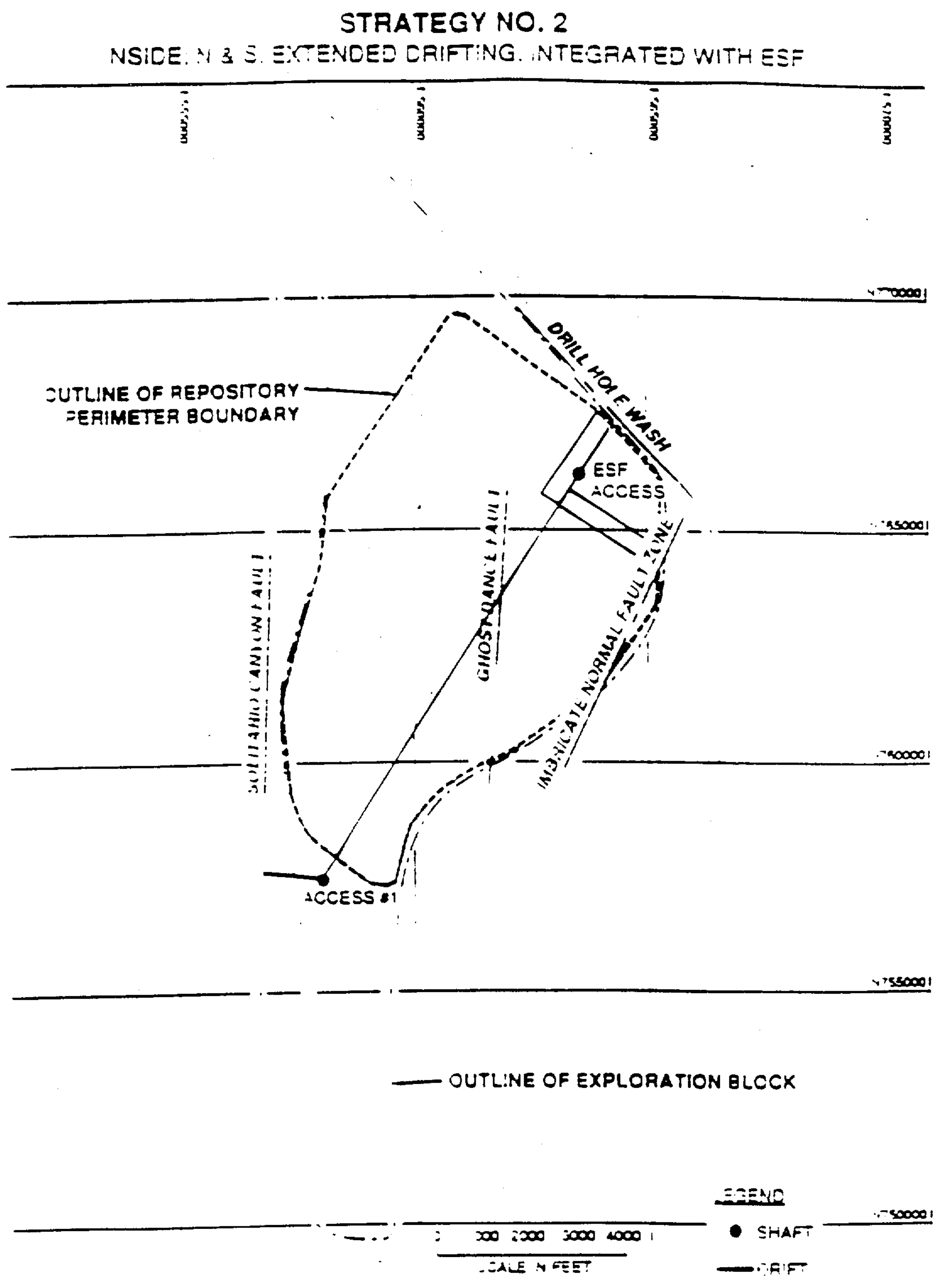
Design	5057000	80%	$4,045,600
Utilities 1st	1741000	90%	$1,566,900
Utilities 2nd	1209000	90%	$1,088,100
Test Level uti	1990000	80%	$1,592,000
Safety	1053000	80%	$842,400
Waste Water	217000	90%	$195,300
Ventilation	167000	90%	$150,300
Conveyance 1st	1514000	50%	$757,000
Conveyance 2nd	2201000	50%	$1,100,500
Capital Equip	3768000	80%	$3,014,400
Total			$14,352,500

Optional Services	14352500	25%	$3,588,125

Testing Program: rate	$10,000		
(initial)	Personnel	months	
SNL	10	36	$3,600,000
LANL	10	36	$3,600,000
USGS	10	36	$3,600,000
Install &Reeco	25	30	$4,500,000

Revised 4/13/90

Figure 1.4-7 Sketch depicting Calico Hills characterization Strategy No. 2.



Calico Hills Stategy # 2
Cost Estimate
Summary

-1-MAY-1990 04:36:48 PM

.t Elements			Total Cost
Design Cost, Mgt and Integation, QA:	Construction		$7,924,600
	Decommissioning		$14,399,250
Construction Cost:			
Site Preparation		$39,830	
Surface Facilities		$400,000	
First Shaft		$1,800,000	
Second Shaft		$2,001,200	
Subsurface Excavation		$28,000,000	
Underground Services		$5,522,500	
Construction Operations		$6,690,000	
Construction Management		$2,151,000	
Capital Equipment		$6,809,500	

Subtotal			$53,414,030
Testing Program			$30,300,000
Decommissioning		$17,520,000	
Capital Equipment		$3,000,000	
		------------	$20,520,000
-ntingency			0

Grand Total Estimated Cost			$126,557,880

27-APR-1990

MAJOR ACTIVITIES	CALICO HILLS STRATEGY # 2 START	FINISH	Duration
DESIGN, TITLE I, II	01/01/94	03/30/99	
SITE PREPARATIONS	05/01/94	08/31/94	3
FIRST SHAFT CONST(ESF EXTENTION)	08/20/94	02/28/95	6
SURFACE FACILITIES CONSTRUCTION	09/01/94	02/28/95	6
SECOND SHAFT CONSTRUCTION	03/01/97	08/31/97	6
UNDERGROUND EXCAVATION	03/01/95	12/30/96	22
CALICO HILLS TESTING DELAY DUE TO SECOND SHAFT	01/01/96	12/31/98	36
DECOMMISSIONING	09/01/98	08/30/01	36

CHARACTERIZING CALICO HILLS
Strategy # 2

DESCRIPTION:
N & S location, inside the site, 2 accesses, extended drifting, integrated with ESF.

COST ESTIMATE DETAIL:

		ESF COST	PERCENT OF	AMOUNT
Design:	Title I, II, & III			
(Initial)	Mgt & Integration			
	QA	$17,153,000	20%	$3,430,600
	Health & Safety			
Construction Mgt		4302000	50%	$2,151,000

Site Preparation	ESF	ESF $	percent of	
Design		2261000	5%	$113,050
Roads & pads	4286000		0%	$0
Electric		1794000	1%	$17,940
Water		1109000	1%	$11,090
Communications		304000	2%	$6,080
Sewage		157000	1%	$1,570
Mobilization		63000	5%	$3,150
Capital Equip.		8333000	0%	$0
Total				$152,880

Surface Facilities:	ESF	percent of		
Design	$3,300,000		3%	$99,000
Adm. Bldg	4833000	TRAILERS	1	$100,000
Change Bldg.			2	$200,000
Warehouse			1	$100,000
Communications Bldg.			0	$0
Generator Bldg	553000		0%	$0
Hoist house	241000		0%	$0
Instrumentation Data Bldg				$0
Shaft collar	246000		0%	$0
Capital Equip.	940000		0%	$0
Total				$499,000

Primary Shaft Extention of ESF		Drill and blast	
Design	$2,315,000	0%	$0
Mob/Demob	307000	0%	$0
Sink/line	3000	600	$1,800,000
Hoist	423000	0%	$0
Headframe	116000	0%	$0
Capital Equip.	1908000	0%	$0
Total			$1,800,000

Secondary Access

Raised Bore to ESF

600 ft.

Design	$2,315,000	5%	$115,750
Mob/Demob	307000	50%	$153,500
Sink and line	$3,000	600	$1,800,000
Hoist	423000	50%	$211,500
Headframe	116000	50%	$58,000
Capital Equip.	2218000	10%	$221,800
Total			$2,338,750

Underground Drifting Sizes 12 X 14 FT.

Length in Ft.	14,000	$2,000	$28,000,000
Design	1415000	80%	$1,132,000
Capital Equip.:			
Mining Machine	3136000	80%	$2,508,800
Hauling Machine	included above		0
Total			$31,640,800

Underground Services

Design	5057000	60%	$3,034,200
Utilities 1st	1741000	30%	$522,300
Utilities 2nd	1209000	30%	$362,700
Test Level uti	1990000	80%	$1,592,000
Safety	1053000	80%	$842,400
Waste Water	217000	90%	$195,300
Ventilation	167000	90%	$150,300
Conveyance 1st	1514000	50%	$757,000
Conveyance 2nd	2201000	50%	$1,100,500
Capital Equip	3768000	80%	$3,014,400
Total			$11,571,100

Testing Program:	rate	$10,000		
Initial		Personnel	months	
SNL		10	36	$3,600,000
LANL		10	36	$3,600,000
USGS		10	36	$3,600,000
Install &Reeco		25	30	$4,500,000
Instr & supplies, IDS, Boreholes				$15,000,000
Total				$30,300,000

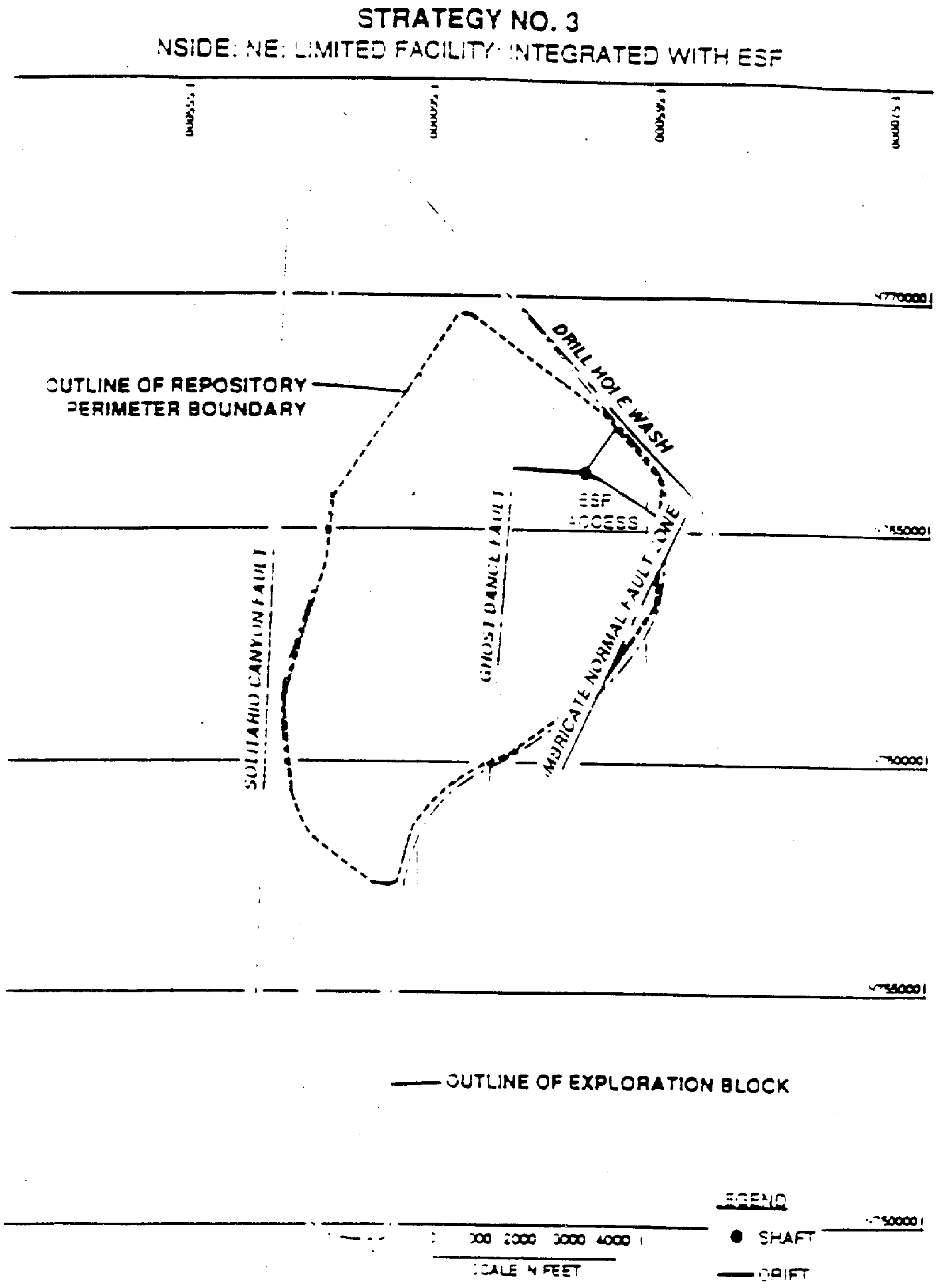
Construction Operations & Maintenance:

Maintenance	6113000	40%	$2,445,200
Operations	5306000	80%	$4,244,800
Electric	included above		
Sanitation	included above		
Water	included above		
Capital Equip	2129000	50%	$1,064,500
Total			$7,754,500

Decommisioning: (initial)	Original excavation Cost	percent of	
Design and Seal Development	6898750	60%	$4,139,250
Backfill drifts	28000000	60%	$16,800,000
Fill and seal Shaft #1	1800000	20%	$360,000
Fill and seal Shaft #2	1800000	20%	$360,000
Remove Surface Facilitie	499000	0%	$0
Site Restoration	152880	0%	$0
Capital Equip			$3,000,000
Rate	$9,000	months	
Management/Integration/QA	30	38	$10,260,000
Total			$34,919,250

04:36:48 PM Grand Total $126,557,880

Figure 2.4-8 Sketch depicting Calico Hills characterization Strategy No. 3.



Calico Hills Stategy # 3
Cost Estimate
Summary

01-MAY-1990

Cost Elements			Total Cost
Design Cost, Mgt and Integation, QA:	Construction		$5,120,950
	Decommissioning		$9,194,313
Construction Cost:			
Site Preparation		$39,830	
Surface Facilities		$400,000	
First Shaft		$1,800,000	
Second Shaft		$0	
Subsurface Excavation		$10,000,000	
Underground Services		$2,263,400	
Construction Operations		$3,120,050	
Construction Management		$1,290,600	
Capital Equipment		$5,457,300	

Subtotal			$24,371,180
Testing Program			$21,600,000
Decommissioning		$6,360,000	
Capital Equipment		$3,000,000	
		------------	$9,360,000
Contingency			0

Grand Total Estimated Cost			$69,646,443

01-MAY-1990

CALICO HILLS
STRATEGY # 3

MAJOR ACTIVITIES	START		FINISH
DESIGN, TITLE I, II	01/01/94		09/01/97
SITE PREPARATIONS	05/01/94	3	08/31/94
FIRST SHAFT CONST(ESF EXTENTION)	08/20/94	6	02/28/95
SURFACE FACILITIES CONSTRUCTION	09/01/94	6	02/28/95
SECOND SHAFT CONSTRUCTION		N/A	
UNDERGROUND EXCAVATION	03/01/95	10	12/30/95
CALICO HILLS TESTING	06/01/95	24	05/30/97
DECOMMISSIONING	02/01/97	20	12/30/98

CHARACTERIZING CALICO HILLS
Strategy # 3

SCRIPTION:
NE location, inside the site, 1 access, limited drifting, integrated with ESF

		ESF COST	PERCENT OF	AMOUNT
Design: (Initial)	Title I, II, & III			
	Mgt & Integration			
	QA	$17,153,000	15%	$2,572,950
	Health & Safety			
Construction Mgt		4302000	30%	$1,290,600
Site Preparation		ESF Cost	percent of	
	Design	2261000	5%	$113,050
	Roads & pads	4286000	0%	$0
	Electric	1794000	1%	$17,940
	Water	1109000	1%	$11,090
	Communications	304000	2%	$6,080
	Sewage	157000	1%	$1,570
	Mobilization	63000	5%	$3,150
	Capital Equip.	8333000	0%	$0
	Total			$152,880
Surface Facilities:		ESF Cost	percent of	
	Design	$3,300,000	3%	$99,000
	Adm. Bldg	4833000	1	$100,000
	Change Bldg.		2	$200,000
	Warehouse		1	$100,000
	Communications Bldg.		0	$0
	Generator Bldg	553000	0%	$0
	Hoist house	241000	0%	$0
	Instrumentation Data Bldg		0%	$0
	Shaft collar	246000	0%	$0
	Capital Equip.	940000	0%	$0
	Total			$499,000
Primary Shaft Extention of ESF			Drill and blast	
	Design	$2,315,000	0%	$0
	Mob/Demob	307000	0%	$0
	Sink/line	$3,000	600	$1,800,000
	Hoist	423000	0%	$0
	Headframe	116000	0%	$0
	Capital Equip.	1908000	0%	$0
	Total			$1,800,000

Secondary Access None

Design	$2,315,000	0%	$0
Mob/Demob	307000	0%	$0
Sink and line	$3,000	0%	$0
Hoist	423000	0%	$0
Headframe	116000	0%	$0
Capital Equip.	2218000	0%	$0
Total			$0

Underground Drifting Size 12 X 14 FT.

Length in Ft.	5,000	$2,000	$10,000,000
Design	1415000	40%	$566,000
Capital Equip.:			
Mining Machine	3136000	80%	$2,508,800
Hauling Machine	included above		0
Total			$13,074,800

Underground Services

Design	5057000	35%	$1,769,950
Utilities 1st	1741000	30%	$522,300
Utilities 2nd	1209000	0%	$0
Test Level uti	1990000	45%	$895,500
Safety	1053000	70%	$737,100
Waste Water	217000	50%	$108,500
Ventilation	167000	0%	$0
Conveyance 1st	1514000	0%	$0
Conveyance 2nd	2201000	0%	$0
Capital Equip	3768000	50%	$1,884,000
Total			$5,917,350

Testing Program:	Rate	$10,000		
		Personnel	Months	
SNL		10	24	$2,400,000
LANL		10	24	$2,400,000
USGS		10	24	$2,400,000
Install &Reeco		20	20	$2,400,000
Instr & supplies, IDS, Boreholes				$12,000,000
		------		------------
Total		50		$21,600,000

Construction Operations & Maintenance:

Maintenance	6113000	25%	$1,528,250
Operations	5306000	30%	$1,591,800
Electric	included above		
Sanitation	included above		
Water	included above		
Capital Equip	2129000	50%	$1,064,500

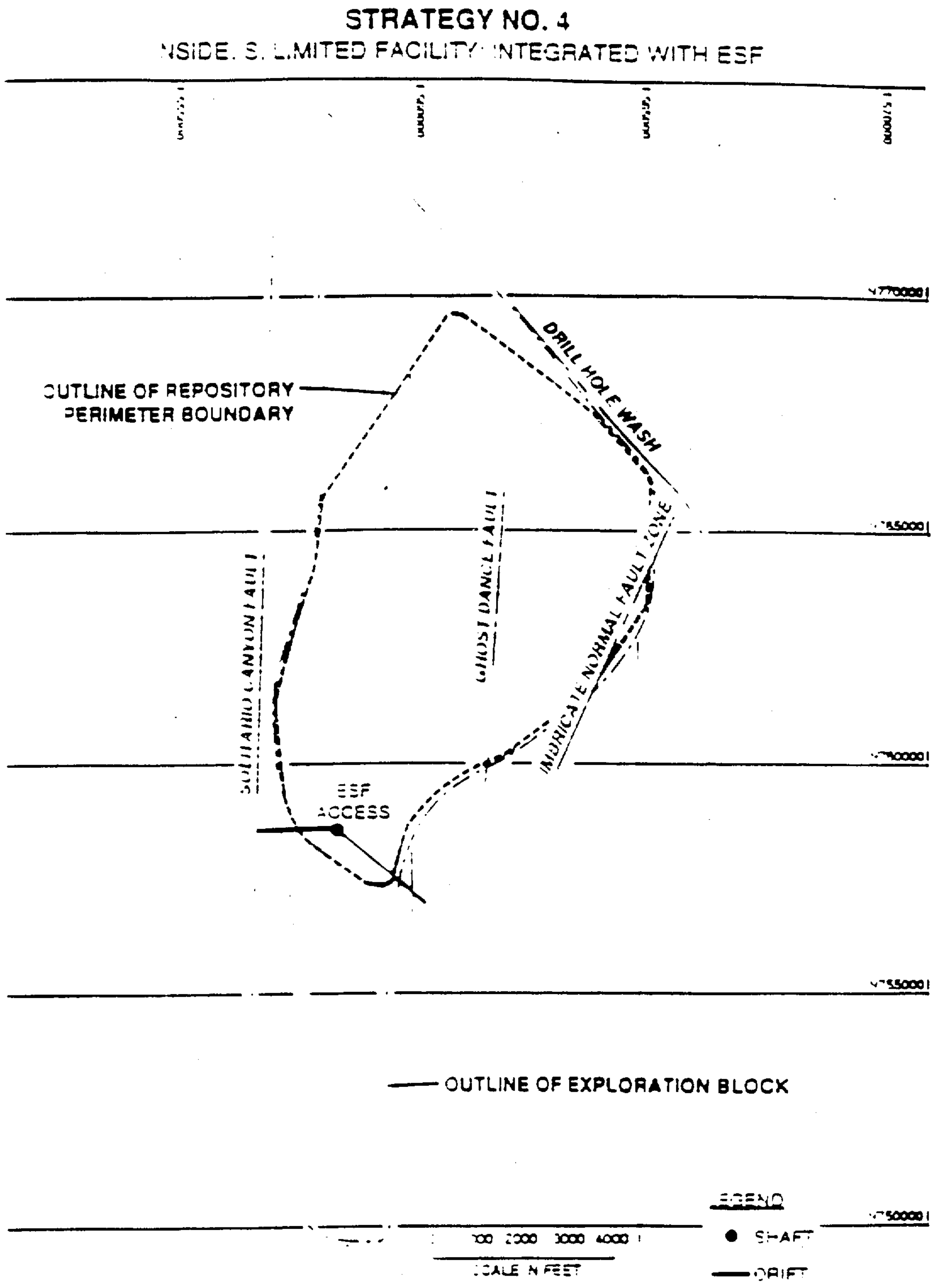
	Total		$4,184,550

Decommisioning: (initial)		Original excavation Cost	percent of	
Design and Seal Development		6898750	55%	$3,794,313
Backfill drifts		10000000	60%	$6,000,000
Fill and seal Shaft #1		1800000	20%	$360,000
Fill and seal Shaft #2		0	20%	$0
Remove Surface Facilitie		499000	0%	$0
Site Restoration		152880	0%	$0
Capital Equip				$3,000,000
	Rate	$9,000	Months	
Management/Integration/QA		30	20	$5,400,000

Total				$18,554,313

Grand total	$69,646,443

Figure 2.4-9 Sketch depicting Calico Hills characterization Strategy No. 4.



Calico Hills Stategy # 4
Cost Estimate
Summary

-MAY-1990

c Elements			Total Cost
Design Cost, Mgt and Integation, QA:	Construction		$5,120,950
	Decommissioning		$9,194,313
Construction Cost:			
Site Preparation		$39,830	
Surface Facilities		$400,000	
First Shaft		$1,800,000	
Second Shaft		$0	
Subsurface Excavation		$10,000,000	
Underground Services		$2,263,400	
Construction Operations		$3,120,050	
Construction Management		$1,290,600	
Capital Equipment		$5,457,300	

Subtotal			$24,371,180
Testing Program			$21,600,000
Decommissioning		$6,360,000	
Capital Equipment		$3,000,000	
		------------	$9,360,000
tingency			0

Grand Total Estimated Cost			$69,646,443

27-APR-1990

MAJOR ACTIVITIES	CALICO HILLS STRATEGY # 4 START	FINISH	
DESIGN, TITLE I, II	01/01/94	09/01/97	
SITE PREPARATIONS	05/01/94	08/31/94	3
FIRST SHAFT CONST(ESF EXTENTION)	08/20/94	02/28/95	6
SURFACE FACILITIES CONSTRUCTION	09/01/94	02/28/95	6
SECOND SHAFT CONSTRUCTION	N/A		
UNDERGROUND EXCAVATION	03/01/95	12/30/95	10
CALICO HILLS TESTING	06/01/95	05/30/97	24
DECOMMISSIONING	02/01/97	12/30/98	20

CHARACTERIZING CALICO HILLS
Strategy # 4

DESCRIPTION:
South location, inside the site, 1 access, limited drifting, integrated with ESF

COST ESTIMATE DETAIL:

		ESF COST	PERCENT OF	AMOUNT
Design: (Initial)	Title I, II, & III Mgt & Integration QA Health & Safety	$17,153,000	15%	$2,572,950
Construction Mgt		4302000	30%	$1,290,600

Site Preparation		ESF Cost	percent of	
	Design	2261000	5%	$113,050
	Roads & pads	4286000	0%	$0
	Electric	1794000	1%	$17,940
	Water	1109000	1%	$11,090
	Communications	304000	2%	$6,080
	Sewage	157000	1%	$1,570
	Mobilization	63000	5%	$3,150
	Capital Equip.	8333000	0%	$0
	Total			$152,880

Surface Facilities:		ESF Cost	percent of	
	Design	$3,300,000	3%	$9[illegible]00
	Adm. Bldg	4833000	1	$10[illegible]00
	Change Bldg.		2	$200,000
	Warehouse		1	$100,000
	Communications Bldg.		0	$0
	Generator Bldg	553000	0%	$0
	Hoist house	241000	0%	$0
	Instrumentation Data Bldg		0%	$0
	Shaft collar	246000	0%	$0
	Capital Equip.	940000	0%	$0
	Total			$499,000

Primary Shaft Extention of ESF			Drill and blast	
	Design	$2,315,000	0%	$0
	Mob/Demob	307000	0%	$0
	Sink/line	$3,000	600	$1,800,000
	Hoist	423000	0%	$0
	Headframe	116000	0%	$0
	Capital Equip.	1908000	0%	$0
	Total			$1,800,000

Secondary Access None

Design	$2,315,000	0%	$0
Mob/Demob	307000	0%	$0
Sink and line	$3,000	0%	$0
Hoist	423000	0%	$0
Headframe	116000	0%	$0
Capital Equip.	2218000	0%	$0
Total			$0

Underground Drifting Size 12 X 14 FT.

Length in Ft.	5,000	$2,000	$10,000,000
Design	1415000	40%	$566,000
Capital Equip.:			
Mining Machine	3136000	80%	$2,508,800
Hauling Machine	included above		0
Total			$13,074,800

Underground Services

Design	5057000	35%	$1,769,950
Utilities 1st	1741000	30%	$522,300
Utilities 2nd	1209000	0%	$0
Test Level uti	1990000	45%	$895,500
Safety	1053000	70%	$737,100
Waste Water	217000	50%	$108,500
Ventilation	167000	0%	$0
Conveyance 1st	1514000	0%	$0
Conveyance 2nd	2201000	0%	$0
Capital Equip	3768000	50%	$1,884,000
Total			$5,917,350

Testing Program:	Rate	$10,000		
		Personnel	Months	
SNL		10	24	$2,400,000
LANL		10	24	$2,400,000
USGS		10	24	$2,400,000
Install &Reeco		20	20	$2,400,000
Instr & supplies, IDS, Borehole				$12,000,000
		------		------------
Total		50		$21,600,000

Construction Operations & Maintenance:

Maintenance	6113000	25%	$1,528,250
Operations	5306000	30%	$1,591,800
Electric	included above		
Sanitation	included above		
Water	included above		
Capital Equip	2129000	50%	$1,064,500

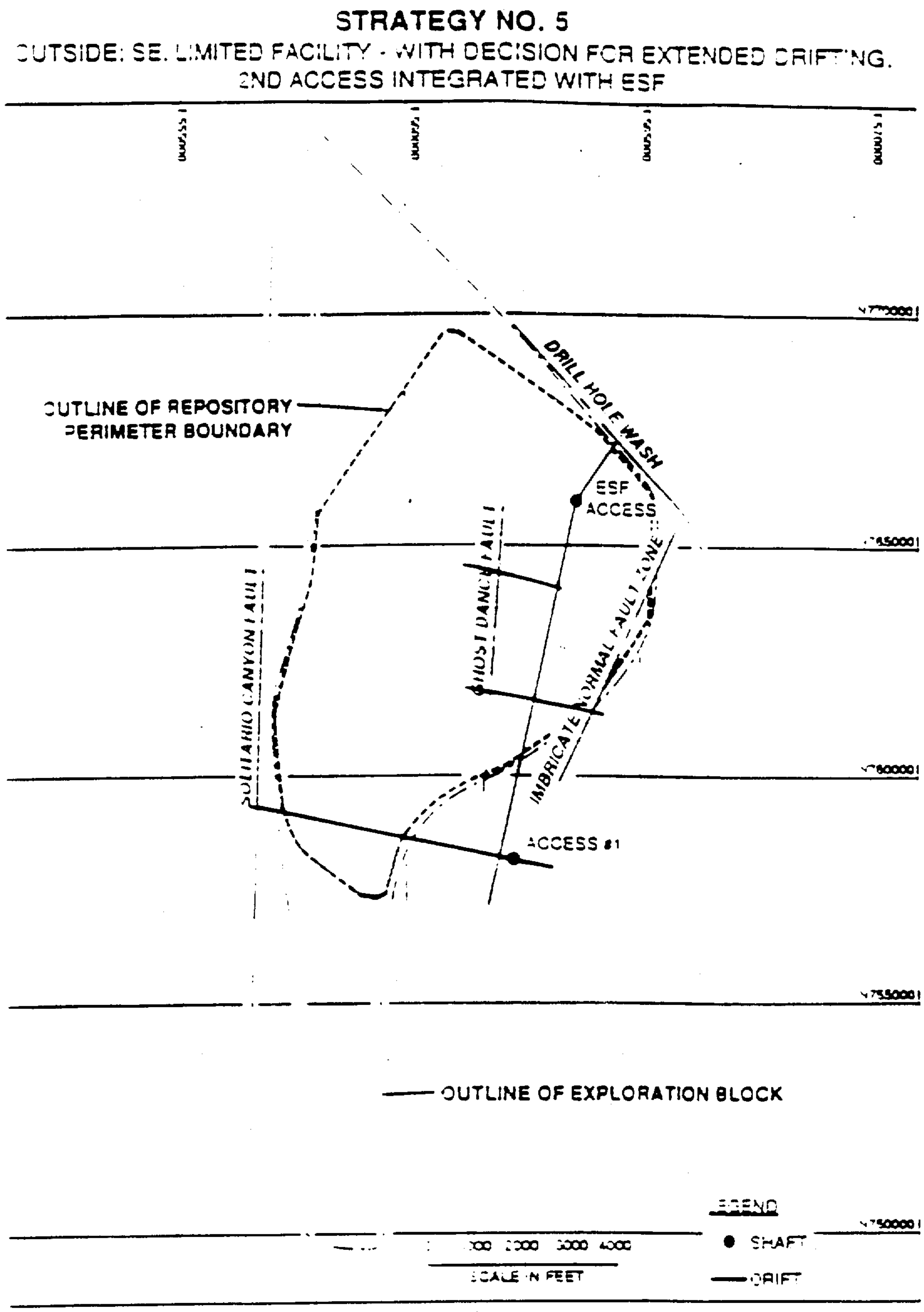
	Total		$4,184,550

Decommisioning: (initial)	Original excavation Cost	percent of	
Design and Seal Development	6898750	55%	$3,794,313
Backfill drifts	10000000	60%	$6,000,000
Fill and seal Shaft #1	1800000	20%	$360,000
Fill and seal Shaft #2	0	20%	$0
Remove Surface Facilitie	499000	0%	$0
Site Restoration	152880	0%	$0
Capital Equip			$3,000,000
Rate	$9,000	Months	
Management/Integration/QA	30	20	$5,400,000

Total			$18,554,313

05:06:53 PM Grand total $69,646,443

Figure 2.4-10 Sketch depicting Calico Hills characterization Strategy No. 5.



Calico Hills Stategy # 5
Cost Estimate
Summary

02-MAY-1990

Cost Elements			Total Cost
INITIAL PHASE			
Design Cost, Mgt and Integation, QA:	Construction		$10,165,050
	Decommissioning		$9,194,313
Construction Cost:			
Site Preparation		$2,654,900	
Surface Facilities		$1,500,200	
First Shaft		$5,565,400	
Surface Base Test Facilities		$2,010,500	
Subsurface Excavation		$10,000,000	
Underground Services		$4,215,300	
Construction Operations		$3,568,740	
Construction Management		$1,720,800	
Capital Equipment		$11,673,550	

Subtotal			$42,909,390
Testing Program - Underground			$21,600,000
Surface Based			$15,400,000
Decommissioning		$10,370,255	
Capital Equipment		$3,000,000	

			$13,370,255
Contingency			0

Total Estimated Cost - Initial Program			$112,639,008

EXTENDED OPTIONAL PHASE

Design Cost, Mgt and Integation, QA:	Construction	$6,979,465	
	Decommissioning	$4,188,578	
		------------	$11,168,043
Construction Cost:			
Site Preparation			0
Surface Facilities			0
Second Shaft		$1,861,400	
Subsurface Excavation		$24,000,000	
Underground Services		$2,587,900	
Construction Operations		$6,851,400	
Construction Management		$2,107,980	
Capital Equipment		$2,194,900	

Subtotal			$39,603,580
Testing Program			$23,500,000
Decommissioning		$18,060,000	
Capital Equipment		0	

			$18,060,000
Contingency			0

Total Estimated Cost - Optional Extended Drifting			$92,331,623
Grand Total- Initial Program and Option			$204,970,631

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CALICO HILLS
STRATEGY # 5
SCHEDULE

01-MAY-1990

MAJOR ACTIVITIES	START	FINISH	
DESIGN, TITLE I, II, III	04/15/91	06/30/96	
SURFACE BASED TEST PREP	01/01/92	04/30/92	4
SURFACE BASED TESTING (PROW PASS)	05/01/92	04/30/94	24
SITE PREP FOR SHAFT	07/15/92	10/30/92	3.5
FIRST SHAFT CONSTRUCTION	11/01/92	07/30/93	9
SURFACE FACILITIES CONSTRUCTION	10/01/92	03/30/93	6
UNDERGROUND EXCAVATION	08/01/93	05/30/94	10
CALICO HILLS TESTING	11/01/93	10/30/95	24
DECOMMISSIONING	11/01/95	08/30/97	20
DECISION POINT	10/30/94		

PHASED OPTION - EXTENDED DRIFTING

DESIGN	11/01/94		
SECOND SHAFT - ESF EXTENTION	02/01/95	07/30/95	6
UNDERGROUND EXCAVATION NORTHWARD	02/01/95	01/15/97	23.5
CALICO HILLS TESTING	11/01/95	10/30/98	36
DECOMMISSIONING	11/01/98	10/30/01	36

CHARACTERIZING CALICO HILLS
STRATEGY # 5

DESCRIPTION:

SE location, outside the site, access, limited drifting, no ESF Integration. Include surface base testing. Phased option could be excersized with extended drifting. A second access would be integrated with the ESF.

COST ESTIMATE DETAIL:

		ESF COST	PERCENT OF	AMOUNT
Design: Initial	Title I, II, & III Mgt & Integration QA Health & Safety	$17,153,000	15%	$2,572,950
Design: Optional	Title I, II, & III Mgt & Integration QA Health & Safety	5145900	35%	$1,801,065
Construction Mgt		4302000	40%	$1,720,800
Optional Const. Mgt.		3011400	70%	$2,107,980

Site Prep - Initial		ESF Cost	percent of	
	Design	2261000	30%	$678,300
	Roads & pads	4286000	30%	$1,285,800
	Electric	1794000	50%	$897,000
	Water	1109000	30%	$332,700
	Communications	304000	20%	$60,800
	Sewage	157000	30%	$47,100
	Mobilization	63000	50%	$31,500
	Capital Equip.	8333000	40%	$3,333,200
	Total			$6,666,400

Surface Fac - Initial		ESF	percent of	
	Design	$3,300,000	25%	$825,000
	Adm. Bldg	4833000	Trailers 2	$200,000
	Change Bldg.		2	$200,000
	Warehouse		1	$300,000
	Communications Bldg.		1	$100,000
	Generator Bldg	553000	20%	$110,600
	Hoist house	241000	80%	$192,800
	Instrumentation Data Bldg			$200,000
	Shaft collar	246000	80%	$196,800
	Capital Equip.	940000	100%	$940,000
	Total			$3,265,200

Primary Shaft		Drill and blast		
	Design	$2,315,000	40%	$926,000
	Mob/Demob	307000	60%	$184,200
	Sink/line	3000	1650	$4,950,000
	Hoist	423000	80%	$338,400
	Headframe	116000	80%	$92,800
	Capital Equip.	1908000	80%	$1,526,400
	Total			$8,017,800

Surface Base Testing

SBT Site Prep Crow Pass		ESF Cost	percent of	
	Design	2261000	20%	$452,200
	Roads & pads	4286000	20%	$857,200
	Electric	1794000	30%	$538,200
	Water	1109000	20%	$221,800
	Communications	304000	10%	$30,400
	Sewage	157000	20%	$31,400
	Mobilization	63000	50%	$31,500
	Capital Equip.	8333000	5%	$416,650
	Total			$2,579,350

SBT Surface Fac		ESF	percent of	
	Design	$3,300,000	3%	$99,000
	Adm. Bldg	4833000	Trailers 2	$200,000
	Communications Bldg.		1	$100,000
	Total			$399,000

Surface Based Testing		Rate Personnel	$10,000 Months	
	Labs	20	12	$2,400,000
	REECO	10	10	$1,000,000
	Drilling Spt.	1000000	6	$6,000,000
	Instrum. & supplies			$6,000,000
	Total			$15,400,000

Secondary Access Integrated with ESF

Optional	Shaft:	Rate $3,000 per ft.		
	Design	$2,315,000	0%	$0
	Mob/Demob	307000	20%	$61,400
	Sink and line	above	600	$1,800,000
	Hoist	423000	0%	$0
	Headframe	116000	0%	$0
	Capital Equip.	2218000	0%	$0
	Total			$1,861,400

Underground Drifting			Rate	
	Length in feet	5,000	$2,000	$10,000,000
	Size	12 X 14 FT.		
	Design	1415000	40%	$566,000
	Capital Equip.:			
	Mining Machine	3136000	80%	$2,508,800
	Hauling Machine	included above		0
	Total			$13,074,800

Option for drifting inside the block 12 x14

Length in ft.	12000	$2,000	$24,000,000
Design	1416000	80%	$1,132,800
Total			$25,132,800

Underground Services

Design	5057000	80%	$4,045,600
Utilities 1st	1741000	90%	$1,566,900
Utilities 2nd	1209000	0%	$0
Test Level uti	1990000	45%	$895,500
Safety	1053000	70%	$737,100
Waste Water	217000	50%	$108,500
Ventilation	167000	90%	$150,300
Conveyance 1st	1514000	50%	$757,000
Conveyance 2nd	2201000	0%	$0
Capital Equip	3768000	50%	$1,884,000
Total			$10,144,900

Optional Services
Underground Services

Design	5057000	80%	$4,045,600
Utilities 1st	1741000	0%	$0
Test Level uti	1990000	80%	$1,592,000
Safety	1053000	70%	$737,100
Waste Water	217000	50%	$108,500
Ventilation	167000	90%	$150,300
Capital Equip	3768000	30%	$1,130,400
Total			$7,763,900

Testing Program: rate $10,000
(initial)

	Personnel	months	
SNL	10	24	$2,400,000
LANL	10	24	$2,400,000
USGS	10	24	$2,400,000
Install &Reeco	20	20	$2,400,000
Instr & Supplies, IDS, Boreholes			$12,000,000
Total	50		$21,600,000

Optional Extended Testing

	Personnel		
SNL	10	36	$3,600,000
LANL	10	36	$3,600,000
USGS	10	36	$3,600,000
Install &Reeco	15	30	$2,700,000
Instr & Supplies			$10,000,000
TOTAL	45		$23,500,000

Construction Operations & Maintenance:

Maintenance	6113000	28%	$1,711,640
Operations	5306000	35%	$1,857,100
Electric	included above		
Sanitation	included above		
Water	included above		
Capital Equip	2129000	50%	$1,064,500
Includes Prow Pass Fac.			
Total			$4,633,240

Optional Operations and Maint			
Maintenance	6113000	60%	$3,667,800
Operations	5306000	60%	$3,183,600
Electric	included above		
Sanitation	included above		
Water	included above		
Capital Equip	2129000	50%	$1,064,500
	Total		$7,915,900

Decommisioning: (initial)	Original excavation Cost	percent of	
Design and Seal Development	6898750	55%	$3,794,313
Initial			
Backfill drifts	10000000	60%	$6,000,000
Fill and seal Shaft #1	4950000	40%	$1,980,000
Fill and seal Shaft #2	1800000	0%	$0
Remove Sur Fac(Incl SBTF	3664200	40%	$1,465,680
Site Restor(Incl SBT)	9245750	10%	$924,575
Capital Equip			$3,000,000
Rate	$9,000	Months	
Management/Integration/QA	30 personnel	20	$5,400,000
Total			$22,564,568
Optional drifting Decom:			
Backfill drifts	24000000	70%	$16,800,000
Fill/ seal Shaft #2	1800000	70%	$1,260,000
Design and Seal Development	$3,794,313	25%	$948,578
Management/Integration/QA	10	36	$3,240,000
Total	OPTION		$22,248,578
Total-Initial			$112,639,008
Total- Option			$92,331,623
08:28:56 AM	Grand Total		$204,970,631

CALICO HILLS STRATEGY # 6
COST ESTIMATE
SUMMARY

02-MAY-1990

Design Cost, Management and Integration, QA	Construction		$2,279,200
	Decommissioning		$460,000
Construction Cost:			
Site Preparation		$1,710,500	
Site Facilities		$300,000	
Capital Equipment		$416,650	
Construction Management		$324,000	
Operations and Maint		$720,000	

			$3,471,150
Testing Program			$18,020,000
Decommissioning			$1,229,650
Contingency			0

	Total Estimated Cost		$25,460,000

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CALICO HILLS
STRATEGY # 6
SCHEDULE

	START	FINISH	Duration
DESIGN	08/01/92	12/30/93	
SITE PREP	01/02/93	06/30/93	6
SURFACE FACILITIES	05/01/93	10/30/93	6
SURFACE BASED TESTING	09/01/93	08/30/95	24
DECOMMISSIONING	09/01/95	06/30/96	10

CHARACTERIZING CALICO HILLS
STRATEGY # 6

DESCRIPTION:

Surface based testing at various locations including drill holes from the ESF Main Test Level. Includes a site at the Prow.

Site Prep Crow Pass		ESF Cost	percent of	
	Design	2261000	20%	$452,200
	Roads & pads	4286000	20%	$857,200
	Electric	1794000	30%	$538,200
	Water	1109000	20%	$221,800
	Communications	304000	10%	$30,400
	Sewage	157000	20%	$31,400
	Mobilization	63000	50%	$31,500
	Capital Equip.	8333000	5%	$416,650
	Total			$2,579,350

SBT Surface Fac		ESF	percent of	
	Design	$3,300,000	3%	$99,000
	Adm. Bldg	4833000	Trailers 2	$200,000
	Communications Bldg.		1	$100,000
	Total			$399,000

Surface Based Testing		Personnel	Rate $10,000 Months	
	Labs	20	18	$3,600,000
	REECO	18	14	$2,520,000
	Drilling Spt.	1000000	5	$5,000,000
	Excavation			$900,000
	Instrum. & supplies			$6,000,000
	Total	38		$18,020,000
Management and Integration, QA		8	$9,000 24	$1,728,000
Construction Management		2	18	$324,000
Operations and Maintenance		4	20	$720,000

Decommissioning		Original Cost		
	Design			$100,000
	Plug Holes	5000000	20%	$1,000,000
	Site Restorati	2127150	10%	$214,650
	Remove Surface	300000	5%	$15,000
	Management & Integration, QA	4	10	$360,000
				$1,689,650
	Total Option #6			$25,460,000

CALICO HILLS - COST AND SCHEDULE GUIDANCE AND ASSUMPTIONS

1. LOWEST COST ALTERNATIVES - SHAFTS NOT RAMPS
2. SHORT PERIOD OF TIME TO COMPLETE THEREFORE BEST ESTIMATES AVAILABLE
3. CONSISTENCY BETWEEN EACH STRATEGY IMPORTANT
4. ALL COST IN PRESENT VALUE AND NO CONTINGENCY ADDED
5. MOST CONSTRUCTION COST ESTIMATES BASED ON ESF COST
6. OTHER COST AND SCHEDULE VALUES:
   - A. 5,000 FT. OF DRIFTING FOR LIMITED FACILITY
   - B. 12,000 FT. OF DRIFTING FOR EXTENDED FACILITY
   - C. 1,650 FT. SHAFT DEPTH FOR NEW SHAFTS
   - D. 600 FT. SHAFT CONNECTIONS TO ESF MTL
   - E. DRIFTING COST AT $2,000 PER FT., 18 FT. PER DAY
   - F. SHAFT SINKING AT $3,000 PER FT., 8 FT. PER DAY
   - G. TESTING TIME: 3 YRS FOR EXTENDED FACILITY
2 YRS FOR LIMITED FACILITY
7. TESTING COST HAVE LEAST BASIS SINCE ESF TESTING IS DIFFERENT
8. DECOMMISSIONING COST ADDED WITH NO ESF EQUIVALENT
DECOM COST BASED ON A PERCENT OF CONSTRUCTION COST
9. CALICO HILLS STRATEGIES BEGIN AFTER 2 YEARS OF SURFACE BASED TESTING 1/93

SAIC

Science Applications International Corporation

ELH:sjt:M90-015
WBS 1.2.5.2
QA

INTEROFFICE MEMO

DATE: April 17, 1990

TO: Victor J. Rohrer, T-10

FROM: Ernest L. Hardin, T-13 ELH

SUBJECT: Guidance for Cost/Schedule Estimation for Calico Hills Characterization Strategies

Approximate incremental cost estimates for the Calico Hills characterization strategies will be needed on 5/1/90. The strategies are described in the meeting summary for the 3/30/90 task force meeting, and are further described in the interim product for element 2.4 of the study (Compose Alternative Characterization Strategies as described in the plan, (YMP/90-3). This product will receive review and concurrence of the task force during the meeting scheduled for April 16, 17, and 18.

The strategies do not specify all of the major design details which you may need. However, the choices for such design features are fairly straight-forward. Where a strategy is indeterminate in this way, for example whether a shaft or ramp is constructed for primary or secondary access to the Calico Hills unit, assume the design choice that results in lowest cost.

For your information, an example of costing for a similar study may be found in the briefing package for the ESF alternatives pilot study, however, less detailed cost estimates are needed for the Calico Hills study. The following optional guidance is provided for your use.

You may assume that the shaft for a single access, limited facility with no ESF connection would be built in a cost-effective manner, with three stations, to a total depth of no more than 1,650 feet. Surface facilities, utilities, and road access would be needed for such a facility. You may assume that the extent of drifting in such a facility would be 5,000 feet, representing limited penetration along three or more headings. For testing costs associated with a single-access, limited Calico Hills facility, you may assume the following: (1) a preliminary dry-drilled corehole from the surface (similar to one of the multi-purpose boreholes) to explore rock conditions; (2) geologic mapping of all underground openings by photogrammetric means; (3) sampling throughout the facility and in the muck-pile for matrix hydrologic tests, hydrochemistry tests, etc.; (4) perched water test; (5) a series of radial boreholes tests, involving 2,000 feet of drilling from the shaft; and (6) hydrologic properties of faults. These tests would be conducted during construction, in the manner of the construction phase ESF tests.

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For an operational facility with a second access (outside part of Strategy 1, or second phase of Strategy 6), you may assume that the secondary access is a raise bore, either (1) to the surface, or (2) to the ESF, depending on whether there is an ESF connection. For Strategy 2, you may assume that the primary access to the Calico Hills is an extension of a drill-blast shaft constructed for the ESF, and that the secondary access is a 600-foot raise bore connected with the ESF (i.e., for both accesses the part between the surface and the ESF main test level is covered under ESF cost). For all operational facilities (Strategies 1, 2, and 5) you may assume that the extent of drifting totals 12,000 feet, and the construction phase tests identified in the previous paragraph are carried out. In addition, you may assume that two major hydrologic tests are conducted during a testing phase subsequent to the construction phase, using the bulk permeability and infiltration tests in the ESF as models.

For limited facilities that are connected with the ESF (i.e., second phase of Strategy 1, and Strategies 3 and 4), you may assume that the access is a drill-blast shaft that extends 600 feet downward from the MTL of the ESF, with limited drifting and construction phase testing such as described above for limited facilities with no ESF connection.

Only approximate estimates of incremental cost, beyond the cost of the ESF and the SCP-basis SBT program, are needed for the Calico Hills study. Relative (not absolute) accuracy of cost estimates needed for comparing different strategies, is on the order of 25%. Emphasize consistency of assumptions used for the different strategies. Estimate all costs in terms of present value. For simplicity, you may estimate only a few cost values, such as primary access (both separate from and integrated with the ESF), limited development and construction phase testing, secondary access (both separate from and integrated with the ESF), and extended development and major tests. These values can then be combined to develop estimates for the different strategies. A similar approach may be taken for strategies which involve SBT in addition to the SCP-basis SBT program (Strategies 4 and 5).

Schedule information will be difficult to develop at this time because of uncertainty as to the ESF configuration and schedule. Therefore you may consider schedule only in broad terms, and after cost estimates have been developed. Make use of existing schedule data for the SCP-basis ESF facility construction and testing to the extent practicable. Detailed scheduling is not needed for this exercise, rather, the approximate duration of construction and testing phases would be adequate. You may assume that each Calico Hills strategy begins after 2 years of the SCP-basis surface-based testing program. Assume that each strategy begins at the same time and runs concurrently with the ESF, except those that depend on the ESF for primary access, which will be delayed as the ESF is developed (you might use the Title I ESF design as a basis for estimating this delay).

Victor J. Rohrer
ELH:sjt:M90-015
April 17, 1990
Page Three

If you have questions on this assignment, please feel free to consult with Errol Gardiner or any other task force member. Use the help of Bruce Schepens to the extent practical, but please restrict strategy cost data from other task force members until May 1st. Let me know if you need additional resources. Thanks for your contribution to this important study.

7567

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CALICO HILLS STUDY
COST AND SCHEDULE INFORMATION
MISCELLANEOUS BACKUP
MAY 2, 1990

SOURCES OF DATA:

Bruce Schepens, REECo
John Peck, SAIC
Jim Taylor, SAIC
Ivan Cottle, SAIC
Bob Graham, SAIC
Kathleen Bujard, LANL
Bob Craig, USGS
Derrick Wagg, SAIC

Samples of Testing Cost:

Underground Mapping	$2 Million
Perched Water	$.98 Million
USGS Activities	$3.6 Million
Diffusion Test	$2 Million

About 35 People would be involved during the Program

Surface Based Testing:

Deepen Multi-purpose Boreholes	$1 M
Drill 3 Angle boreholes from surface	3 M
Drill 2 dry angle from MTL (ESF) to Ghost Dance Fault	$2 M
Excavate a small Fault	$ .4M
Shallow adit 200 ft. Deep for Hydrologic	$ .5 M

10-May-89

EXPLORATORY SHAFT FACILITY BUDGET SUPPORT DATA

(Total Project Costs)

(Thousands of FY 1990 Dollars, Year of Expenditure Dollars where noted by *)

Spreadsheet: 10-MAY-89
Project: NNWSI

EXPLORATORY SHAFT FACILITY WBS ELEMENT	Actual Expenditures Prior *	FY88 *	Fiscal Year 80 1989	1990	1991	1992	1993	1994	1995	Subtotal
5.1. Management and Integration	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
TEC	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Design	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Title I	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Architect-Engineer	$0	$940	$0	$0	$0	$0	$0	$0	$0	$940
Other	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Title II	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Architect-Engineer	$0	$0	$1,545	$1,486	$0	$0	$0	$0	$0	$3,031
Other	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Title III	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Architect-Engineer M&I	$0	$0	$151	$599	$1,810	$424	$0	$0	$0	$2,984
Architect-Engineer Design	$0	$0	$453	$1,796	$5,429	$1,271	$0	$0	$0	$8,949
Other	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Prior Years Summary	$1,249	$0	$0	$0	$0	$0	$0	$0	$0	$1,249
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal w/o Contingency	$1,249	$940	$2,149	$3,881	$7,239	$1,695	$0	$0	$0	$17,153
Contingency	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design Subtotal	$1,249	$940	$2,149	$3,881	$7,239	$1,695	$0	$0	$0	$17,153
Escalation			$0	$0	$362	$178	$0	$0	$0	$540
Design Total *	$1,249	$940	$2,149	$3,881	$7,601	$1,873	$0	$0	$0	$17,693
BA *	$1,249	$940	$1,839	$4,542	$7,607	$1,855	$0	$0	$0	$18,032
Construction	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Management	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Support Contractor	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Architect-Engineer	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Construction Manager	$0	$0	$370	$1,731	$1,756	$445	$0	$0	$0	$4,302
Other	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other (specify)	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
[NTS ALLOCATION]	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capital Equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal w/o Contingency	$0	$0	$370	$1,731	$1,756	$445	$0	$0	$0	$4,302
C[illegible]ngency - Capital Equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Contingency - Other Construct.	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Construction Subtotal	$0	$0	$370	$1,731	$1,756	$445	$0	$0	$0	$4,302
Escalation	$0	$0	$0	$0	$88	$47	$0	$0	$0	$135
Construction Total *	$0	$0	$370	$1,731	$1,844	$492	$0	$0	$0	$4,437
BA - Capital Equipment *	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
BA - Other Construction *	$0	$0	$317	$2,026	$1,846	$487	$0	$0	$0	$4,676
TEC M & I Subtotal	$1,249	$940	$2,519	$5,612	$8,995	$2,140	$0	$0	$0	$21,455
Contingency	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Unescalated Subtotal	$1,249	$940	$2,519	$5,612	$8,995	$2,140	$0	$0	$0	$21,455
Escalation	$0	$0	$0	$0	$450	$225	$0	$0	$0	$674
TEC M & I Total *	$1,249	$940	$2,519	$5,612	$9,445	$2,365	$0	$0	$0	$22,129
BA - Capital Equipment *	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
BA - Design & Construction *	$1,249	$940	$2,156	$6,568	$9,453	$2,342	$0	$0	$0	$22,708

Note: Contingency includes special scope change allowances as follows:

1.
2.
3.

EXPLORATORY SHAFT FACILITY BUDGET SUPPORT DATA
(Total Project Costs)
(Thousands of FY 1990 Dollars, Year of Expenditure Dollars where noted by *)

Spreadsheet: 31-MAY-89
Project: NNWSI

EXPLORATORY SHAFT FACILITY WBS ELEMENT	Actual Expenditures Prior *	FY88 *	Fiscal Year 80 1989	1990	1991	1992	1993	1994	1995	Subtotal
5.1. Management and Integration	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
NON-TEC	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Design	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Conceptual Design	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Architect-Engineer	$1,168	$0	$0	$0	$0	$0	$0	$0	$0	$1,168
Other	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Architect-Eng. Title III	$0	$0	$0	$0	$0	$3,812	$4,301	$1,121	$953	$10,187
Lab Mgr.	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Prior Years Testing	$19,321	$8,019	$0	$0	$0	$0	$0	$0	$0	$27,340
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal w/o Contingency	$20,489	$8,019	$0	$0	$0	$3,812	$4,301	$1,121	$953	$38,695
Contingency	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design Subtotal	$20,489	$8,019	$0	$0	$0	$3,812	$4,301	$1,121	$953	$38,695
Escalation	$0	$0	$0	$0	$0	$400	$718	$266	$297	$1,682
Design Total *	$20,489	$8,019	$0	$0	$0	$4,212	$5,019	$1,387	$1,250	$40,377
BA *	$20,489	$8,019	$0	$0	$0	$4,173	$4,830	$1,382	$1,250	$40,143
Operations	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Management	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Support Contractor	$998	$1,804	$2,499	$3,440	$4,000	$4,000	$2,700	$1,640	$1,640	$22,721
Architect-Engineer	$1,377	$2,092	$3,032	$3,675	$2,640	$3,736	$3,412	$1,452	$1,180	$22,596
Construction Manager	$283	$509	$752	$0	$0	$1,336	$1,810	$1,294	$1,324	$7,308
Lab Mgr.	$1,019	$765	$1,766	$2,049	$1,195	$1,097	$1,103	$979	$689	$10,662
QA	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Support Contractor	$111	$175	$290	$360	$360	$360	$360	$360	$360	$2,736
Architect-Engineer	$386	$697	$310	$345	$330	$317	$342	$301	$296	$3,324
Construction Manager	$0	$11	$46	$229	$298	$298	$298	$155	$155	$1,490
Labs	$232	$91	$0	$0	$0	$0	$0	$0	$0	$323
Health & Safety	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Support Contractor	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Architect-Engineer	$0	$13	$227	$187	$131	$123	$137	$115	$112	$1,045
Construction Manager	$0	$0	$43	$63	$63	$63	$63	$63	$63	$421
Labs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other (specify)	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
[NTS ALLOCATION]	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Prior Years Summary	$8,469	$0	$0	$0	$0	$0	$0	$0	$0	$8,469
Other Agencies	$0	$22	$296	$296	$0	$0	$0	$0	$0	$614
Capital Equipment	$4,405	$0	$444	$116	$0	$32	$0	$0	$0	$4,997
Subtotal w/o Contingency	$17,280	$6,179	$9,705	$10,760	$9,017	$11,362	$10,225	$6,359	$5,819	$86,706
Contingency - Capital Equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Contingency - Other Operations	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Operations Subtotal	$17,280	$6,179	$9,705	$10,760	$9,017	$11,362	$10,225	$6,359	$5,819	$86,706
Escalation	$0	$0	$0	$0	$451	$1,193	$1,708	$1,507	$1,816	$6,674
Operations Total *	$17,280	$6,179	$9,705	$10,760	$9,468	$12,555	$11,933	$7,866	$7,635	$93,380
BA - Capital Equipment *	$4,405	$0	$444	$116	$0	$35	$0	$0	$0	$5,000
BA - Other Operations *	$12,875	$6,179	$7,927	$12,458	$9,476	$12,403	$11,482	$7,840	$7,635	$88,275
NON-TEC M & I Subtotal	$37,769	$14,198	$9,705	$10,760	$9,017	$15,174	$14,526	$7,480	$6,772	$125,401
Contingency	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Unescalated Subtotal	$37,769	$14,198	$9,705	$10,760	$9,017	$15,174	$14,526	$7,480	$6,772	$125,401
Escalation	$0	$0	$0	$0	$451	$1,593	$2,426	$1,773	$2,113	$8,356
NON-TEC M & I Total *	$37,769	$14,198	$9,705	$10,760	$9,468	$16,767	$16,952	$9,253	$8,885	$133,757
BA - Capital Equipment *	$4,405	$0	$444	$116	$0	$35	$0	$0	$0	$5,000
BA - Design & Operations *	$33,364	$14,198	$7,927	$12,458	$9,476	$16,576	$16,312	$9,222	$8,885	$128,418

: Contingency includes special scope change allowances as follows:
1. Prior Years Testing Equipment = 4405
2.
3.

EXPLORATORY SHAFT FACILITY BUDGET SUPPORT DATA
(Total Project Costs)
(Thousands of FY 1990 Dollars, Year of Expenditure Dollars where noted by *)

Spreadsheet: ?1-MAY-89
Project: NNWSI

EXPLORATORY SHAFT FACILITY WBS ELEMENT	Actual Expenditures Prior *	FY88 *	Fiscal Year 80 1989	1990	1991	1992	1993	1994	1995	Subtotal
5.2. Site Preparation	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Design	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Title I	$0	$468	$0	$0	$0	$0	$0	$0	$0	$468
Title II	$364	$0	$1,141	$421	$0	$0	$0	$0	$0	$1,926
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal w/o Contingency	$364	$468	$1,141	$421	$0	$0	$0	$0	$0	$2,394
Contingency	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design Subtotal	$364	$468	$1,141	$421	$0	$0	$0	$0	$0	$2,394
Escalation	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design Total *	$364	$468	$1,141	$421	$0	$0	$0	$0	$0	$2,394
BA *	$364	$468	$952	$477	$0	$0	$0	$0	$0	$2,261
Construction	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Mob/Demob	$0	$0	$63	$0	$0	$0	$0	$0	$0	$63
Roads & Pads	$0	$0	$3,568	$718	$0	$0	$0	$0	$0	$4,286
Power System	$0	$0	$0	$1,794	$0	$0	$0	$0	$0	$1,794
Water Systems	$0	$0	$0	$1,109	$0	$0	$0	$0	$0	$1,109
Communication System	$0	$0	$0	$304	$0	$0	$0	$0	$0	$304
Sewage Systems	$0	$0	$0	$157	$0	$0	$0	$0	$0	$157
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other (specify)	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
[NTS ALLOCATION]	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Prior Years Summary	$1,973	$0	$0	$0	$0	$0	$0	$0	$0	$1,973
Capital Equipment	$0	$0	$0	$6,946	$0	$0	$0	$0	$0	$6,946
Subtotal w/o Contingency	$1,973	$0	$3,631	$11,028	$0	$0	$0	$0	$0	$16,632
...tingency - Capital Equipment	$0	$0	$0	$1,390	$0	$0	$0	$0	$0	$1,390
...tingency - Other Construct.	$0	$0	$574	$783	$0	$0	$0	$0	$0	$1,357
...struction Subtotal	$1,973	$0	$4,205	$13,201	$0	$0	$0	$0	$0	$19,379
...calation	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Construction Total *	$1,973	$0	$4,205	$13,201	$0	$0	$0	$0	$0	$19,379
BA - Capital Equipment *	$0	$0	$0	$8,333	$0	$0	$0	$0	$0	$8,333
BA - Other Construction *	$1,973	$0	$3,509	$5,517	$0	$0	$0	$0	$0	$10,999
Site Preparation Subtotal	$2,337	$468	$4,772	$11,449	$0	$0	$0	$0	$0	$19,026
Contingency	$0	$0	$574	$2,173	$0	$0	$0	$0	$0	$2,747
Unescalated Subtotal	$2,337	$468	$5,346	$13,622	$0	$0	$0	$0	$0	$21,773
Escalation	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
SITE PREPARATION TOTAL *	$2,337	$468	$5,346	$13,622	$0	$0	$0	$0	$0	$21,773
BA - Capital Equipment *	$0	$0	$0	$8,333	$0	$0	$0	$0	$0	$8,333
BA - Design & Construction *	$2,337	$468	$4,461	$5,994	$0	$0	$0	$0	$0	$13,260

Note: Contingency includes special scope change allowances as follows:
1.
2.
3.

EXPLORATORY SHAFT FACILITY BUDGET SUPPORT DATA
(Total Project Costs)
(Thousands of FY 1990 Dollars, Year of Expenditure Dollars where noted by *)

Spreadsheet: 01-MAY-89
Project: NNWSI

EXPLORATORY SHAFT FACILITY WBS ELEMENT	Actual Expenditures Prior *	FY88 *	Fiscal Year 80 1989	1990	1991	1992	1993	1994	1995	Subtotal
6.3. Surface Facilities	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Design	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Title I	$0	$317	$0	$0	$0	$0	$0	$0	$0	$317
Title II	$434	$0	$1,235	$1,298	$0	$0	$0	$0	$0	$2,967
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal w/o Contingency	$434	$317	$1,235	$1,298	$0	$0	$0	$0	$0	$3,284
Contingency	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design Subtotal	$434	$317	$1,235	$1,298	$0	$0	$0	$0	$0	$3,284
Escalation	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design Total *	$434	$317	$1,235	$1,298	$0	$0	$0	$0	$0	$3,284
BA *	$434	$317	$1,235	$1,314	$0	$0	$0	$0	$0	$3,300
Construction	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Surface Data/Comm Bldg.	$0	$0	$0	$161	$403	$0	$0	$0	$0	$564
Trailers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Mechanical Shop	$0	$0	$0	$144	$0	$0	$0	$0	$0	$144
Warehouse	$0	$0	$0	$105	$0	$0	$0	$0	$0	$105
Change House	$0	$0	$0	$415	$0	$0	$0	$0	$0	$415
Generator Bldg	$0	$0	$0	$553	$0	$0	$0	$0	$0	$553
Subsurface Data Bldg	$0	$0	$0	$0	$40	$128	$0	$0	$0	$168
Hoist House	$0	$0	$0	$241	$0	$0	$0	$0	$0	$241
ES-1 Collar	$0	$0	$64	$182	$0	$0	$0	$0	$0	$246
ES-2 Collar	$0	$0	$64	$182	$0	$0	$0	$0	$0	$246
Other (specify)	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
(NTS ALLOCATION)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
entel Comm. Building	$0	$0	$0	$94	$0	$0	$0	$0	$0	$94
rior Years Summary	$1,475	$0	$0	$0	$0	$0	$0	$0	$0	$1,475
Capital Equipment	$1,045	$0	$0	$940	$0	$0	$0	$0	$0	$1,985
Subtotal w/o Contingency	$2,520	$0	$128	$3,017	$443	$128	$0	$0	$0	$6,236
Contingency - Capital Equipment	$0	$0	$0	$134	$0	$0	$0	$0	$0	$134
Contingency - Other Construct.	$0	$0	$26	$415	$88	$26	$0	$0	$0	$555
Construction Subtotal	$2,520	$0	$154	$3,566	$531	$154	$0	$0	$0	$6,925
Escalation	$0	$0	$0	$0	$27	$16	$0	$0	$0	$43
Construction Total *	$2,520	$0	$154	$3,566	$558	$170	$0	$0	$0	$6,968
BA - Capital Equipment *	$1,045	$0	$0	$1,074	$0	$0	$0	$0	$0	$2,119
BA - Other Construction *	$1,475	$0	$154	$2,522	$526	$156	$0	$0	$0	$4,833
Surface Facilities Subtotal	$2,954	$317	$1,363	$4,315	$443	$128	$0	$0	$0	$9,520
Contingency	$0	$0	$26	$549	$88	$26	$0	$0	$0	$689
Unescalated Subtotal	$2,954	$317	$1,389	$4,864	$531	$154	$0	$0	$0	$10,209
Escalation	$0	$0	$0	$0	$27	$16	$0	$0	$0	$43
SURFACE FACILITIES TOTAL *	$2,954	$317	$1,389	$4,864	$558	$170	$0	$0	$0	$10,252
BA - Capital Equipment *	$1,045	$0	$0	$1,074	$0	$0	$0	$0	$0	$2,119
BA - Design & Construction *	$1,909	$317	$1,389	$3,836	$526	$156	$0	$0	$0	$8,133

Note: Contingency includes special scope change allowances as follows:
1.
2.
3.

EXPLORATORY SHAFT FACILITY BUDGET SUPPORT DATA
(Total Project Costs)
(Thousands of FY 1990 Dollars, Year of Expenditure Dollars where noted by *)

Spreadsheet: 01-MAY-89
Project: NNWSI

EXPLORATORY SHAFT FACILITY	Actual Expenditures		Fiscal Year 80							Subtotal
WBS ELEMENT	Prior *	FY88 *	1989	1990	1991	1992	1993	1994	1995	
6.4. First Shaft	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Design	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Title I	$0	$336	$0	$0	$0	$0	$0	$0	$0	$336
Title II	$371	$0	$739	$1,077	$0	$0	$0	$0	$0	$2,187
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal w/o Contingency	$371	$336	$739	$1,077	$0	$0	$0	$0	$0	$2,523
Contingency	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design Subtotal	$371	$336	$739	$1,077	$0	$0	$0	$0	$0	$2,523
Escalation	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design Total *	$371	$336	$739	$1,077	$0	$0	$0	$0	$0	$2,523
BA *	$371	$336	$739	$1,111	$0	$0	$0	$0	$0	$2,557
Construction	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Mob/Demob	$0	$0	$0	$586	$0	$555	$0	$0	$0	$1,141
Sink & Line Shaft	$0	$0	$0	$1,447	$1,310	$803	$0	$0	$0	$3,560
Hoists & Foundations	$0	$0	$0	$373	$0	$0	$0	$0	$0	$373
Headframes & Supports	$0	$0	$0	$75	$0	$0	$0	$0	$0	$75
Instl Sinking/Developmnt Equip	$0	$0	$0	$243	$0	$353	$0	$0	$0	$596
Other (specify)	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
[NTS ALLOCATION]	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capital Equipment	$555	$0	$210	$1,143	$0	$0	$0	$0	$0	$1,908
Subtotal w/o Contingency	$555	$0	$210	$3,867	$1,310	$1,711	$0	$0	$0	$7,653
Contingency - Capital Equipment	$0	$0	$42	$229	$0	$0	$0	$0	$0	$271
Contingency - Other Construction	$0	$0	$0	$1,355	$998	$793	$0	$0	$0	$3,146
Construction Subtotal	$555	$0	$252	$5,451	$2,308	$2,504	$0	$0	$0	$11,070
Escalation	$0	$0	$0	$0	$115	$263	$0	$0	$0	$378
Construction Total *	$555	$0	$252	$5,451	$2,423	$2,767	$0	$0	$0	$11,448
BA - Capital Equipment *	$555	$0	$252	$1,372	$0	$0	$0	$0	$0	$2,179
BA - Other Construction *	$0	$0	$0	$4,209	$2,498	$2,536	$0	$0	$0	$9,243
First Shaft Subtotal	$926	$336	$949	$4,944	$1,310	$1,711	$0	$0	$0	$10,176
Contingency	$0	$0	$42	$1,584	$998	$793	$0	$0	$0	$3,417
Unescalated Subtotal	$926	$336	$991	$6,528	$2,308	$2,504	$0	$0	$0	$13,593
Escalation	$0	$0	$0	$0	$115	$263	$0	$0	$0	$378
FIRST SHAFT TOTAL *	$926	$336	$991	$6,528	$2,423	$2,767	$0	$0	$0	$13,971
BA - Capital Equipment *	$555	$0	$252	$1,372	$0	$0	$0	$0	$0	$2,179
BA - Design & Construction *	$371	$336	$739	$5,320	$2,498	$2,536	$0	$0	$0	$11,800

Note: Contingency includes special scope change allowances as follows:

1. Added Contingency 2,000 (813,736,451)
2.
3.

EXPLORATORY SHAFT FACILITY BUDGET SUPPORT DATA
(Total Project Costs)
(Thousands of FY 1990 Dollars, Year of Expenditure Dollars where noted by *)

V. 1

Spreadsheet: ?1-MAY-89
Project: NNWSI

EXPLORATORY SHAFT FACILITY WBS ELEMENT	Actual Expenditures Prior *	FY88 *	Fiscal Year BO 1989	1990	1991	1992	1993	1994	1995	Subtotal
6.5. Second Shaft	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Design	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Title I	$0	$438	$0	$0	$0	$0	$0	$0	$0	$438
Title II	$353	$0	$681	$843	$0	$0	$0	$0	$0	$1,877
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal w/o Contingency	$353	$438	$681	$843	$0	$0	$0	$0	$0	$2,315
Contingency	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design Subtotal	$353	$438	$681	$843	$0	$0	$0	$0	$0	$2,315
Escalation	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design Total *	$353	$438	$681	$843	$0	$0	$0	$0	$0	$2,315
BA *	$353	$438	$681	$946	$0	$0	$0	$0	$0	$2,418
Construction	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Mob/Demob	$0	$0	$0	$248	$59	$0	$0	$0	$0	$307
Sink & Line Shaft	$0	$0	$0	$540	$2,774	$0	$0	$0	$0	$3,314
Hoists & Foundations	$0	$0	$0	$423	$0	$0	$0	$0	$0	$423
Headframes & Supports	$0	$0	$0	$116	$0	$0	$0	$0	$0	$116
Instl Sinking/Developmnt Equip	$0	$0	$0	$243	$332	$0	$0	$0	$0	$575
Other (specify)	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
[NTS ALLOCATION]	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capital Equipment	$0	$372	$699	$1,147	$0	$0	$0	$0	$0	$2,218
Subtotal w/o Contingency	$0	$372	$699	$2,717	$3,165	$0	$0	$0	$0	$6,953
Contingency - Capital Equipment	$0	$0	$139	$229	$0	$0	$0	$0	$0	$368
Contingency - Other Construct.	$0	$0	$0	$594	$1,354	$0	$0	$0	$0	$1,948
Construction Subtotal	$0	$372	$838	$3,540	$4,519	$0	$0	$0	$0	$9,269
Escalation	$0	$0	$0	$0	$226	$0	$0	$0	$0	$226
Construction Total *	$0	$372	$838	$3,540	$4,745	$0	$0	$0	$0	$9,495
BA - Capital Equipment *	$0	$372	$838	$1,379	$0	$0	$0	$0	$0	$2,589
BA - Other Construction *	$0	$0	$0	$2,427	$4,350	$0	$0	$0	$0	$6,777
Second Shaft Subtotal	$353	$810	$1,380	$3,560	$3,165	$0	$0	$0	$0	$9,268
Contingency	$0	$0	$139	$823	$1,354	$0	$0	$0	$0	$2,316
Unescalated Subtotal	$353	$810	$1,519	$4,383	$4,519	$0	$0	$0	$0	$11,594
Escalation	$0	$0	$0	$0	$226	$0	$0	$0	$0	$226
SECOND SHAFT TOTAL *	$353	$810	$1,519	$4,383	$4,745	$0	$0	$0	$0	[illegible]
BA - Capital Equipment *	$0	$372	$838	$1,379	$0	$0	$0	$0	$0	$2,589
BA - Design & Construction *	$353	$438	$681	$3,373	$4,350	$0	$0	$0	$0	[illegible]

Note: Contingency includes special scope change allowances as follows:
1. Added Contingency 1,000 (279,721)
2.
3.

EXPLORATORY SHAFT FACILITY BUDGET SUPPORT DATA
(Total Project Costs)
(Thousands of FY 1990 Dollars, Year of Expenditure Dollars where noted by *)

Spreadsheet: 31-MAY-89
Project: NNWSI

EXPLORATORY SHAFT FACILITY WBS ELEMENT	Actual Expenditures Prior *	FY88 *	Fiscal Year 80 1989	1990	1991	1992	1993	1994	1995	Subtotal
6.6. Subsurface Excavations	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Design	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Title I	$0	$244	$0	$0	$0	$0	$0	$0	$0	$244
Title II	$240	$0	$438	$308	$0	$0	$0	$0	$0	$986
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal w/o Contingency	$240	$244	$438	$308	$0	$0	$0	$0	$0	$1,230
Contingency	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design Subtotal	$240	$244	$438	$308	$0	$0	$0	$0	$0	$1,230
Escalation	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design Total *	$240	$244	$438	$308	$0	$0	$0	$0	$0	$1,230
BA *	$240	$244	$438	$494	$0	$0	$0	$0	$0	$1,416
Construction	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Main Test Levels	$0	$0	$0	$0	$2,461	$3,173	$535	$0	$0	$6,169
Exploratory Drifts	$0	$0	$0	$0	$0	$5,890	$4,465	$0	$0	$10,355
Secondary Levels	$0	$0	$0	$0	$373	$0	$0	$0	$0	$373
Other (specify)	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
[NTS ALLOCATION]	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capital Equipment	$0	$0	$0	$0	$2,909	$227	$0	$0	$0	$3,136
Subtotal w/o Contingency	$0	$0	$0	$0	$5,743	$9,290	$5,000	$0	$0	$20,033
Contingency - Capital Equipment	$0	$0	$0	$0	$583	$46	$0	$0	$0	$629
Contingency - Other Construct.	$0	$0	$0	$0	$986	$3,360	$2,031	$0	$0	$6,377
Construction Subtotal	$0	$0	$0	$0	$7,312	$12,696	$7,031	$0	$0	$27,039
Escalation	$0	$0	$0	$0	$366	$1,333	$1,174	$0	$0	$2,873
struction Total *	$0	$0	$0	$0	$7,678	$14,029	$8,205	$0	$0	$29,912
- Capital Equipment *	$0	$0	$0	$0	$3,667	$302	$0	$0	$0	$3,969
- Other Construction *	$0	$0	$0	$0	$4,802	$13,249	$7,522	$0	$0	$25,573
Subsurface Excavation Subtotal	$240	$244	$438	$308	$5,743	$9,290	$5,000	$0	$0	$21,263
Contingency	$0	$0	$0	$0	$1,569	$3,406	$2,031	$0	$0	$7,006
Unescalated Subtotal	$240	$244	$438	$308	$7,312	$12,696	$7,031	$0	$0	$28,269
Escalation	$0	$0	$0	$0	$366	$1,333	$1,174	$0	$0	$2,873
SUBSURFACE EXCAVATION TOTAL *	$240	$244	$438	$308	$7,678	$14,029	$8,205	$0	$0	$31,142
BA - Capital Equipment *	$0	$0	$0	$0	$3,667	$302	$0	$0	$0	$3,969
BA - Design & Construction *	$240	$244	$438	$494	$4,802	$13,249	$7,522	$0	$0	$26,989

Note: Contingency includes special scope change allowances as follows:

1. Added Contingency 3,000 (420,1548,1032)
2.
3.

EXPLORATORY SHAFT FACILITY BUDGET SUPPORT DATA
(Total Project Costs)
(Thousands of FY 1990 Dollars, Year of Expenditure Dollars where noted by *)

REV. 1

Spreadsheet: 01-MAY-89
Project: NNWSI

EXPLORATORY SHAFT FACILITY WBS ELEMENT	Actual Expenditures Prior *	FY88 *	Fiscal Year 80 1989	1990	1991	1992	1993	1994	1995	Subtotal
6.7. Underground Service Systems	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXX
Design	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXX
Title I	$0	$952	$0	$0	$0	$0	$0	$0	$0	$952
Title II	$300	$0	$1,801	$1,993	$0	$0	$0	$0	$0	$4,094
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal w/o Contingency	$300	$952	$1,801	$1,993	$0	$0	$0	$0	$0	$5,046
Contingency	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design Subtotal	$300	$952	$1,801	$1,993	$0	$0	$0	$0	$0	$5,046
Escalation	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design Total *	$300	$952	$1,801	$1,993	$0	$0	$0	$0	$0	$5,046
BA *	$300	$952	$1,801	$2,004	$0	$0	$0.	$0	$0	$5,057
Construction	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXX
ES-1 Shaft Utilities	$0	$0	$0	$0	$0	$1,283	$458	$0	$0	$1,741
ES-2 Shaft Utilities	$0	$0	$0	$31	$1,178	$0	$0	$0	$0	$1,209
MTL Utilities	$0	$0	$0	$0	$538	$686	$122	$0	$0	$1,346
Exploratory Drift Utilities	$0	$0	$0	$0	$0	$734	$1,256	$0	$0	$1,990
Secondary Level Utilities	$0	$0	$0	$0	$50	$0	$0	$0	$0	$50
Life Safety	$0	$0	$0	$0	$0	$1,053	$0	$0	$0	$1,053
Waste Water System	$0	$0	$0	$217	$0	$0	$0	$0	$0	$217
Ventilation System	$0	$0	$0	$167	$0	$0	$0	$0	$0	$167
Compressed Air System	$0	$0	$0	$224	$0	$0	$0	$0	$0	$224
ES-1 Internals & Conveyances	$0	$0	$0	$37	$0	$1,477	$0	$0	$0	$1,514
ES-2 Internals & Conveyances	$0	$0	$0	$37	$983	$1,181	$0	$0	$0	$2,201
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other (specify)	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXX
[S ALLOCATION]	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Prior Years Summary	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capital Equipment	$1,145	$0	$0	$709	$324	$1,590	$0	$0	$0	$3,768
Subtotal w/o Contingency	$1,145	$0	$0	$1,422	$3,073	$8,004	$1,836	$0	$0	$15,480
Contingency - Capital Equipment	$0	$0	$0	$142	$64	$319	$0	$0	$0	$525
Contingency - Other Construct.	$0	$0	$0	$140	$509	$1,243	$358	$0	$0	$2,250
Construction Subtotal	$1,145	$0	$0	$1,704	$3,646	$9,566	$2,194	$0	$0	$18,255
Escalation	$0	$0	$0	$0	$182	$1,004	$366	$0	$0	$1,553
Construction Total *	$1,145	$0	$0	$1,704	$3,828	$10,570	$2,560	$0	$0	$19,808
BA - Capital Equipment *	$1,145	$0	$0	$851	$407	$2,109	$0	$0	$0	$4,512
BA - Other Construction *	$0	$0	$0	$857	$3,841	$7,969	$2,347	$0	$0	$15,014
UG Service Systems Subtotal	$1,445	$952	$1,801	$3,415	$3,073	$8,004	$1,836	$0	$0	$20,526
Contingency	$0	$0	$0	$282	$573	$1,562	$358	$0	$0	$2,775
Unescalated Subtotal	$1,445	$952	$1,801	$3,697	$3,646	$9,566	$2,194	$0	$0	$23,301
Escalation	$0	$0	$0	$0	$182	$1,004	$366	$0	$0	$1,553
UG SERVICE SYSTEMS TOTAL *	$1,445	$952	$1,801	$3,697	$3,828	$10,570	$2,560	$0	$0	$24,854
BA - Capital Equipment *	$1,145	$0	$0	$851	$407	$2,109	$0	$0	$0	$4,512
BA - Design & Construction *	$300	$952	$1,801	$2,861	$3,841	$7,969	$2,347	$0	$0	$20,071

Note: Contingency includes special scope change allowances as follows:
1.
2.
3.

EXPLORATORY SHAFT FACILITY BUDGET SUPPORT DATA
(Total Project Costs)
(Thousands of FY 1990 Dollars, Year of Expenditure Dollars where noted by *)

Spreadsheet: 01-MAY-89
Project: NNWSI

EXPLORATORY SHAFT FACILITY WBS ELEMENT	Actual Expenditures Prior *	FY88 *	Fiscal Year 80 1989	1990	1991	1992	1993	1994	1995	Subtotal
6.8. Operations	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXX
Non-TEC	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Facility Operations	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Support	$0	$0	$0	$0	$0	$1,360	$1,813	$1,152	$1,108	$5,433
Service	$0	$0	$0	$0	$0	$3,145	$2,739	$2,721	$2,721	$11,326
Utilities	$0	$0	$0	$0	$0	$1,231	$1,255	$1,255	$459	$4,200
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Facility Maintenance	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Surface	$0	$3	$0	$0	$0	$1,764	$2,352	$2,076	$2,076	$8,271
Subsurface	$0	$0	$0	$0	$0	$222	$493	$495	$495	$1,705
Other (specify)	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
IDS Design	$0	$36	$2,218	$2,716	$2,716	$2,100	$1,400	$1,400	$700	$13,286
IDS Management	$0	$307	$557	$666	$965	$757	$757	$757	$757	$5,523
IDS Proto-Type Testing	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
[NTS ALLOCATION]	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
IDS Maint/Operations	$0	$0	$0	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$12,000
Prior Years Summary	$602	$0	$0	$0	$0	$0	$0	$0	$0	$602
Capital Equipment (IDS)	$620	$0	$1,493	$4,144	$1,160	$200	$200	$100	$100	$8,017
Subtotal w/o Contingency	$1,222	$346	$4,268	$9,526	$6,841	$12,779	$13,009	$11,956	$10,416	$70,363
Contingency - Capital Equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Contingency - Other Operations	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Non-TEC Operations Subtotal	$1,222	$346	$4,268	$9,526	$6,841	$12,779	$13,009	$11,956	$10,416	$70,363
Escalation	$0	$0	$0	$0	$342	$1,342	$2,173	$2,834	$3,250	$9,940
Non-TEC Operations Total *	$1,222	$346	$4,268	$9,526	$7,183	$14,121	$15,182	$14,790	$13,666	$80,303
- Capital Equipment *	$620	$0	$1,493	$4,144	$1,218	$221	$233	$124	$131	$8,184
- Other Operations *	$602	$346	$2,286	$6,278	$6,001	$13,773	$14,930	$14,642	$13,535	$72,393
TEC	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Facility Operations	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Support	$0	$0	$1,171	$1,698	$1,984	$453	$0	$0	$0	$5,306
Service	$0	$0	$0	$1,364	$3,570	$1,049	$0	$0	$0	$5,983
Utilities	$0	$0	$0	$989	$1,928	$411	$0	$0	$0	$3,328
Facility Maintenance	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
Surface	$0	$0	$495	$2,484	$2,546	$588	$0	$0	$0	$6,113
Subsurface	$0	$0	$0	$20	$297	$74	$0	$0	$0	$391
Other (specify)	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXX
IDS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Surface Cable Install	$0	$0	$0	$119	$0	$0	$0	$0	$0	$119
Subsurface Cable Install	$0	$0	$0	$0	$1,100	$1,100	$0	$0	$0	$2,200
[NTS ALLOCATION]	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capital Equipment	$0	$0	$224	$1,345	$560	$0	$0	$0	$0	$2,129
Subtotal w/o Contingency	$0	$0	$1,890	$8,019	$11,985	$3,675	$0	$0	$0	$25,569
Contingency - Capital Equipment	$0	$0	$45	$269	$112	$0	$0	$0	$0	$426
Contingency - Other Operations	$0	$0	$0	$24	$220	$220	$0	$0	$0	$464
TEC Operations Subtotal	$0	$0	$1,935	$8,312	$12,317	$3,895	$0	$0	$0	$26,459
Escalation	$0	$0	$0	$0	$616	$409	$0	$0	$0	$1,025
TEC Operations Total *	$0	$0	$1,935	$8,312	$12,933	$4,304	$0	$0	$0	$27,484
BA - Capital Equipment *			$269	$1,614	$706					$2,589
BA - Other Operations *			$1,373	$7,813	$12,301	$4,265				$25,752

Note: Contingency includes special scope change allowances as follows:
1.
2.
3.

'0-May-89

*) Cost Estimate

	Item Cost	Total Cost
1. Engineering, design, and inspection...........		$34,485
2. Construction costs............................		$107,815
(a) Site preparation............................	$9,686	
(b) Surface facilities..........................	$4,287	
(c) First shaft.................................	$5,990	
(d) Second shaft................................	$4,893	
(e) Subsurface excavation.......................	$18,825	
(f) Underground service systems.................	$12,830	
(g) Construction operations.....................	$24,397	
(h) Construction management.....................	$4,437	
(i) Capital equipment...........................	$22,470	
Subtotal.............................		$142,300
3. Contingency...................................		$21,115
4. NTS allocation................................		$0
Total Estimated Cost................		$163,415

SAIC

Science Applications International Corporation

MMD:GAF:gjj:M90-4193
WBS 1.2.5.4
QA

INTEROFFICE MEMO

DATE: June 20, 1990

TO: Ernest Hardin, 517/T-13
Geotechnical Department

FROM: Monica Dussman, 517/T-14 Greg Fasano for
Environmental Field Programs
Department

SUBJECT: Environmental Cost/Schedule Information for the Calico Hills Study

The environmental information that you requested consists of costs and schedules for preactivity surveys and data collection in the disciplines of terrestrial ecosystems and archaeological studies for each of the eight strategies (Enclosures 1 and 2, respectively).

If you have any questions, please call Greg Fasano at 4-7793.

Enclosures:
1. Terrestrial Ecosystems Cost and Schedule Input
2. Archaeological Cost and Schedule Input

cc w/encls:
D. K. Chandler, 517/T-29
M. M. Dussman, 517/T-14
G. A. Fasano, 517/T-11
E. W. McCann, 517/T-11
V. J. Rohrer, 517/T-10

EG&G ENERGY MEASUREMENTS
Las Vegas Area Operations
EG&G ENERGY MEASUREMENTS, INC., P. O. BOX 1912, LAS VEGAS, NEVADA 89125 TEL(702)

LV90-1494
June 18, 1990

Mr. Greg Fasano
Science Applications
International Corporation
101 Convention Center Dr
Suite 400
Las Vegas, Nevada

Dear Greg:

Below is the unofficial cost and schedule for conducting preactivity surveys to support the Calico Hills Study. This cost and schedule estimate is for planning only. If the services of EG&G/EM is required an official estimate must come from Dr. H. A. Lamonds' office (EG&G/EM Program Manager).

Two additional concerns impact all of the strategies. Any change from the activities as described in the Biological Assessment will require consultation with the Fish and Wildlife Service which will include a Biological Assessment. The assessment will require less effort than the first one for YMP. However, it will require two weeks to develop and may require up to 90 days to receive FWS comments and opinion. Second all works will require training on desert tortoise prior to initiation of field work.

These cost and schedule estimates are based on the following assumptions:

1. All areas to be impacted will require preactivity surveys. Each area to be disturbed will be surveyed and staked
2. Surveys will be 100% coverage of the disturbed area plus a 100 yard buffer around the areas.
3. Each new road will be surveyed and have a 100 yard buffer on each side of the proposed road.
4. All existing roads are presumed to require no improvements and are cleared for use
5. Soil samples will be required and soil analysis costs are included in the estimate
6. Surface-based vertical boreholes will not require a separate survey because they will be part of the ESF survey process.
7. Shafts and associated muck piles within the drift boundary (Strategies 2-6) will not require a separate survey because the activity will be part of the ESF survey process.
8. All Surface-based angle boreholes will be dry drilled and all material will be transported to the ESF muck pile
9. Each surface-based angle borehole will disturb 2.5 acres and no roads will be required
10. The Prow Pass Test Facility will be comprised of two miles of new road, one 2.5 acre drill pad, and one 0.25 acre muck pile.
11. The Calico Hills Test Area will disturb 45 acres plus 1 mile of new road will be constructed.

STRATEGY NO. 1, 7, and 8

Surveys will include the Prow Pass Test Facility, three drill pads, and the Calico Hills Study Site. Surveys will require six weeks to conduct the surveys, send soil samples for analysis, and complete the report (soil analysis not included).

LABOR	$ 40.0 K
MATERIAL	
soil analysis	$ 26.0 K
TOTAL	$ 66.0 K

STRATEGIES 2 - 5

No additional money or schedule will be required for these strategies because the surveys will be conducted as part of the ESF preactivity surveys.

STRATEGY NO. 6

Surveys will include three drill pads and the Prow Pass Test Facility. About 4 weeks will be required to complete the surveys, send the soil samples for analysis, and prepare the report (soil analysis not included)

LABOR	$ 20.0 K
MATERIAL	
soil analysis	$ 7.6 K
TOTAL	$ 27.6 K

cc:

B. Kaiser
M. Dussman

ENCLOSURE 2

ARCHAEOLOGICAL SURVEY AND DATA RECOVERY COSTS AND SCHEDULES FOR THE EIGHT CALICO HILLS STUDY ALTERNATIVES

Below is the unofficial cost and schedule for conducting archaeology preactivity surveys and data recovery associated with the Calico Hills study. This cost and schedule estimate is for planning purposes only and does not represent a request for budget should the work actually need to be done.

Enclosed are two types of costs and schedules relative to archaeological studies; preactivity surveys and data recovery. Four of the eight Calico Hills study strategies pose potential problems associated with the Prow Pass Test Facility. The Prow Pass area is fairly rich in archaeological resources and represents a significant religious and social value resource area to the Native Americans. There are 18 known physical resource sites in the area. Because the design specifics of the facility (especially exact location) are unknown, a worst-case scenario of costs and schedules for preactivity surveys and data recovery, including excavations, has been presented herein. There is the potential, however, that any new surveys will uncover additional sites that would require additional time and budget to study.

Because the Prow Pass area represents a significant religious area to Native Americans, at a minimum, consultations with these people will be required. This could result in a potential redesign of the facility. There are regulations that are germane to these topics including the American Indian Religious Freedom Act and the National Historic Preservation Act. However, the DOE has the final decision as to what should be done regarding the outcome of consultations with the Native Americans.

The cost and schedule estimates are based on the following assumptions:

1. All surface areas to be directly impacted will require preactivity surveys. Each area will be surveyed and staked.

2. Surveys will be 100 percent coverage of the disturbed area (including roads) plus a 200 meter buffer around or adjacent to the areas.

3. All existing roads in good repair are presumed to require no improvements.

4. Disturbances in Drill Hole Wash will be surveyed and studied as part of the ESF process (Strategies 1, 6, 7, 8).

5. Shafts and associated muck piles within the repository perimeter boundary (Strategies 2-6) will not require a separate survey because they will be part of the ESF survey process.

6. Each surface-based angle borehole will disturb 2.5 acres and no new roads will be required.

7. The Prow Pass Test Facility will be comprised of two miles of new road, one 2.5 acre pad, and one .25 acre muck pile. A complete survey for direct and indirect impacts and data recovery on the 18 known archaeological sites will be conducted.

8. The Calico Hills Test Area will require limited surveys and data recovery since the area has been studied in the past.

Strategy Nos. 1, 7, and 8

Surveys will include the Prow Pass Test Facility area, two drill pads (Drill Hole Wash will be done as part of ESF process), and the Calico Hills Test area. The surveys will require 6 weeks to complete.

Labor and Materials $40.0 k

Data recovery, including excavations, will be performed in the Prow Pass area and will require 6 months to complete.

Labor and Materials $300.0 k

Total $340.0 k

Strategies 2-5

No additional time and budget will be required for these strategies because the surveys and potential data recovery will be conducted as part of the ESF process.

Strategy No. 6

Surveys will include two drill pads and the Prow Pass Test Facility and will require 3 weeks to complete.

Labor and Materials $20.0 k

Data recovery, including excavations, will be performed in the Prow Pass and will require 6 months to complete.

Labor and Materials $300.0 k

Total $320.0 k

I N T E R O F F I C E   M E M O R A N D U M

Date: 22-Jun-1990 02:30pm PS
From: Victor (Vic) Rohrer
ROHRERV
Dept: Project Management
Tel No: 794-7338

TO: Ernest (Ernie) Hardin (HARDINE)

CC: Errol Gardiner (GARDINERE)

Subject: REVISED COST AND SCHEDULE FOR CALICO HILLS STRATEGIES

Attached are revised cost estimates for the eight (8) Calico Hills strategies, as requested in your letter EHL:sjt:M90-026, dated May 30, 1990.

This revision incorporates cost and schedule changes for the second access for facilities with limited drifting and also incorporates the environmental cost, when required.

Participants from SNL did make contact but elected not to make any changes to my estimates.

CALICO HILLS COST COMPARISON
TESTING COST

REVISION 2 ($ in Millions)

22-JUN-1990

	TOTAL ESTIMATED COST	TESTING COST	TESTING % OF TOTAL
STRATEGY # 1 REVISION 1	$215	$59	27.2%
STRATEGY # 2	$127	$30	23.9%
STRATEGY # 3 REVISION 1	$75	$22	29.0%
STRATEGY # 4 REVISION 1	$75	$22	29.0%
STRATEGY # 5 REVISION 1	$127	$30	23.9%
STRATEGY # 6 REVISION 1	$26	$18	69.8%
STRATEGY # 7 REVISION 1	$174	$47	27.3%
STRATEGY # 8 REVISION 1	$127	$39	33.1%

ABOVE COST INCLUDE ENVIRONMENTAL ACTIVITY COST, IF REQUIRED.

CALICO HILLS - COST AND SCHEDULE
GUIDANCE AND ASSUMPTIONS

REVISION 1

1. LOWEST COST ALTERNATIVES UTILIZED - SHAFTS NOT RAMPS

2. SHORT PERIOD OF TIME TO COMPLETE THIS ESTIMATE THEREFORE BEST ESTIMATES AVAILABLE WERE UTILIZED

3. MOST CONSTRUCTION COST ESTIMATES BASED ON ESF COST

4. CONSISTENCY BETWEEN EACH STRATEGY IMPORTANT

5. ALL COST IN PRESENT VALUE AND NO CONTINGENCY ADDED

6. OTHER COST AND SCHEDULE VALUES:

   A. 5,000 FT. OF DRIFTING FOR LIMITED FACILITY

   B. 12,000 TO 14,000 FT. OF DRIFTING FOR EXTENDED FACILITY

   C. 1,650 FT. SHAFT DEPTH FOR NEW SHAFTS

   D. 600 FT. SHAFT CONNECTIONS TO ESF MTL

   E. DRIFTING COST AT $2,000 PER FT., 18 FT. PER DAY

   F. SHAFT SINKING AT $3,000 PER FT., 8 FT. PER DAY

   G. TESTING TIME: 3 YEARS FOR EXTENDED FACILITY
      2 YEARS FOR LIMITED FACILITY

   H. A SECOND SHAFT ADDED FOR THE LIMITED DRIFTING TO ENSURE PROPER UNDERGROUND AIR SUPPLY

7. DECOMMISSIONING COST ADDED WITH NO ESF EQUIVALENT DECOM. COST BASED ON A PERCENT OF CONSTRUCTION COST

8. CALICO HILLS STRATEGIES BEGIN AFTER 2 YEARS OF SURFACE BASED TESTING IN 1/93

9. ENVIRONMENTAL COSTS INCLUDED IN THE CALICO HILLS COSTS ARE BASED ON THE ASSUMPTIONS ATTACHED

CALICO HILLS - COST AND SCHEDULE
ENVIRONMENTAL COST ASSUMPTIONS

COST ESTIMATES ARE FOR PLANNING PURPOSES ONLY

TWO ACTIVITIES ARE REQUIRED BEFORE SITE WORK CAN BEGIN:

1. PREACTIVITY SURVEYS
2. DATA COLLECTION - ARCHAEOLOGICAL AND TERRESTRIAL ECOSYSTEMS

THE FOLLOWING ASSUMPTIONS APPLY:

1. All areas to be impacted will require preactivity surveys. Each area to be disturbed will be surveyed and staked
2. Surveys will be 100% coverage of the disturbed area plus a 100 yard buffer around the areas.
3. Each new road will be surveyed and have a 100 yard buffer on each side of the proposed road.
4. All existing roads are presumed to require no improvements and are cleared for use
5. Soil samples will be required and soil analysis costs are included in the estimate
6. Surface-based vertical boreholes will not require a separate survey because they will be part of the ESF survey process.
7. Shafts and associated muck piles within the drift boundary (Strategies 2-6) will not require a separate survey because the activity will be part of the ESF survey process.
8. All Surface-based angle boreholes will be dry drilled and all material will be transported to the ESF muck pile
9. Each surface-based angle borehole will disturb 2.5 acres and no roads will be required
10. The Prow Pass Test Facility will be comprised of two miles of new road, one 2.5 acre drill pad, and one 0.25 acre muck pile.
11. The Calico Hills Test Area will disturb 45 acres plus 1 mile of new road will be constructed.

I N T E R O F F I C E   M E M O R A N D U M

Date: 17-Dec-1990 08:55am PD
From: Victor (Vic) Rohrer
ROHRERV
Dept: Project Management
Tel No: 794-7338 OR 794-7747

TO: Ernest (Ernie) Hardin (HARDINE)

Subject: REVISED COST FOR CALICO HILLS

Attached are revised cost and schedule sheets for Calico Hills, based on the new assumptions identified in your letter dated December 10, 1990.

Cost has increased in four of the eight strategies, but the schedule impact is minimum, if testing in Calico Hills remains at three years. In strategies # 2 and # 5, testing would be completed by 12/98, which still allows about 18 months for re-testing or comment review before License Application.

A revised assumption list is also attached.

CALICO HILLS - COST AND SCHEDULE
GUIDANCE AND ASSUMPTIONS

DECEMBER 14, 1990 REVISION 3

1. LOWEST COST ALTERNATIVES UTILIZED
EXCEPT RAMPS ADDED PER ESF ALT NO. 30

2. SHORT PERIOD OF TIME TO COMPLETE THIS ESTIMATE THEREFORE
BEST ESTIMATES AVAILABLE WERE UTILIZED

3. MOST CONSTRUCTION COST ESTIMATES BASED ON ESF COST

4. CONSISTENCY BETWEEN EACH STRATEGY IMPORTANT

5. ALL COST IN PRESENT VALUE AND NO CONTINGENCY ADDED

6. OTHER COST AND SCHEDULE VALUES:

   A. 5,000 FT. OF DRIFTING FOR LIMITED FACILITY

   B. 12,000 TO 14,000 FT. OF DRIFTING FOR EXTENDED FACILITY INCREASED TO 19,000 FOR STRATEGY 2 & 5 PER ESF ALTERNATIVE

   C. 1,650 FT. SHAFT DEPTH FOR NEW SHAFTS

   D. 600 FT. SHAFT CONNECTIONS TO ESF MTL

   E. DRIFTING COST AT $2,000 PER FT., 18 FT. PER DAY

   F. SHAFT SINKING AT $3,000 PER FT., 8 FT. PER DAY
   RAMP FT. PER DAY MAXIMUM - 55 FT PER DAY BUT DUE TO DOWNGRADE AND CURVE, 24 FT AVE USED IN ESF STUDIES. IN ADDITION, TESTING AND MAPPING DELAY THE TBM PROGRESS.

   G. TESTING TIME: 3 YEARS FOR EXTENDED FACILITY
   2 YEARS FOR LIMITED FACILITY

   H. A SECOND SHAFT ADDED FOR THE LIMITED DRIFTING TO ENSURE PROPER UNDERGROUND AIR SUPPLY

   I. RAMPS FOR STRATEGY 2 & 5 ARE: NORTH - 6,000 FT.
   SOUTH - 5,000 FT.
   RAMP COST, INCLUDING TUNNEL BORING MACHINES, ARE FROM ESF ALT. STUDY, NO. 30.

7. DECOMMISSIONING COST ADDED WITH NO ESF EQUIVALENT
DECOM. COST BASED ON A PERCENT OF CONSTRUCTION COST

8. CALICO HILLS STRATEGIES BEGIN AFTER 2 YEARS OF SURFACE
BASED TESTING IN 1/93

9. ENVIRONMENTAL COSTS INCLUDED IN THE CALICO HILLS COSTS ARE BASED ON THE ASSUMPTIONS ATTACHED

Note: The first shaft for the Calico Hills investigation above, is an extention to the second ESF shaft, since the second ESF shaft is completed first.

CALICO HILLS COST COMPARISON
EXCLUDES DECOMM. COST

REVISION 3 ADD RAMPS ($ in Millions)

14-DEC-1990

	PREVIOUS ESTIMATED COST	REVISION 3 ESTIMATED COST	COST INCREASE	SCHEDULE IMPACT
STRATEGY # 1	$172	$199	$27	
TESTING COMPLETE	8/97	2/98		NONE
STRATEGY # 2	$92	$141	$49	
TESTING COMPLETE	12/98	12/98		NONE
STRATEGY # 3	$56	$77	$22	
TESTING COMPLETE	5/97	8/97		NONE
STRATEGY # 4	$56	$77	$22	
TESTING COMPLETE	5/97	8/97		NONE
STRATEGY # 5	$92	$141	$49	
TESTING COMPLETE	12/98	12/98		NONE
STRATEGY # 6	$25	$25	$0	
TESTING COMPLETE	8/95	8/95		NONE
STRATEGY # 7	$138	$138	$0	
TESTING COMPLETE	3/97	3/97		NONE
STRATEGY # 8	$103	$103	$0	
TESTING COMPLETE	3/96	3/96		NONE

ABOVE COST INCLUDE ENVIRONMENTAL ACTIVITY COST, IF NOT INCLUDED WITH ESF.

CALICO HILLS COST COMPARISON
EXCLUDES DECOMM. COST

REVISION 3 ADD RAMPS ($ in Millions)

14-DEC-1990

	PREVIOUS ESTIMATED COST	REVISION 3 ESTIMATED COST	COST INCREASE
STRATEGY # 1	$172	$199	$27
STRATEGY # 2	$92	$141	$49
STRATEGY # 3	$56	$77	$22
STRATEGY # 4	$56	$77	$22
STRATEGY # 5	$92	$141	$49
STRATEGY # 6	$25	$25	$0
STRATEGY # 7	$138	$138	$0
STRATEGY # 8	$103	$103	$0

ABOVE COST INCLUDE ENVIRONMENTAL ACTIVITY COST, IF NOT INCLUDED WITH ESF.

CALICO HILLS COST COMPARISON
INCLUDES DECOMM. COST

REVISION 3 ADD RAMPS ($ in Millions)

14-DEC-1990	PREVIOUS ESTIMATED COST	REVISION 3 ESTIMATED COST	COST INCREASE
STRATEGY # 1	$215	$249	$34
STRATEGY # 2	$127	$211	$84
STRATEGY # 3	$75	$118	$43
STRATEGY # 4	$75	$118	$43
STRATEGY # 5	$127	$211	$84
STRATEGY # 6	$26	$26	$0
STRATEGY # 7	$174	$174	$0
STRATEGY # 8	$127	$127	$0

ABOVE COST INCLUDE ENVIRONMENTAL ACTIVITY COST, IF NOT INCLUDED WITH ESF.

CALICO HILLS COST COMPARISON
EXCLUDES DECOMM. COST
INCLUDES CONTINGENCY

AT 40%

REVISION 3 ADD RAMPS ($ in Millions)

14-DEC-1990	PREVIOUS ESTIMATED COST	REVISION 3 ESTIMATED COST	COST INCREASE
STRATEGY # 1	$241	$278	$38
STRATEGY # 2	$128	$197	$69
STRATEGY # 3	$78	$108	$30
STRATEGY # 4	$78	$108	$30
STRATEGY # 5	$128	$197	$69
STRATEGY # 6	$34	$34	$0
STRATEGY # 7	$193	$193	$0
STRATEGY # 8	$144	$144	$0

ABOVE COST INCLUDE ENVIRONMENTAL ACTIVITY COST, IF NOT INCLUDED WITH ESF.

14-DEC-1990
REVISION 2

CALICO HILLS
STRATEGY # 1
SCHEDULE

MAJOR ACTIVITIES	START	DUR.	FINISH
DESIGN, TITLE I, II, III	10/01/91		12/30/96
ENVIRONMENTAL SURVEY/DATA RECOVERY	05/01/92	8	12/30/92
SITE PREPARATIONS - SE LOCATION	01/02/93	3.5	04/15/93
SITE PREP FOR PROW PASS SITE	01/02/93	4	04/30/93
FIRST SHAFT CONSTRUCTION	04/01/93	9	12/30/93
SURFACE FACILITIES CONSTRUCTION	04/01/93	9	12/30/93
SURFACE BASED TESTING	05/01/93	24	04/30/95
UNDERGROUND EXCAVATION	01/15/94	23.5	12/30/95
CALICO HILLS TESTING	04/01/94	36	03/30/97
DECOMMISSIONING	01/01/00	30	06/30/02
CONFIRMATORY STUDIES			
DESIGN	04/01/95		12/30/96
RAMP EXTENTION FROM ESF	03/01/95	10	12/30/95
UNDERGROUND EXCAVATION	01/01/96	14	02/28/97
TESTING PROGRAM	09/01/96	18	02/28/98
DECOMMISSIONING	10/01/00	42	03/30/04

Testing completed in 1998, in this strategy.
Six month longer than original Calico Hills estimate.

Calico Hills Stategy # 1
Cost Estimate

14-DEC-1990 REVISION 2

Cost Elements ($000)

FACILITY OFF THE BLOCK IN THE SE			Total Cost
Design Cost, Mgt and Integation, QA:	Construction		$13,838
	Decommissioning		$13,169
Construction Cost:			
Site Preparation		$2,655	
Surface Facilities		$1,611	
First Shaft		$5,565	
Second Shaft		$5,535	
Subsurface Excavation		$24,000	
Underground Services		$7,293	
Construction Operations		$6,851	
Construction Management		$3,011	
Capital Equipment		$13,940	
Subtotal			$70,461
Environmental Surveys & Data Recovery			406
Testing Program			$30,300
Decommissioning		$18,066	
Capital Equipment		$3,000	
			$21,066
Contingency			0
Total Estimated Cost - Initial Program			$149,240

CONFIRMATORY LIMITED FACILITY, INSIDE BLOCK, NE			
Design Cost, Mgt and Integation, QA:	Construction		$1,808
	Decommissioning		$9,527
Construction Cost:			
Site Preparation		0	
Ramp Access from ESF	Includes TBM	$23,000	
Shaft Connection to ESF		$1,831	
Subsurface Excavation		$10,000	
Underground Services		$1,823	
Surface Base Test Facilities		0	
Construction Management		$90	
Construction Operations		$685	
Capital Equipment		$860	
Subtotal			$38,289
Testing Program			$11,208
Decommissioning			$14,868
Contingency			0
Total Estimated Cost Confirmatory Program			$75,701

SURFACE BASED FACILITY AT PROW PASS

Design Cost, Mgt and Integation, QA:	Construction		$2,279
	Decommissioning		$460
Construction Cost:			
Site Preparation		$1,711	
Surface Facilities		300	
Capital Equip.		$417	
Construction Mgt.		324	
Operations and Maintenance		720	

	Subtotal		$3,471
Testing Program			$17,020
Decommissioning			$1,030
Contingency			0

	Total - Prow Pass Program		$24,260
Grand Total			$249,201

CALICO HILLS STRATEGY # 2
REVISED COST ESTIMATE
BASED ON ESF #30

12-DEC-1990 ($000)

	ORIGINAL ESTIMATE	REVISED ESTIMATE	DIFFERENCE
DESIGN	$6,998	$7,186	$188
FIRST ENTRY	$10,565	$34,424	$23,858
ENTRY TESTING	$1,252	$1,317	$65
SECOND ENTRY	$9,514	$34,424	$24,910
DRIFTING	$33,009	$34,876	$1,868
TESTING	$30,300	$29,291	-$1,009
	$91,639	$141,518	$49,879
DECOM	$34,919	$69,959	$35,040
	$126,558	$211,477	$84,919

Cost increased due primarily to purchase of two tunnel boring machines and additional excavation due to use of ramps. Drifting excavation increased to 19,000 feet. Conventional miner still required to mine corners. Decommissioning cost much greater since ramps are over three time longer than shafts.
Testing cost reduced due to reduced support cost in the ESF cost study.

CALICO HILLS STRATEGY # 2
SCHEDULE

MAJOR ACTIVITIES	START	FINISH		COMPLETION DATE CHANGE TO ORIGINAL
DESIGN	1/1/93	12/31/94	24	
SITE PREPARATIONS	1/1/94	5/30/94	5	
FIRST RAMP (ESF EXTENSION)	8/01/94	5/30/95	10	
SECOND RAMP (ESF EXTENTION)	10/1/94	9/30/95	12	23 MONTHS IMPROVEMENT
UNDERGROUND EXCAVATION	6/1/95	1/30/97	18	3 MONTHS SLIP
CALICO HILLS TESTING	1/1/96	12/31/98	36	NO CHANGE
DECOMMISSIONING	10/01/00	9/30/04	48	

This schedule is based on ESF Alternative study #30.
Testing time remains at three years.
Two ramps are used instead of shafts, using two tunnel boring machines.

This schedule allows sufficient time for NRC review and and comments before License Application preparation in year 2000.

Calico Hills Stategy # 3
Cost Estimate
Summary

14-DEC-1990

REVISION 2

Cost Elements			($000) Total Cost
Design Cost, Mgt and Integation, QA:	Construction		$5,584
	Decommissioning		$13,112
Construction Cost:			
Site Preparation		$40	
Surface Facilities		$400	
Ramp Access from ESF	includes TBM	$23,000	
Second Shaft		$2,177	
Subsurface Excavation		$10,000	
Underground Services		$3,176	
Construction Operations		$3,956	
Construction Management		$1,291	
Capital Equipment		$5,648	

Subtotal			$49,688
Envirionmental Cost	Included with ESF Cost		0
Testing Program			$21,600
Decommissioning		$24,720	
Capital Equipment		$3,000	
		------------	$27,720
Contingency			0

Grand Total Estimated Cost			$117,704

CALICO HILLS
SCHEDULE
STRATEGY # 3

14-DEC-1990

MAJOR ACTIVITIES	START	FINISH	CHANGE
DESIGN, TITLE I, II	10/01/93	09/01/97	
SITE PREPARATIONS	05/01/94	08/31/94 3	
RAMP (ESF EXTENTION)	08/01/94	05/30/95 10	FOUR MO. SLIP
SURFACE FACILITIES CONSTRUCTION	09/01/94	02/28/95 6	
UNDERGROUND EXCAVATION	06/01/95	03/30/96 10	THREE MO. SLIP
CALICO HILLS TESTING	09/01/95	08/30/97 24	THREE MO. SLIP
DECOMMISSIONING	10/01/00	01/30/03 28	8 MO.s ADDED

The schedule allows sufficient time for NRC review and comments before License Application in year 2000.

Calico Hills Stategy # 4
Cost Estimate
Summary

14-DEC-1990 REVISION 2

Cost Elements			($000) Total Cost
Design Cost, Mgt and Integation, QA:	Construction		$5,584
	Decommissioning		$13,112
Construction Cost:			
Site Preparation		$40	
Surface Facilities		$400	
Ramp Access from ESF	includes TBM	$23,000	
Second Shaft		$2,177	
Subsurface Excavation		$10,000	
Underground Services		$3,176	
Construction Operations		$3,956	
Construction Management		$1,291	
Capital Equipment		$5,648	

Subtotal			$49,688
Envirionmental Cost	Included with ESF Cost		0
Testing Program			$21,600
Decommissioning		$24,720	
Capital Equipment		$3,000	
		------------	$27,720
Contingency			0

Grand Total Estimated Cost			$117,704

CALICO HILLS
SCHEDULE
STRATEGY # 4

14-DEC-1990

MAJOR ACTIVITIES	START	FINISH		CHANGE
DESIGN, TITLE I, II	10/01/93	09/01/97		
SITE PREPARATIONS	05/01/94	08/31/94	3	
RAMP (ESF EXTENTION)	08/01/94	05/30/95	10	FOUR MO. SLIP
SURFACE FACILITIES CONSTRUCTION	09/01/94	02/28/95	6	
UNDERGROUND EXCAVATION	06/01/95	03/30/96	10	THREE MO. SLIP
CALICO HILLS TESTING	09/01/95	08/30/97	24	THREE MO. SLIP
DECOMMISSIONING	10/01/00	01/30/03	28	8 MO.s ADDED

The schedule allows sufficient time for NRC review and comments before License Application in year 2000.

CALICO HILLS STRATEGY # 5
REVISED COST ESTIMATE
BASED ON ESF #30

12-DEC-1990 ($000)

	ORIGINAL ESTIMATE	REVISED ESTIMATE	DIFFERENCE
DESIGN	$6,998	$7,186	$188
FIRST ENTRY	$10,565	$34,424	$23,858
ENTRY TESTING	$1,252	$1,317	$65
SECOND ENTRY	$9,514	$34,424	$24,910
DRIFTING	$33,009	$34,876	$1,868
TESTING	$30,300	$29,291	-$1,009
	$91,639	$141,518	$49,879
DECOM	$34,919	$69,959	$35,040
	$126,558	$211,477	$84,919

Cost increased due primarily to purchase of two tunnel boring machines and additional excavation due to use of ramps. Drifting excavation increased to 19,000 feet. Conventional miner still required to mine corners. Decommissioning cost much greater since ramps are over three time longer than shafts.
Testing cost reduced due to reduced support cost in the ESF cost study.

CALICO HILLS STRATEGY # 5
SCHEDULE

MAJOR ACTIVITIES	START		FINISH	COMPLETION DATE CHANGE TO ORIGINAL
DESIGN	1/1/93	24	12/31/94	
SITE PREPARATIONS	1/1/94	5	5/30/94	
FIRST RAMP (ESF EXTENSION)	8/01/94	10	5/30/95	
SECOND RAMP (ESF EXTENTION)	10/1/94	12	9/30/95	23 MONTHS IMPROVEMENT
UNDERGROUND EXCAVATION	6/1/95	18	1/30/97	3 MONTHS SLIP
CALICO HILLS TESTING	1/1/96	36	12/31/98	NO CHANGE
DECOMMISSIONING	10/01/00	48	9/30/04	

This schedule is based on ESF Alternative study #30.
Testing time remains at three years.
Two ramps are used instead of shafts, using two tunnel boring machines.

This schedule allows sufficient time for NRC review and and comments before License Application preparation in year 2000.

14-DEC-1990

REVISION 1

CALICO HILLS
STRATEGY # 7
SCHEDULE

MAJOR ACTIVITIES	START	DUR.	FINISH
DESIGN, TITLE I, II, III	10/01/91		12/30/96
ENVIRONMNTL. SURVEY DATA RECOVERY	05/01/92	8	12/30/92
SITE PREP FOR PROW PASS SITE	01/02/93	4	04/30/93
SITE PREPARATIONS FOR SHAFT	01/02/93	3.5	04/15/93
FIRST SHAFT CONSTRUCTION	04/01/93	9	12/30/93
SURFACE FACILITIES CONSTRUCTION	04/01/93	9	12/30/93
SURFACE BASED TESTING	05/01/93	24	04/30/95
SECOND SHAFT CONSTRUCTION	08/01/94	8	03/30/95
UNDERGROUND EXCAVATION	01/15/94	23.5	12/30/95
CALICO HILLS UG TESTING	04/01/94	36	03/30/97
DECOMMISSIONING	10/01/00	36	03/30/03

No change except Decommissioning time moved out.

14-DEC-1990

REVISION 1

CALICO HILLS
STRATEGY # 8
SCHEDULE

MAJOR ACTIVITIES	START	DUR.	FINISH
DESIGN, TITLE I, II, III	10/01/91		12/30/96
ENVIRONMT. SURVEYS/DATA RECOVERY	05/01/92	8	12/30/92
SITE PREP FOR PROW PASS SITE	01/02/93	4	04/30/93
SITE PREPARATIONS FOR 1ST SHAFT Off Block	01/02/93	3.5	04/15/93
FIRST SHAFT CONSTRUCTION	04/01/93	9	12/30/93
SURFACE FACILITIES CONSTRUCTION	04/01/93	9	12/30/93
SURFACE BASED TESTING	05/01/93	24	04/30/95
UNDERGROUND EXCAVATION	01/02/94	12	12/30/94
SECOND SHAFT CONSTRUCTION	08/01/94	6	02/28/95
CALICO HILLS UG TESTING	04/01/94	24	03/30/96
DECOMMISSIONING	10/01/00	30	03/30/03

No change except Decommissioning time moved out.

APPENDIX C

DOCUMENTATION OF INTERFACE WITH ESF ALTERNATIVES STUDY

SAIC
Science Applications International Corporation

WBS 1.2.5.2.2
QA

May 16, 1990

Thomas O. Hunter
Technical Project Officer
for Yucca Mountain Project
ATTN: Al Stevens
Sandia National Laboratories
Organization 6310
P.O. Box 5800
Albuquerque, NM 87185

INFORMATION REQUESTED AT TASK GROUP COORDINATION MEETING

At the May 9, 1990, coordination meeting, the Calico Hills task group presented preliminary results including a position pertaining to integration of the alternative Calico Hills characterization strategies, with the options under consideration by the exploratory shaft facility (ESF) alternatives evaluation. The position was stated as follows:

> "Strategies 1, 3, 5 (or 6) can be accommodated if a shaft or ramp access in the N-NE part of the block is constructed to support extensive exploration in the Calico Hills unit, in conjunction with another Calico Hills access outside the block.
>
> At least 3 different approaches to characterizing the Calico Hills unit can be supported in this manner."

This integration position was based on limited interpretation of preliminary test accuracy information ("test likelihood functions") from the Calico Hills study. The rationale is that the ESF alternatives evaluation can place less emphasis on integration with those Calico Hills strategies that involve accesses in the southern part of the block, inside the repository perimeter and integrated with ESF openings. This is because the vitric facies of the Calico Hills unit (CHn) can be explored outside the block to the southeast, as well as inside the block. This position helps to limit the range of possibilities that define "flexibility to characterize the Calico Hills unit" in the ESF alternatives evaluation.

The position stated above suggests a way to maintain several different options for characterizing the CHn, without requiring an ESF access in the southern part of the block. Several points are related for clarity:

1. It is not recommended at this time that a N-NE access be constructed into the CHn, merely that the portion of such an access serving the main test level (MTL) be designed to support future exploration of the CHn.

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Other SAIC Offices: Albuquerque, Ann Arbor, Arlington, Atlanta, Boston, Chicago, Huntsville, La Jolla, Los Angeles, McLean, Orlando, Santa Barbara, Sunnyvale, and Tucson

2. The scope of exploration that would be supported by a N-NE access to the CHn could vary considerably depending on whether a limited or extensive facility is recommended by the task group.

3. This integration position is based on preliminary results and is not intended to be used as the basis for defining explicit assessments to be made in the ESF alternatives evaluation. Rather, it is anticipated that the position will be used in evaluating the flexibility of various ESF options for characterizing the CHn.

A request was made at the coordination meeting for additional detail on the nature of exploration and testing in the CHn, and on the services required. This letter provides that information consistent with the scope of the Calico Hills analysis. The following information items were requested:

1. Location of Calico Hills Test Area. Underground excavation strategies for characterizing the CHn do not limit testing to a particular area. The principal objective is exploration, which will be accomplished chiefly by mapping, sampling, and drilling of the shaft/ramp and drift walls throughout the excavation. Hydrologic and transport testing may be conducted to investigate the characteristics of specific features or facies encountered in exploration. To set the location for such testing a priori is to pre-suppose much that is not currently known about the CHn, such as the significance of faults and fractures for water-borne transport.

2. Length (footage) of Test Drifts in the Calico Hills. This information is described in the strategies report developed by the Calico Hills task group. To maintain flexibility, the N-NE shaft/ramp access should provide the capability to support 12,000 feet of drifting in the CHn. The schedule for such drifting, relative to construction of the ESF MTL, has not been defined.

3. Size of underground openings in the Calico Hills. The task group has assumed the cross-section of drifts in the CHn to be 12 feet high by 14 feet wide.

4. Flexibility for Additional Drifting. The footage given above is an upper bound. Scheduling of such development is addressed below.

5. Utility Requirement in the Calico Hills Test Room. This refers to the drill room at the ESF MTL, which would be used in Strategy 6 to drill angled, dry boreholes down into the CHn, intersecting the Ghost Dance Fault. The depth of these borings would be 400 to 600 feet. The drill room would require 75 kW electrical power, 650 to 900 CFM compressed air at 110 psi, and 5 gpm water service.

6. Number of Persons in the Test Area. As stated above, no test area has been identified for Calico Hills testing. The emphasis will be on exploration, and tests will be located so as to investigate the significance of features or facies encountered. For estimation

purposes, however, some assumptions have been made concerning testing. About 35 scientific personnel would be involved in the testing program. The nature of tests that would be conducted has been described in a widely distributed memorandum (ELH:sjt:M90-015).

7. Construction/Operation Schedule. A 7-day, 3-shift schedule would be used for construction and operation of exploratory facilities in the CHn.

8. Support Facilities Required. An underground shop sufficient for maintenance and minor repair of road headers, LHDs, and other heavy equipment will be required in the CHn facility. At the surface, the scope of facilities required to support testing and construction would be increased by roughly 50 percent.

9. Schedule for Developing Calico Hills Test Area. Preliminary schedules developed by the task group show that for an exploratory facility integrated with ESF underground openings, access extension into the CHn follows directly on access construction to the ESF MTL. Consistency with the U.S. Department of Energy (DOE) Mission Plan schedule indicates that drifting in the CHn would be conducted concurrently with development of long drifts at the MTL.

10. Restrictions on Excavation Method. The task group is assuming that drifting in the CHn would be performed using a mechanized "road header" and that rock bolts and mesh will provide adequate ground support. No restrictions have been placed on the method of shaft/ramp access construction. Although core photos from boreholes at Yucca Mountain indicate that certain strata of the CHn may have low competence for excavation (esp. vitric facies), the same photos show that competent strata are available. Excavation can be largely restricted to these strata without major impact on the utility of data obtained. It is expected that the use of steel sets or similar methods of ground support will thus be limited, although not eliminated, by selection of strata. Drilling from the underground openings would be relied upon to characterize rock quality and collect data from less competent zones.

The number and location of tests was also discussed in the coordination meeting. The memorandum cited above states the assumptions used for cost estimation by the task group. Further definition of testing requirements depends on the results of exploration, which will include mapping and sampling during construction. Perched water testing (similar to that planned for the ESF) will be performed if necessary. A series of radial boreholes will be drilled and tested from the shaft/ramp access, using the ESF radial boreholes test as a model.

Several comments were received in the coordination meeting to the effect that a second access, probably a raised bore from the Calico Hills breakout level to the ESF MTL or to the surface, would be required by the DOE even for a limited facility. This requirement is based on safety and health considerations, and interpretation of DOE Order 5480.4 which cites the California Mine and Tunnel Safety Orders. There is caution among the engineers of the Calico Hills task group as to whether a second access would be required under all conditions. Accordingly, we defer specification of such an access but will assume, for the purpose of estimating schedule and assessing impacts to the site, that a second access will be constructed. For the case of a limited facility, the second would probably be constructed near the first. To accommodate such an access, a flexible ESF configuration could include a drill room. Otherwise, the second access would be constructed to the surface, and located in a shaft pillar that could decrease the usable repository area.

As another outcome of the coordination meeting, the Calico Hills alternative strategy list distributed in early April may be revised by the task group. In the process of developing the strategies, the group used certain assumptions developed by the ESF alternatives evaluation, including that the general boundaries of the repository-ESF were fixed. However, Strategy No. 5 would produce an underground opening that extends from the repository to a shaft access outside the repository block. This could effectively extend the perimeter of the repository facility. The next scheduled meeting of the task group on May 23-24, 1990, will consider whether Strategy No. 5 is consistent with this assumption, or should be changed.

I hope you find this information useful. Please feel free to direct any questions to Errol Gardiner at (702) 794-7786 or FTS 544-7786 or Ernest Hardin at (702) 794-7617 or FTS 544-7617.

John E. Shaler
John E. Shaler
Assistant Project Manager
Technical Support
Technical and Management
Support Services

JES:ELH:sjt:L90-035

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Science Applications International Corporation

WBS #1.2.1.2.5
QA: N/A

June 20, 1990

Distribution

DISTRIBUTION OF MEMORANDUM OF UNDERSTANDING, CONTRACT #DE-AC08-87NV10576

The enclosed Interface Memorandum of Understanding (MOU) 630002, Rev. 0, Sheets 1 through 5, has been accepted and signed by the affected participants, and is being distributed for your action or information. Upon conclusion of all actions and acceptance by the requestor, the MOU will be closed and redistributed for your records.

If you have any questions, please contact K. R. Harbert at (702) 794-7637 or FTS 544-7637, or F. J. Linder at (702) 794-7634 or FTS 544-7634 of my staff.

M. D. Voegele /for

John H. Nelson, Project Manager
Technical and Management
Support Services

JHN:FJL:po:L90-034

Enclosure
As Stated

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cc w/encl:
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Distribution—Letter dated 6/20/90

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YUCCA MOUNTAIN PROJECT
MEMORANDUM OF UNDERSTANDING

1 INTERFACE CONTROL NO.	2 REVISION	4 WBS NO(S).	7 QUALITY RELATED
630002	0	1261 1251	[X] YES [ ] NO

3 CI NO(S).	5 REQUESTED BY/ORGANIZATION	8 PREPARED BY/ORGANIZATION
TBD	L. S. Costin/SNL	A. W. Dennis/SNL

9 SUBJECT: Inclusion of Calico Hills Risk/Benefit Study Results into the ESF Alternatives Study

10 DESCRIPTION:

Purpose:

The purpose of this Memorandum of Understanding (MOU) is to identify the information that the Calico Hills Risk/Benefit Study group will provide to Sandia National Laboratories (SNL) for inclusion in the ESF Alternatives Study, the method and schedule for transmission of this information from the Calico Hills Study (CHS) to the ESF Alternatives Study (ESF-AS), and the procedure the ESF-AS will use to incorporate this information into the ESF Alternatives Study.

11 REASON: Results are needed to complete ESF/Repository Options for the ESF Alternatives Study evaluation.

12 NEED DATE:	13 SUPPLIER ORGANIZATION(S)
See Block 9	See Block 9

14 SIGNATURE AND ORGANIZATION	DATE	SIGNATURE AND ORGANIZATION	DATE
Thomas O. [signature] /SNL	6-14-90		
J. H. Nelson /T&MSS	6-14-90		

[1] INTERFACE CONTROL NO.	[2] REVISION	[4] PREPARED BY/ORGANIZATION
630002	0	A.W DENNIS /SNL

Background:

The Yucca Mountain Project Office has assigned responsibility for forming and chairing a working group to implement the Calico Hills Risk/Benefit Plan (YMP/90-3) to the Technical and Management Support Services (T&MSS). Sandia National Laboratories (SNL) has responsibility for conducting the ESF Alternatives Study.

Scope-of-Work:

The following is a clarification of the scope of work in the implementation plans of the ESF-AS and the Calico Hills studies:

1. Information that the Calico Hills Study group will provide:

   a. The CHS group will identify one or more preferred strategies for characterizing the Calico Hills unit for inclusion in the ESF-AS and explain the basis for the preference with respect to the factors considered in the CHS.

   b. The CHS group will summarize the basis used to determine the selected strategy(s) and if this basis included a risk-benefit analysis, as identified in Section 8.3.1.2.2.4.6 of the Site Characterization Plan and Section 3.2.1 of the Nuclear Regulatory Commission (NRC) Staff's Site Characterization Analysis (applicable text from these documents is quoted in Attachment 1). The ESF-AS needs this information to estimate the potential for addressing NRC concerns with regard to Calico Hills characterization.

   c. The CHS group will provide a description, layout sketch, cost estimate, and development schedule for each preferred strategy and will identify constraints on the proposed construction method for the preferred strategy. The cost and schedule estimates will be as consistent as possible with those being developed in the ESF-AS.

2. Method and schedule for transmission of information:

   a. The CHS group will provide the information identified above, in an interface control document, to the ESF-AS (SNL) and to the Project Office on or before June 30, 1990.

   b. SNL will confirm whether the information provided by the CHS is a sufficient basis for SNL to proceed with incorporating the preferred strategy or strategies into the ESF-AS, and will request Project Office concurrence, if necessary.

   c. The CHS information will be accepted by the Project Office and any revisions provided to SNL by August 31, 1990.

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3. Incorporation of information provided by the CHS group into the ESF-AS:

   a. In the case where a single strategy is selected for characterization of the Calico Hills, the ESF-AS group will incorporate that strategy into all the ESF-AS options. In the case where multiple Calico Hills strategies are selected, the ESF-AS group will incorporate one of the selected Calico Hills strategies into each of the ESF-AS options (combinations will be made on a "best-fit" basis). Incorporation will be by extension of proposed surface-to-underground shafts and/or ramps; identification of new ESF Main Test Level (MTL) to Calico Hills Test Level (CHTL) shafts and/or ramps; or some other combination of shafts, ramps, and/or drifts to establish the ESF MTL to CHTL connection.

   b. The ESF-AS group will develop a description, layout sketch, cost estimate, and development schedule and will identify the proposed construction method(s) for each of the combined options.

   c. The ESF-AS group will analyze the resulting ESF-repository options, rank order them, and select a preferred ESF-repository option in accordance with the procedures identified in the Exploratory Shaft Facility Alternatives Study Implementation Plan.

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ATTACHMENT 1

SITE CHARACTERIZATION PLAN
VOLUME IV, PART B, CHAPTER 8
DECEMBER 1988

8.3.1.2.2.4.6 Activity: Calico Hills test in the exploratory shaft facility. The Calico Hills nonwelded unit is expected to be a principal barrier to the flow of ground water and transport of radionuclides. Therefore, it is critical to have high confidence in the understanding of the unit's hydrologic processes, conditions, and properties, under both present and expected future conditions. In particular, it is important to understand the effects that fractures and faults have on flow paths and travel times, and the conditions under which fracture flow may occur. Although the need to characterize the Calico Hills is apparent, it is possible, in some circumstances, that penetration of the unit within the repository block for testing purposes could affect the performance of the site. For this reason, a test program that would be designed for the acquisition of in situ data in the Calico Hills would represent a potential trade-off between the need to acquire data and the need to preserve site-performance capability. Alternative approaches under consideration for the testing include shaft sinking and drifting in the Calico Hills unit in the vicinity of the site and various combinations of vertical and angle drillholes and underground excavation. Additional discussion of the data needs, methods of acquisition, and potential risks is presented in Section 8.4. A risk/benefit analysis and selection of appropriate test options will be prepared before the initiation of testing.

NRC STAFF SITE CHARACTERIZATION ANALYSIS OF THE DEPARTMENT OF ENERGY'S
SITE CHARACTERIZATION PLAN, YUCCA MOUNTAIN SITE, NEVADA

3.2.1 Geohydrology and Pre-Closure Hydrology Programs. "...With respect to the sufficiency of field studies and activities to test hypotheses about individual features, events and processes, the staff has identified the following concerns: (1) Plans to characterize the geohydrologic properties of the Calico Hills unit (a nonwelded tuff unit under-lying the repository horizon) are not complete. It is currently hypothesized in the SCP that groundwater flow through fractures and faults within the the Calico Hills nonwelded unit is negligible. As a result, the Calico Hills nonwelded unit has been designated the primary natural barrier to groundwater flow and radionuclide transport. However, current plans for characterization of the Calico Hills unit are limited to surface-based studies (vertical bore-holes). It is acknowledged in the SCP that the surface-based studies will

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provide very limited information about the distribution and flow characteristics of fractures and faults in the Calico Hills unit and thus, are of limited use in supporting the hypothesis of negligible flow through faults and fractures. Development of in situ testing in the Calico Hills unit as part of an exploratory shaft facility is being held in abeyance because of a concern that penetration of the unit within the repository block may adversely affect the performance of the site. Alternative approaches (shaft sinking and drifting in the vicinity of the site and various combinations of vertical and angle drillholes and excavations) are being considered. Potential tradeoffs between the need to acquire data and the need to preserve site-performance capability are being evaluated by DOE with a risk-benefit analysis. Selection of appropriate test options will be made, and consultations with NRC staff held prior to initiating testing. Because of the importance placed on the Calico Hills unit in demonstrating compliance with the performance objectives of Part 60, the staff considers development and completion of an adequate testing plan for the unit to be a significant open item; and..."

NUCLEAR WASTE POLICY ACT OF 1982

Section 113(c) Restrictions. "(1) The Secretary may conduct at any candidate site only such site characterization activities as the Secretary considers necessary to provide the data required for evaluation of the suitability of such candidate site for an application to be submitted to the Commission for a construction authorization for a repository at such candidate site, and for compliance with the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.)..."

SAIC
Science Applications International Corporation

WBS 1.2.5.2.2
QA

June 30, 1990

M. B. Blanchard, YMP, NV
T. O. Hunter, SNL, Albuquerque, NM

INTERFACE CONTROL INPUT FROM CALICO HILLS RISK/BENEFIT ANALYSIS (CHRBA), TO THE EXPLORATORY SHAFT FACILITY (ESF) ALTERNATIVES STUDY

The following information is provided to Sandia National Laboratories for inclusion in the ESF Alternatives Study, in accordance with Memorandum of Understanding (MOU) 630002, Rev. 0.

A. Preferred strategies.

The CHRBA task group recommends that ESF alternatives be evaluated using characterization strategy #2 or #5, as they are described in Attachment 1. These strategies involve extensive drifting in the Calico Hills nonwelded (CHn) hydrogeologic unit, inside the repository block. Strategies #2 and #5 differ chiefly with respect to CHn access location. No significant difference between these strategies with respect to performance impacts or the accuracy of information obtained, has been identified by the task group.

It is recommended that the ESF be designed to accommodate strategy #2 or #5, and that the CHn accesses be constructed as soon as practicable. The CHRBA task group has assumed that two proximale accesses would be required. No constraints on construction method or type of access (e.g., shaft or ramp), because of performance impacts or accuracy of information obtained, have been identified by the task group. Once the accesses have been constructed, it is anticipated that the extent of exploration and testing will be determined from factors including the available information about the CHn unit. Eventually, the extent of exploration and testing could reach that which is defined for strategies #2 and #5.

The CHRBA task group finds that among the alternatives considered, strategies #2 and #5 will provide the most accurate information about the CHn unit. However, the task group also finds that such information is unlikely to alter the present expectation that site performance will meet the total system performance objective by a wide margin.

The CHRBA task group also finds that strategies #2 and #5 each would result in larger expected impacts on site performance than the other strategies considered. However, the expected change in releases of radionuclides from the site that is attributable to implementation of either strategy #2 or #5 is a minor component of the total releases from the site, and the site is expected to meet the total system performance objective by a wide margin. These results are based on expected values for performance and the impacts of the strategies. (Ongoing sensitivity studies will examine the effects of using different percentiles of prior distributions for performance outcomes.)

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B. Basis for selection.

The overall objective of the CHRBA is to recommend to the U.S. Department of Energy (DOE) a characterization strategy that balances the value of reducing uncertainty, and the potential increase of risk associated with CHn characterization activities. The CHRBA employs a value-of-information approach to model the reduction of uncertainty, and compares this value with estimated impacts to the postclosure performance of a geologic disposal system at Yucca Mountain.

Information needs for characterizing the CHn unit were identified by the task group using the Site Characterization Plan (SCP) and other sources. Alternative conceptual models as identified in the SCP were a factor in developing information needs. The task group concluded that all the strategies considered in the study, and the baseline SCP program (consisting of surface-based testing and testing at the ESF main test level) would address each of the information needs identified. However, they would be addressed to different degrees by the strategies, resulting in different levels of confidence about the contribution of CHn performance to system performance.

Strategies were composed in a systematic approach that is documented in Attachment 1. Alternatives for major features of a Calico Hills characterization strategy were identified, and combined to form all possible combinations. These were screened and categorized, then grouped according to simple indications of test utility and potential for waste isolation impacts. The possible configurations were used to compose a set of strategies that represents each of the groups identified.

Possible states of the CHn unit were identified for performance estimation. Total system performance was judged to be sensitive to hydrologic conditions, and four possible flow regimes were identified and defined using numeric criteria, as follows:

> Concentrated Fracture Flow. Defined as >1,000 cubic meters/yr moving through one or more faults, including associated fracture zones, providing pathways through >90% of the CHn unit. The plan area of such zones would be on the order of 5% of the repository area, requiring an effective flux-concentrating mechanism.
>
> Distributed Fracture Flow. Defined as >1,000 cubic meters/yr moving through fractures distributed over 50% or more of the repository area, and providing pathways through >90% of the CHn unit.
>
> Fast Matrix Flow. Defined as >1,000 cubic meters/yr moving at an average velocity of >10 cm/yr along matrix pathways through the CHn.
>
> Slow Matrix Flow. Defined to include matrix flow and fracture flow conditions not described above.

These conditions represent prevailing conditions over 10,000 yr and may not exist at present. It was assumed that any flow condition could be paired with one of the regimes, based on which definition fits best. The threshold flow rate approximates a quantity of water sufficient to dissolve a volume fraction of spent fuel that could result in releases that approach the total system objective, as calculated by Sinnock et al. (1987).

For each flow regime the prior expected probability of occurrence was estimated. The probability that each strategy would correctly identify each flow regime, given that it exists, was estimated. These "test likelihood functions" were used to generate updated probabilities for flow regimes.

The measure used to assess total system performance was the sum of release ratios as defined in 40CFR191. The effects of engineered barriers, flow pathways, chemical retardation, matrix diffusion, dispersion, and other transport processes were considered in the direct assessments on this measure. The cumulative inventory of radionuclides available at the upper CHn contact over 10,000 yr. was postulated at different levels, and the inventory to be transported through the CHn unit estimated. The constitution of the inventory was assumed to consist of a volume fraction of spent fuel, enriched in Tc-99 to the same activity level as the most abundant actinide. This was a conservative treatment, based on recent laboratory and theoretical work (Apted et al., 1990) that uranium oxidation may play an important role in release from the waste form. The proportion of actinides and Tc-99 in the released inventory remains roughly the same from 1,000 to 10,000 yr, up to theoretical release levels at which Tc-99 is depleted from the waste.

The availability of radionuclides at the top of the CHn unit ("source term") was assessed for each flow regime as a cumulative distribution function (cdf). The performance of the CHn unit was assessed for each flow regime, for several mass-points representing the "source-term" distribution. The performance contribution of the saturated zone was addressed as a cdf, on a reduction factor applied to the total system performance measure, for any flow regime. These assessments describe a performance model that is essentially linear.

Waste isolation impact was assessed as a factor by which the cdf on site performance for any flow regime would be multiplied, given the excavations and boreholes associated with each strategy. Thus the greater the impact, the "flatter" the cdf on performance for a flow regime. The impact factor was also assessed as a cdf. The reference conceptual repository design (SNL, 1987) was assumed for these assessments.

A valuation model was constructed for comparative evaluation of different test outcomes and strategies. This model assumes that future actions (e.g., license application, repository construction and operation) taken on the basis of release predictions which are based on test results, may have different value than actions based on knowledge of actual releases (if it were available). The range of possible releases was defined in intervals: R<0.01, 0.01<R<0.1, 0.1<R<1.0, and R>1.0, where R is the expected value of the total system performance measure. The ranges of predicted and actual releases were correlated producing 16 possible outcomes. Each of these was assigned a a value, based on consequential costs, by a management panel that was not part of the CHRBA task group. The resulting values were combined with assessed distributions on site performance, and direct cost, in a probabilistic formulation yielding present value of each strategy.

The valuation model results are preliminary, but are not used as the basis for the recommendation. The results show that because of low probabilities for outcomes associated with high costs, the value of testing is dominated by the direct cost of each strategy. In other words, using this model the "payback" from testing has a small dollar value because predicted site performance already meets the total system objective by a wide margin, and small changes in predictions based on test outcomes are expected. However, the task group recognizes that there are additional values that were not considered in the valuation model, including subsystem performance objectives (e.g., groundwater travel time), evaluation of alternative conceptual models, and the need to develop scientific and regulatory consensus on system performance. In addition, the task group recognizes technical direction from the Nuclear Waste Technical Review Board regarding CHn unit characterization, as well as the preliminary recommendation from a recent independent peer review on unsaturated zone hydrology studies for the Yucca Mountain Project. Finally, the task group acknowledges that the plan for the CHRBA specifies a recommendation to the DOE, based chiefly on the tradeoff between test utility and performance impact.

The rationale for the recommendation is therefore based on the following: (1) testing in the CHn unit is valuable for reasons not considered in the valuation model discussed above; (2) information collected in the near future from other activities (e.g., surface-based testing) may indicate a compelling need for accurate test results from the CHn unit; (3) strategies #2 and #5 were judged by the task group to be the most accurate; and (4) waste isolation impacts from extensive exploration in the CHn unit are expected to be minor.

C. Strategy description.

The description, rationale, and rough layout sketch for all the strategies considered are provided in Attachment 1. Cost estimates and schedules for strategies #2 and #5 are provided in Attachment 2, which also lists the assumptions used to produce these estimates.

References

Apted, M. J., W. J. O'Connell, K. H. Lee, A. T. MacIntyre, T.-S. Ueng, T. H. Pigford, and W. W.-L. Lee, 1990, Preliminary Calculations of Release Rates of Tc-99, I-129, Cs-135, & Np-237 From Spent Fuel in a Tuff Repository, prepared by working group #2: Engineered Barrier System Group, for the U.S. Dept. of Energy, OCRWM, dated May 1990 (WG2-5-90).

Sinnock, S., Y. T. Lin, and J. P. Brannen, 1987, Preliminary Bounds on the Expected Postclosure Performance of the Yucca Mountain Repository Site, Southern Nevada, JGR, V.92, No.B8, pp. 7820-7842.

SNL (Sandia National Laboratories), 1987, Site Characterization Plan Conceptual Design Report, SAND84-2641, 6 Vol., Sandia National Laboratories, Albuquerque, NM.

Questions regarding this interface input may be directed to Ernest L. Hardin of Science Applications International Corporation at (702) 794-7617 or FTS 544-7617.

M.D. Voegele /for

John H. Nelson, Project Manager
Technical and Management
Support Services

JHN:ELH:sjt:L90-047

Attachments:
1. Description of strategies, incl. #2 and #5
2. Cost/schedule report for strategies #2 and #5

cc w/out encl:
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Revised 5/29/90

2.4 COMPOSE ALTERNATIVE CHARACTERIZATION STRATEGIES

NOTE: This report has been revised from the previous version dated 4/18/90. Strategy No.'s 1, 2, and 5 have been changed, and Strategy No.'s 7 and 8 have been added in this version. A summary of the changes is presented near the end of the text.

Assumptions and Overview

In developing the list of strategies, a series of steps was defined. These steps included definition of the option space, permuted combinations, screened combinations, grouped combinations, selected combinations, and development of combinations into strategies. To accomplish this process the following guidelines were used:

* options should span the space of possibilities
* options should be substantially different with discriminating features
* options should be reasonable
* general boundaries of the repository are fixed
* ESF to be integrated with the repository
* 70,000 MTU capacity for the repository
* costs, environmental impacts, socioeconomic impacts, etc. will not be considered, but may be considered in the final steps in the study methodology

The following terminology will be used in this discussion. The options space is defined by axes which represent ways that options may differ, and are called factors. The factors may occupy different states, corresponding to different characterization program configurations. The list of possible combinations of these factors is referred to as a list of combinations, which is screened to become a list of access options. The access options are grouped, and representative options chosen from the groups. Representative access options are consolidated and modified using rationale, to form characterization strategies. Strategies may be augmented with other details such as testing requirements, provision for special testing underground, and surface-based testing (SBT) in addition to the Site Characterization Plan (SCP) SBT program. Once the strategies are identified, additional descriptive information such as opening size and construction method may be specified, as appropriate, to describe the detailed strategies for evaluation.

Strategies that involve SBT take into account the SCP program plans for surface-based investigation of the Calico Hills unit (CHn), and also:

* Expanded scope of surface-based drilling into the CHn.

* Surface-based angle-hole drilling.

* Outcrop studies near Prow Pass, north of the site area.

* Drilling into the CHn from the ESF main test level.

* Geophysics, either surface-based or with subsurface borehole control, in the site area.

Analysis of underground excavation considerations resulted in 24 access options (Figure 2.4-3) which take into account the following:

1. Possible areas of exploration; north-northeast, south-southeast, west, or central.

2. Location of the initial penetration into the CHn; whether inside or substantially outside of the defined exploration block.

3. The possible need for an extensive facility to support exploration and testing.

4. Whether or not access is combined and integrated with the ESF underground openings.

The factors listed above are depicted on the "option space" diagram, Figure 2.4-1. The SBT vector on the diagram shows that the SBT strategies were considered separately from the excavation options until the SBT and the excavation strategies were developed. At that point, strategies combining SBT and underground excavations were considered.

The 24 possible combinations were screened, eliminating outside options that require ESF integration. The basis for this resides in the initial assumptions that the ESF is to be integrated (i.e., shared openings) the repository, and that the general boundaries of the facility are fixed. If outside openings are constructed which may ultimately be connected with the repository, then the boundary of the repository may be extended. This was judged not to eliminate any options which would have tended maximize test utility or waste isolation.

An additional screening step eliminated inside options that would not be integrated with the ESF. These possibilities were based on the idea that a shaft or ramp could be constructed inside the exploration block and never integrated with either the ESF or the repository openings. A barrier pillar would be maintained, and the repository usable area would be reduced. The basis for the idea was that waste isolation performance might be enhanced slightly if there were no direct connection from the waste emplacement areas, to openings within the CHn natural barrier. However, this concept would also require at least one additional opening (and possibly two or more) from the surface through the repository block. The possible adverse impact of such extra penetrations was judged to offset the possible benefit to waste isolation.

Based on the screening, a matrix of 12 options was developed (Figure 2.4-4). Combining like attributes, the options (including SBT) were reduced to nine strategies. Each strategy includes the basic SCP characterization program, and has a reasonable likelihood of providing the needed information for characterization of the CHn, although some strategies are more likely to provide this information than others.

<u>Defining the Option Space for Underground Excavation</u>

For strategies involving underground excavation, the following were developed as the principal factors describing the space of possibilities:

1) Location of initial penetration into the CHn.

Penetrations into the CHn may take several forms. A single shaft or ramp will be excavated initially. An additional access may be constructed to facilitate ventilation and egress. This additional access may be constructed in the immediate vicinity of the initial access, or may be distant. For this study, the location of the initial penetration was judged to be more important than whether or where an additional access is constructed. This position simplifies the range of options to be considered, and is explained in the following paragraphs.

A additional access could be as simple as a raise bore with diameter of a few feet, in the immediate vicinity of the initial CHn penetration. The pilot hole drilling and raise boring operations could probably be performed dry, and the rockmass damage from excavation would be minimal. The impact of such an access on test utility or waste isolation, while potentially significant, does not warrant explicit consideration in the Calico Hills study, unless it is constructed in a different part of the site area (i.e., north, west, central, or south).

Even if penetrations at more than one location are planned, it has been assumed in this study that they would not be constructed concurrently. It is expect that after construction of the initial access, and after roughly two years of SBT as planned in the SCP, significantly more will be known about CHn performance. This information will support evaluation of the impacts of a second penetration. Thus at the present time, the location of the initial penetration is more important than that of an additional access.

The term penetration refers to the underground opening through the upper limit of the CHn, that might become a transport pathway depending on prevailing hydrologic conditions, and the performance of other barriers, during the postclosure performance period. The location of the surface portal for a ramp is considered insignificant relative to that of the CHn penetration.

The possibilities for primary penetration location were determined to be: (1) north, south, or central locations inside the exploration block; and (2) northeast, west, or southeast locations outside the block. The basis for using the exploration block, and the rationale for the location possibilities listed above, are discussed further below.

2) Limited vs. extensive facility.

Access to significant features of the CHn unit from underground openings in the site area, is chiefly limited by the extent of excavation. More extensive drifting within or in the immediate vicinity of the repository block, could increase the potential for adverse impacts to waste isolation. Alternatively, extensive drifting outside the repository block could provide information needed for site characterization (possibly in conjunction with surface-based or ESF activities), while substantially limiting adverse impacts. To examine this tradeoff, the extent of drifting in the CHn was included as an explicit factor in the study. The number of accesses was not considered as an explicit factor as discussed below.

Mining regulations (e.g. 30 CFR 57) give general requirements for worker health and safety. The mining engineers on the task group stated that although rigid rules do not exist, exploratory drifting would be limited by a single access. For the case of a shaft, drifting might be limited to roughly 2,000 feet in any direction because of ventilation, egress, and other concerns. For a ramp, the length of the access would be on the order of 6,000 to 8,000 feet, leaving only a few thousand feet at the objective horizon before access was curtailed. A single-access facility would thus be restricted to exploration of features within a limited distant of the access.

The task group considered that scientific testing would be required in an underground facility in the CHn. As a minimum, sampling and geologic mapping would be conducted throughout the facility. Exploratory drilling or drifting would be relied upon to characterize local variation in stratigraphy, the extent of a discontinuity, or for testing of a hydrologic feature. The simplest hydrologic tests would involve borehole stress tests and instrumented monitoring activities. The task group was in general agreement that such testing would require at least 20 scientific personnel to work underground at the same time, and that the facility would be what the engineers referred to as "operational."

Thus a single access facility would be limited to exploratory excavation and drilling, with restrictions on the extent of drifting and scope of testing. A second access would be needed to support major testing, and would also permit more extensive exploratory drifting, regardless of the location of the second access with respect to the initial access. An additional access constructed by raise boring or comparable methods in the immediate vicinity of the initial access was ignored in development of options. However, haulage and service requirements on such an access could be determined from the extent of drifting that was associated with each option.

Finally, the relationship of extensive drifting to access locations was considered. Targets for extensive drifting within the block were identified as: lateral facies transition in the central part of the site, Ghost Dance Fault, Solitario Canyon Fault, Drillhole Wash, and bounding structures to the east or southeast. It was determined that roughly 12,000 lineal feet of drifting could reach substantially all of these features from an inside access, and that a similar scope of drifting would be adequate to explore all of the features accessible from an outside access. The specific layout for drifting, and the locations where features would be intercepted, were not defined.

3) Connection/integration with the ESF vs. no connection/integration

This factor represents a possible major design feature of the ESF, and thus of the repository, and was treated explicitly in the Calico Hills study. An access for CHn exploration inside the exploration block could be integrated with an ESF shaft or ramp, and would share surface facilities as well. In principle, a shaft or ramp for access to the CHn could also be constructed inside the exploration block, but with no connection to the ESF. This possibility is discussed further in the description of screening.

4) Provision for special area for "aggressive testing."

Some task group members maintained that flexibility to perform large-scale hydrologic or transport experiments in the CHn was an important factor. This could be accomplished in either of two ways: (1) by providing access to features of interest well outside the exploration block (more flexibility); or (2) by providing information as the basis for evaluating whether it is reasonable to perform such testing within the exploration block. The latter approach was implemented in the development of options rather than the former, to limit the number of options considered and because the approach to "aggressive testing" was judged to be much less important than the extent of exploration, for evaluating the test utility of alternative strategies.

The exploration block that is outlined in the map provided as Figure 2.4-2, was chosen to define the location aspect of strategies. In general, penetrations inside this area have a stronger possibility of lying along potential pathways for radionuclide transport than those outside. Penetrations more than about 2,000 feet from the exploration block in the unsaturated zone are unlikely to lie along such pathways unless the repository is expanded, or there is strong lateral diversion between the respository and the water table. The exploration block (Figure 2.4-2) was used in lieu of the conceptual repository perimeter (SCP Conceptual Design Report) to accommodate limited future expansion. A distance of 2,000 feet extends well into or beyond the structures which bound the exploration block and may drain diverted or perched groundwater. In addition, the boundary of the exploration block is more uniformaly closer to these bounding structures than the conceptual repository perimeter. In the absence of more concrete knowledge of lateral diversion and respository expansion, the exploration block boundary was adopted.

Defining the Option Space: Rationale for Location Factor

In developing strategies, locations outside of the exploration block were considered to be distinct from inside locations, i.e., inside and outside penetrations were considered to be separated by at least 2,000 feet. It was assumed that the utility of outside locations can be considered in terms of the location of the initial penetration (defining what part of the site will be most intensively explored early in the site characterization program), and whether extensive drifting is incorporated.

The term test utility is used throughout this discussion to refer principally to the location and extent of sampling that is afforded by an option or strategy. Options that involve miles of drifting have inherent test utility advantages over limited options. In general, the same types of tests would be performed in both types of facilities, but the more extensive coverage would produce greater test utility. In the extensive options, more testing could be located at features of interest noted from exploration. The extent of coverage inside vs. outside the exploration block could also affect test utility.

Outside locations were further restricted by considering conditions in the CHn that are desirable for exploration and testing. Foremost is the height of the basal vitrophyre of the Topopah Spring Member above the water table. This should be at least 100 m feet to allow for roughly 40 m feet of nonwelded Topopah Spring Member below the vitrophyre, and roughly 50 m feet of capillary fringe. This condition was considered by examining the USGS cross- sections (Scott and Bonk, 1984). Cross section D-D' shows that adequate conditions probably do not extend beyond Teacup Wash to the northeast. Cross-section B-B' shows that adequate conditions are increasingly unlikely to the east of the SE portion of Drillhole Wash. Cross-section C-C' shows that adequate conditions are found over a relatively large E-W extent, south of the exploration block. Finally, cross-section A-A' shows that adequate conditions probably exist under Jet Ridge. The water table altitude in borehole USW H-6 on the eastern flank of Jet Ridge is less than 1 m higher that in H-5 on Yucca Crest (SCP Figure 3-28). Extrapolating conditions about 3,000 feet south of cross-section A-A', conditions are probably adequate despite downfaulting.

The following generalized outside locations were developed: (1) west of the exploration block and the Solitario Canyon Fault, under the south-central portion of the eastern flank of Jet Ridge; (2) northeast of the block, extending to Teacup Wash; and (3) south of the block in a broad area east of the Solitario Canyon Fault and under the eastern flank of Yucca Mountain.

Underground Excavation Access Possibilities: Screening

Given the option space and possibilities, a set of combinations was developed and screened. Based on the discussion of factors above, there were six possible locations, two possible definitions for extent, and two possible states for ESF connection/integration. The resulting 24 combinations are indicated in Figure 2.4-3.

The process of screening the 24 options began with identification of one as a baseline case that is understood by the experts and interested parties, and which may be used for relative treatment of scoring results in later parts of the study. The baseline option for the Calico Hills study was the original CDSCP proposal to extend shaft ES-1 into the upper part of the unit at the Coyote Wash location (northeast, option #3 on Figure 2.4-3). Exploratory drilling, limited drifting, mapping, and sampling were conceptually planned. Hydrologic testing concepts were proposed, which would be adapted to the specific features observed.

A number of combinations were eliminated by observing that for outside options, integration between the ESF and the initial CHn penetration is infeasible. This is consistent with the assumptions used to develop options, including that the boundaries of the repository are fixed. Various ramp accesses to the ESF have been proposed which would include portal more than 2,000 feet outside the exploration block, but these would not be readily usable for outside CHn penetration locations. These screening steps reduced the 24 options to 18.

A further simplification resulted from considering only those inside CHn options with ESF connection/integration. In principle, a shaft or ramp could be constructed inside the exploration block and never connected with ESF/repository openings. A barrier pillar would be maintained, and the repository usable area would be reduced. The basis for the idea is that waste isolation performance could be enhanced slightly if there were no direct connection from the waste emplacement areas, to openings within the CHn natural barrier. However, this concept would also require at least one additional penetration (and possibly two or more) from the surface through the repository block. The potential adverse impact of such extra penetrations was judged to offset the possible benefit to waste isolation. This screening step further reduced the number of underground excavation options to 12.

The grouping process began with a discussion of hypotheses about what would be the most important factors in scoring, i.e., how would different options score on waste isolation and test utility. The most important of these ideas should be tested in the evaluation process, by assessing options that represent the range of alternatives. The ideas discussed included: (1) whether north/central/south location, inside/outside, and limited/extensive are significant choices with respect to waste isolation and test utility; and (2) whether the options that appear to provide best waste isolation or best test utility are significantly better than medial combinations combining both. To identify options which define the alternatives for testing these ideas, seven subsets of combinations were formed as noted on Figure 2.4-4. The task group then considered which groups are associated with greatest/least potential impacts to waste isolation and test utility. The results are as follows:

		Waste Isolation	Test Utility
Potential Adverse Impact:	Least	group 5	union of groups 2, 4
	Greatest	group 2	group 5

The rationale for these assignments is straightforward. Potential adverse impacts to waste isolation are least for outside, limited facility options, and greatest for inside options involving extensive drifting. Potential adverse impacts to test utility are least for options involving extensive drifting, especially those inside the exploration block, but also those located outside. A check was done to confirm that ignoring the distinction of group 2 as producing greatest potential adverse impacts to waste isolation does not fail to include any option with potentially high test utility.

Underground Excavation Strategies

Composition of characterization strategies from options took into account the following objectives: (1) limit the number of assessments required of the expert panel in the scoring part of the study, (2) choose strategies that represent the range of possible options, and (3) consider factors such as phasing of different access options, which could not easily have beed addressed in the foregoing process. The option grouping results were relied upon, and an intuitive process was also used to identify representative options from within the groups, and to determine whether the strategy list adequately represents the tradeoff between waste isolation and test utility.

Several members of the task group produced lists of strategies for consideration, and these are compiled in Figure 2.4-5. Discussion of these lists developed the following positions: (1) the strategies should be selected for clear comparison of possible answers to the questions posed as grouping hypotheses; (2) explicit use of phasing to combine access configurations tends to reduce the clarity of the comparisons; and (3) definition of access location is necessary for the results to be used as ESF design input (i.e., strategies which give only a selection of possible alternative access locations have less value as design input).

The discussion resulted in the underground excavation strategies described in the list at the end of this section. The rationale for these strategies is as follows:

Strategy No. 1 (Outside, southeast, 2 accesses, extended drifting, no ESF connection, w/ additional SBT; in addition another facility inside, northeast, integrated w/ the ESF) This strategy represents a way to achieve high test utility while limiting impacts to the rock mass along likely transport pathways. The major facility would be located outside the block where there would be relatively fewer constraints on facility design (e.g. repository design control) or testing. The facility would be designed to support support extensive drifting, and testing as appropriate, in the area of the facies transition in the CHn. Drifts would be constructed to explore a portion of the imbricate normal fault zone, and the southern extension of the Ghost Dance Fault. The influence of facies on the hydrologic importance of structure would be investigated. A SBT program in addition to the SCP program would be conducted, including a Prow Pass facility, several angle boreholes, and deepening of two planned boreholes (these are discussed in more detail for Strategy No. 6). The outside facility could be constructed first (although not necessarily) along with the incremental SBT. The limited NE facility could then be confirmatory, and its design could be based on preliminary information from the other facilities and on early results from the SCP SBT program. In short, this Strategy would maximize information about the CHn unit while limiting direct excavation within the exploration block.

Strategy No. 2 (Inside, 2 accesses in the south, extended drifting, integrated w/ the ESF) This strategy maximizes test utility and data representativeness, and would also produce the greatest potential impacts on waste isolation. Approximately 12,000 feet of drifting would be supported, to provide access to major features including the Solitario Canyon Fault, Ghost Dance Fault, Drill Hole Wash, imbricate normal fault zone to the east, and the vitric-zeolitic facies transition.

Strategy No. 3 (Inside, northeast, limited facility, integrated w/ the ESF) This is the baseline strategy, corresponding to the CDSCP program. It is the most widely known and understood configuration for a CHn characterization facility. It can be used as the reference basis for relative comparisons among strategies, particularly with regard to test utility, and will also be used to evaluate whether north vs. south location is an important factor for limited facilities. This strategy would provide access to several major features, including Drill Hole Wash, Ghost Dance Fault, and the imbricate normal fault zone to the east, while limiting drifting to about 5,000 lineal feet.

Strategy No. 4 (Inside, south, limited facility, integrated w/ the ESF) Some of the options under consideration in the ongoing ESF alternative configurations study, involve shaft or ramp accesses to the ESF in the southern part of the exploration block. The unsaturated zone is thicker there, and the Calico Hills lithology is mostly vitric, so the waste isolation impact may be reduced relative to the baseline Strategy No. 3. However, access to major features would be limited to the Solitario Canyon Fault zone in the southern part of the exploration block.

Strategy No. 5 (Inside, 2 accesses in the northeast, extended drifting, integrated w/ the ESF) This strategy is similar to No. 2, except the accesses would be in the northeast part of the block rather than the south. The drifting and testing would be virtually the same for No.'s 2 and 5. Tradeoff between waste isolation and test utility will be evaluated for northeast vs. south access location. The combination of No.'s 2 and 5 ensures that at least one alternative representing high test utility, can be integrated with the ESF accesses wherever they are sited.

Strategy No. 7 (Outside, southeast, extensive drifting, no ESF connection, w/ additional SBT) This alternative is similar to No. 1, but without the limited facility inside the northeast part of the block. This strategy would thus maximize the information on both vitric and zeolitic facies, without direct excavation in the block. Similar to Strategy No. 1, the extensive outside facility would support exploration and testing as appropriate, in an area that includes the facies transition and known faulting. This strategy is included in addition to No. 1 to examine the relative significance of the limited, inside facility to the northeast. The results of evaluating both strategies can be considered together to represent the benefits of phasing the outside and inside facilities.

Strategy No. 8 (Outside, southeast, limited facility, no ESF connection, w/ additional SBT) Because of the scope and location, this alternative would minimize potential adverse impacts to waste isolation, and represents the "Least Potential Impact" set identified in the grouping process. In addition, this option includes the incremental SBT in addition to the SCP program, which increases the overall test utility. The excavation would explore the southern extension of the Ghost Dance Fault.

In summary, the strategies discussed above (Strategy No.'s 1 through 5, and No.'s 7 and 8) provide good representation of the groups identified in the previous section as having least potential adverse impacts to waste isolation and test utility that were identified in the previous section. Strategy No. 8 represents least potential adverse impacts to waste isolation (for alternatives involving direct excavation in the CHn). Strategy No. 7 is similar to No. 8 but provides for an extensive outside facility, and thus exchanges aspects potentially favorable to waste isolation, for increased test utility. Strategy No. 4 represents the intermediate group but retains aspects potentially favorable to waste isolation, and is intended to test the importance of north vs. south location for inside facilities such as the baseline configuration. Strategy No.'s 2 and 5 represent most favorable test utility. Strategy No. 1 combines aspects potentially favorable to both waste isolation and test utility. Access to the facies transition is an important test utility attribute for Strategy No. 1, and potential waste isolation impacts associated with being downdip from waste emplacement areas would be mitigated because of separation distance and intervening structures. The CDSCP strategy for direct excavation in the CHn (Strategy No. 3) is incorporated so that comparison among the strategies can be based on a well known configuration, and performance evaluations from the literature which use the baseline configuration can be used more directly in the assessments for this study.

The central and west locations for inside and outside facilities, respectively, were not included in the strategies list for the following reasons. The west location would require extensive development of support facilities such as roads and utilities, and was judged unlikely to provide more information, nor present different potential impacts to waste isolation, than Strategy No. 1. Central locations were eliminated because although they could provide access to the facies transition with a limited facility, and do so within the exploration block where test utility is highest, they would tend to produce the greatest constraints on repository layout and the ESF. Central locations could produce the greatest impact on repository usable area, and were judged to be no more favorable than Strategy No.'s 1, 3, or 7 with respect to either waste isolation or test utility.

Other assumptions were also developed by the task group. The possibility that ramps would be used to access the CHn was discussed, and a position was reached that for outside accesses, and probably for inside accesses, shafts would involve far less excavation, and there is no obvious difference in waste isolation impact or test utility effect. Mining in the CHn would probably be done by mechanized miner, which could be transported in a modest shaft. Also, some assumption on the plugging/sealing of mined openings is needed to assess the postclosure performance implications of the alternative strategies. The approach to backfilling, plugging, and sealing is addressed in Sections 2.5 and 2.6.

The number of penetrations through recognized fault zones, associated with each strategy, was discussed both with respect to data representativeness and assessment of potential adverse impacts. Accordingly, it was assumed for limited excavation Strategy No.'s 3, 4, and 8, that each targeted structure would be penetrated at two different (nearby) locations. Extensive excavation Strategy No.'s 2, 5, and 7 would also penetrate each targeted structure at two locations, except for the Ghost Dance Fault which would be penetrated at three locations. In addition, Strategy No.'s 1, 7, and 8 would be located outside the block to the southeast, where multiple faults are inferred from mapping by Scott and Bonk (1984). Accordingly, the extent of fault penetrations is likely to be increased by a factor of two, with allowance for the magnitude of the faults which may be encountered, and the uncertainty inherent to surface indications of faulting.

<u>Testing Underground</u>

Underground excavation access strategies considered above do not limit testing to a particular area. The principal objective is exploration, which would be accomplished chiefly by mapping, sampling, and exploratory drilling of shaft/ramp and drift walls throughout the excavation.

The extent of exploratory drilling from the underground openings was assumed for the purpose of assessing test utility and potential waste isolation impact. Drilling would be limited, on average over the entire Calico Hills facility, such that all the boreholes drilled from each 100 m of drift would have aggregated length sufficient to penetrate the entire CHn (unsaturated) thickness at that location.

The scope of underground testing was discussed by the task group, and for a limited facility (up to 5,000 feet of drifting) would include: (1) preliminary, dry-drilled coreholes ahead of the penetration to explore rock conditions; (2) geologic mapping of all underground openings by photogrammetric means; (3) sampling throughout the facility and in the muck-pile for matrix hydrologic tests, hydrochemistry studies, etc.; (4) perched water test as required; (5) a series of radial boreholes tests conducted from the penetration, involving about a total of about 2,000 feet of dry drilling; and (6) testing for hydrologic and transport properties of faults, as described in Consultation Draft SCP Section 8.3.1.2.2.4.6. For extensive facilities (up to 12,000 feet of drifting) it was also assumed that two major hydrologic tests would be performed. For the purpose of assessing test utility and potential waste isolation impact, these tests were assumed to provide information on variation of hydrologic properties and processes with scale, validation of models for flow and transport, and monitoring of in situ conditions. In this respect, major underground tests in the Calico Hills unit would be similar to the bulk permeability and infiltration tests planned for the ESF MTL, and the suite of borehole stemming and monitoring tests performed for the prototype testing program in G-tunnel on the Nevada Test Site.

Surface-Based Testing Strategy

A strategy was developed which would involve SBT, and also drilling from the main test level (MTL) of the ESF, in addition to the baseline SCP characterization program. No underground excavations would be constructed in the CHn, except for a shallow adit into the CHn outcrop near Prow Pass. It was the consensus of the task group that the possible waste isolation impact from dry drilling, geophysics, and outcrop studies was so insignificant, that a single comprehensive surface-based testing strategy should be developed for comparison to the other strategies (which involve excavation in the CHn). That strategy is discussed below.

The task group recognized that the feasibility of drilling applications such as angle-holes, or drilling from the MTL, is strongly affected by whether dry drilling is required, or fluid controls are removed from drilling activities. The possibility for two SBT-only strategies, one "dry" and one permitting "wet" drilling with mud, air-mist, or alternatives, was considered. As pointed out in Section 2.3, the test utility of drillholes is limited compared to direct excavation. Test utility would be further reduced by contamination of samples and the borehole environment by fluid. Waste isolation implications could also be associated with the introduction of large amounts of water or other materials into the natural barriers. Accordingly, the "wet" SBT-only strategy was rejected.

The SBT strategy can also be described as a drilling-only strategy, combined with a special test facility near Prow Pass. Task group members assigned to consider this strategy found that the SCP-basis characterization program already contains extensive surface-based, vertical, dry-drilling. Angle-hole drilling is called out in the SCP as a possibility in the second phase of the systematic drilling program (Study 8.3.1.4.3.1). Angle-hole drilling from the surface should be included in the SBT strategy, particularly for characterizing the Solitario Canyon Fault, the Ghost Dance Fault, and the Drill Hole Wash structure, in the zeolitic and vitric facies. Accordingly, at least three such boreholes would be included in Strategy No. 6, located in Solitario Canyon, in the vicinity of Drill Hole Wash, and near the Ghost Dance Fault to the southeast. In addition, the SBT strategy includes deepening of the planned multipurpose boreholes near the exploratory shafts, to the water table.

Within the ESF, drillholes from the MTL down to the water table are included. One such hole would be vertical, located near the exploratory shaft. Another hole would extend from the MTL west of the Ghost Dance Fault, and intersect the fault at depth. Some flexibility as to the location of these holes, and possible additional holes of this type, is inferred. Thus the strategy could be carried out with any of the possible ESF configurations under consideration in the ESF alternatives study.

The SBT strategy also includes a testing program at an outcrop of the tuffaceous beds of the Calico Hills, plus underlying strata, north of the site area near the physiographic feature known as Prow Pass. Although the lithostratigraphic units comprising the CHn at the site are exposed here, lithologic conditions may not be exactly representative of zeolitized CHn in the site area. A testing facility would be constructed to support outcrop studies, open-cast excavation of structural features, and a shallow adit with a test alcove for drilling a pattern of exploratory boreholes and conducting hydrologic and transport tests.

The SBT strategy does not explicitly rely on geophysical methods beyond the planned feasibility tests (RE: DOE/YMP-90-38, in review) and characterization tests. The use of seismic and geoelectric methods to investigate faulting/fracturing and alteration/moisture content, respectively, in the CHn is potentially feasible. However, such concerns as sensitivity and repeatability of these methods, and the validity of correlation between geophysical properties and characterization parameters, have not been resolved. Implicit in the SBT strategy, is the effort to establish the validity of these methods and apply them using the planned boreholes at the site, if appropriate.

Combined SBT and Excavation in the Calico Hills Unit

Another application of additional SBT is to augment an excavation strategy that does not involve extensive drifting, or drifting within the exploration block. Such an application of SBT tends to extend the test utility of the excavation strategy, without much increase in potential waste isolation impact. Although additional SBT could be added to any excavation strategy, relatively little would be gained in this study by combining SBT with Strategies 2, 3, or 5. Strategy No.'s 2 and 5 involve extended drifting that will investigate the zeolitic facies. Strategy No. 3 is the baseline strategy, and involves drifting to structures within the zeolitic facies.

SBT could be combined with Strategies 1, 4, 7, and 8, consistent with the objectives of this study. These involve limited facilities, constructed to the south-southeast, either inside or outside the exploration block. By incorporating elements of the SBT strategy with Strategy No.'s 1, 7, and 8, test utility is increased because the zeolitic facies would be more intensively investigated. These elements include: (1) deepening the multi-purpose boreholes; (2) surface-based dry-drilled angle-boreholes to investigate structures bounding the exploration block, particularly in the zeolitic facies; and (3) construction and operation of a testing facility at the Prow Pass outcrop of the CHn. Strategy No.'s 7 and 8 remain essentially independent of ESF construction, by omission of the angle-holes drilled from the MTL of the ESF.

The incremental SBT elements were not added to Strategy No. 4, so as not to confuse the comparison of No.'s 3 and 4 in the scoring process. Also, the extra SBT is included in Strategy No. 8, which is similar to No. 4 but involves no direct excavation within the block. The additional SBT can, in principle, be included in any strategy. For purposes of this study, more insight is to be gained by maintaining clear comparisons between north vs. south, and inside vs. outside, than be combining elements in every possible combination.

Description of Changes in This Version (5/29/90) Relative to the 4/18/90 Version

The following list summarizes the changes in this version of the 2.4 interim product for the Calico Hills study, relative to the previous version dated 4/18/90. These changes were made prior to the conclusion of expert assessment of test accuracy and performance characteristics.

1) An initial assumption was added to the first subsection, that ESF will be integrated with the repository (i.e., shared openings, with ESF openings considered permanent items).

2) The 36 possible access configurations were reduced to 24 by simplifying the ESF integration factor.

3) The 24 possibilities were screened to 12 by eliminating outside options with ESF connection, and by eliminating inside options with no ESF connection.

4) Development of the rationale for possible locations was changed, to acknowledge possible configurations of multiple accesses, and to eliminate the concept of a primary penetration.

5) The extent of drifting needed to access major features from an inside, extensive facility was revised from 10,000 to 12,000 lineal feet.

6) Elimination of inside options with no ESF connection is discussed in the screening description, rather than in the text describing formation of strategies.

7) In the grouping analysis, groups were renumbered in Figure 2.4-4.

8) Strategy No.'s 1, 2, and 5 were changed, and Strategy No. 7 added in accordance with the results of the 5/23/90 meeting.

9) Strategy No. 8 was added to represent least potential impact on waste isolation.

10) Assumptions on backfilling/plugging/sealing were deferred to Sections 2.5 and 2.6.

11) An error in the text was corrected, such that Strategy No. 4 does not have include incremental SBT as stated on p. 11 of the 4/18/90 report.

12) Information on number of fault penetrations was provided as the basis assumptions for data representativeness and impacts analysis.

Strategies List

The following list of strategies for characterizing the CHn at Yucca Mountain will be assessed in the remainder of the study. A brief description of each strategy is provided. Further information on each of the strategies, can be obtained from the sketches as noted.

Strategy No. 1 **Outside, Southeast, Extended Drifting, No ESF Connection; Combined With Additional SBT; Also Combined With Limited Facility, Inside, Northeast, Integrated With the ESF (Figure 2.4-6)**

This strategy requires the construction of an "operational," 2-access facility, located at least 2000 feet outside the boundary of the repository exploration block to the southeast. This facility would have no underground connection to the ESF. It would support 12,000 lineal feet of drifting in the CHn, which could be distributed over two or more different levels. Drifting targets would include the facies transition (exploration of the different facies in representative settings) and the imbricate normal fault zone east of the block. Based on limited available stratigraphic information (see Figure 6-13 of Fernandez et al., 1987) there would be ample access to the zeolitic facies in this area.

Additional SBT elements from Strategy No. 6 are included for increased test utility. The proposed test facility at Prow Pass would be constructed. At least three surface-based, angle drillholes would be drilled "dry," to explore conditions along the Solitario Canyon Fault, Ghost Dance Fault, and Drill Hole Wash. The Multi-Purpose Boreholes at the Coyote Wash ESF location would be deepened to the water table for additional information on the CHn.

In addition, an underground facility would be constructed in the northeast, within the block boundary at or near the Coyote Wash site. This facility would be a limited facility similar to the CDSCP-proposed, baseline CHn testing facility. It could have just one access if permitted by applicable DOE

Orders and other regulations, otherwise it could have a small-diameter secondary access in the immediate vicinity.

Strategy No. 2 **Inside, 2 Accesses, South, Extensive Drifting, Integrated w/ESF** (Figure 2.4-7)

Approximately 12,000 linear feet of drifting in the CHn, within the boundary of the exploration block, would be supported from accesses in the south. These accesses could be shafts, ramps, or some combination, and would be integrated with the ESF. The underground layout would target the Ghost Dance Fault, the Solitario Canyon Fault, the imbricate normal fault zone to the east, the Drillhole Wash Structure, and the vitric-zeolitic facies change.

Based on limited available stratigraphic information (see Figure 6-13 of Fernandez et al., 1987) there would be ample CHn thickness to explore the target structures, while maintaining mined openings at or above 2,650 feet elevation (at least 70 m above the current water table). This specification is adopted from the original CDSCP configuration, and is intended to ensure that a minimum thickness of the CHn, corresponding to the minimum thickness found anywhere beneath the conceptual repository, remains unexcavated.

Strategy No. 3 **Inside, NE, Limited Facility, Integrated w/ESF** (Figure 2.4-8)

This strategy includes the CDSCP configuration, refined to include drifting to the Ghost Dance Fault, the Drillhole Wash structure, and the Imbricate normal fault zone to the east. The extent of any single drift from the single access would be limited to around 2000 linear feet. Excavated openings would be maintained at or above 2,650 feet elevation to maintain a minimum thickness of unexcavated CHn.

Strategy No. 4 **Inside, South, Limited Facility, Integrated w/ESF** (Figure 2.4-9)

A single access would be constructed in the south end of the exploratory block and would be connected with the ESF in that area. Exploratory drifts would be extended to the Abandoned Wash area and to the Solitario Canyon Fault. Each drift would be limited to approximately 2000 linear feet in length. Excavated openings would be maintained at or above 2,650 feet elevation to maintain a minimum thickness of unexcavated CHn.

Strategy No. 5 **Inside, 2 Accesses, North, Extensive Drifting, Integrated w/ESF** (Figure 2.4-10)

Approximately 12,000 linear feet of drifting in the CHn, within the boundary of the exploration block, would be supported from accesses in the north. These accesses could be shafts, ramps, or some combination, and would be integrated with the ESF. The underground layout would target the Ghost Dance Fault, the Solitario Canyon Fault, the imbricate normal fault zone to the east, the Drillhole Wash Structure, and the vitric-zeolitic facies change. This strategy would be similar to No. 2 in every aspect except the access locations and any associated differences in the underground layout.

Strategy No. 6 **Surface-Based Testing (Figure 2.4-11)**

The multi-purpose boreholes would be deepened to the water table. Three dry, angle-boreholes would be drilled from the surface, located in Solitario Canyon, in the vicinity of Drill Hole Wash, and to the southeast of the exploration block. The target structures would be the Solitario Canyon Fault, the Ghost Dance Fault or the Drill Hole Wash structure in the zeolitic facies, and the Ghost Dance Fault to the southeast in vitric facies. Dry angle-boreholes would be drilled from the MTL of the ESF, in proximity to the Ghost Dance Fault, to intersect the fault in the zeolitized facies. At least two such boreholes would be drilled. Considerable flexibility in the number and location of such boreholes is inferred. For example, a pattern of boreholes may be drilled into the Ghost Dance Fault from single drillroom in the NE part of the repository block. In addition to the above, a surface-based testing facility would be constructed at the Prow, north of the site. This facility would include excavation of a small fault, and construction of a shallow adit (e.g. depth of 200 feet) to obtain access for hydrologic tests possibly involving liquid water flow with tracers, and additional drilling into the fault.

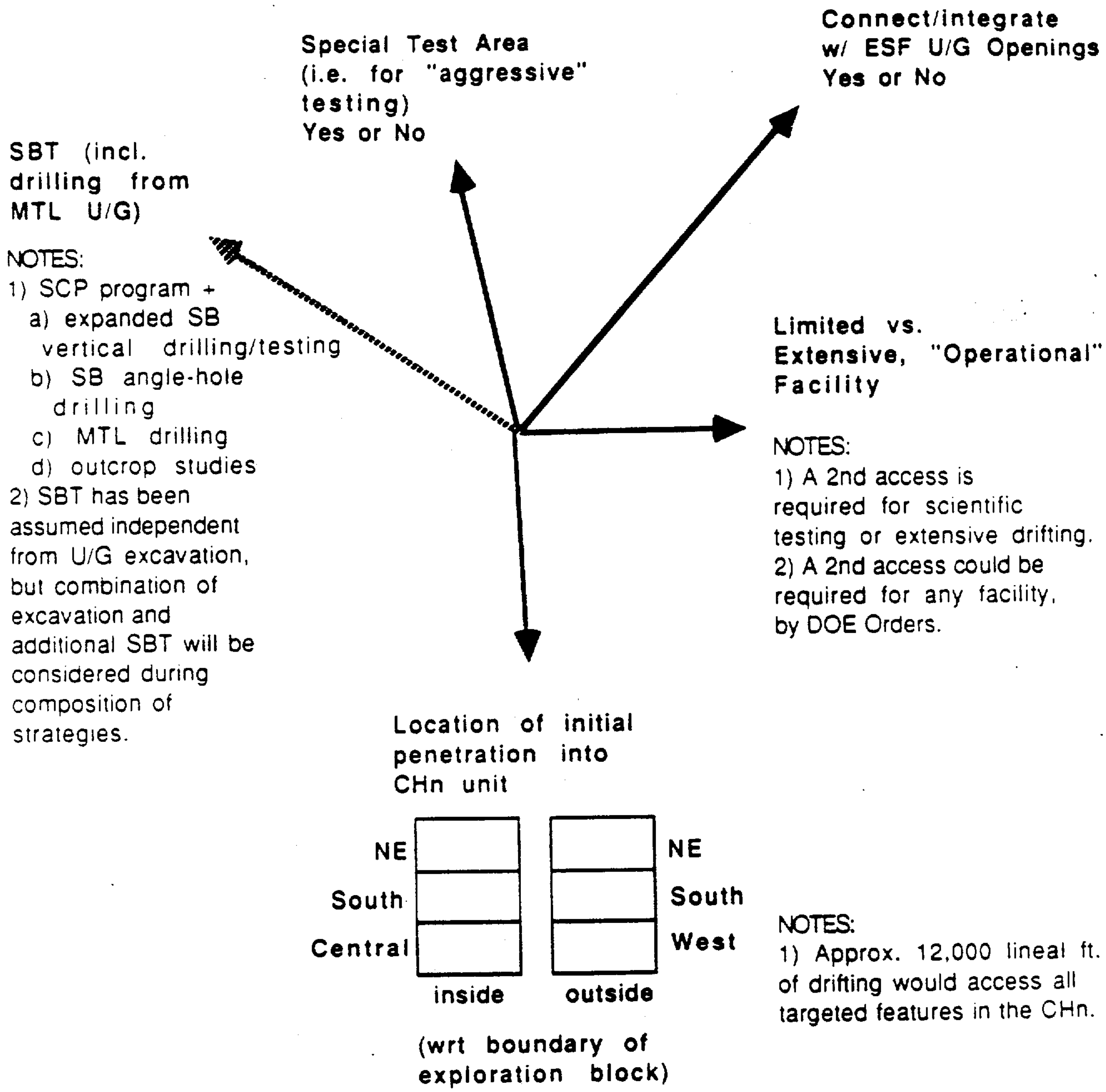
Strategy No. 7 **Outside, Southeast, Extended Drifting, No ESF Connection; Combined With Additional SBT (Figure 2.4-12)**

This strategy requires the construction of an "operational," 2-access facility, located at least 2000 feet outside the boundary of the repository exploration block to the southeast. This facility would have no underground connection to the ESF. It would support 12,000 lineal feet of drifting in the CHn, which could be distributed over two or more different levels. Drifting targets would include the facies transition (exploration of the different facies in representative settings) and the imbricate normal fault zone east of the block. Additional SBT elements from Strategy No. 6 are included for increased test utility. The proposed test facility at Prow Pass would be constructed. At least three surface-based, angle drillholes would be drilled "dry," to explore conditions along the Solitario Canyon Fault, Ghost Dance Fault, and Drill Hole Wash. The multi-purpose boreholes at the Coyote Wash ESF location would be deepened to the water table for additional information on the CHn. This strategy would be the same as No. 1, except that no excavation in the CHn would constructed within the exploration block.

Strategy No. 8 Outside, Southeast, Limited Facility, No ESF Connection; Combined With Additional SBT (Figure 2.4-13)

This strategy involves only a limited facility (which may have 2 accesses if required) located at least 2000 feet outside the boundary of the repository exploration block to the southeast. This facility would have no underground connection to the ESF. It would support 5,000 lineal feet of drifting in the CHn, which could be distributed over two or more different levels. Drifting targets would include southern extension of the Ghost Dance Fault. Additional SBT elements from Strategy No. 6 are included for increased test utility. The proposed test facility at Prow Pass would be constructed. At least three surface-based, angle drillholes would be drilled "dry," to explore conditions along the Solitario Canyon Fault, Ghost Dance Fault, and Drill Hole Wash. The multi-purpose boreholes at the Coyote Wash ESF location would be deepened to the water table for additional information on the CHn.

Figure 2.4-1· Factors comprising the option space for surface-based testing and underground excavation strategies for CHn characterization.



Calico Hills Study
Option Space w/ Possibilities
Developed from March 14-15 task force meeting

Revised 5/29/90

Figure 2.4-2 Map used to define exploration block.

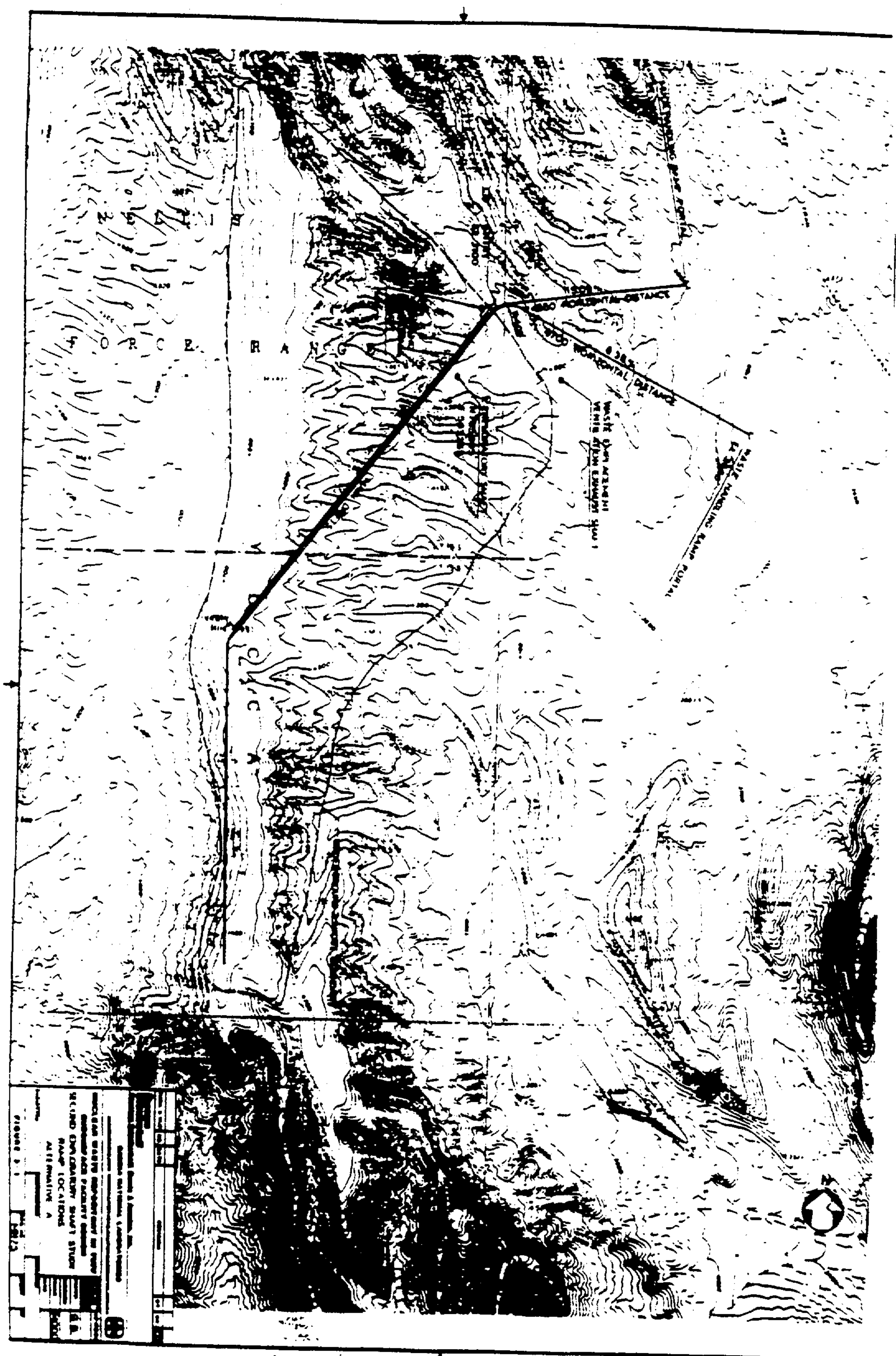


Figure 2.4-3 Table of 24 possible combinations for configuration of underground excavation in the CHn.

Location of Initial CH penetration		Extensive. Operational Facility	Integrate Facility w/ ESF U/G Openings	Description	ID #
General Area	Inside/ Outside				
NE	Inside	Yes	Yes		1
			No		2
		No	Yes		3
			No		4
	Outside	Yes	Yes		5
			No		6
		No	Yes		7
			No		8
South	Inside	Yes	Yes		9
			No		10
		No	Yes		11
			No		12
	Outside	Yes	Yes		13
			No		14
		No	Yes		15
			No		16
Central	Inside	Yes	Yes		17
			No		18
		No	Yes		19
			No		20
West	Outside	Yes	Yes		21
			No		22
		No	Yes		23
			No		24

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Figure 2.4-4 Table of 12 screened options for underground excavation in the CHn, with grouping and categorization of groups according to potential adverse impacts to waste isolation and test utility.

Location of Primary CH penetration		Extensive, Operational Facility	Integrate Facility w/ ESF U/G Openings	ID #	Group(s)	Least Potential Impact on Waste Isolation	Greatest Potential Impact on Waste Isolation	Great-est Test Utility	Least Test Utility	Intermediate Group
General Area	Inside/ Outside									
NE	Inside	Yes	Yes	1	2		X	X		
		No	Yes	3	3					X
	Outside	Yes	No	6	1,4			X		
		No	No	8	1,5	X			X	
South	Inside	Yes	Yes	9	2		X	X		
		No	Yes	11	3					X
	Outside	Yes	No	14	1,4			X		
		No	No	16	1,5	X			X	
Central	Inside	Yes	Yes	17	2		X	X		
		No	Yes	19	3					X
West	Outside	Yes	No	22	1,4			X		
		No	No	24	1,5	X			X	

Groups
1 = outside, no ESF connection
2 = inside, 2nd access
3 = inside, no 2nd access
4 = outside, 2nd access
5 = outside, no 2nd access

Least potential adverse impact on waste isolation = group 5
Greatest potential adverse impact on waste isolation = group 2
Greatest test utility = union of groups 2,4
Least test utility = group 5
Intermediate (not included in other classes) = group 3

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Figure 2.4-5 Candidate strategies contributed by task group members as indicated.

Excavation Strategies for Calico Hills Unit: Summary of Task Group Input

Contributor	Strategy 1	Strategy 2	Strategy 3	Strategy 4	Strategy 5	Strategy 6	Strategy 7	Straigegy 8	Strategy 9
Dobson	(#10, 22 or 34) Outside primary access, NE, S, or W; 2nd access Ext drifts, no ESF connection, and a special test area	(#30) Inside primary access, Central location no 2nd access, no ESF connection	(#22) Outside primary access, South; Ext drifts outside block, 2nd access, no ESF connection, special test area	(#1/2/3 or 13/14/15 or 25/26/27) Inside primary access, NE, S or Central location. Ext drifts; 2nd access, ESF connection non discriminatory	(#3) Inside primary access. NE location; Ext drifts, 2nd access, ESF connections; special test area outside block	(#5 option 3 or 17) Inside primary access NE ESF connection, option for 2nd access or another limited facility inside to the South	(#17 option 15 or 5) Inside primary access, S location, ESF connection, option for 2nd access or another limited facility inside to the NE		
Sinnock	(#5) Baseline CDSCP strategy, NE inside; no Ext drifting; no 2nd access, ESF connection	Withdrawn	(#17) Primary access inside, South no 2nd access, ESF connection	(#6) Primary access inside North no 2nd access, no Ext drifts no ESF connection	(#12) Primary access outside just outside NE block boundary, no 2nd access no Ext drifts, no ESF connection	(#24) Primary access outside SE location close in no 2nd access no ESF connection	(#24) Primary access just outside far South boundary of block, no 2nd access no ESF connection	A (#1/2/3 or 13/14/15) N or S inside 2nd access Ext drifts in block, ESF connection B (see Dobson 1) N or S w/ Ext drifts in block	(#10 or 22) Primary access outside N or S 2nd access, no ESF connection, Ext drifts outside of expl block (includes Sinnock 10)
Robertson	(#22) Primary access outside South; 2nd access NE Ext drifts in block, no ESF connection	(#13/14/15) Primary access inside South, 2nd access, Ext drifts in block ESF connection but not specified	(#17) Primary access inside, South location, no Ext drifts, no 2nd access, ESF connection	(#24) Primary access outside SE location; no Ext drifts; no 2nd access no ESF connection	(#5) Baseline CDSCP option, primary access inside NE location, no 2nd access, no Ext drifts, ESF connection				
Hardin	(#12 option for 8) Primary access outside, NE, no 2nd access or connection w/ ESF, option to add Ext drifts and 2nd access connected w/ ESF	(#17) Primary access inside, South location no 2nd access, ESF connection	(#24 option for 20) Primary access outside S or SE, no 2nd access or ESF connection, option to add Ext drifts and 2nd access w/ ESF connection	(#30) Primary access inside, Central location no 2nd access no ESF connection, limited facility	(#5) Baseline CDSCP option primary access inside NE location, no 2nd access, no Ext drifts, ESF connection	(#12 or 24 w/ SBT) Combine a limited UG facility, outside N or S w/ no 2nd access or ESF connection w/ SBT in addition to SCP prgm	(#5 or 17 w/ SBT) Combine a limited UG facility, inside N or S w/ no 2nd access or ESF connection w/ SBT in addition to SCP prgm		

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Figure 2.4-6 Sketch depicting CHn characterization Strategy No. 1.

STRATEGY NO. 1

OUTSIDE; SE; EXTENDED DRIFTING; NO ESF CONNECTION - ADDITIONAL SBT - WITH INSIDE, NE, LIMITED FACILITY; INTEGRATED WITH ESF

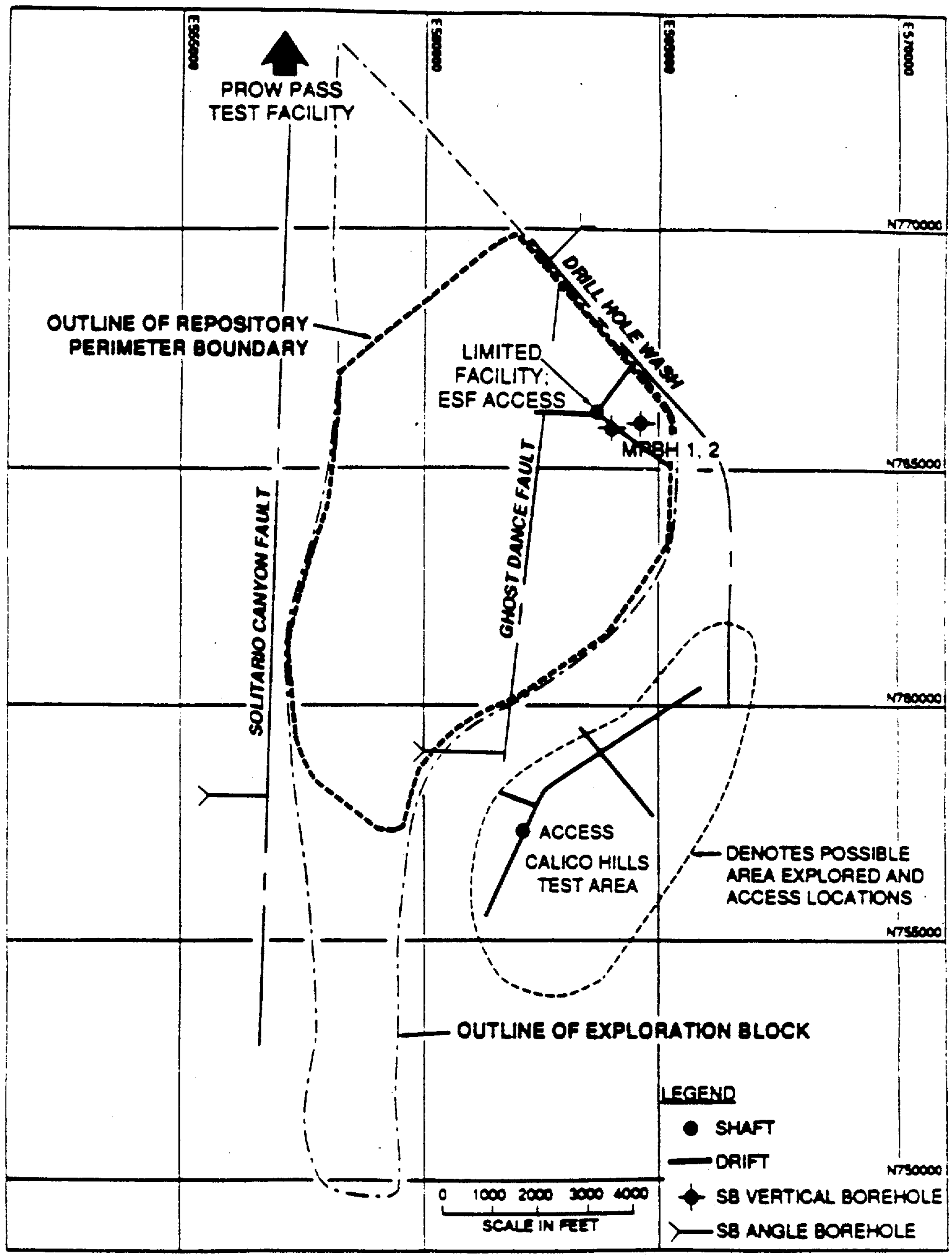

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Figure 2.4-7 Sketch depicting CHn characterization Strategy No. 2.

STRATEGY NO. 2

INSIDE; S; EXTENDED DRIFTING; INTEGRATED WITH ESF

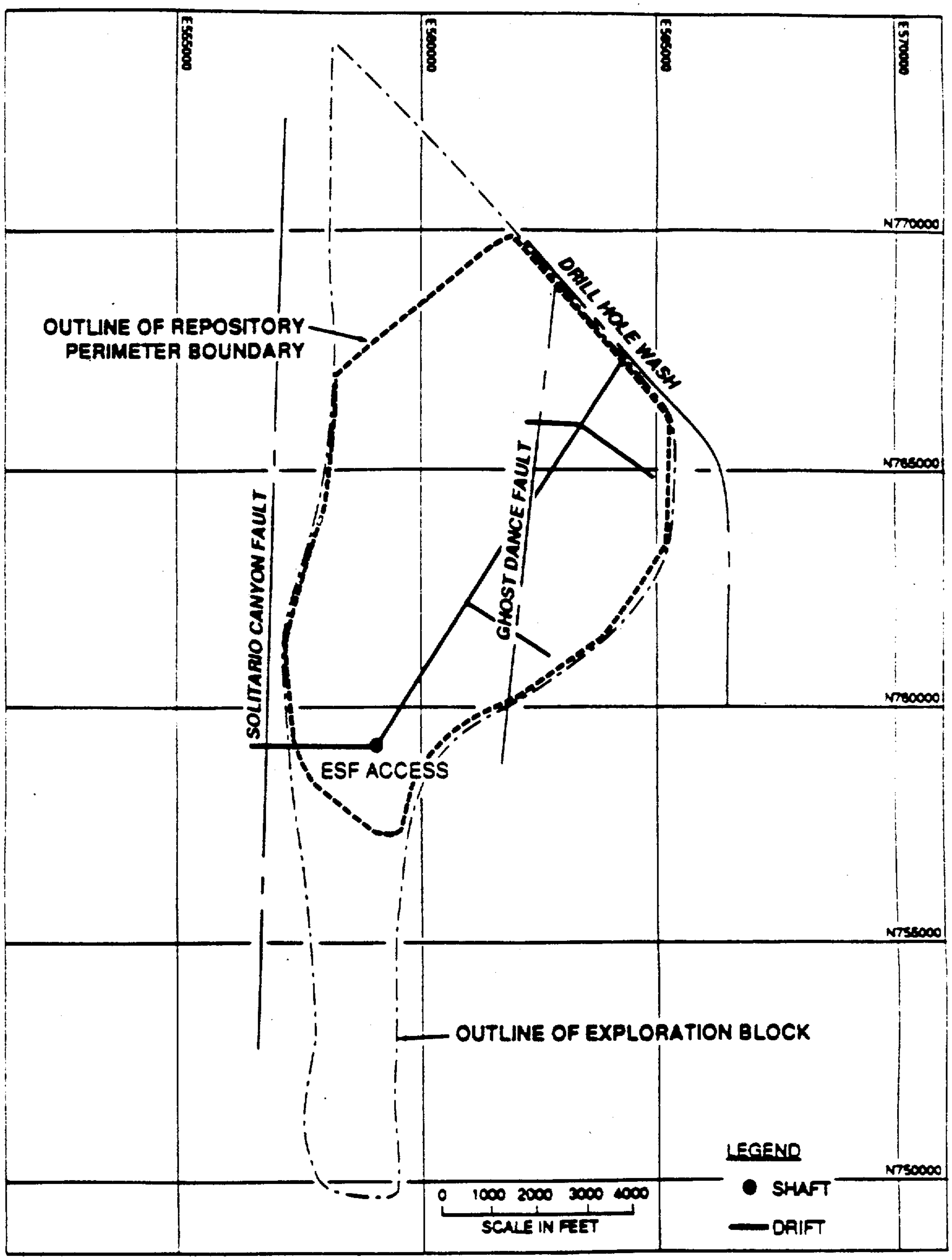

Figure 2.4-8 Sketch depicting CHn characterization Strategy No. 3.

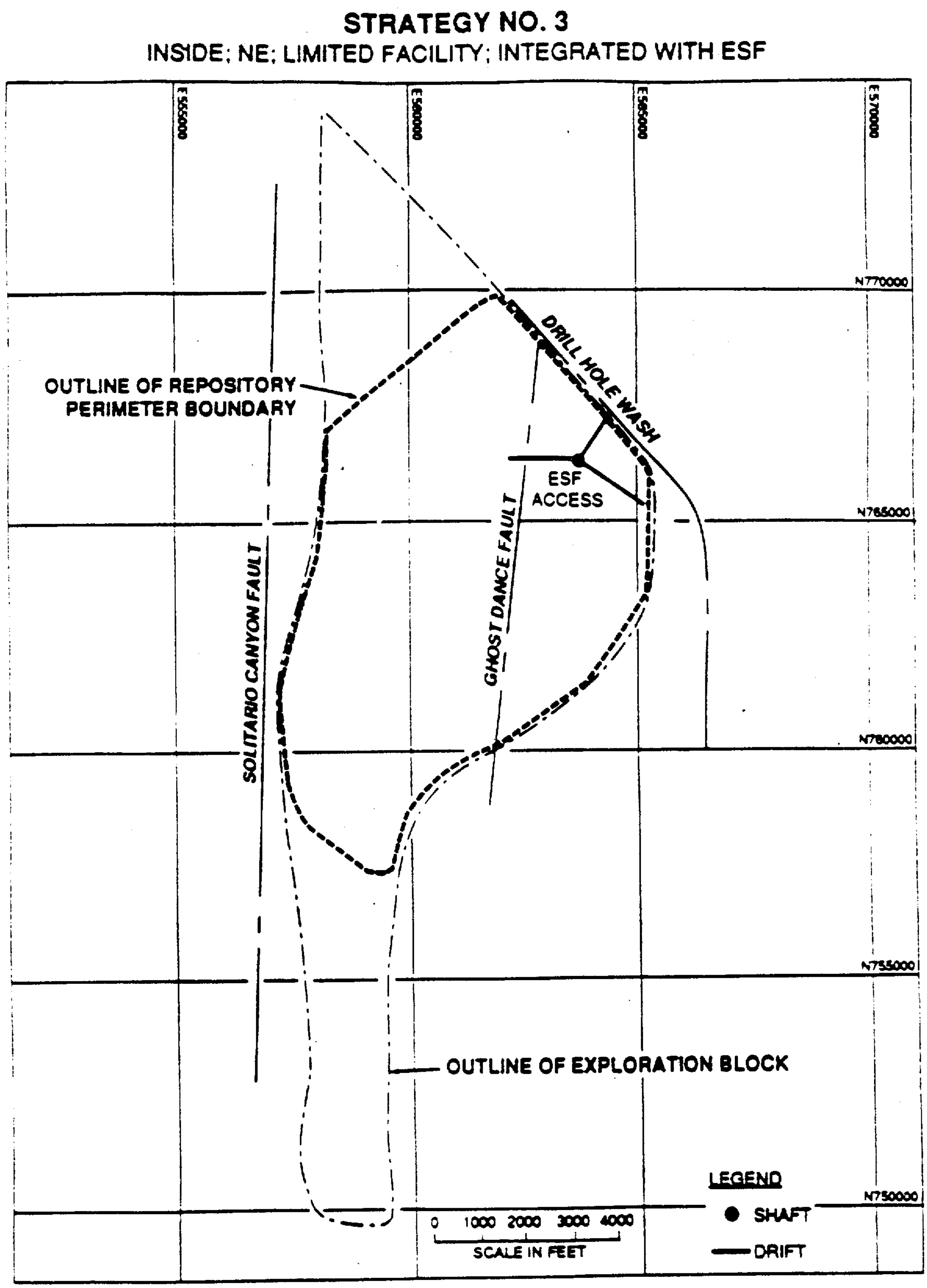

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Figure 2.4-9 Sketch depicting CHn characterization Strategy No. 4.

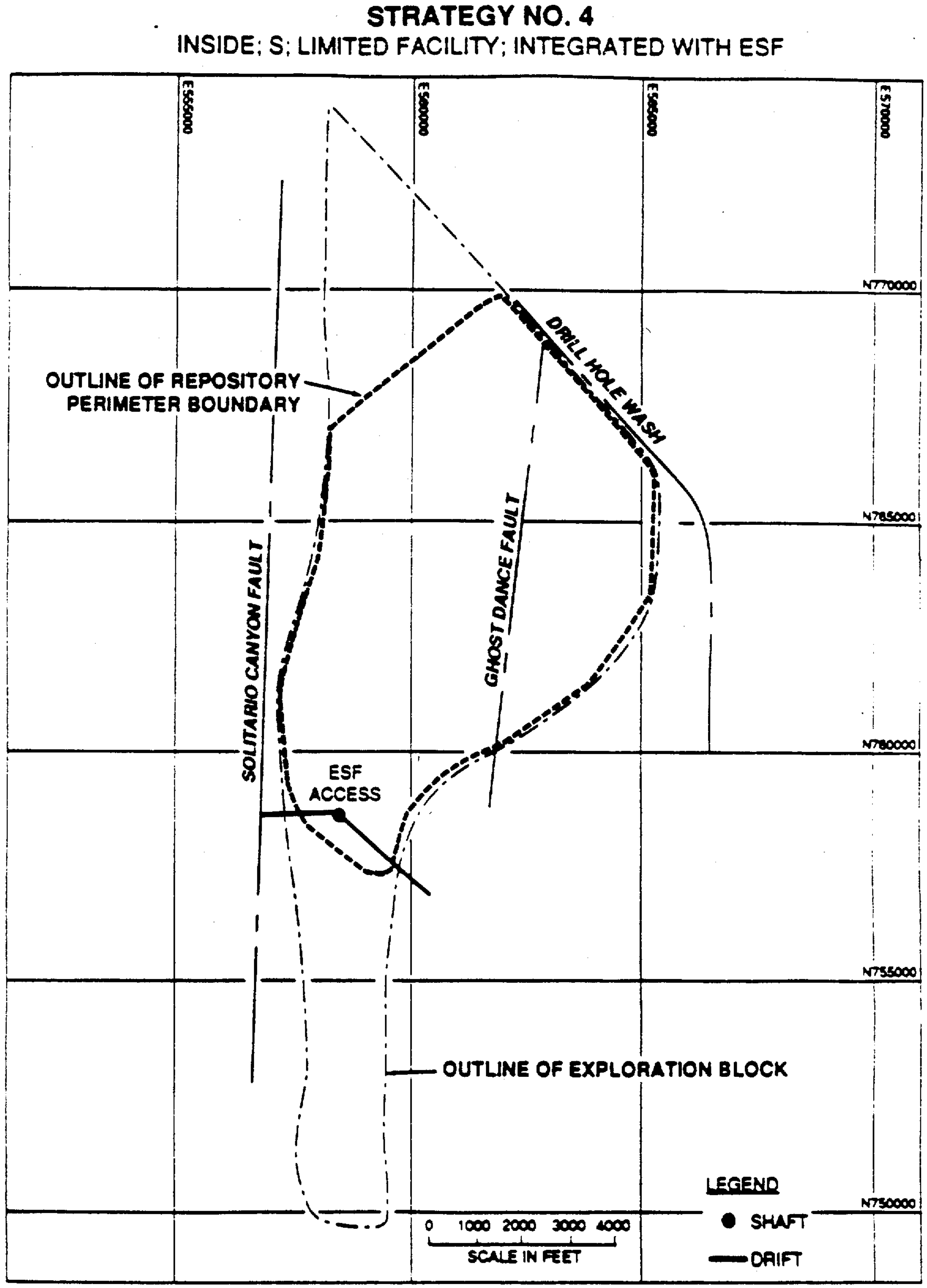

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Figure 2.4-10 Sketch depicting CHn characterization Strategy No. 5.

STRATEGY NO. 5

INSIDE; NE; EXTENDED DRIFTING; INTEGRATED WITH ESF

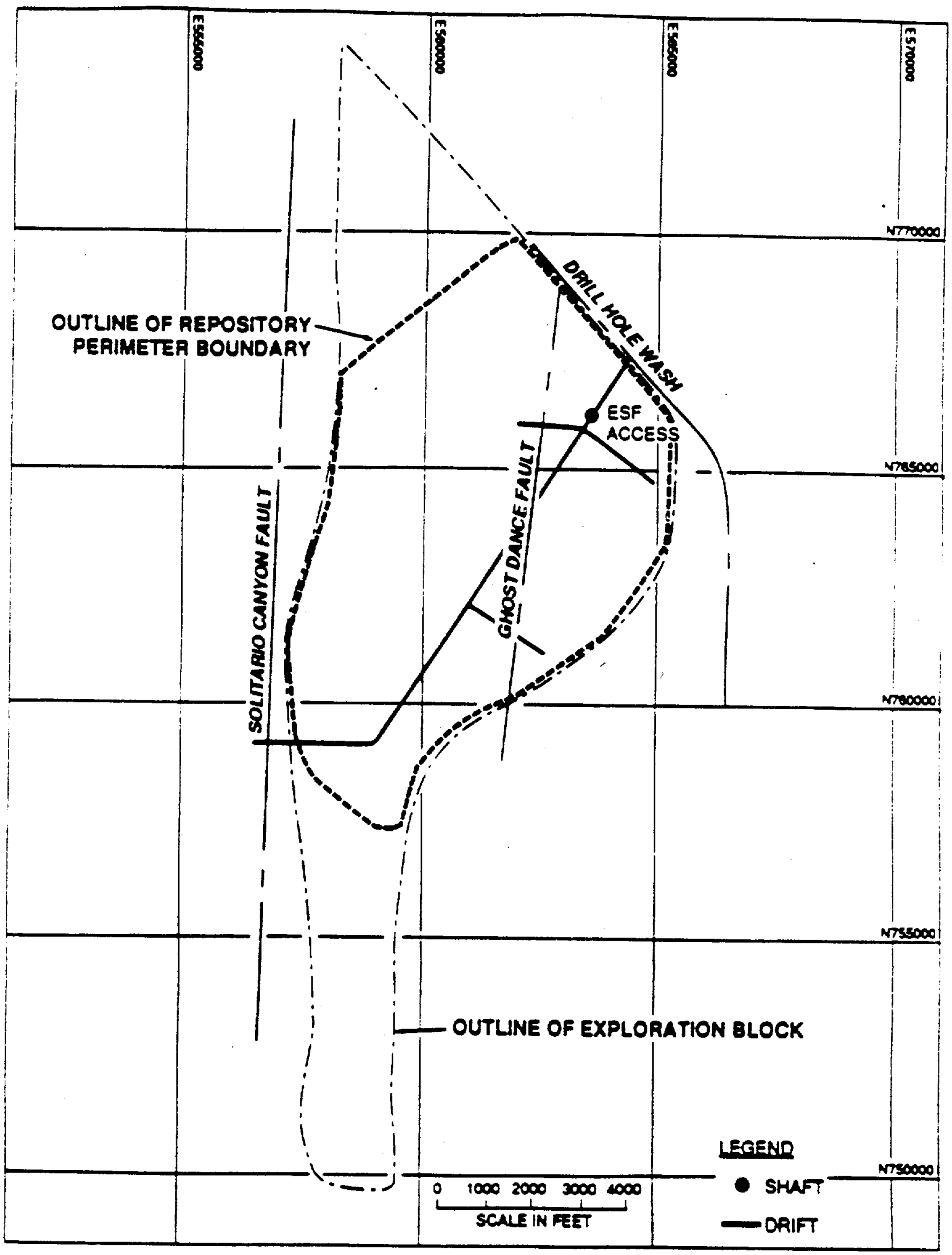

Figure 2.4-11 Sketch depicting CHn characterization Strategy No. 6.

STRATEGY NO. 6

ADDITIONAL SURFACE-BASED TESTING (WITH U/G DRILLING FROM THE ESF MTL)

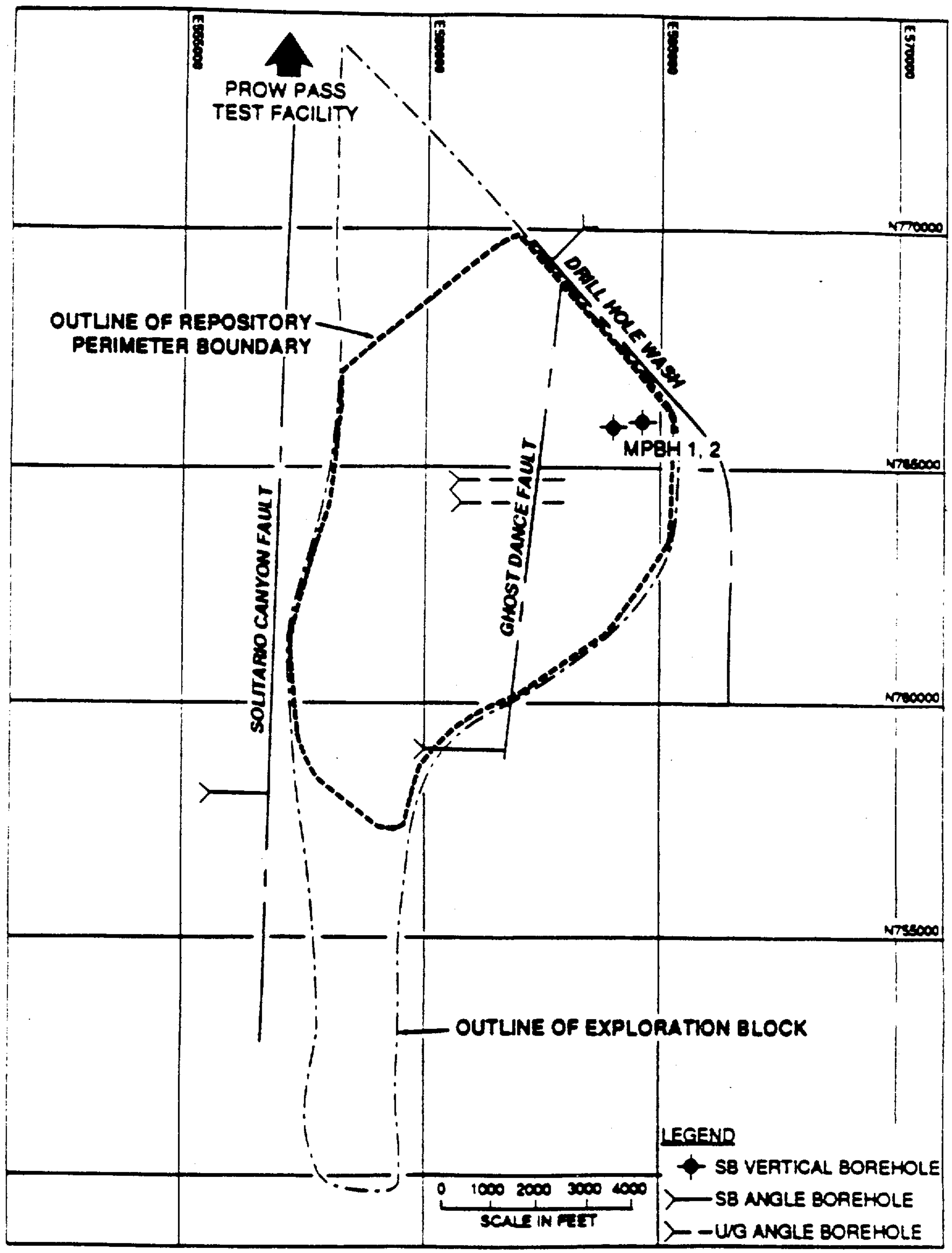

Figure 2.4-12 Sketch depicting CHn characterization Strategy No. 7.

STRATEGY NO. 7

OUTSIDE; SE; EXTENDED DRIFTING; NO ESF CONNECTION - ADDITIONAL SBT