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- o Transmittal letter
- o Yucca Mountain Project Change Control Log, dated 1/5/89
- o Minutes, Yucca Mountain Project Change Control Board, dated 12/13/88
- o Cost/Schedule Change Requests 89/001 through 89/021

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VOLUME VIII, FY 1989

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CHANGE CONTROL BOARD RECORDS

VOLUME VIII
FY 1989

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA

UNITED STATES DEPARTMENT OF ENERGY
NEVADA OPERATIONS OFFICE/YUCCA MOUNTAIN PROJECT OFFICE

Changes thru 12/20/88

YUCCA MOUNTAIN PROJECT CHANGE CONTROL LOG
ADJUSTMENTS TO BASELINE
05 January 89

CHANGE NUMBER	SUBMIT DATE	APPROVAL DATE	DESCRIPTION & REASON FOR ADJUSTMENT	P&S ACCT. FROM	P&S ACCT. TO	LABOR/COC ADJUSTMENT	LABOR/COC ADJ. BUDGET
89/001	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance With the Approved ESF Engineering Change Request 008				
89/002	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Requests 010.				
89/003	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance With the Approved ESF Engineering Change Request 011.				
89/004	12/13/88 SAIC	12/15/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with Approved ESF Engineering Change Request 012.				
89/005	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design requiremens Document (SDRD) NVO-309 in Accordance with Approved ESF Engineering Change Request 013.				

Changes thru 12/20/88

YUCCA MOUNTAIN PROJECT CHANGE CONTROL LOG
ADJUSTMENTS TO BASELINE
05 January 89

CHANGE NUMBER	SUBMIT DATE	APPROVAL DATE	DESCRIPTION & REASON FOR ADJUSTMENT	P&S ACCT. FROM	P&S ACCT. TO	LABOR/ODC ADJUSTMENT	LABOR/ODC ADJ. BUDGET
89/006	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements document (SCRD) NVO-309 in Accordance with Approved ESF Engineering Change Request 014.				
89/007	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with Approved ESF Engineering Change Request 015.				
89/008	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with Approved ESF Engineering Change Request 016.				
89/009	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with Approved ESF Engineering Change Request 017.				
89/010	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with Approved ESF Engineering Change Request 018.				

Changes thru 12/20/88

YUCCA MOUNTAIN PROJECT CHANGE CONTROL LOG
ADJUSTMENTS TO BASELINE
05 January 89

CHANGE NUMBER	SUBMIT DATE	APPROVAL DATE	DESCRIPTION & REASON FOR ADJUSTMENT	P&S ACCT. FROM	P&S ACCT. TO	LABOR/ODC ADJUSTMENT	LABOR/ODC ADJ. BUDGET
89/011	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with Approved ESF Engineering Change Request 019.				
89/012	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with Approved ESF Engineering Change Request 020.				
89/013	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with Approved ESF Engineering Change Request 021.				
89/014	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with Approved ESF Engineering Change Request 022.				
89/015	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with Approved ESF Engineering Change Request 023.				

Changes thru 12/20/88

YUCCA MOUNTAIN PROJECT CHANGE CONTROL LOG
ADJUSTMENTS TO BASELINE
05 January 89

CHANGE NUMBER	SUBMIT DATE	APPROVAL DATE	DESCRIPTION & REASON FOR ADJUSTMENT	P&S ACCT. FROM	P&S ACCT. TO	LABOR/CDC ADJUSTMENT	ADJ BUDGET
89/016	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO 309 in Accordance with Approved ESF Engineering Change Request 024.				
89/017	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with Approved ESF Engineering Change Request 025.				
89/018	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with Approved ESF Engineering Change Request 026.				
89/019	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with Approved ESF Engineering Change Request 027.				
89/020	12/13/88 SAIC	12/13/88	Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with Approved ESF Engineering Change Request 028.				

YUCCA MOUNTAIN PROJECT CHANGE CONTROL LOG
ADJUSTMENTS TO BASELINE
05 January 89

CHANGE NUMBER	SUBMIT DATE	APPROVAL DATE	DESCRIPTION & REASON FOR ADJUSTMENT	P&S ACCT. FROM	P&S ACCT. TO	LABOR/ODC ADJUSTMENT	LABOR/ODC ADJ BUDGET
89/021	12/13/88 YMPO	12/13/88	Change Project WBS and WBS Dictionary from a Baseline to a Controlled Document. Approval of all Changes will Remain with the CCB				

MINUTES
YUCCA MOUNTAIN PROJECT
CHANGE CONTROL BOARD

December 13, 1988

CCB Chairman and Board Member Attendees: E. L. Wilmot, L. P. Skousen, W. R. Dixon, R. V. Barton (Alternate for M. B. Blanchard) and P. C. Merkley, CCB Secretary.

CCB Meeting Observers: A. Hardy, USGS, R. Knecht, SAIC, D. G. Hubbard, MACTEC, J. D. Waddell, SAIC,, C. Newbury, DOE/YMP, J. E. Shaler, SAIC, J. V. Smith, SAIC, M. C. Brake, SAIC, W. A. Wilson, DOE/YMP and L. L. Andrist, SAIC.

1. The meeting was opened by W. A. Wilson at 9:20 A.M.

2. P. C. Merkley, CCB Secretary identified the previous CCB Minutes, held on August 12, 1987 had been approved.

3. P. C. Merkley presented a C/SCR Summary for the period of 9/1/87 through 12/13/88. (See Attachment A.)

4. P. C. Merkley, CCB Secretary presented the CCB members and observers copies of the Baseline Change Evaluation Summary for each of the change requests on the agenda.

5. Summary of discussions concerning the requested changes to the Project Baseline elements is as follows:

   a. Changes to the exploratory shaft facility (ESF) Subsystem Design Requirements Document (SDRD) in accordance with approved Engineering Change Requests (ECR):

      o C/SCR 89/001 - WBS # 1.2.6.1.1.T - SAIC
        ECR 008 - Replace (add) Appendix B data for the Integrated Data System (IDS).

        Disposition: Approved with Conditions

        Implementation: Approved for use in the ESF Title I however anomalies as identified by the Project Office QA evaluation concerning the forms utilized within the document are required to be corrected for use in the ESF Title II Design. Issue change through Document Control.

      o C/SCR 89/002 - WBS # 1.2.6.1.1.T - SAIC
        ECR 010 - Change "Trailers" to "Temporary Facilities" in Section 1.2.6.3 - Surface Facilities, Subpart 1.2.6.3.8 - Temporary Facilities, and the Table of Contents.

        Disposition: Approved

        Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution.

- C/SCR 89/003 - WBS # 1.2.6.1.1.T - SAIC
  ECR 011 - Remove Assumption 1 from Section 1.2.6.4.5 - Hoist System, page 4.5-2 which states: "the existing government furnished equipment (GFE) headframe shall be modified as required and erected for shaft sinking operation."

  Disposition: Approved

  Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution

- C/SCR 89/004 - WBS # 1.2.6.1.1.T - SAIC
  ECR 012 - Add report titled "Exploratory Shaft Seismic Design Basis," prepared by the special working group chartered by the ESF ICWG, be adopted as design criteria for the ESF.

  Disposition: Requested Change Deferred

  Instruction: Originator of requested change to verify that the ESF Seismic Design Basis was utilized as the design criteria for the ESF Title I. If verified CCB Chairman to approve the change.

- C/SCR 89/005 - WBS # 1.2.6.1.1.T - SAIC
  ECR 013 - Delete all information under "A/E Building (Area 25)" as found in Section 1.2.6.3 - Surface Facility Functional Requirements.

  Disposition: Approved

  Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution.

- C/SCR 89/006 - WBS # 1.2.6.1.1.T - SAIC
  ECR 014 - Delete the entire Section 1.2.6.3.9 - "A/E Building (Area 25)," pages 3.9-1 and 3.9-2.

  Disposition: Approved

  Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for Controlled distribution.

- C/SCR 89/007 - WBS # 1.2.6.1.1.T - SAIC
  ECR 015 - Change Section 1.2.6.0 - General Exploratory Shaft Facility, page 0-1.

  Disposition: Approved

  Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution.

- C/SCR 89/008 - WBS # 1.2.6.1.1.T - SAIC
  ECR 016 - Change Section 1.2.6.2 - Utilities, pages 2-1 and 2-2.

  Disposition: Approved

  Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution.

- C/SCR 89/009 - WBS # 1.2.6.1.1.T - SAIC
  ECR 017 - Change Section 1.2.6.7 - Underground Utilities Systems, pages 7-1 and 7-2.

  Disposition: Approved

  Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution.

- C/SCR 89/010 - WBS # 1.2.6.1.1.T - SAIC
  ECR 018 - Change Section 1.2.6.1 - Site, page 1-1.

  Disposition: Approved

  Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution.

- C/SCR 89/011 - WBS # 1.2.6.1.1.T - SAIC
  ECR 019 - Change Section 1.2.6.3 - Surface Facilities, page 3-1.

  Disposition: Approved

  Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution.

- C/SCR 89/012 - WBS # 1.2.6.1.1.T - SAIC
  ECR 020 - Change Section 1.2.6.2.1 - Power Systems, page 2.1-2; Section 1.2.6.4 First Shaft page 4-3; and Section 1.2.6.5 Second Shaft, page 5-3.

  Disposition: Approved with Conditions

  Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution.

  Instruction: Related Cost and Schedule impact, if any, to be addressed in ESF Title II Design.

- C/SCR 89/013 - WBS # 1.2.6.1.1.T - SAIC
  ECR 021 - Change Section 1.2.6.4 - First Shaft, page 4-1.

Disposition: Approved

Implementation: Revised pages of ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution.

- C/SCR 89/014 - WBS # 1.2.6.1.1.T - SAIC
ECR 022 - Change Section 1.2.6.6 - Underground Excavations, pages 6-1 and 6-2.

Disposition: Approved

Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution.

- C/SCR 89/015 - WBS # 1.2.6.1.1.T - SAIC
ECR 023 - Change Section 1.2.6.6.2 - Test Areas, page 6.2-1.

Disposition: Approved

Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution.

- C/SCR 89/016 - WBS # 1.2.6.1.1.T - SAIC
ECR 024 - Change Section 1.2.6.8 - Underground Tests, page 8-3.

Disposition: Approved

Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution.

- C/SCR 89/017 - WBS # 1.2.6.1.1.T - SAIC
ECR 025 - Change Section 1.2.6.8.5 - Hydrologic and Transport Phenomena Test, page 8.5-2.

Disposition: Approved

Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution.

- C/SCR 89/018 - WBS # 1.2.6.1.1.T - SAIC
ECR 026 - Change Section 1.2.6.1.1 - Main Pad, page 1.1-1 and Section 1.2.6.1.2 - Auxiliary Pads, page 1.2-1.

Disposition: Approved with Conditions

Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution.

Instruction: Related Cost and/or Schedule impacts, if any are to be addressed in the ESF Title II Design.

- C/SCR 89/019 - WBS # 1.2.6.1.1.T - SAIC
  ECR 027 - Change Section 1.2.6.3.7 - Warehouse, page 3.7-1.

  Disposition: Approved with Conditions

  Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution.

  Instruction: (1) W. Dixon to assure that the two 1200 Sq. ft. warehouse buildings are included in the Resource Management Division's Project inventory. (2) Related Cost and/or Schedule impacts, if any, will be addressed in the ESF Title II Design.

- C/SCR 89/020 - WBS # 1.2.6.1.1.T - SAIC
  ECR 028 - Change Section 1.2.6.1.2 - Auxiliary Pads, page 1.2-1.

  Disposition: Approved with Conditions

  Implementation: Revised pages of the ESF SDRD and the Revision/Change Record to be supplied to Document Control for controlled distribution.

b. Changes to the Work Breakdown Structure (WBS) and the WBS Dictionary Project Baseline.

- C/SCR 89/021 - Remove from the Project Baseline the following documents: (1) NNWSI/88-8, NNWSI Baseline Documents - NNWSI Project Work Breakdown Structure and (2) NNWSI/88-7, NNWSI Project Work Breakdown Structure Dictionary.

  Disposition: Approved with Conditions

  Implementation: Provide copy of the existing Project Work Breakdown Structure Index as an attachment to the C/SCR and establish it as a non-baseline Controlled Document.

  Instruction: Although the WBS and the WBS Dictionary will be controlled documents all future revisions will require review and ultimate approval by the CCB Chairman.

6. General Discussions Summary:

During the course of the meeting various topics relating to the presented changes and the change control process were discussed. They are:

a. E. L. Wilmot recommended a summary of each change be provided to expedite review by the CCB members.

b. J. E. Shaler identified the change procedures, presently in development, will require the originator to provide a complete change package including detailed impact analysis and shall be presented to the CCB Chairman for disposition. The chairman at that time may approve the request or direct further evaluation and schedule it to be presented at a CCB meeting.

c. E. L. Wilmot requested that in the future the sponsors of the proposed changes be present at the scheduled CCB meetings to answer questions and/or defend the requested change.

d. D. G. Hubbard recommended future CCB meetings include a stenographer to record the meeting minutes.

e. E. L. Wilmot requested:

- Project Office Division Directors or assigned members of their staff to review and evaluate all requested changes.

- CCB Secretary to summarize the change request evaluations and distribute them to the CCB members prior to the CCB Meeting.

- Division Directors to review the change request evaluation summaries prior to the scheduled CCB meeting.

f. E. L. Wilmot stated the Division Directors are required to attend each CCB meeting and that Director alternates to the meeting will not be acceptable.

g. E. L. Wilmot requested that the location of future CCB meetings be held in the offices of SAIC and that the meeting room be efficiently configured allowing the grouping of board members separated from observers.

h. It was mutually agreed by board members that CCB meetings will be scheduled once per month on a Friday. The selection of which week within the month is yet to be determined.

i. L. P. Skousen recommended Change Evaluation Summaries be made available to the CCB Members prior to CCB meeting thus expediting review of the proposed change.

7. Meeting was adjourned by the Chaiman at 11:00 A.M.

P Merkley

P. C. Merkley, CCB Secretary

Approved:

E. L. Wilmot, CCB Chairman

NNWSI PROJECT
COST/SCHEDULE CHANGE REQUEST (C/SCR)

N AD-036
9/87

Change No:	Organization:	Originator:	Origination Date:
89/001	SAIC	M. E. Spaeth	11/15/88

Title:

Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Request 008

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: Replace (add) Appendix B data for the Integrated Data System (IDS) in the ESF SDRD with the attached package.

REASON: This change incorporates comments from Interface Control Working Group (ICWG) Participants and expands Appendix B to include IDS Title I design.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:

1. Letter, L. P. Skousen to M. E. Spaeth, July 19, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Request (ECR) 008.
2. ESF ECR 008.
3. IDS Title I Design, dated 5/2/88.

Responsible Organization M. E. Spaeth Date 11/22/88

CCB Secretary P. C. Merkley Date 12/13/88

Approval: Project Manager, WMPO C. P. Gertz Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revised ESF SDRD in accordance with Approved ESF-ECR 008.

C/SCR No: 89/001

Summary of Recommended Actions:

	Project Office				T&MSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☒	☐	☐	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☒ (1)	☐	☐	☐
Non Concurrence	☐	☐	☐	☒ (2)	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation: (1) "Note attached Schedule out dated". (Re: Page 28 of 28)
(2) "The attached package to the ESF-SDRD is a series of form type pages (no form number) for which there are no approval procedures to indicate how the form should be completed. Block 6 on page 1 of 28 has no log number included in the block. Block 7, 8, and 9 on the same page indicate some sort of approval process but no signatures are present. Block 12 on the same page indicates revision 1 dated 5/13/88 but has no description nor any initials in what appears to be block for initials. The QALAS referenced in block 21 on page 7 of 28 should be listed. No plan date is indicated in the block 21 on page 9 of 28. Duplication of numbers 21 and 23 with different titles. Block 27 on page 10 of 28 not completed".

Impact Analyses: Data was not provided to update the schedule as referenced in Item (1) above.

CCB Secretary P. C. Merklev Date 12/12/88

Page 1 of 1

CSCB '89 001

Department of Energy
Nevada Operations Office
P. O. Box 98518
Las Vegas, NV 89193-8518

JUL 19 1988

RECEIVED
M. E. SPAETH Merkley
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PCM 1/23

Michael E. Spaeth
Technical Project Officer
for NNWSI
ATTN: Philip C. Herkley
Science Applications
International Corporation
Suite 407
101 Convention Center Drive
Las Vegas, NV 89109

PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUEST (ECR) 008

The Chairman of the Interface Control Working Group approved the subject ECR on June 30, 1988. This information needs to be added to the information now contained in Appendix B of the SDRD under the formal project baseline process. Send all holders of the SDRD controlled copies of this revision. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

for Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2954

Enclosure:
ECR 008

cc w/encl:
V. J. Cassella, HQ (RW-123) FORS
Dean Stucker, HQ (RW-223) FORS
M. C. Brake, SAIC, Las Vegas, NV
G. K. Beall, SAIC, Las Vegas, NV
R. R. Reust, SAIC, Las Vegas, NV
J. L. Rast, SAIC, Las Vegas, NV
S. H. Klein, SAIC, Las Vegas, NV
W. E. Narrows, SAIC, Las Vegas, NV
James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

Received in Configuration Management Division
JUL 21 1988

SAIC/T&MSS
JUL 20 1988
CCF RECEIVED

CSCR ____ '89 001

ESF ENGINEERING CHANGE REQUEST

ESTP11.FMB-12/28/87

ECR NO. 008 — PAGE 1 OF 1

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL	III	PARTICIPANT	Los Alamos
SOURCE	Los Alamos	DATE	5/2/88
WBS DESIGNATION	1261	ORIGINATOR	Merson
TITLE	ESF	REV. NO. ____ DATE ____	
DESCRIPTION		REV. NO. ____ DATE ____	

Replace (add) Appendix B data for the Integrated Data System (IDS) in the Exploratory Shaft Facility Subsystems Design Requirements Document with the attached package.

BASIS FOR CHANGE
1. Review comments from ICWG Participants incorporated
2. Expanded information to include IDS Title I design

SCOPE CHANGE ____ YES x NO   CONSTRUCTION IMPACT ____ YES x NO

PARTICIPANT QA REP [signature] DATE 5/2/88   ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 5/2/88

SECTION 2. ACTION

1. PROCEED WITH ECR EVALUATION ____ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO

[signature]
ESF ICWG CHAIRMAN

3. TOTAL COSTS (increase/decrease)

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT

ENGINEERING ____ ____ WEEKS
CONSTRUCTION ____ ____ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

ESF CHAIRMAN ICWG

6. FUNDING:

____ CHANGE ORDER ____ SPECIAL STUDIES
____ NOT FUNDED, PROJECTED ONLY

ESF CHAIRMAN ICWG

7. APPROVED FOR BASELINING

[signature]
ESF CHAIRMAN ICWG

ENCLOSURE

ESF TEST DESCRIPTION AND REQUIREMENTS CSCR ---'89 001

1. TEST PLAN TITLE (ESTP)	2. PREVIOUS ISSUE DATE	3. DATE	PAGE
INTEGRATED DATA SYSTEM	2/18/88	5/2/88	1 of 25
4. KEY ISSUE Provide QA Level I System For Collecting and Archiving ESF Test Data.	5. TEST PLAN NUMBER (WBS) 1.2.6.9.3	6. LOG NUMBER	

7. PRINCIPAL INVESTIGATOR (PI) APPROVAL:	8. TECHNICAL PROJECT OFFICER (TPO) APPROVAL:	9. WASTE MANAGEMENT PROJECT OFFICE (WMPO) STAFF APPROVAL:
Robert J. Crowley	Donald T. Oakley	Lester P. Skousen, Chief Tech. Dev. & Eng. Branch
7a ADDRESS/PHONE Los Alamos Nat'l Lab. P.O. Box 1663, MS G787 Los Alamos, NM 87545 FTS 843-7459	8a ADDRESS/PHONE Los Alamos Nat'l Laboratory P. O. Box 1663, MS J521 Los Alamos, NM 87545 FTS 843-1310	9a ADDRESS/PHONE Waste Management Project Office U.S. Dept. of Energy Box 14100, LV., NV 89114 FTS 544-7929

10. TECHNICAL DESCRIPTIONS

	Attached	Will Be Provided	Deliverable Date
a. Equipment Requirements/specification	☐	☒	* 10/88
b. Equipment Data Sheets	☐	☒	10/88
c. Equipment Catalog Sheets	☐	☒	10/88
d. Installation Requirements & Space Allocation	☒	☐	See Attachments 1 thru 6
e. Operational Requirements & Space Allocation	☐	☒	10/88
f. Maintenance Requirements & Space Allocation	☐	☒	10/88
g. System Interfaces	☐	☒	10/88
h. Utility Interfaces	☐	☒	10/88
i. Utility Requirements	☒	☐	See Attachment 8
j. Deliverables, Milestones, & Schedule	☒	☐	See Attachment 9

* For IDS Phase I only; For Phase II, see attachments 1 thru 7.

11. TEST PACKAGE COSTS

TOTAL ESTIMATE TO DATE: TBD

UNCERTAINTY ON ESTIMATE TO COMPLETE:

12. REFERENCES

Nevada Nuclear Waste Storage Investigations Project, Exploratory Shaft Facility, Integrated Data System Title I, Preliminary Design, March 2, 1988. Prepared by EG&G Energy Measurements, Las Vegas Operations.

REV. NO.	DATE	DESCRIPTION	PI	TPO	WMPO
1	5/3/88				

TEST PLAN TITLE (ESTP)	DATE	Page
INTEGRATED DATA SYSTEM	5/2/88	2 Of 28

13. GENERAL DESCRIPTION OF TEST PLAN

- Provide a Data Acquisition System to collect ESF Site Characterization Data throughout the ES-1 and drift space.
- Provide interfaces to the various equipments used by the Experimenters to allow timely control and data gathering functions.
- To periodically distribute QA Level I data to the Experimenters and to archive all data collected by the IDS in a secure location.

14. SYSTEM INTERFACES

- Data acquisition and calibration to all test sensors.
- Test controllers furnished by SNL, LANL, LLNL, and USGS.
- Communications Systems between the IDS main computer facility, downhole test locations and the testing organizations at Los Alamos, Livermore, Albuquerque and Denver.
- Utility systems in the ES-1 shaft and drift spaces.

TEST PLAN TITLE (ESTP) INTEGRATED DATA SYSTEM	DATE 5/2/88	Page 3 Of 28

15. SUMMARY OF TEST PLAN ITEMS AND RESPONSIBILITIES

Test Item	Primary Responsibility	Designed by	Procured by	Fabricated by	Date Req.
IDS	LANL	EG&G	EG&G	EG&G	* 4/89
UPS System	LANL	A & E	REECO	VENDOR	* 4/89
Power	LANL	A & E	REECO	REECO	* 4/89
IDS Data Communication	LANL	EG&G	EG&G	EG&G	* 4/89
External IDS Communication	LANL	A & E	REECO	REECO	* 4/39
Telephones & Intercoms	LANL	A & E	REECO	CENTEL	* 4/89
IDS Space	LANL	A & E	REECO	REECO	* 4/89

* IDS Phase I only; For Phase II, see attached schedule.

TEST PLAN TITLE (ESTP)	DATE	Page
INTEGRATED DATA SYSTEM	5/2/88	4 Of 28

16. MAXIMUM TEST AREA REQUIRED AND SPACE ALLOCATION

See Attachments 1 thru 7. These sketches are for reference only. Exact dimensions, placement and utility requirement will be provided as the information is developed.

TEST PLAN TITLE (ESTP)	DATE	Page
INTEGRATED DATA SYSTEM	5/2/88	5 of 28

17. TEST DIMENSIONAL OUTLINE

See Attachments 1 thru 7

TEST PLAN TITLE (ESTP)	DATE	Page
INTEGRATED DATA SYSTEM	5/2/88	6 Of 28

18. PLANS, SECTIONS, AND ELEVATIONS

See Attachments 1 thru 7.

TEST PLAN TITLE (ESTP)	DATE	Page
INTEGRATED DATA SYSTEM	5/2/88	7 of 28

19. UTILITY INTERFACES - LIST QUANTITIES, CONSUMPTIONS, INPUTS, OUTPUTS, ETC.

A. AIR NONE

B. WATER Fire sprinkler system at IDS Surface Bldg. and at IDS Data Alcove on main test level. Domestic water at Main Surface Bldg. Fire protection requirements TBD.

C. POWER See attached NNWSI IDS equipment lists. See Attachment 8.

D. VENTILATION Sufficient to remove heat from all spaces containing computer equipment. See Attachment 8.

E. DATA LINK TBD

F. OTHER (SPECIFY) Phones, Intercom

20. DESIGN CONSTRAINTS

The minimum separation between power cabling and signal cabling (of) either twisted shielded pair or coax type) should be 5 ft. if the power wiring is in conduit (not open raceways) and 10 ft. if the power wiring is not in conduit. All crossings of power and signal cabling should be at right angles with the maximum practical separation. Separation of power wiring and fiber optic cabling is not critical with respect to distance.

21. DESIGN ASSUMPTIONS

See approved QALAS for the IDS.

TEST PLAN TITLE (ESTP) INTEGRATED DATA SYSTEM	DATE 5/2/88	Page 8 Of 28

22. DELIVERABLES

DESCRIPTION	DELIVER TO	Estimated DATE
TBD		

23. MILESTONES

DESCRIPTION	(Estimated) TARGET DATE	(Estimated) COMPLETION DATE
See Attachment 9.		

ESF TEST DESCRIPTION AND REQUIREMENTS

CSCR '89 001

TEST PLAN TITLE (ESTP)	21. STATUS DATE	PLAN DATE	Page
INTEGRATED DATA SYSTEM	5/2/88		9 Of 22

24. TEST PLAN NUMBER	23. PRINCIPAL INVESTIGATOR
	Robert J. Crowley

25. MILESTONE ACTIVITY DELIVERABLES	25. CALENDER TIME (Estimated)
See Attachment 9	

ESP TEST OPERATIONAL DESCRIPTION AND REQUIREMENTS SUMMARY

CSCR ____ '89 001

TEST PLAN TITLE (ESTP) INTEGRATED DATA SYSTEM	DATE 5/2/88	Page 10 of 28

26. REFERENCE OPERATING PROCEDURE NUMBER AND TITLE

27. DURATION OF TEST

____ Calendar Days

28. DESCRIPTION OF MEN/CRAFTS REQUIRED TO INSTALL, CHECKOUT, OPERATE AND DISMANTLE TEST

PHASE	CRAFT	NUMBER	DURATION
INSTALL			
CHECKOUT			
OPERATE			
DISMANTLE			

Information TBD

29. TOTAL MANPOWER AND SCHEDULE REQUIREMENTS

PHASE	MAN-DAYS	CALENDAR TIME	DATES
INSTALLATION			
CHECKOUT			
OPERATE			
DISMANTLE			

30. TOTALS

31. DESCRIPTION OF MATERAILS (CONSUMABLES, OPERATING, ETC.) REQUIRED TO CHECK OUT AND PERFORM THE TEST(S).

DESCRIPTION	COST(S)

32. ESTIMATED CONSUMABLE MATERIAL COSTS $ TBD

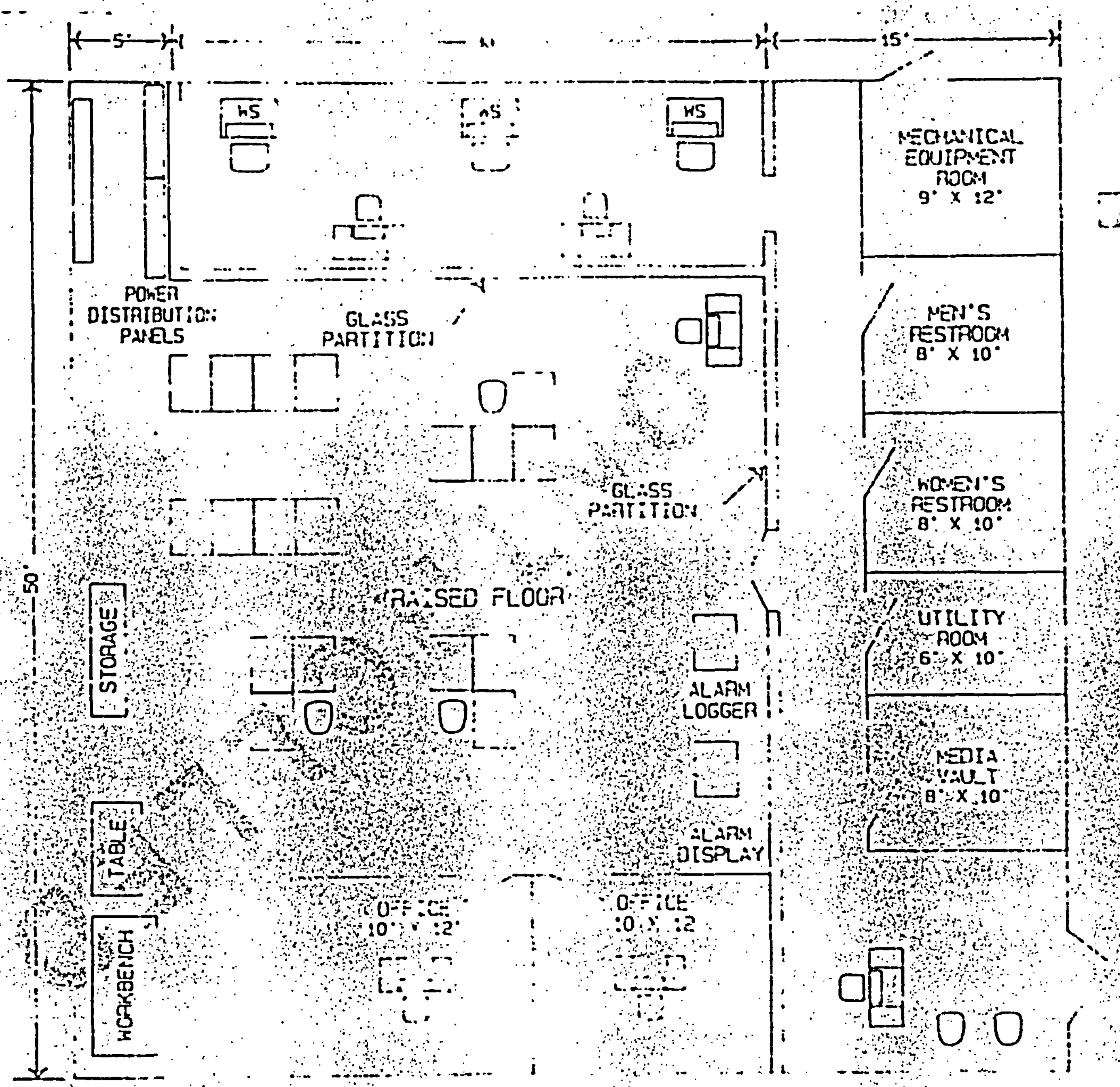
ESF TEST OPERATIONAL DESCRIPTION AND REQUIREMENTS SUMMARY

CSCR '89 001

TEST PLAN TITLE (ESTP) INTEGRATED DATA SYSTEM	DATE 5/2/88	Page 11 of 28

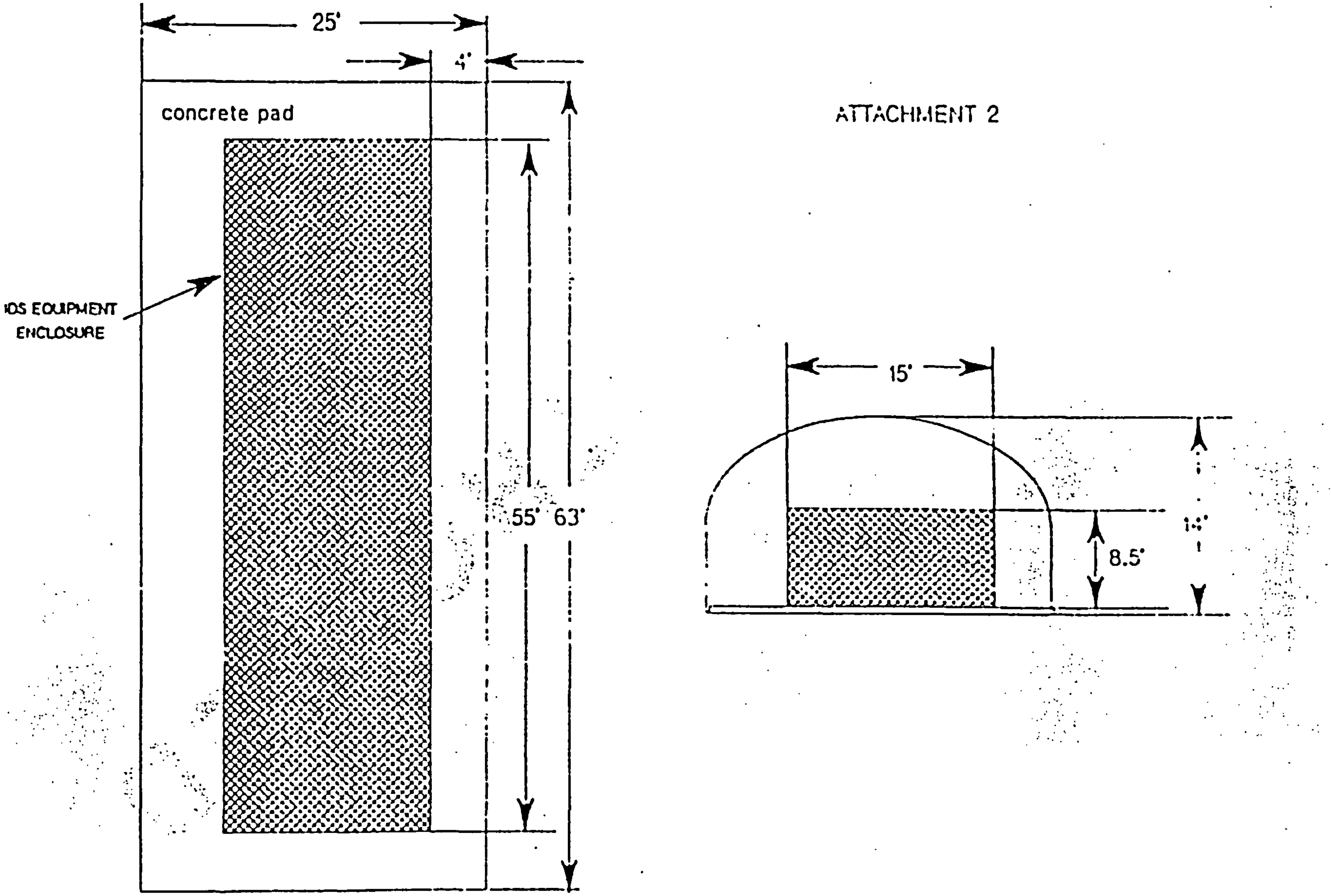
33. OPERATIONAL MILESTONE ACTIVITY/ DELIVERABLES	25. CALENDER TIME (Estimated)
See Attached Schedule.	

ATTACHMENT 1



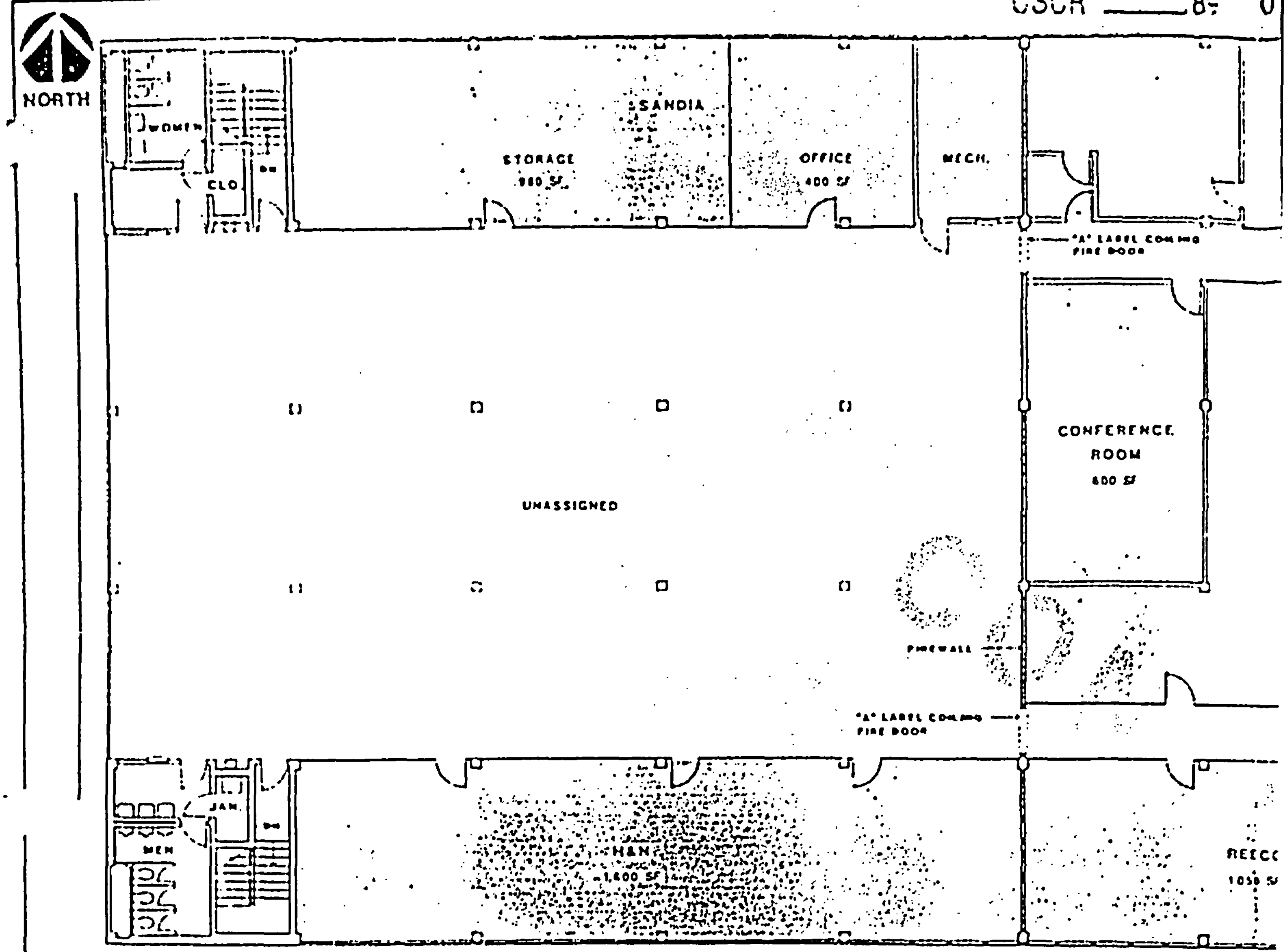
NNWSI PROJECT DIS SURFACE FACILITY

CSCR ______'89 001



NNWSI MTL IDS ALCOVE

USCR ____ '89 0

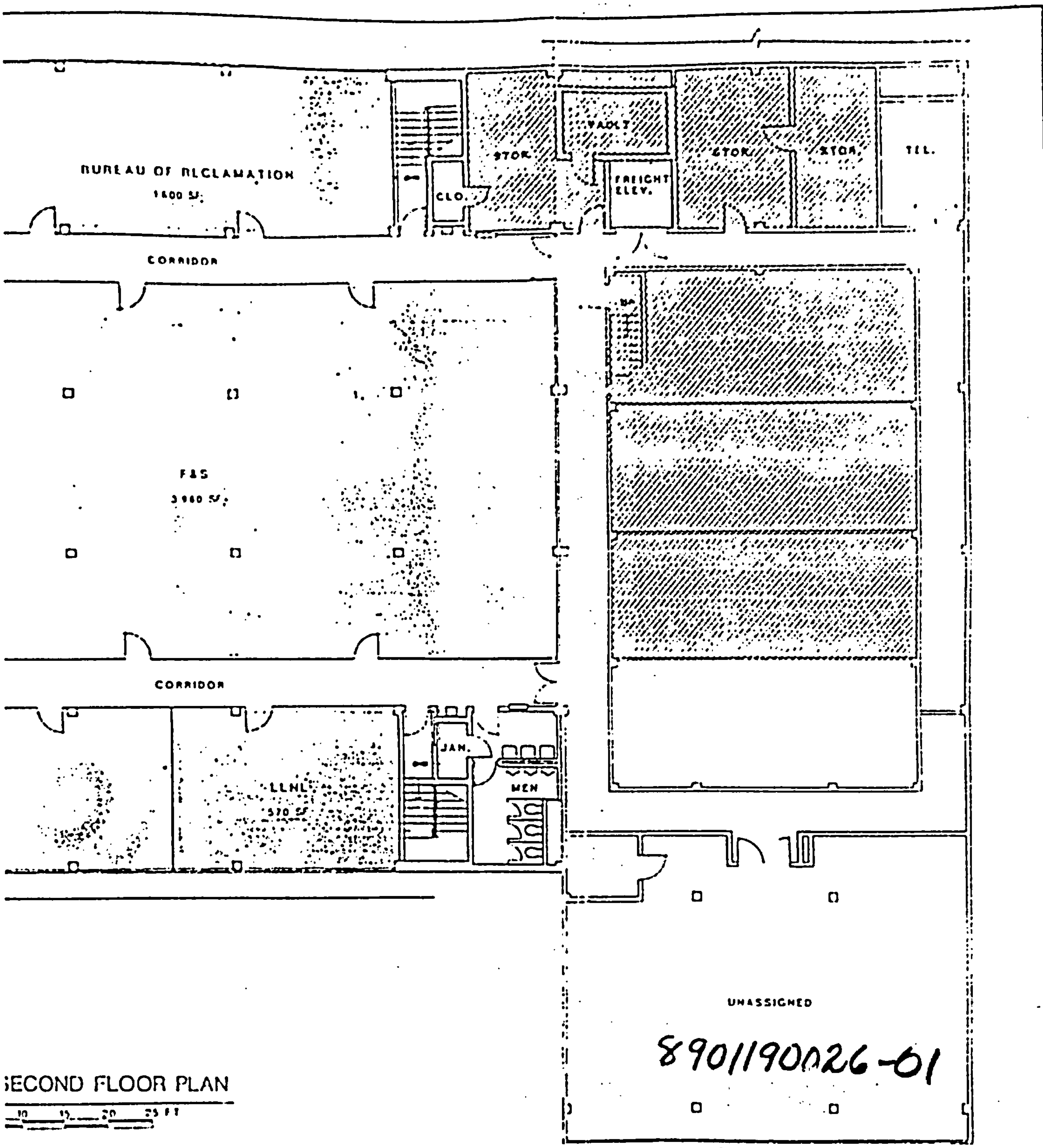


ADMINISTRATION AND ENGINEERING BUILDING

SCALE: 1/8" = 1'-0"

INTEGRATED DATA SPACE REQUIREMENT

ATTACHMENT 3



SECOND FLOOR PLAN

STEM

SI APERTURE CARD

Also Available On Aperture Card

U. S. DEPARTMENT OF ENERGY

NEVADA TEST SITE — AREA 25

NNWSI STUDY NO. 3

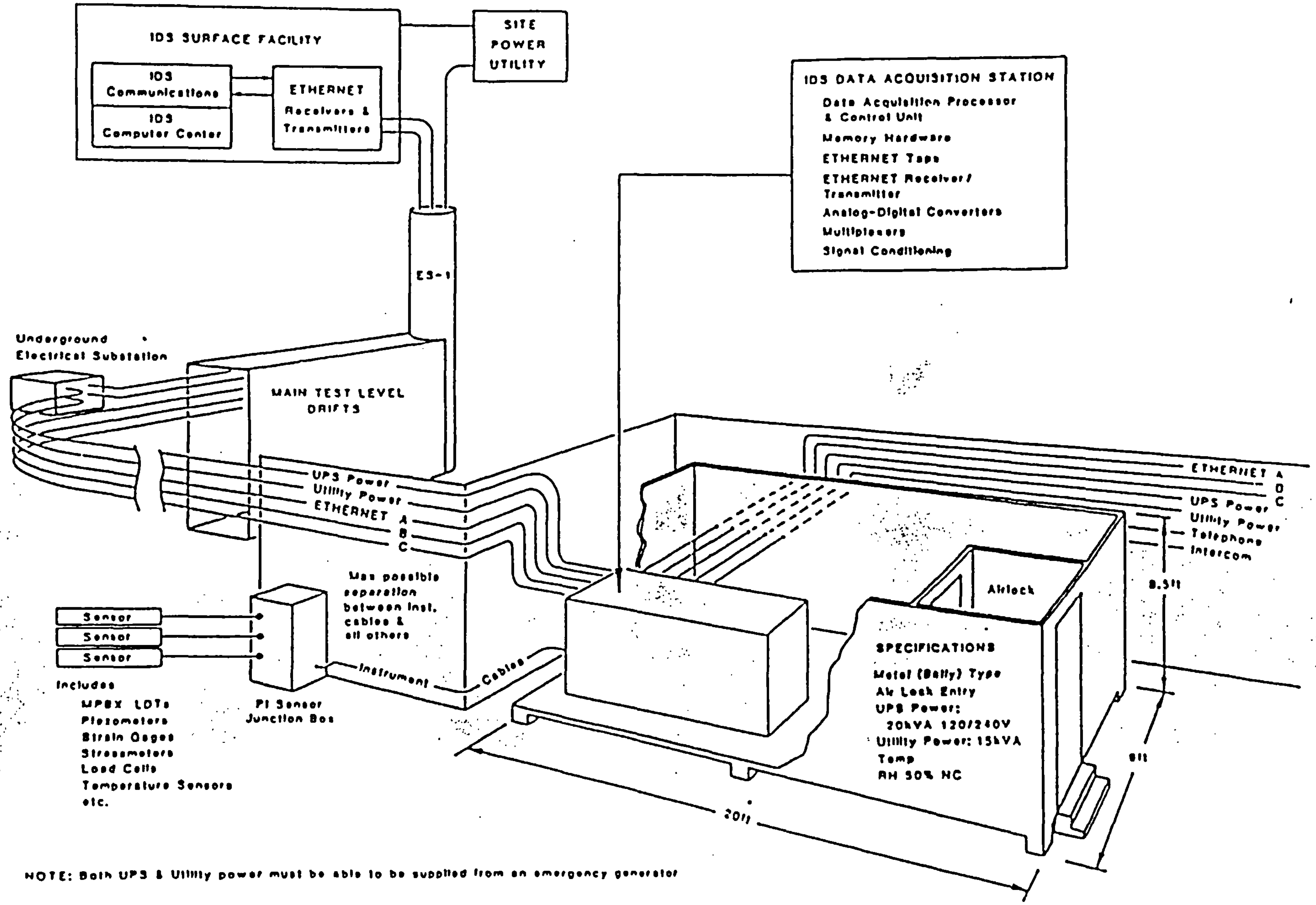
A&E BLDG. 2ND FLR. ARCH. LAYOUT

HOLMES & NARVER INC

SK-025-4015-A?

ATTACHMENT 3

ATTACHMENT 4

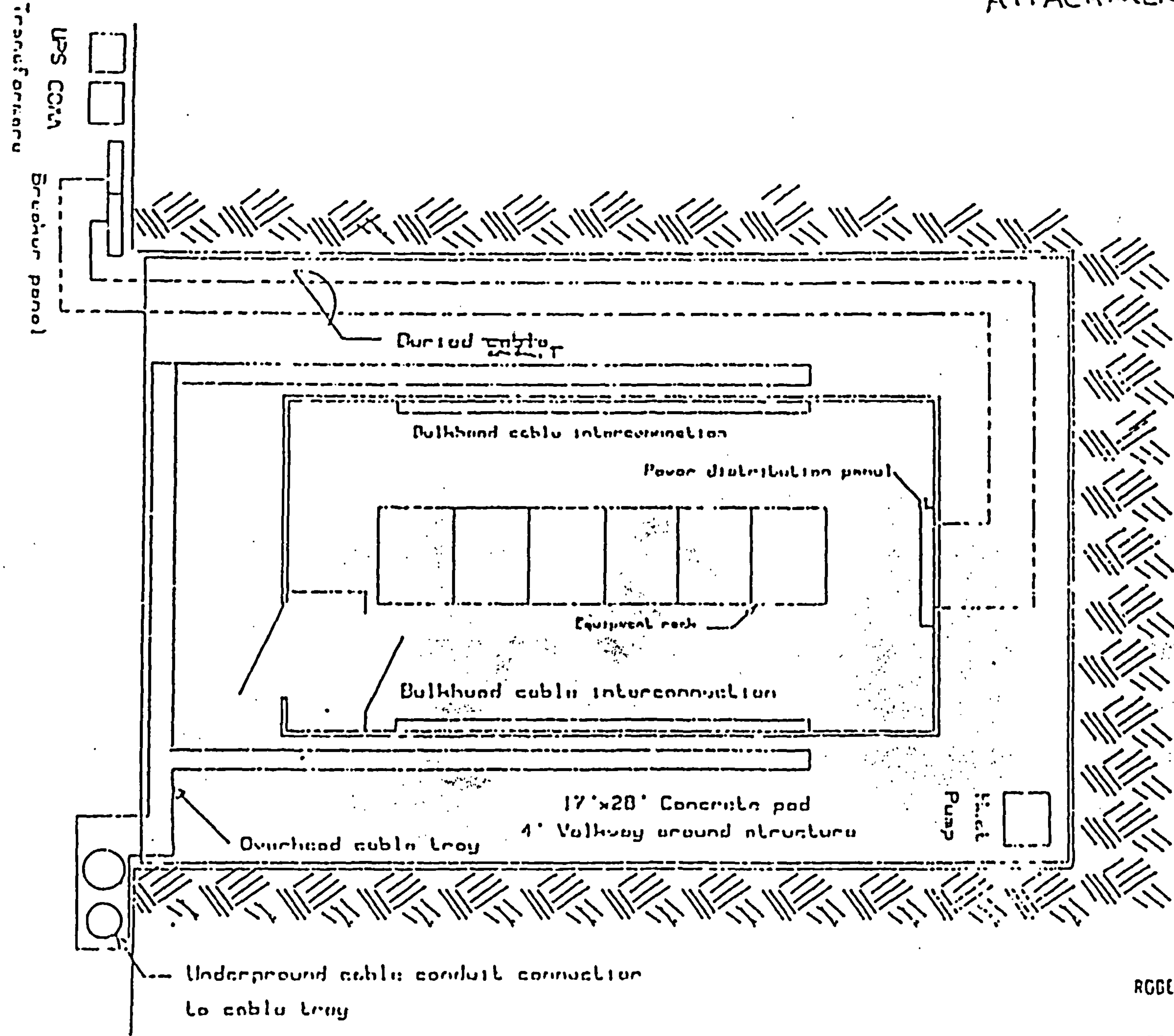


NOTE: Both UPS & Utility power must be able to be supplied from an emergency generator

IDS Data Acquisition Station

CSCR —'89 001

ATTACHMENT J

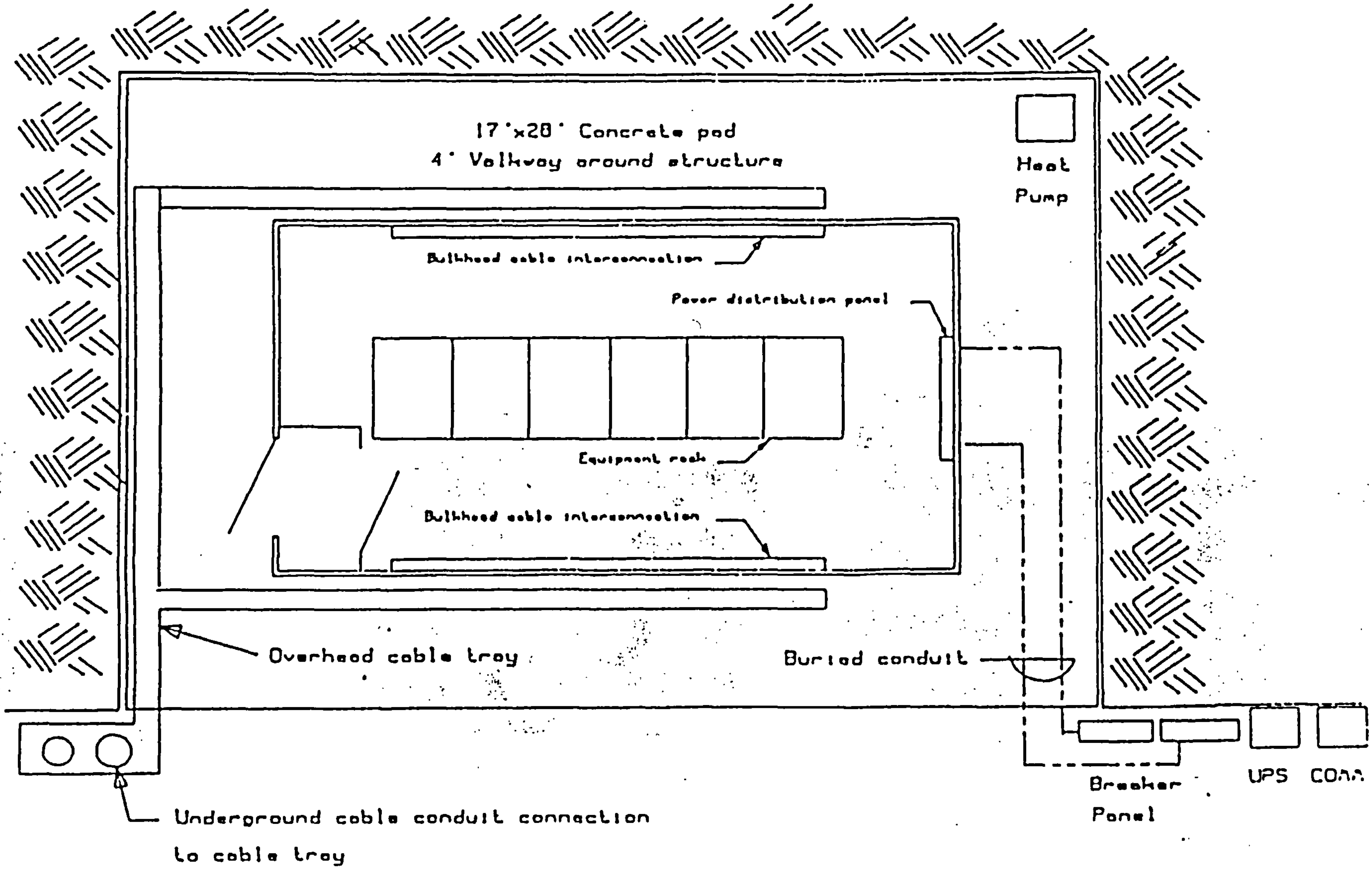


ROBERT J CROWLEY

PROJECT IDS

DATE 2-19-88

ATTACHMENT 6



ROBERT J. CROWLEY

PROJECT IDS

DATE 2-17-88

CSCR ____'89 001

ATTACHMENT 7

MTL IDS EQUIPMENT LOCATIONS

The sketch for the IDS Data Alcove and the IDS Data Acquisition Stations at the main test level will be revised and coodinated through the ICWG.

CSCR ____'89 001

ATTACHMENT 8

05-03-88

NNWSI IDS EQUIPMENT

COMPONENT NAME: DATA ACQUISITION STATION #1
SUPPORTED TESTS: DIFFUSION, INFILTRATION

SENSOR TYPES: NUMBER:
LOCATION: MAIN TEST LEVEL, ACROSS DRIFT FROM INFILTRATION TEST
SIZE: 9x20x9.5 feet, 4 ft. CLEARANCE
CONSTRUCTION: METAL (BALLY) TYPE, AIR LOCK ENTRY
MOUNTING: CONCRETE PAD
POWER REQ. UPS:20 KVA, 120/240, 3 WI. UTILITY: 15 KVA (BOTH ON EMERG)
ENVIRONMENTAL REQ.: COMPUTER GRADE, 12 KW COMPUTER HEAT LOAD
FIRE REQ.: HALON SAFETY: COMPUTER SHUTDOWN
COMMUNICATIONS: 2 ETHERNET LOOP-THRU, TELEPHONE, INTERCOM
CABLING: IDS: SENSOR:
NOTES: 1000 CHANNEL CAPACITY, NON-REDUNDANT

COMPONENT NAME: DATA ACQUISITION STATION #2
SUPPORTED TESTS: BULK PERMEABILITY

SENSOR TYPES: NUMBER:
LOCATION: MAIN TEST LEVEL, ADJACENT TO BULK PERMEABILITY TEST
SIZE: 9x20x8.5 feet, 4 ft. CLEARANCE
CONSTRUCTION: METAL (BALLY) TYPE, AIR LOCK ENTRY
MOUNTING: CONCRETE PAD
POWER REQ. UPS:20 KVA, 120/240, 3 WI. UTILITY: 15 KVA (BOTH ON EMERG)
ENVIRONMENTAL REQ.: COMPUTER GRADE, 12 KW COMPUTER HEAT LOAD
FIRE REQ.: HALON SAFETY: COMPUTER SHUTDOWN
COMMUNICATIONS: 2 ETHERNET LOOP-THRU, TELEPHONE, INTERCOM
CABLING: IDS: SENSOR:
NOTES: 1000 CHANNEL CAPACITY, NON-REDUNDANT

CSCR ___'89 001

05-03-99

NNWSI IDS EQUIPMENT

COMPONENT NAME: DATA ACQUISITION STATION #3
SUPPORTED TESTS: LOWER DEMONSTRATION BREAKOUT ROOM TESTS

SENSOR TYPES: NUMBER:
LOCATION: MAIN TEST LEVEL, ADJACENT TO LDBR
SIZE: 9x20x8.5 feet, 4 ft. CLEARANCE
CONSTRUCTION: METAL (BALLY) TYPE, AIR LOCK ENTRY
MOUNTING: CONCRETE PAD
POWER REQ. UPS:20 KVA, 120/240, 3 WI. UTILITY: 15 KVA (BOTH ON EMERG)
ENVIRONMENTAL REQ.: COMPUTER GRADE, 12 KW COMPUTER HEAT LOAD
FIRE REQ.: HALON SAFETY: COMPUTER SHUTDOWN
COMMUNICATIONS: 2 ETHERNET LOOP-THRU, TELEPHONE, INTERCOM
CABLING: IDS: SENSOR:
NOTES: 1000 CHANNEL CAPACITY, NON-REDUNDANT

COMPONENT NAME: DATA ACQUISITION STATION #4
SUPPORTED TESTS: SEQUENTIAL DRIFT MINING

SENSOR TYPES: NUMBER:
LOCATION: MAIN TEST LEVEL, ADJACENT TO SEQUENTIAL DRIFT MINING TEST
SIZE: 9x20x8.5 feet, 4 ft. CLEARANCE
CONSTRUCTION: METAL (BALLY) TYPE, AIR LOCK ENTRY
MOUNTING: CONCRETE PAD
POWER REQ. UPS:20 KVA, 120/240, 3 WI. UTILITY: 15 KVA (BOTH ON EMERG)
ENVIRONMENTAL REQ.: COMPUTER GRADE, 12 KW COMPUTER HEAT LOAD
FIRE REQ.: HALON SAFETY: COMPUTER SHUTDOWN
COMMUNICATIONS: 2 ETHERNET LOOP-THRU, TELEPHONE, INTERCOM
CABLING: IDS: SENSOR:
NOTES: 1000 CHANNEL CAPACITY, NON-REDUNDANT

CSCR '89 001

05-03-88

NNWSI IDS EQUIPMENT

COMPONENT NAME: DATA ACQUISITION STATION #5
SUPPORTED TESTS: WASTE PACKAGE HORIZONTAL TEST

SENSOR TYPES: NUMBER:
LOCATION: MAIN TEST LEVEL, ACROSS DRIFT FROM WP HORIZONTAL TEST
SIZE: 9x20x8.5 feet, 4 ft. CLEARANCE
CONSTRUCTION: METAL (BALLY) TYPE, AIR LOCK ENTRY
MOUNTING: CONCRETE PAD
POWER REQ. UPS:20 KVA, 120/240, 3 WI. UTILITY: 15 KVA (BOTH ON EMERG)
ENVIRONMENTAL REQ.: COMPUTER GRADE, 12 KW COMPUTER HEAT LOAD
FIRE REQ.: HALON SAFETY: COMPUTER SHUTDOWN
COMMUNICATIONS: 2 ETHERNET LOOP-THRU, TELEPHONE, INTERCOM
CABLING: IDS: SENSOR:
NOTES: 1000 CHANNEL CAPACITY, NON-REDUNDANT

COMPONENT NAME: DATA ACQUISITION STATION #6
SUPPORTED TESTS: WASTE PACKAGE VERTICAL TEST

SENSOR TYPES: NUMBER:
LOCATION: MAIN TEST LEVEL, ACROSS DRIFT FROM WP VERTICAL TEST
SIZE: 9x20x8.5 feet, 4 ft. CLEARANCE
CONSTRUCTION: METAL (BALLY) TYPE, AIR LOCK ENTRY
MOUNTING: CONCRETE PAD
POWER REQ. UPS:20 KVA, 120/240, 3 WI. UTILITY: 15 KVA (BOTH ON EMERG)
ENVIRONMENTAL REQ.: COMPUTER GRADE, 12 KW COMPUTER HEAT LOAD
FIRE REQ.: HALON SAFETY: COMPUTER SHUTDOWN
COMMUNICATIONS: 2 ETHERNET LOOP-THRU, TELEPHONE, INTERCOM
CABLING: IDS: SENSOR:
NOTES: 1000 CHANNEL CAPACITY, NON-REDUNDANT

CSCR ——'89 001

05-03-89

NNWSI IDS EQUIPMENT

COMPONENT NAME: DATA ACQUISITION STATION #7
SUPPORTED TESTS: UPPER DEMONSTRATION BREAKOUT ROOM TESTS

SENSOR TYPES: NUMBER:
LOCATION: UDBR
SIZE: 9x20x8.5 feet, 4 ft. CLEARANCE
CONSTRUCTION: METAL (BALLY) TYPE, AIR LOCK ENTRY
MOUNTINS: CONCRETE PAD
POWER REQ. UPS:20 KVA, 120/240, 3 WI. UTILITY: 15 KVA (BOTH ON EMERG)
ENVIRONMENTAL REQ.: COMPUTER GRADE, 12 KW COMPUTER HEAT LOAD
FIRE REQ.: HALON SAFETY: COMPUTER SHUTDOWN
COMMUNICATIONS: 2 ETHERNET LOOP-THRU, TELEPHONE, INTERCOM
CABLING: IDS: SENSOR:
NOTES: 1000 CHANNEL CAPACITY, NON REDUNDANT

COMPONENT NAME: DATA ACQUISITION STATION #8
SUPPORTED TESTS: CALICO HILLS TESTS

SENSOR TYPES: NUMBER:
LOCATION: CALICO HILLS
SIZE: 9x20x8.5 feet. 4 ft. clearance
CONSTRUCTION: METAL (BALLY) TYPE, AIR LOCK ENTRY
MOUNTING: CONCRETE PAD
POWER REQ. UPS:20 KVA, 120/240, 3 WI. UTILITY: 15 KVA (BOTH ON EMERG)
ENVIRONMENTAL REQ.: COMPUTER GRADE, 12 KW COMPUTER HEAT LOAD
FIRE REQ.: HALON SAFETY: COMPUTER SHUTDOWN
COMMUNICATIONS: 2 ETHERNET LOOP-THRU, TELEPHONE, INTERCOM
CABLING: IDS: SENSOR:
NOTES: 1000 CHANNEL CAPACITY, NON-REDUNDANT

CSCR ______'89 001

05-03-89

NNWSI IDS EQUIPMENT

COMPONENT NAME: IDS ALCOVE COMPUTER SYSTEM
SUPPORTED TESTS: HEATED BLOCK, CANISTER SCALE HEATER

SENSOR TYPES: NUMBER:
LOCATION: IDS ALCOVE, MAIN TEST LEVEL
SIZE: 825 SQ. FT. 20x40x8
CONSTRUCTION: METAL, AIR LOCK ENTRY, RAISED FLOOR
MOUNTING: CONCRETE PAD
POWER REQ. UPS:35 KVA, 3 PH, 208/120 UTILITY: 30 KVA (BOTH ON EMERG)
ENVIRONMENTAL REQ.: COMPUTER GRADE, INCOMING AIR HIGHLY FILTERED
FIRE REQ.: HALON, SPRINKLER BACKUP SAFETY: COMPUTER SHUTDOWN
COMMUNICATIONS: 2 ETHERNET LOOP-THRU, TELEPHONE, INTERCOM
CABLING: IDS: VARIOUS ETHERNET SENSOR:
NOTES:

COMPONENT NAME: IDS MAIN COMPUTER SYSTEM
SUPPORTED TESTS: ALL

SENSOR TYPES: NUMBER:
LOCATION: IDS MAIN SURFACE FACILITY
SIZE: 2600 SQ. FT.
CONSTRUCTION: METAL (BUTLER) TYPE
MOUNTING: CONCRETE PAD
POWER REQ. UPS:50 KVA, 2-200A,30CKT P UTILITY: 50 KVA, 3 PH, 208/120
ENVIRONMENTAL REQ.: RAISED FLOOR, 74 +/-3 DEG, RH 50%NC, 40 KW HEAT
FIRE REQ.: HALON, SPRINKLER BACKUP SAFETY: COMPUTER SHUTDOWN
COMMUNICATIONS: 3 ETHERNET, TELEPHONE, INTERCOM
CABLING: IDS: 3 ETHERNETS SENSOR:IDS SURF. COMMON DATA
NOTES:

CSCR '89 001

05-03-88

NNWSI IDS EQUIPMENT

COMPONENT NAME: IN-SHAFT DATA ACQUISITION STATION #1
SUPPORTED TESTS: RADIAL BOREHOLE #1

SENSOR TYPES: NUMBER:
LOCATION: ES-1, 10 FEET ABOVE BOREHOLE #1
SIZE: 3x3x6 FEET
CONSTRUCTION: HEAVY DUTY NEMA-12 (SEE ATTACHED SKETCH)
MOUNTING: RECESSED IN SHAFT WALL, MUST BE ABLE TO RACK OUT
POWER REQ. UPS:120 VAC, 1.5 KVA UTILITY: NONE
ENVIRONMENTAL REQ.: FILTERED AIR, POSSIBLE TEMPERATURE CONTROL
FIRE REQ.: NONE SAFETY: NONE
COMMUNICATIONS: DATA TO SURFACE AND/OR DATA ALCOVE, INTERCOM
CABLING: IDS: SENSOR:
NOTES:

COMPONENT NAME: IN-SHAFT DATA ACQUISITION STATION #2
SUPPORTED TESTS: RADIAL BOREHOLE #2

SENSOR TYPES: NUMBER:
LOCATION: ES-1, 10 FEET ABOVE BOREHOLE #2
SIZE: 3x3x6 FEET
CONSTRUCTION: HEAVY DUTY NEMA-12 (SEE ATTACHED SKETCH)
MOUNTING: RECESSED IN SHAFT WALL, MUST BE ABLE TO RACK OUT
POWER REQ. UPS:120 VAC, 1.5 KVA UTILITY: NONE
ENVIRONMENTAL REQ.: FILTERED AIR, POSSIBLE TEMPERATURE CONTROL
FIRE REQ.: NONE SAFETY: NONE
COMMUNICATIONS: DATA TO SURFACE AND OR DATA ALCOVE, INTERCOM
CABLING: IDS: SENSOR:
NOTES:

05-03-89

NNWSI IDS EQUIPMENT

COMPONENT NAME: IN-SHAFT DATA ACQUISITION STATION #3
SUPPORTED TESTS: RADIAL BOREHOLE #3

SENSOR TYPES: NUMBER:
LOCATION: ES-1, 10 FEET ABOVE BOREHOLE #3
SIZE: 3x3x6 FEET
CONSTRUCTION: HEAVY DUTY NEMA-12 (SEE ATTACHED SKETCH)
MOUNTING: RECESSED IN SHAFT WALL, MUST BE ABLE TO RACK OUT
POWER REQ. UPS:120 VAC, 1.5 KVA UTILITY: NONE
ENVIRONMENTAL REQ.: FILTERED AIR, POSSIBLE TEMPERATURE CONTROL
FIRE REQ.: NONE SAFETY: NONE
COMMUNICATIONS: DATA TO SURFACE AND OR DATA ALCOVE, INTERCOM
CABLING: IDS: SENSOR:
NOTES:

COMPONENT NAME: IN-SHAFT DATA ACQUISITION STATION #4
SUPPORTED TESTS: RADIAL BOREHOLE #4

SENSOR TYPES: NUMBER:
LOCATION: ES-1, 10 FEET ABOVE BOREHOLE #4
SIZE: 3x3x6 FEET
CONSTRUCTION: HEAVY DUTY NEMA-12 (SEE ATTACHED SKETCH)
MOUNTING: RECESSED IN SHAFT WALL, MUST BE ABLE TO RACK OUT
POWER REQ. UPS:120 VAC, 1.5 KVA UTILITY: NONE
ENVIRONMENTAL REQ.: FILTERED AIR, POSSIBLE TEMPERATURE CONTROL
FIRE REQ.: NONE SAFETY: NONE
COMMUNICATIONS: DATA TO SURFACE AND OR DATA ALCOVE, INTERCOM
CABLING: IDS: SENSOR:
NOTES:

05-03-99

NNWSI IDS EQUIPMENT

COMPONENT NAME: IN-SHAFT DATA ACQUISITION STATION #5
SUPPORTED TESTS: RADIAL BOREHOLE #5

SENSOR TYPES: NUMBER:
LOCATION: ES-1, 10 FEET ABOVE BOREHOLE #5
SIZE: 3x3x6 FEET
CONSTRUCTION: HEAVY DUTY NEMA-12 (SEE ATTACHED SKETCH)
MOUNTING: RECESSED IN SHAFT WALL, MUST BE ABLE TO RACK OUT
POWER REQ. UPS:120 VAC, 1.5 KVA UTILITY: NONE
ENVIRONMENTAL REQ.: FILTERED AIR, POSSIBLE TEMPERATURE CONTROL
FIRE REQ.: NONE SAFETY: NONE
COMMUNICATIONS: DATA TO SURFACE AND OR DATA ALCOVE, INTERCOM
CABLING: IDS: SENSOR:
NOTES:

COMPONENT NAME: IN-SHAFT DATA ACQUISITION STATION #5
SUPPORTED TESTS: RADIAL BOREHOLE #5

SENSOR TYPES: NUMBER:
LOCATION: ES-1, 10 FEET ABOVE BOREHOLE #5
SIZE: 3x3x6 FEET
CONSTRUCTION: HEAVY DUTY NEMA-12 (SEE ATTACHED SKETCH)
MOUNTING: RECESSED IN SHAFT WALL, MUST BE ABLE TO RACK OUT
POWER REQ. UPS:120 VAC, 1.5 KVA UTILITY: NONE
ENVIRONMENTAL REQ.: FILTERED AIR, POSSIBLE TEMPERATURE CONTROL
FIRE REQ.: NONE SAFETY: NONE
COMMUNICATIONS: DATA TO SURFACE AND OR DATA ALCOVE, INTERCOM
CABLING: IDS: SENSOR:
NOTES:

CSCR ____ '89 001

05-03-89

NNWSI IDS EQUIPMENT

COMPONENT NAME: IN-SHAFT DATA ACQUISITION STATION #7
SUPPORTED TESTS: RADIAL BOREHOLE #7

SENSOR TYPES: NUMBER:
LOCATION: ES-1, 10 FEET ABOVE BOREHOLE #7
SIZE: 3x3x6 FEET
CONSTRUCTION: HEAVY DUTY NEMA-12 (SEE ATTACHED SKETCH)
MOUNTING: RECESSED IN SHAFT WALL, MUST BE ABLE TO RACK OUT
POWER REQ. UPS:120 VAC, 1.5 KVA UTILITY: NONE
ENVIRONMENTAL REQ.: FILTERED AIR, POSSIBLE TEMPERATURE CONTROL
FIRE REQ.: NONE SAFETY: NONE
COMMUNICATIONS: DATA TO SURFACE AND OR DATA ALCOVE, INTERCOM
CABLING: IDS: SENSOR:
NOTES:

COMPONENT NAME: IN-SHAFT DATA ACQUISITION STATION #8
SUPPORTED TESTS: RADIAL BOREHOLE #8

SENSOR TYPES: NUMBER:
LOCATION: ES-1, 10 FEET ABOVE BOREHOLE #8
SIZE: 3x3x6 FEET
CONSTRUCTION: HEAVY DUTY NEMA-12 (SEE ATTACHED SKETCH)
MOUNTING: RECESSED IN SHAFT WALL, MUST BE ABLE TO RACK OUT
POWER REQ. UPS:120 VAC, 1.5 KVA UTILITY: NONE
ENVIRONMENTAL REQ.: FILTERED AIR, POSSIBLE TEMPERATURE CONTROL
FIRE REQ.: NONE SAFETY: NONE
COMMUNICATIONS: DATA TO SURFACE AND OR DATA ALCOVE, INTERCOM
CABLING: IDS: SENSOR:
NOTES:

ATTACHMENT 9

CSCR ____ '89 001

IDS PHASE 1 PROJECT SCHEDULE, Revision 1, 12/21/87, File 89WPAS01.DAT
Prepared by R.J.CROWLEY

IDS PHASE 1 PROJEC
Revision 1, 12/21/

```
                                    Oct 87               Nov             Dec                      Jan 88              Feb           FebMar
Job Description                     1  8  15 22 29 5  12 19 26 3  10 17 24 31 7  14 21 28 4  11 18 25 3  10 17 24 31
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  1 TITLE I, PH. 1&2 DESIGN         0=======================>
  2 REVISED TITLE I DESIGN DOC.     .  .  .  .  .  .  .  .  >===========================X  .  .  .  .  .  .  .  .  .
  3 IDS COMMITTEE MEETING           .  .  .  .  .  .  .  .  X  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
  4 TITLE II, PHASE 1 DESIGN        .  .  .  .  .  .  .  .  >==============================================================
  5 PHASE I INSTALLATION            .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .

  6 PH. 1 DEV. SYSTEM TEST REPORT   .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  X
  7 PH. 1 S/W INTERIM DES. REPORT   .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  X
  8 PH. 1&2 FACIL. RQMTS. DOCUMENT  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
  9 PH. 1 H/W INTERIM DES. REPORT   .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
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 12 PH. 1 S/W VER. & VAL. REPORT    .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
 13 PH. 1 H/W ACCEPT. TEST REPORT   .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
 14 INSTALL IN-SHAFT STATIONS       .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
 15 PH. 1 TITLE III ENGRG. REPORT   .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .

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Sorting order is Current order
From the first job to the last job
Jobs using all skills

Symbol-Explanation
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>-->   Duration of a normal job
>..>   Slack time for a normal job
>==>   Duration of a critical path job
>::>   Duration of a completed job
*      Job with zero duration
+      Job deadline
0-->   Job with no prerequisites
>--X   Job with no successors
!      Time break due to holiday or week-off
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CSCR ____'89 001

DULE
le 89WPAS01.DAT

IOS PHASE 1 PROJECT SCHEDULE
Revision 1, 12/21/87, File 89WPAS01.DAT

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IDS PHASE 1 PROJECT SCHEDULE
Revision 1, 12/21/87, File 89WPAS01.DAT

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CSCR ______'89 0

IDS PHASE 1 PROJECT SCHEDULE
Revision 1, 12/21/87, File 89WPAS01.DAT

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Dec          Jan90 Jan   Feb          Mar          Apr            May             Jun           Jul          Aug90
7  14 21 28  4  11 18 25 1  8  15 22  1  8  15 22 29 5  12 19 26  3  10 17 24 31  7  14 21 28  5  12 19 26  2
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NNWSI PROJECT
COST/SCHEDULE CHANGE REQUEST (C/SCR)

N-AD-036
9/87

Change No.:	Organization:	Originator:	Origination Date:
89-002	SAIC	M. E. Spaeth	11/15/88

Title:
Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Request (ECR) 010

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 010.

REASON: See the "Basis for Change" on ESF ECR 010.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:
1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010 through 027.
2. ESF ECR 010.

Responsible Organization M. E. Spaeth [signature] Date 11/22/88

CCB Secretary P. C. Merkley [signature] Date 12/13/88

Approval: Project Manager, WMPO for C. P. Gertz [signature] Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF ECR 010.	C/SCR No: 89/002

Summary of Recommended Actions:

	Project Office				T&MSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☒	☒	☒	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☐	☐	☐	☐
Non Concurrence	☐	☐	☐	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation:

Impact Analyses:

CCB Secretary P. C. Merklev (signature) Date 12/12/88

Page 1 of 1

CSCR ____'89 002

Department of Energy
Nevada Operations Office
P. O. Box 98518
Las Vegas, NV 89193-8518

JUL 20 1988

RECEIVED
M. E. SPAETH

JUL 21 1988
Route Merkley - XTHA
Copies ____

Michael E. Spaeth
Technical Project Officer
for NNWSI
ATTN: Phil Merkley
Science Applications
International Corporation
Suite 407
101 Convention Center Drive
Las Vegas, NV 89109

PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

Received In Configuration
Management Division

JUL 22 1988

SAIC/T&MSS

JUL 21 1988

CCF RECEIVED

CSCR ____'89 002

cc w/o encl:
V. J. Cassella, HQ (RW-123) FORS
Dean Stucker, HQ (RW-223) FORS
G. K. Beall, SAIC, Las Vegas, NV
M. C. Brake, SAIC, Las Vegas, NV
R. R. Reust, SAIC, Las Vegas, NV
John Nimmo, SAIC, Las Vegas, NV
S. H. Klein, SAIC, Las Vegas, NV
W. E. Narrows, SAIC, Las Vegas, NV
James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

CSCR ____'89 002

ESF ENGINEERING CHANGE REQUEST

ESTP11 FMB-12/28/I

ECR NO. 010

PAGE 1 OF 2

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL III
SOURCE Holmes & Narver, Inc.
WBS DESIGNATION 1.2.6.3.1.6
TITLE Buildings
DESCRIPTION Trailers (Main Pad)

PARTICIPANT Holmes & Narver, Inc.
DATE May 11, 1988
ORIGINATOR S. H. Williams
REV. NO.____ DATE____
REV. NO.____ DATE____

Holmes & Narver, Inc. (H&N) recommends the Subsystem Design Requirements Document (SDRI 1.2.6.3 Surface Facilities be changed in Subpart 1.2.6.3.8 from "Trailers" to "Temporary Facilities"; in the paragraph Functional Requirements 1.h. change "Trailers" to "Temporary Facilities"; and in 1.h.8, 9 and 10 change "trailers" to "facility".

In Subpart 1.2.6.3.8 change the wording of the first line beginning "The trailers . . ." to "The Temporary facilities . . .". In the paragraph Functional Requirements change sentences 1,2,3 and 4 from "shall" to "may". (Cont'd) SEE CONTINUATION PAGE

BASIS FOR CHANGE Title 8, California Administrative Code, Part I, Chapter 4, Subchapter 17, Article 7, Section 6977, Paragraph g reads as follows: "It is recommended that working clothes be either elevated by suitable means, such as chains, to the upper air of the change house or that separate rooms be used for working and street clothes." The recommendation of separate rooms for street SEE CONTINUATION PAGE

SCOPE CHANGE x YES ____ NO   CONSTRUCTION IMPACT x YES ____ NO

PARTICIPANT QA REP [signature] DATE 5/18/88   ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 5/18/88

SECTION 2. ACTION

1. PROCEED WITH ECR EVALUATION ✓ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO

[signature]
ESF ICWG CHAIRMAN

3. TOTAL COSTS (increase/decrease)

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT

ENGINEERING ____ WEEKS
CONSTRUCTION ____ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

ESF CHAIRMAN ICWG

6. FUNDING:

____ CHANGE ORDER ____ SPECIAL STUDIES
✓ NOT FUNDED, PROJECTED ONLY

[signature]
ESF CHAIRMAN ICWG

7. APPROVED FOR BASELINING

[signature]
ESF CHAIRMAN ICWG

CSCR ____'89 002

ESF ENGINEERING CHANGE REQUEST

ESTP12.FMB-11/24

ECR NO. 010

Continuation Page

TITLE Buildings Trailers (Main Pad)

CONTINUATION DATA In the paragraph Performance Criteria change "first aid trailer" to "first aid facility". In the two paragraphs Constraints and Assumptions change "change room trailers" to "change room facility". (See attached SDRD)

These changes are to also be made in the H&N Scope and Planning Basis Document (SPBD) 1.2.6.3.1.6 and the Design Basis Document (DBD) 1.2.6.3.1.6. (See attached SPBD and DBD).

BASIS FOR CHANGE (Cont.)

and work clothes almost doubles the trailer requirements necessary for the change house To meet this recommendation and to provide adequate space for first aid, lamp charging/repair, office space, and storage it is recommended that a pre-engineered building be substituted for change house trailers. Trailers do not provide adequate overhead clearance for hanging baskets and a facility with concrete floors is much more appropriate for change house/shower facilities. The constraint of trailers only for main pad buildings that is placed upon the A&E does not allow the A&E to design the best possible and most cost efficient facility. Pre-engineered metal buildings are temporary structures and they provide considerable cost savings over modular trailers. A facility of sufficient size to accommodate miners, supervisors, inspectors, etc. and to also allow the incorporation of some office space, safety room, first aid, etc. in lieu of using trailers as specified is recommended by H&N.

For comparison, the Area 3 modular office complex consisted of 12 each 14'x60' modular trailers. Based on actual work orders received for the office-type trailers and site preparation only, the cost was $82 per square foot. The Area 6 physical fitness facility consisted of a 6,000 square foot pre-engineered metal building including the concrete slab and utilities at a completed cost of $52 per square foot. These comparisons indicate that a pre-engineered metal building should cost less per square foot than trailers and provide a more usable facility.

OTHER INFORMATION

EXISTING

CSCR ____'89 002

Rev. 1

EXPLORATORY SHAFT FACILITY

SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT

TABLE OF CONTENTS

1.2.6.5.3 Station
1.2.6.5.4 Furnishings
1.2.6.5.5 Hoist System
1.2.6.5.6 Sump

1.2.6.6 UNDERGROUND EXCAVATIONS

1.2.6.6.1 Operations Support Areas
1.2.6.6.2 Test Areas

1.2.6.7 UNDERGROUND UTILITY SYSTEMS

1.2.6.7.1 Power Distribution System
1.2.6.7.2 Communications System
1.2.6.7.3 Lighting System
1.2.6.7.4 Ventilation System
1.2.6.7.5 Water Distribution System
1.2.6.7.6 Mine Wastewater Collection System
1.2.6.7.7 Compressed Air Distribution Systems
1.2.6.7.8 Fire Protection System
1.2.6.7.9 Muck Handling Systems
1.2.6.7.10 Sanitary Facilities
1.2.6.7.11 Monitoring and Warning Systems

1.2.6.8 UNDERGROUND TESTS

1.2.6.8.1 Integrated Data Acquisition System (IDS)
1.2.6.8.2 Geological Tests
1.2.6.8.3 Geomechanics Tests
1.2.6.8.4 Near-Field and Thermally Perturbed Tests
1.2.6.8.5 Hydrologic and Transport Phenomena Tests
1.2.6.8.6 Prototype Tests

1.2.6.9 ESF DECOMMISSIONING STRATEGY

1.2.6.9.1 Surface Facilities
1.2.6.9.2 Shafts and Underground Facilities

1.2.6 APPENDICES

Appendix A ESF Sketches
Appendix B Test and IDS requirements and test data sheets
Appendix C ESF Drilling Requirements
Appendix D Reference Project documentation
Appendix E Applicable regulations, codes, and specifications (including OGR/GRD Appendix E-Crosswalk)
Appendix F Work order system / Work Breakdown Structure

1.2.6.3 SURFACE FACILITIES

Subparts are:

1.2.6.3.1 Ventilation System
1.2.6.3.2 Test Support Facilities
1.2.6.3.3 Trailer Spaces
1.2.6.3.4 Parking Areas
1.2.6.3.5 Materials Storage Facilities
1.2.6.3.6 Shop
1.2.6.3.7 Warehouse
1.2.6.3.8 Trailers
1.2.6.3.9 A&E Building (Area 25)
1.2.6.3.10 Communications/Data Building

Definition of Subsystem Elements

The surface facilities system and subsystem includes all the facilities, systems, and services for the surface buildings and trailers that are required for the support of ESF operations and in situ site characterization.

Applicable Regulations, Codes, and Specifications

The designs shall be in accordance with:

1. DOE 6430.1

In addition, see Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

Functional Requirements

1. Provide buildings and supporting equipment for the following functions:

   a. Ventilation system
   b. Test support facilities
      1) Test apparatus assembly pad
   c. Trailer spaces
   d. Parking areas
      1) Surface mobile equipment
      2) Personnel parking
      3) Visitor parking
   e. Materials storage facilities
   f. Shop
   g. Warehouse
   h. Trailers

1) Offices for Principal Investigators (PIs)
2) Offices for site security
3) Offices for site operations staff
4) Offices for site administration and training
5) Offices for Quality Assurance
6) Offices for support of shaft and facility construction
7) Laboratories, etc.
8) Change trailers
9) First aid trailer
10) Test support trailer
11) NRC and State offices

i. A&E building (Area 25)

1) Administration
2) Visitors
3) Training
4) Engineering staff
5) Security
6) Labs (as required)
7) Sleeping quarters (as required)
8) Offices for PIs
9) NRC and State offices

j. Communications and data building

1) Computer/control system
2) Data acquisition (IDS)
3) Communications equipment

2. Provide air quality monitoring.

3. Provide water quality monitoring (including the physical, chemical, and biological characteristics of ESF wastewater, the receiving water body, and any other water bodies that could be affected by ESF operations).

4. Provide dust control and/or collection facilities.

5. Provide for the detection of and protection from fires and explosions.

6. Provide onsite transportation facilities for equipment, materials, and rock.

Performance Criteria

1. The surface facilities shall meet the operational requirements of the users.

2. The surface facilities shall be designed and constructed for a nominal 5-year life, unless otherwise noted.

3. The surface facilities and their locations shall (a) facilitate the flow of material and personnel within the ESF site and (b) provide adequate ESF site security, including controlled access and emergency response.

4. The facilities shall be complete with Heating Ventilation and Air Conditioning (HVAC), compressed air, plumbing and sanitary facilities, lighting, communications, and fire protection systems, as appropriate for the intended use.

5. Surface facilities shall combine functions when the combinations are cost effective.

6. The surface facilities shall be located away from potential dust generating areas to the extent practicable.

Interface Control Requirements

See Section 1.2.6.0, Interface Control Requirements.

Constraints

1. The general layout of the surface facilities shall be designed to minimize disturbance to the existing area.

2. To the extent practicable and economical, modular, relocatable, or portable structures shall be considered for surface facilities.

3. To the extent practicable and consistent with procurement regulations, consideration of surplus government equipment shall be given to fulfill the requirements for the surface facilities and equipment.

4. Each inhabited structure shall have rest rooms, water heating, space heating, and air conditioning, as required for the intended use.

Assumptions

None.

1.2.6.3.8 TRAILERS

Definition of Subsystem Elements

The trailer(s) are defined by the facilities, systems, and services that will be utilized for the offices, change rooms, first aid, and test support required to support ESF construction, operations, and maintenance personnel for the site characterization program.

Functional Requirements

1. Trailers shall be provided for office spaces.
2. Trailers shall be provided for change rooms of sufficient size to provide all necessary personnel a place to change clothes.
3. A trailer shall be provided for the first aid center.
4. Trailers shall be provided for test support functions.

Performance Criteria

1. The first aid trailer shall provide at least 200 square feet for the first aid facility, plus 50 square feet for storage.

Constraints

1. Office spaces shall be based on a minimum of 100 square feet per office.
2. Overhead baskets and locker facilities in the change room trailers shall be sized to accommodate the ESF underground personnel for both operations and underground testing.

Assumptions

1. The government owned change trailers may satisfy the requirements for the change room trailers.

CSCR ______'89 002
PROPOSED MODIFICATION

EXPLORATORY SHAFT FACILITY

SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT

TABLE OF CONTENTS

1.2.6.3 SURFACE FACILITIES

Subparts are:

1.2.6.3.1 Ventilation System
1.2.6.3.2 Test Support Facilities
1.2.6.3.3 Trailer Spaces
1.2.6.3.4 Parking Areas
1.2.6.3.5 Materials Storage Facilities
1.2.6.3.6 Shop
1.2.6.3.7 Warehouse
1.2.6.3.8 Temporary Facilities
1.2.6.3.9 A&E Building (Area 25)
1.2.6.3.10 Communications/Data Building

Definition of Subsystem Elements

The surface facilities system and subsystem includes all the facilities, systems, and services for the surface buildings and trailers that are required for the support of ESF operations and in situ site characterization.

Applicable Regulations, Codes, and Specifications

The designs shall be in accordance with:

1. DOE 6430.1

In addition, see Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

Functional Requirements

1. Provide buildings and supporting equipment for the following functions:

   a. Ventilation system
   b. Test support facilities
      1) Test apparatus assembly pad
   c. Trailer spaces
   d. Parking areas
      1) Surface mobile equipment
      2) Personnel parking

3) Visitor parking

e. Materials storage facilities

f. Shop

g. Warehouse

h. Temporary Facilities
   1) Offices for Principal Investigators (PIs)
   2) Offices for site security
   3) Offices for site operations staff
   4) Offices for site administration and training
   5) Offices for Quality Assurance
   6) Offices for support of shaft and facility construction
   7) Laboratories, etc.
   8) Change facilities
   9) First aid facilities
   10) Test support facilities
   11) NRC and State offices

i. A&E building (Area 25)
   1) Administration
   2) Visitors
   3) Training
   4) Engineering staff
   5) Security
   6) Labs (as required)
   7) Sleeping quarters (as required)
   8) Offices for PIs
   9) NRC and State offices

j. Communications and data building
   1) Computer/control system
   2) Data acquisition (IDS)
   3) Communications equipment

2. Provide air quality monitoring.

3. Provide water quality monitoring (including the physical, chemical, and biological characteristics of ESF wastewater, the receiving water body, and any other water bodies that could be affected by ESF operations).

4. Provide dust control and/or collection facilities.

5. Provide for the detection of and protection from fires and explosions.

6. Provide onsite transportation facilities for equipment, materials, and rock.

Performance Criteria

1. The surface facilities shall meet the operational requirements of the users.

2. The surface facilities shall be designed and constructed for a nominal 5-year life, unless otherwise noted.

3. The surface facilities and their locations shall (a) facilitate the flow of material and personnel within the ESF site and (b) provide adequate ESF site security, including controlled access and emergency response.

4. The facilities shall be complete with Heating Ventilation and Air Conditioning (HVAC), compressed air, plumbing and sanitary facilities, lighting, communications, and fire protection systems, as appropriate for the intended use.

5. Surface facilities shall combine functions when the combinations are cost effective.

6. The surface facilities shall be located away from potential dust generating areas to the extent practicable.

Interface Control Requirements

See Section 1.2.6.0, Interface Control Requirements.

Constraints

1. The general layout of the surface facilities shall be designed to minimize disturbance to the existing area.

2. To the extent practicable and economical, modular, relocatable, or portable structures shall be considered for surface facilities.

3. To the extent practicable and consistent with procurement regulations, consideration of surplus government equipment shall be given to fulfill the requirements for the surface facilities and equipment.

4. Each inhabited structure shall have rest rooms, water heating, space heating, and air conditioning, as required for the intended use.

Assumptions

None.

1.2.6.3.8 TEMPORARY FACILITIES

Definition of Subsystem Elements

The temporary facilities are defined by the facilities, systems, and services that will be utilized for the offices, change rooms, first aid, and test support required to support ESF construction, operations, and maintenance personnel for the site characterization program.

Functional Requirements

1. Temporary facilities may be provided for office spaces.
2. Temporary facilities may be provided for change rooms of sufficient size to provide all necessary personnel a place to change clothes.
3. A temporary facility may be provided for the first aid center.
4. Temporary facilities may be provided for test support functions.

Performance Criteria

1. The first aid facility shall provide at least 200 square feet for the first aid facility, plus 50 square feet for storage.

Constraints

1. Office spaces shall be based on a minimum of 100 square feet per office.
2. Overhead baskets and locker facilities in the change room facility shall be sized to accommodate the ESF underground personnel for both operations and underground testing.

Assumptions

1. The government owned change facility may satisfy the requirements for the change room trailers.

NNWSI PROJECT
COST/SCHEDULE CHANGE REQUEST (C/SCR)

N-AD-036
9/87

Change No.:	Organization:	Originator:	Origination Date:
89/003	SAIC	M. E. Spaeth	11/15/88

Title:

Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Request (ECR) 011

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR.

REASON: See the "Basis for Change" on ESF ECR 011.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:
1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010.
2. ESF ECR 011.

Responsible Organization M. E. Spaeth [signature] Date 11/27/88

CCB Secretary P. C. Merkley [signature] Date 12/13/88

Approval: Project Manager, WMPO for C. P. Gertz [signature] Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF-ECR 011.

C/SCR No: 89/003

Summary of Recommended Actions:

	Project Office				T&MSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☒	☒	☐	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☒ (1)	☐	☐	☐
Non Concurrence	☐	☐	☐	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation: (1) "This change will have a cost & schedule impact".

Impact Analyses: Data was not provided to indicate impact relating to Cost and Schedule.

CCB Secretary P. C. Merkley [signature]   Date 12/12/88

Page 1 of 1

CSCR ____'89 003

Department of Energy
Nevada Operations Office
P. O. Box 98518
Las Vegas, NV 89193-8518

JUL 20 1988

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Michael E. Spaeth
Technical Project Officer
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101 Convention Center Drive
Las Vegas, NV 89109

PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Iiby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

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Management Division

JUL 22 1988

SAIC/T&MSS

JUL 21 1988

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CSCR ____ '89 003

JUL 20 1988

cc w/o encl:
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Dean Stucker, HQ (RW-223) FORS
G. K. Beall, SAIC, Las Vegas, NV
M. C. Brake, SAIC, Las Vegas, NV
R. R. Reust, SAIC, Las Vegas, NV
John Nimmo, SAIC, Las Vegas, NV
S. H. Klein, SAIC, Las Vegas, NV
W. E. Narrows, SAIC, Las Vegas, NV
James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

CSCR ____'89 005

ESF ENGINEERING CHANGE REQUEST

ESTP11 FMB-12/28/

ECR NO. 011

PAGE 1 OF 1

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL ____
SOURCE NNWSI-DOE
WBS DESIGNATION 1.2.6.4.5
TITLE SDRD
DESCRIPTION ES-1 GFE Headframe

PARTICIPANT Fenix & Scisson
DATE 4/21/88
ORIGINATOR B. Stanley
REV. NO. 1 DATE 12/18/87
REV. NO. ____ DATE ____

Remove from the SDRD, Section 1.2.6.4.5, Assumption 1 which states:
"the existing government furnished equipment (GFE) headframe shall be modified as required and erected for shaft sinking operation."

SEE CONTINUATION PAGE

BASIS FOR CHANGE

The configuration of the GFE headframe will not allow suitable fulfillment of SDRD, 1.2.6.4.5, PC 1, 7, 10 and 11. Modification of the existing structure will not solve problems with safety, flexibility, and accommodation of the hoisting system relative to construction, operation, and site characterization needs.

SEE CONTINUATION PAGE

SCOPE CHANGE X YES ____ NO   CONSTRUCTION IMPACT ____ YES X NO

PARTICIPANT QA REP [signature] DATE 7/1/88   ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 7/1/88

SECTION 2. ACTION

1. PROCEED WITH ECR EVALUATION ✓ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO

[signature]
ESF ICWG CHAIRMAN

3. TOTAL COSTS (increase/decrease)

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT

ENGINEERING ____ WEEKS
CONSTRUCTION ____ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

ESF CHAIRMAN ICWG

6. FUNDING:

____ CHANGE ORDER ____ SPECIAL STUDIES
✓ NOT FUNDED, PROJECTED ONLY

[signature]
ESF CHAIRMAN ICWG

7. APPROVED FOR BASELINING

[signature]
ESF CHAIRMAN ICWG

1.2.6.4.5 HOIST SYSTEM

Definition of Subsystem Elements

The Hoist system is defined as those systems and components for the transportation of personnel and equipment between the surface and subsurface to meet the needs of ESF shaft sinking, construction, and underground site characterization testing. The hoist system includes the structural steel members used to support the hoisting conveyance, the headframes, and the hoist house.

The hoist house is defined as those facilities to accommodate one hoist operator and the necessary equipment and instrumentation for the hoist, air compressor system, control room, electrical and motor control centers, and an area for repairs and lay down.

Functional Requirements

The hoist system shall provide for the transport and support of personnel, materials, and construction equipment, and serve as the emergency egress from the underground during shaft sinking, ESF construction (mining operations), and underground testing.

Performance Criteria

1. The ESF hoisting system capacities shall be consistent with the requirements of ESF construction, operation, and underground site characterization needs.
2. The hoisting conveyance shall be designed to permit the inspection of shaft performance monitoring instrumentation, as well as other shaft inspection and maintenance activities.
3. The conveyance system shall consist of a cage and sinking bucket in an out-of-balance arrangement operated by a ground-mounted hoist.
4. The cage shall be designed to act as a crosshead for the sinking bucket.
5. The hoist shall be designed with a separate and independent power distribution system.
6. The hoisting systems shall have a rated capacity sufficient for emergency egress.

7. Headframe shall elevate the hoist sheaves sufficiently above the collar level to provide room for normal conveyance unloading and over-travel allowances.

8. A hoist foundation shall be provided to accommodate the hoist dimensions and mounting details, independent of the hoist house foundation.

9. The hoist house control and operator's room shall be complete with a heating and air conditioning system.

10. The headframe shall provide sufficient facilities for dumping buckets during shaft construction.

11. The headframe shall be designed and constructed to serve subsurface construction and underground test operations.

12. Clearances in the headframe directly above the collar shall be designed to accommodate the rigging of all anticipated underground equipment.

13. The hoisting systems shall be designed and constructed for the evacuation of all underground personnel to safety within one hour.

14. Area flood lighting and lightning protection shall be provided atop the shaft headframe.

Constraints

1. The hoisting system shall be designed to have all necessary safety features.

2. The hoist shall be designed to accommodate the uncertainty allowance (see Section 1.2.6.0, Performance Criteria item #2.)

Assumptions

1. DELETED

2. The existing GFE 900 HP hoist shall be used for shaft sinking and ESF construction and operation activities.

1.2.6.4.5 HOIST SYSTEM

Definition of Subsystem Elements

The Hoist system is defined as those systems and components for the transportation of personnel and equipment between the surface and subsurface to meet the needs of ESF shaft sinking, construction, and underground site characterization testing. The hoist system includes the structural steel members used to support the hoisting conveyance, the headframes, and the hoist house.

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The hoist system shall provide for the transport and support of personnel, materials, and construction equipment, and serve as the emergency egress from the underground during shaft sinking, ESF construction (mining operations), and underground testing.

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Constraints

1. The hoisting system shall be designed to have all necessary safety features.

2. The hoist shall be designed to accommodate the uncertainty allowance (see Section 1.2.6.0, Performance Criteria item #2.)

Assumptions

1. The existing government furnished equipment (GFE) headframe shall be modified as required and erected for shaft sinking operation.

2. The existing GFE 900 HP hoist shall be used for shaft sinking and ESF construction and operation activities.

COST/SCHEDULE CHANGE REQUEST (C/SCR)

Change No:	Organization:	Originator:	Origination Date:
89/004	SAIC	M. E. Spaeth	11/15/88

Title:
Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO 309 in Accordance with the Approved ESF Engineering Change Request (ECR) 012

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 012.

REASON: See the "Basis for Change" on ESF ECR 012.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:
1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010 through 027.
2. ESF ECR 012.

Responsible Organization M. E. Spaeth [signature] Date 11/22/88
CCB Secretary P. C. Merkley [signature] Date 12/13/88
Approval: Project Manager, WMPO C. P. Gertz [signature] Date 12/15/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF-ECR 012.

C/SCR No: 89/004

Summary of Recommended Actions:

	Project Office				TSMSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☐	☒	☐	☒	☒	☒	☒
Concurrence with Conditions	☐	☒ (1)	☐	☐	☐	☐	☐	☐
Non Concurrence	☐	☐	☐	☒ (2)	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation: (1) "Question - It is not clear from the C/SCR this is wanted as a reference to the SDRD or a document by itselt".
(2) "The report titled "Exploratory Shaft Seismic Design Basis" is presently undergoing review. It has not been approved for use. Until approved concurrence can not be given for use as a reference."

Impact Analyses:

CCB Secretary P. C. Merkley [signature] Date 12/12/88

Page 1 of 1

CSCR ____'89 004

Department of Energy

Nevada Operations Office
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PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

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Management Division
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JUL 21 1988
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CSCR ____'89 004

JUL 20 1988

cc w/o encl:
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S. H. Klein, SAIC, Las Vegas, NV
W. E. Narrows, SAIC, Las Vegas, NV
James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

CSCR ____'89 004

ESF ENGINEERING CHANGE REQUEST

ESF11 FMB-12/25

ECR NO. 012 PAGE 1 OF 1

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL ____ PARTICIPANT SNL
SOURCE SNL DATE 7/1/88
WBS DESIGNATION 1261 ORIGINATOR Stinebaugh
TITLE ESF REV. NO.____ DATE____
DESCRIPTION OF CHANGE

SEE ATTACHED DESIGN CHANGE REQUEST (SNL DCR 014)

NOTE: The report titled "Exploratory Shaft Seismic Design Basis" requested to be added as ESF design criteria by DCR 014 will be superseded by a SAND report which will be referenceable (traceable) and contain disclaimers where necessary for the data and conclusions contained therein.

SEE CONTINUATION PAGE

BASIS FOR CHANGE

Incorporation of seismic design criteria that is specific to site and appropriate for ESF function.

SEE CONTINUATION PAGE

PARTICIPANT QA REP [signature] DATE 7/1/88 ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 7/1/88

SECTION 2. ICWG CHAIRMAN ACTION ____ NOT APPLICABLE

1. PROCEED WITH ECR EVALUATION ✓ YES ____ NO SCOPE CHANGE ____ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO CONSTRUCTION IMPACT ____ YES ____

3. TOTAL COSTS (increase/decrease) ____ NOT APPLICABLE

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT ____ NOT APPLICABLE
   ENGINEERING ____ WEEI
   CONSTRUCTION ____ WEEI

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
   PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

6. FUNDING:
   ____ NOT APPLICABLE ✓ NOT FUNDED, PROJECTED ONLY
   ____ CHANGE ORDER ____ SPECIAL STUDIES

[signature] 7/8/88
ICWG CHAIRMAN/DATE

7. APPROVED

[signature] 7/8/88
ICWG CHAIRMAN/DATE

ENCLOSURE 2

CSCR '89 004

Date ________ DESIGN CHANGE REQUEST DCR# 014 Class 3

Originator R. E. Stinebaugh Title ESF Seismic Design Basis

Description of Change

This change requests the report titled "Exploratory Shaft Seismic Design Basis," prepared by the special working group chartered by the ESF ICWG be adopted as design criteria for the ESF.

Interfaces Affected
ESF/Repository

Impact if not approved

Seismic design criteria used for the ESF will ~~be overly restrictive.~~ NOT BE SITE SPECIFIC
&. RH 6/20/88

Evaluation WBS# Cost

None RH 6/16/88

	concur	non concur		concur	non concur
R Stinebaugh 6/16/86 date	☒	☐	________	☐	☐
________ date	☐	☐	[signature] date 6/16/88	☒	☐
________ date	☐	☐	SEIC JGY by RRH date 6/16/88	☒	☐
________ date	☐	☐	Sec. Roger R Hill date 6/16/88	☒	☐
________ date	☐	☐	Al Stevens 6/16/88 Chairman Signature date		

☐ Approved
☐ Disapproved
☒ Submit to ~~SEIC~~ ESF ICWG

Engineering Directive (by chairman)

ENCLOSURE 3

CSCR ____'89 004

Nevada Nuclear Waste Storage Investigations Project

Working Group Report

Exploratory Shaft Seismic Design Basis

April 1988

TABLE OF CONTENTS

List of Tables

List of Figures

EXECUTIVE SUMMARY

This report prepared by a special working group (WG) authorized by the Exploratory Shaft (ES) Interface Control Working Group (ICWG), provides recommendations for the seismic design parameters for the design of the shafts associated with the Exploratory Shaft Facility (ESF) of the proposed nuclear waste repository at Yucca Mountain, Nevada. Although directly intended for design of ESF shaft liners, much of this design basis is also appropriate for seismic design of other shafts and underground structures which do not affect public safety. The recommendations include parameters for both natural earthquakes that may possibly occur at or near the repository site and for underground nuclear explosions (UNEs) which are regularly detonated at the Nevada Test Site (NTS). An evaluation was conducted very recently to determine the functions which the shafts must perform during the pre-closure period of the repository facilities. Based on this evaluation together with the results of studies conducted to support the conceptual design for the site characterization, it was concluded that the shafts need only be designed adequately to provide for worker safety. A failure of the ES will not affect the public radiological safety.

Specifically, the recommended control motion values which are to be applied at the surface are:

<u>Earthquake</u>:

Maximum Horizontal component of acceleration	- 0.3 g
Maximum Vertical component of acceleration	- 0.3 g
Maximum Horizontal component of velocity	- 30 cm/sec.
Maximum Vertical component of velocity	- 20 cm/sec.

UNE:

Maximum Vertical component of acceleration = 0.2 g
Maximum Radial component of acceleration = 0.1 g
Maximum Transverse component of acceleration = 0.1 g
Maximum Vertical component of velocity = 9 cm/sec.
Maximum Radial component of velocity = 12 cm/sec.
Maximum Transverse component of velocity = 12 cm/sec.

An evaluation of faulting potential at the ES site and its vicinity indicates that the annual probability of faulting in excess of a few centimeters (5 cm) is less than 10^{-4} per year. On the basis of this, the report recommends that faulting effects need not be considered in the design of the ES. Further, the report also provides specific guidance for determining or provides (i) the control motions at depth, (ii) the material properties for the different rock layers relevant to seismic design, (iii) the strain tensor for each of the wave forms and the maximum strain components along the shaft liner, and (iv) the method for combining the different strain components along the shaft liner. Finally, to provide further assurance that the design has adequate conservatism or margin to accommodate any uncertainties such as site effects, the WG recommends that the performance of the exploratory shaft be confirmed using best estimate conditions when subjected to ground motions that are a factor of 1.67 times the proposed design basis motions. This evaluation for the larger motions should provide assurance that the major damage of the ES is not expected at these levels.

The report also lists the assumptions and other conditions used to develop the recommendations. In developing the basis for the recommendations, the WG utilized currently available site-specific seismic and geologic data. In recognition of the uncertainties in these data, the seismic design parameters recommended include a reasonable degree of conservatism and are consistent with the seismic design requirements used for similar types of facilities.

ACKNOWLEDGMENT

In addition to the organizations called out in the front page of this report, there were others who helped in putting together this report. This includes J. Kimball of DOE/HQ, J. S. Phillips of division 7111 of Sandia National Laboratories (SNL), G. N. Owen of URS/John A. Blume, Associates & Engineers, Richard Lee (working as a consultant to URS/Blume), and R. P. Kennedy of Structural Mechanics Consulting (working as a consultant to Holmes & Narver). Their contributions included participation in the working group (WG) meetings, providing technical consultation and input to the WG, providing written input to the preparation of the report, reviewing the report contents, and help resolve review comments on the report. Their contributions are gratefully acknowledged herewith.

1.0 INTRODUCTION

This report was prepared by a special Working Group (WG) authorized by the Exploratory Shaft (ES) Interface Control Working Group (ICWG). It provides recommendations for the seismic design parameters to be used for the design of the shafts associated with the Exploratory Shaft Facility (ESF) of the proposed nuclear waste repository at Yucca Mountain, Nevada. In developing the basis for these recommendations, the WG utilized currently available site specific seismic and geologic data. In recognition of the uncertainties in these data, the seismic design parameters recommended include a reasonable degree of conservatism.

There are two shafts in the ES facilities configuration. These shafts have a two-stage service life. First, they will support site characterization by providing access, ventilation, utility support, and emergency egress from the underground test areas; secondly, pending results of site characterization, the shafts will be converted to support repository operations as intake ventilation shafts, a function they will perform until repository closure. As discussed in the baselined Generic Requirements for a Mined Geologic Disposal System (OGR/B-2), four permanent items have been identified that shall be designed, procured, and constructed to be incorporated into the repository. The permanent items include underground openings, operational seals, ground support, and shaft liners. The seismic design recommendations included in this report relate to the above permanent items as appropriate. Other items and structures in the ESF will be designed using other requirements like those of the Uniform Building Code (UBC) (Reference 24).

During the operations phase, the ESF shafts will supply approximately 60 percent of the total air flow needed to support waste emplacement. The remaining air needed is supplied through the waste ramp. Exhausting fans on the emplacement exhaust shaft maintain pressures in the emplacement area lower than the pressures in the development (mining) area.

Concrete liners will be installed in the exploratory shafts concurrent with their sinking. Their functions are:

- to provide effective structural support to the ground
- to eliminate minor rockfall hazards
- to provide a dimensionally consistent cross-section and stable anchorage for installation and alignment of shaft equipment
- to provide a low-friction surface for efficient ventilation throughout the life of the repository.

Neither of the exploratory shafts will at any time, be used to handle radioactive waste. Additionally, the liners are not intended to serve as barriers to radionuclide migration or to entry of water into the repository either during operations or after closure.

The shafts are located in unsaturated geologic formations and are not expected to penetrate any aquifers at the site. Further, any perched water zones encountered during shaft sinking are expected to drain fairly quickly. Thus, the shaft liners will not be required to prevent or control ground water inflows into the shaft. The construction joints between each concrete pour are not planned to be water tight.

If one or both of the exploratory shafts were to be completely blocked due to a failure of a shaft liner (which is highly unlikely), the emplacement area would still be under negative pressure with respect to the development area, and the ventilation leakage path would be maintained in a direction towards the emplacement area. If a waste canister were to be ruptured simultaneously with the failure of the ES shaft, any potentially contaminated air would still be exhausted via the emplacement exhaust shaft through HEPA filters (Reference 25). At this time, no credible accident scenarios have been identified whereby failure of the shaft liner could result in a release of radiation. Therefore, public safety does not appear to be an issue in shaft liner design.

In addition, a preliminary analysis has been completed to determine which structures, systems, and components are important to public radiological safety. This analysis is described in Reference 26. Results of this analysis indicate that there are no shaft structures, systems, and components identified as important to safety.

These discussions indicate that the ES (especially the liner), is not an "essential" or even a "low hazard" facility (i.e., a facility which does not handle or process plutonium) as defined in Reference 1. Based on these reasons, it is justified to design the exploratory shaft liner as a structure which is only required to provide worker safety; i.e., the permanent items such as the liner associated with the exploratory shafts need not be designed as items important to provide public radiological safety, but need to be designed only for a level of seismic input that is sufficient to ensure worker safety and reasonably uninterrupted functions, a level that is consistent with those used for other similar types of facilities. However, the seismic design basis recommendations in this report for the ES are consistent with those required for a low hazard or essential facility, and hence, judged to be more conservative than what may be required. Other non-permanent items and structures in the ES facilities will be designed using other requirements like those of the Uniform Building Code (UBC) (Reference 24).

The recommendations for the seismic design basis parameters given in Section 2 and 3 of this report are based on the discussions in the preceding paragraphs. The recommendations will include ground motion parameters for both natural earthquakes that may possibly occur at or near the site and for underground nuclear explosions (UNEs) which might occur at the Nevada Test Site (NTS).

Section 2.0 of this report provides the recommendations for characterizing the wave motions along with conditions and assumptions used for the development of control motions for natural earthquakes. Section 3.0 provides the same for UNEs. Section 4.0 describes the rule to be used for combining the maximum strains (responses) due to the different wave components. Section 5.0 describes the strain tensors including bending strains for each of the propagating waves due to earthquakes and UNEs which should be considered in the design of the ES. It also describes the determination of the worst strain combination case for use in the design.

Section 6.0 identifies the recommendations for the rock properties for the stratigraphy at the ES site. Section 7.0 presents the WG recommendations regarding consideration of potential fault offsets at the site for the ES design. Finally, the report contains appendices supporting the WG recommendations.

It is noted here that the seismic design basis control motions being proposed for the ES are consistent with the values of effective peak acceleration in ATC-3 (Reference 30) map from which UBC (Reference 24) Zones 2 and 3 are derived for the design of an essential facility. In addition, the proposed recommendations in this report are also consistent with the requirements for important low hazard facilities as called out in References 1 and 2. In Reference 1, the use of UBC requirements for seismic loads for such facilities is recommended. Further, the seismic design basis motions being proposed for the ES are similar to those for nuclear power plant structures, systems and components that may be required for operation of the facility, but which are not important to public safety. They need not be designed to seismic Category I requirements, as per Reference 3. The Standard Review Plan recommends the use of other industrial codes like those from American Petroleum Institute (API) and American Water Works Association (AWWA) both of which utilize UBC type requirements for these structures.

2.0 GROUND MOTION DUE TO EARTHQUAKES

2.1 Introduction

In Section 1.0 it is concluded that the Exploratory Shaft Facility (ESF) need not be designed as a facility important to public radiological safety. Based on this, the Working Group believes that the ESF design should consider earthquake ground motions (vibratory ground motion and faulting) that are reasonably likely to occur during the operating lifetime (less than 100 yr) of the ESF. Specifically, the Working Group recommends consideration of ground motion conditions that recur at average intervals of about one thousand years, i.e., with about one chance in ten of occurring during the maximum operating life. This would result in more conservative values of vibratory ground motions than those given in Reference 30 upon which the UBC (Reference 24) is based.

In June of 1987, design and evaluation guidelines for DOE facilities subjected to natural phenomena hazards were prepared (Reference 2). These guidelines recommend that for mission dependent facilities (where confinement of contents is not essential) that a hazard exceedence probability of 1E-3 be used (recurrence of 1,000 years). These guidelines have been incorporated into a draft revision of Reference 1 which was published in January of 1988. The ESF seismic design recommendation is also consistent with this draft revision.

Deterministic methods are appropriate for establishing conservative levels of ground motion for consideration in the ESF design. Probabilistic methods are appropriate for confirming that the resulting motions are unlikely to be exceeded during the operating lifetime of the ESF.

2.2 Relevant Earthquake Sources

As discussed in Section 7-2, faults in the immediate area of ESF including the Ghost Dance fault appear to slip at intervals measured in tens of thousands of years or longer and, therefore, are an unlikely source of significant earthquake ground motion during the operating life of the ESF. The average slip rate on local faults during the late Quarternary period appears to be less than about 0.02 mm/yr (Carr, 1984-Reference 5). The average recurrence time for magnitude 5 1/2 (potentially damaging) earthquakes on a fault with a slip rate of 0.02 mm/yr exceeds 10,000 yr according to a relationship developed by Slemmons (1982) in Reference 9. Larger magnitude earthquakes (M greater than 5 1/2) would thus have recurrence intervals of longer than 10,000 years, possibly as long as 100,000 years. Geologic evidence suggests that slip on one of the more significant local faults, the Windy Wash fault, results from earthquakes that produce ten centimeters or more displacement per event at recurrence intervals of several tens of thousands of years (Whitney et al., 1986, Reference 10). Although an earthquake of magnitude 5 or smaller might occur on a local fault during the operating life of the ESF, such events are not known to significantly damage well-engineered structures. In addition, experience with underground facilities indicates that earthquakes of magnitude less than about 6.0 are not expected to cause significant damage to underground facilities (Pratt, et al., 1978, Reference 8).

The north-trending Bare Mountain fault, located about 16 km west of the exploratory shaft, appears to be the most likely source of potentially severe ground shaking during the lifetime of the ESF. This fault may have an average Quarternary slip rate of up to 0.15 mm/yr (Reference 12), which indicates that this fault is much more active than faults local to Yucca Mountain. Applying the relationship of (Slemmons, 1982, Reference 9) to a fault with a slip rate of 0.15 mm/yr indicates a minimum recurrence interval of about 6,000 yr for a magnitude 6 1/2 earthquake. Based on this and other considerations including the fact that site ground motions derived from this earthquake are roughly comparable with those from suitably conservative probabilistic hazard analyses (References 11, 13), a magnitude 6 1/2 earthquake on the Bare Mountain fault is used herein as the deterministic basis for establishing ground motion conditions to be considered in the design of the exploratory shaft facilities.

2.3 Control Values for Peak Ground Motions

Among the many parameters that influence earthquake ground motion, earthquake magnitude and source distance appear to be the most important. Many strong-motion recordings have been obtained within 20 km of several earthquakes in the magnitude range 6 to 7. Even though none of these earthquakes are perfect analogs for conditions at Yucca Mountain, the range of observational data is adequate for direct extrapolation.

Regression relationships between peak ground-motion parameters and earthquake magnitude, source distance, local site conditions (e.g., rock or soil), and other parameters have been developed by a number of workers (see the references found in Campbell, 1985, Reference 28). Two recent and representative sets of regression relations for peak horizontal acceleration and peak horizontal velocity are those in Joyner and Fumal (1985) and Campbell (1987), (References 4,6). Results obtained using these relationships are presented in Table 2.1. The results assume reverse and thrust mechanisms for conservatism and that the surface trace of the Bare Mountain fault is 16 km from the ESF location and that the fault is planar and dips eastward at an angle of 70° from the horizontal, the midrange of current estimates (Reference 12). More discussions on this conservative assumption may be found in page 9. For the Campbell (1987) relationships given in Reference 4, the closest distance to the zone of seismic energy release, R, was conservatively taken to be the closest distance to the fault plane, 15.0 km. For the Joyner and Fumal (1985) relationships given in Reference 6, the distance, d, to the surface projection of the rupture zone was estimated at 10.9 km by assuming a maximum rupture depth of 15 km; a shallower rupture depth would increase the distance and reduce the estimated motions.

Based on the results in Table 2.1 and other considerations such as probabilistic hazards, the Working Group recommends that 0.3 g and 30 cm/s be used as control values for peak horizontal acceleration (larger of two randomly oriented horizontal components) and velocity, respectively. The use of the larger of two randomly oriented horizontal components is more conservative than the use of the average of the two components by about 13 percent (Reference 4). Standard practice for defining the design vibratory ground motion for nuclear power plants is to use both of the horizontal components.

Standard engineering practice is to set vertical ground-motion values at two-thirds those of the horizontal values. This approach would probably be adequate for peak accelerations from a magnitude 6 1/2 earthquake at a distance of about 15 km. However, a number of recently obtained close-in recordings of strong motion from large earthquakes have evidenced vertical peak accelerations equal to or even exceeding the peak horizontal accelerations (Shakal, et al., 1986, Huang, et al., 1987-Reference 19, 20). In light of the marginal probability of large vertical accelerations from an earthquake on the Bare Mountain fault and the marginal probability of an earthquake on one of the closer faults (which could be expected to generate vertical accelerations on the order of the horizontal accelerations), the

Working Group deems it prudent to assume equal peak values for horizontal and vertical acceleration, namely 0.3 g.

Empirical observations indicate that ground velocities do not exhibit such near-field increases in the relative amplitude of the vertical components due in part to the relatively lower frequency content associated with ground velocity as compared with ground accelerations. Consequently, the standard practice of setting the vertical component at 2/3 the value of the horizontal component is used to establish a control value of 20 cm/s for the vertical component of ground velocity.

Whereas earthquake ground shaking results from a myriad of seismic waves, the peak motions are expected to be dominated by waves that follow the most direct and efficient route from the earthquake source. As discussed in Appendix A-1, the largest amplitude waves are expected to emerge at a steep angle, within 30° of vertical, at the ES location. These body waves include longitudinal P waves and two types of transverse S waves: horizontally polarized SH waves and orthogonally polarized SV waves with a vertical component of motion. Because the ratio of P-wave to S-wave velocities in the earth's crust is nearly constant (ranging from about 1.6 to 1.7), the three types of body waves (P, SH and SV) are expected to emerge at about the same angle. Futhermore, because of the characteristics of earthquakes waves, the vertical component of peak motion can be associated with P waves or SV waves, and the horizontal components can be associated with SH and SV waves. It should be noted however, that the amplitude of steeply emerging SV waves is constrained by the peak horizontal motions and is therefore limited in its contribution to the vertical motion.

2.4 Checks on Design Basis Motions

Two reconnaissance probabilistic seismic hazard analyses for Yucca Mountain support the adequacy of 0.3 g as a control value for peak horizontal acceleration. Probabilistic seismic hazard analysis integrates the contribution of all known faults and seismic source zones to the probability of exceeding a particular ground motion level and, thus, is a useful means of confirming the adequacy of deterministically derived estimates. A reconnaissance assessment of probabilistic earthquake accelerations at Yucca Mountain by Perkins, et al. (1987) in Reference 12 indicates that a peak horizontal acceleration of 0.3 g has a return period of about 1,500 to 3,000 yrs. A sensitivity study by URS/Blume (1987) in Reference 11 suggests a return period on the order of 1,000 yr for 0.3 g. Both analyses are subject to very large uncertainties but tend to confirm that 0.3 g is a conservative estimate of the peak horizontal ground acceleration that is reasonably likely to occur during the operating lifetime of the ESF.

2.5 Factors That May Influence Ground Motion

In addition to earthquake magnitude and distance, the factors that most influence ground motion include: source type (normal, reverse or strike-slip), rupture dynamics (directivity and variability of stress release on the fault surface), transmission-path effects (wave scattering, attenuation, multi-pathing and dispersion), and site geology (topography and vertical and lateral variations in soil/rock densities seismic velocities and Q values). Considerations of each class of influences are discussed next.

The Bare Mountain fault is a Basin and Range, range-front fault (Carr, 1984, Reference 5), with a normal or oblique-normal sense of slip. McGarr (1984) (Reference 7) has suggested that normal faulting occurs at lower stresses than strike-slip or thrust faulting and that normal-fault events are less energetic at high frequencies than earthquakes with strike-slip or thrust mechanisms. Since the large majority of data that constrain the empirical relationships used in Table 2.1 are from strike-slip and thrust earthquakes, the use of these relationships would result in the direction of added conservatism in the predicted design-basis motions. The Campbell (1987) (Reference 4) peak ground motion regressions used in Table 2-1 take into account fault type (strike-slip or reverse and thrust). In order to provide margin for possible re-evaluation of the tectonic environment by on-going geologic and geophysical studies, the WG has used Campbell's regressions for reverse and thrust earthquake mechanisms. Joyner and

Fumal's regressions do not provide for a distinction in ground motion due to source mechanism.

Effects of rupture dynamics are most influential at distances closer than those being considered here. Close-in strong-motion records sometimes evidence (J. P. Singh, Reference 31) anomalous or at least identifiable motions that can be attributed to irregularities in the rupture process or to focusing (or defocusing) that results from the approaching (or receding) rupture front. J. P. Singh (Reference 31) has written about this and his general conclusions seem to be that the near-field behavior produces great variability in individual parameters, no one of which is sufficient to account for the variability in near-field damage, nor is it possible to estimate near-field spectra by using these parameters to set the levels of spectral shapes based on local site conditions. Individual near-field spectra have to be estimated in a site-specific, rupture specific way. Major effects in the near field are due to "enhancement of the long duration pulse called the 'fling,' which is related to the elastic rebound on the fault, and . . . compression of the duration of the strong shaking in the direction of rupture propagation." The long duration pulse is probably most important for damage to longer period structures. As for the effect of direction of rupture propagation, Singh does not discuss whether the near-field ground motion parameters have greater means or medians than predicted by current attenuation functions if the rupture propagation direction is not known, even though higher ground motions for an approaching rupture and lower ground motions for a receding rupture should be expected. As for the expected effects at the ES site, since large normal-faulting earthquakes typically initiate at depth and propagate upward (Smith and Richins, 1984, Reference 21) away from the site in this case, any bias due to rupture dynamics is expected to reduce ground motions at the site.

Data are not yet available to evaluate the possibility of local biases in the regional seismic-wave transmission characteristics. There are some indications that waves may transmit more efficiently in the southern Great Basin than in California, where most of the relevant strong motion data have been recorded (Rogers, 1987, Reference 22). However, the effects of regional differences in attenuation scale with distance and are probably not significant at source-receiver distances around 15 km. Also, the soil conditions that are generally associated with increased earthquake motions are not present at the rock site.

Perhaps the biggest single source of dispersion in the observations of earthquake motions results from the effects of the local geology. Based on Campbell's (1981) estimates in Reference 23 for dispersion from all sources, a site that amplifies motions more than 84 percent of all sites of the same classification (i.e., a mean-plus-one-standard-deviation site) could result in peak motions about one and one half times as large as the hypothetical average site. Conversely, a site that amplifies motions less than 84 percent of the sites (i.e., a mean-minus-one-standard-deviation site) could attenuate motions by a factor of about two-thirds.

Additional considerations are identified below to accommodate possible uncertainties in the determination of ESF design motions.

2.6 Further Recommendations

Until determinations of local site factors are available, added conservatism is warranted to compensate for this source of uncertainty. Specifically, the Working Group recommends that no credit be taken for attenuation of ground motion with depth below the ground surface nor for the reduction in seismic strains due to the stress-free boundary condition at the ground surface. Available surface and downhole recordings of motions in the area of Yucca Mountain from underground nuclear explosions have been compiled in Appendix A-4 and indicate a reduction in ground motions with depth.

Finally, to provide further assurance that the design has adequate conservatism or margin to accommodate any uncertainties such as site effects, the Working Group recommends that the performance of the exploratory shaft facility be evaluated using best estimate conditions when subjected to ground motions that are a factor of 1.67 larger than the design-basis motions, i.e., for a peak horizontal acceleration of 0.5 g and a peak horizontal velocity of 50 cm/sec. This evaluation for the larger motions should provide assurance that major damage of the ES is not expected at these 'g' levels.

Table 2-1

Predicted Peak Ground Motion Values at the ES Site for an Earthquake on the Bare Mountain Fault and Recommended Peak Ground Motion Values for Consideration in ES Design

	Peak Horizontal Acceleration(1)			Peak Horizontal Velocity(1)		
M	J&F-85(3)	C-87(2)	ESF Design Basis	J&F-85(3)	C-87(2)	ESF Design Basis
6.0	0.21g	0.19g		11.9 cm/s	10.8 cm/s	
6.5	0.27	0.26	0.30g	20.9	16.8	30.0 cm/s
6.75	0.31	0.30		27.8	20.7	

(1) Predicted median (most probable) peak ground motion values (larger of two randomly oriented components) at the ES site from an earthquake on the Bare Mountain Fault.

(2) Campbell (1987) "unconstrained" model; acceleration values have been increased by 13 percent and velocity values by 17 percent to convert from mean of two components to larger of two components. The closest distance to zone of seismogenic rupture, R, is taken as the closest distance to the fault plane, 15.0 km, assuming a 70° eastward dip. For conservatism, higher values corresponding to the assumption of a reverse or thrust mechanism are calculated.

(3) Joyner and Fumal (1985); distance to surface projection of fault rupture, d = 10.9 km, assuming a 70° eastward dip and 15 km maximum rupture depth. Joyner and Fumal do not attempt to obtain distinct regressions for different source mechanisms.

3.0 CONTROL MOTIONS FROM UNDERGROUND NUCLEAR EXPLOSIONS

The control motions from the design basis underground nuclear explosion (UNE) are specified in this section. In addition, background on the design basis UNE and the various assumptions made in the specification of ground motions are also included. Backup material and additional references are provided in Appendices A-2 and A-4.

The nuclear waste repository to be located in the Yucca Mountain is adjacent to the Nevada Test Site (NTS). The repository must not limit the ability of the United States government to test nuclear weapons. The definition of the design basis UNE must reflect this position. Therefore, the event chosen has to produce the maximum ground motions at Yucca Mountain for the maximum credible yield for any given area (regardless of current or future treaties). Figure 3-1 shows the current and proposed testing areas at NTS and their relationship to the Yucca Mountain Area. Vortman (Reference 14) used the results of a 1977 USGS real estate availability study of several areas of NTS and the upper yield limits established for these areas by the Ground Motion and Seismic Evaluation Subcommittee to define the design basis UNE for the repository site. The yield limits were based on offsite damage criteria with special emphasis on damage in Las Vegas. Given the areas selected and the yield limits established, the design basis UNE was chosen as a 700 kt event at a distance of 22.8 km. This event is the largest yield at the closest practical point (from a UNE fielding point of view) in the Buckboard Mesa Area of NTS. This event results in the worst-case situation for ground motions at Yucca Mountain.

The prediction of peak ground motions for this UNE is done with empirical equations developed for the NTS. The major assumptions made in the development of these equations are: (i) source geology is considered to be the same, and (ii) differences in the travel paths are ignored. These equations are based on measured ground motion from many UNEs conducted in the Pahute Mesa Area of NTS. The recording stations used were from several areas of NTS including a few at Yucca Mountain. Equations fitting this data were developed using standard linear regression analysis. An evaluation of the ground motion data recorded at Yucca Mountain indicated that observed ground motions at Yucca Mountain were larger than predicted using the prediction equations; however, the underestimation of the ground motions was within the expected accuracy of the prediction equations (i.e., within the expected accuracy of the mean of all observations at the site). Future work to be completed as part of site characterization will investigate if ground motions in the Yucca Mountain region are larger than other regions in the Nevada Test Site. This work will include an accurate confirmation of accelerograph recording site conditions and an assessment of the representativeness of UNE attenuation equations. In order to provide a conservative estimate of UNE design basis motions, the design basis UNE ground motion parameters specified are given for a nonexceedance probability level of 95 percent (this corresponds to 1.65 times the standard deviation for a normal or lognormal distribution which increases the most probable values by a factor ranging from 2 to 4). The mean values of the predicted ground motions and the recommended design basis values are summarized in Table 3-1. Further discussions of the prediction equations and the various references are given in Appendix A-2.

Assumptions made and conditions used in the development of the design basis UNE are listed below.

- Potential site effects at Yucca Mountain are not included in the specification of the UNE design basis motions because they are not quantified at this time.

- No attenuation of ground motion with depth will be used in the specification of design motions. This assumption is conservative. UNE ground motions are known to attenuate with depth at Yucca Mountain (see Appendix A-4). This assumption along with the use of design basis motions based on the 95 percent nonexceedance probability, makes the recommended values conservative and should compensate for the potential site effects.

- The angle of incidence for ground motions from the UNE to the ES is taken as ranging between 0° (vertical propogation) and 90° (horizontal propagation).

- For nearly horizontal propagation (60° to 90°) peak radial response is primarily from P waves, peak vertical response is primarily from the S_v waves, and peak transverse response is primarily from the S_h waves.

The incidence angle of the ground motions from UNEs are a function of material wave speed through which the waves are travelling. At first, it may appear that each ground motion component (i.e., P, S_v, S_h, and surface waves) could have its own incidence angle. In practice, however, the incidence angles (θ) for all the components are essentially the same. This stems from the way in which the incidence angle is calculated. This calculation uses the change in the arrival times (Δt) of a component of a ground motion from two nearby stations, the distance (Δx) between the two stations and the material wave speed (v): i.e., $\theta = \sin^{-1} (\Delta tV/\Delta x)$ (Reference 15). For the same two stations (i.e., Δx is constant), the wave speed and Δt will change for each ground motion component. These changes will be in opposite directions (as wave speed decreases, Δt will increase). These differences will have a tendency to offset one another, such that the incidence angle calculated will be about the same for all components.

This incidence angle can vary from zero to 90 degrees. A preliminary survey of the UNE ground motion data recorded at Yucca Mountain from Pahute Mesa events indicates that the range of the incidence angle is generally between 10 to 50 degrees. However, because the incidence angle is also a function of distance from the source and because the Yucca Mountain recordings are at distances which are a factor of two more distant from the source than the design-basis UNE, there is a reasonably large amount of uncertainty in the definition of this angle for ES design. To provide adequate conservatism, incidence angles recommended for use in this report are between zero and 90 degrees.

The equations used for the prediction of UNE motions were determined from the absolute peak values recorded on the waveform. No effort was made to determine a fit for each component (P, S_V, S_h, and surface waves). In general, peak accelerations observed in UNE recordings are associated with the P-wave. Peak vertical and transverse velocity may be the result of P-waves or shear waves. All displacements are due to the surface wave components. The design parameter of interest to the ES is the peak particle velocity. It is assumed that the velocity corresponding to the P-waves is the same as the radial component of velocity and the velocities corresponding to the S_V and S_h waves are the same as the vertical and transverse components of velocities, respectively.

Table 3-1

Recommended Motions for the Design Basis UNE

Component	Median Predicted Value	Design Basis UNE Values (95 percent nonexceedance level or 1.65σ)
Vert. Accel. (g)	0.05	0.2
Rad. Accel. (g)	0.03	0.1
Trans. Accel. (g)	0.03	0.1
Vert. Vel. (cm/s)	4	9
Rad. Vel. (cm/s)	4	12
Trans Vel. (cm/s)	3	12
Vert. Disp. (cm)	1	2
Rad. Disp. (cm)	1	3
Trans. Disp. (cm)	1	4

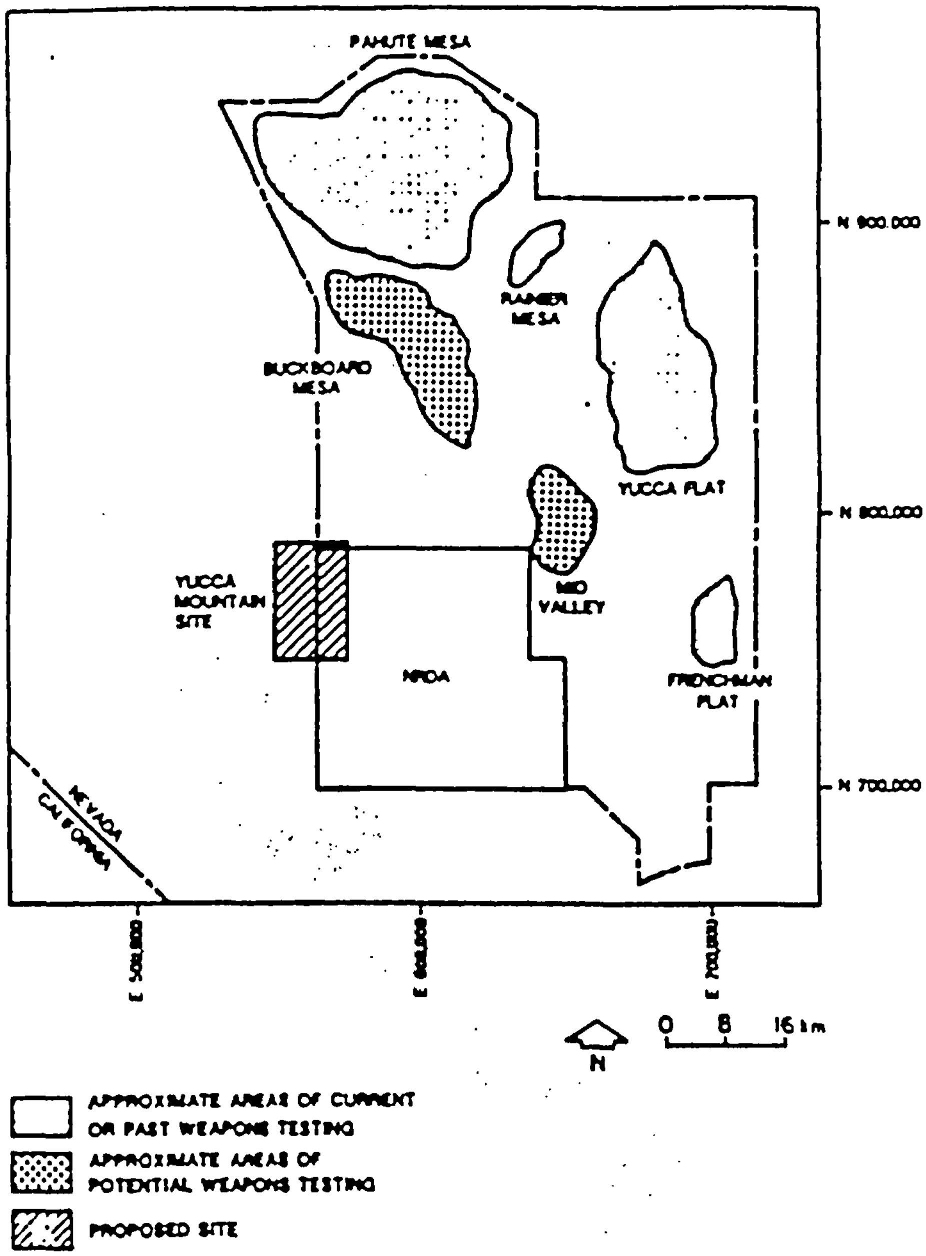

Figure 3-1. Locations of Current and Proposed Testing Areas at NTS and the Yucca Mountain Site

4.0 COMBINATION OF INDIVIDUAL COMPONENT WAVE EFFECTS

Newmark and Hall (Reference 16) have suggested that peak effects from the three orthogonal components of earthquake input motion be considered to be randomly phased relative to each other and thus be combined probabilistically. They then go on to suggest that a conservative and simpler approach to this probabilistic combination can be obtained by absolute vector addition of 100 percent of the largest peak effect from any of the three orthogonal components plus 40 percent of the peak effects from each of the other two components. This approach has come to be known as the 100-40-40 Combination Rule.

This same 100-40-40 Combination Rule can be used for the combination of peak effects from the individual P, S_V, and S_H component waves, so long as these peak component effects can be conservatively or realistically treated as randomly phased relative to each other. Such an assumption is reasonable and slightly conservative for both earthquake and UNE control motions. This point is illustrated by the following examples.

The earthquake control motion peak particle velocities for the three orthogonal components are 30 cm/sec, 30 cm/sec, and 20 cm/sec. Using the 100-40-40 Combination Rule, the absolute addition of these three orthogonal components is given by:

$$V_c = \sqrt{\left(V_1\right)^2 + (0.4)^2 \left[\left(V_2\right)^2 + \left(V_3\right)^2\right]} \qquad (4\text{-}1)$$

where V_c is the combined vector sum, V_1 is the largest orthogonal component effect, and V_2 and V_3 are the other two orthogonal component effects. Using Equation (4-1) together with the three orthogonal component peak particle velocities leads to a vector sum peak particle velocity of 33.3 cm/sec which is 11 percent greater than the largest individual component peak particle velocity. Similarly, peak particle accelerations for the three orthogonal components of the earthquake control motion are each 0.3 g. Using Equation (4-1), the vector sum peak particle acceleration is 0.345 g or 15 percent greater than the largest individual component peak value. A review of actual earthquake records indicates that the peak vector velocities and accelerations tend to be only 4 percent to 12 percent greater than the largest orthogonal component velocities and accelerations (Reference 29), so that the recommended probabilistic combination of the control motions tends to be on the conservative side for earthquakes.

Actually, this conservatism is increased somewhat by the way peak horizontal and vertical control motions are converted into peak P and S_V wave particle motions for inclined waves. For waves that are inclined 30° from the vertical, the P, S_V, and S_H peak particle velocities for the earthquake control motions become 23.1 cm/sec, 34.6 cm/sec, and 30 cm/sec, respectively, which leads to a vector sum peak particle velocity for Equation 4-1 of 37.8 cm/sec or 26 percent greater than the peak control motion particle velocity of 30 cm/sec. Similarly, for the 30° inclined wave case, the vector sum peak particle acceleration becomes 0.392 g which is 31 percent greater than the peak control motion particle acceleration of 0.30 g. Thus, the combined effect of converting control motions to P, S_V and S_H components and then combining these peak component effects by the 100-40-40 rule introduces significant conservatism for 30° inclined waves.

Conservatism also exists when the effects of the three defined orthogonal components of the UNE control motions are combined by the 100-40-40 Combination Rule. For example, the three orthogonal peak particle velocities defined in Table A2-1 of Appendix A-2 are 9 cm/sec, 12 cm/sec, and 12 cm/sec; when combined by Equation 4-1, these values lead to a combined vector sum peak particle velocity of 13.4 cm/sec, which significantly exceeds the peak vector velocity of 10 cm/sec listed in Table A2-1. Similarly, using the three orthogonal peak particle accelerations of 0.2 g, 0.1 g and 0.1 g results in a vector sum peak particle acceleration of 0.21 g using Equation (4-1) versus the vector sum of 0.2 g shown in Table A2-1.

5.0 DEVELOPMENT OF STRAIN TENSORS

5.1 Strain Tensors for Earthquakes

It is concluded in Appendix A-1 that body waves due to earthquakes impinge on the shaft with steep angles of incidence, namely, steeper (less than) than 30°. Further, as discussed in Section 2.3, it can be assumed that the three wave types--P, SV, and SH emerge along the same ray path, that is, with the same angle of incidence and along the same azimuth.

The coordinate system consists of the z axis oriented downward along the axis of the shaft and the x-y plane corresponding to the ground surface. Without loss of generalization, the wave front of each incident wave is normal to the x-z plane, as illustrated in Figure 5-1, so that particle motion is either in the x-z plane (for P- and SV-waves) or normal to the x-z plane (for SH-waves). The following notation is used in the subsequent expressions for strain:

- θ - Angle of incidence for P-, SV-, and SH-waves
- C_p - Propagation velocity of the P-wave
- C_s - Propagation velocity of the SV- and SH-waves
- v_p - Peak particle velocity of the P-wave
- v_{sv} - Peak particle velocity of the SV-wave
- v_{sh} - Peak particle velocity of the SH-wave
- a_p - Peak acceleration of the P-wave
- a_{sv} - Peak acceleration of the SV-wave
- a_{sh} - Peak acceleration of the SH-wave
- v_v - Peak particle velocity at the ground in the vertical direction
- v_h - Peak particle velocity at the ground in the horizontal direction
- a_v - Peak acceleration at the ground in the vertical direction
- a_h - Peak acceleration at the ground in the horizontal direction

The symmetric strain tensor, $\bar{\epsilon}$, consists of three axial strain components and three shear strain components defined as follows:

$$\bar{\epsilon} = \begin{bmatrix} \epsilon_{xx} & \epsilon_{xy} & \epsilon_{xz} \\ \epsilon_{xy} & \epsilon_{yy} & \epsilon_{yz} \\ \epsilon_{xz} & \epsilon_{yz} & \epsilon_{zz} \end{bmatrix} = \begin{bmatrix} \epsilon_{xx} & \frac{1}{2}\gamma_{xy} & \frac{1}{2}\gamma_{xz} \\ \frac{1}{2}\gamma_{xy} & \epsilon_{yy} & \frac{1}{2}\gamma_{yz} \\ \frac{1}{2}\gamma_{xz} & \frac{1}{2}\gamma_{yz} & \epsilon_{zz} \end{bmatrix}$$

where

$$\epsilon_{xx} = \frac{\partial u_x}{\partial x}$$

$$\epsilon_{yy} = \frac{\partial u_y}{\partial y}$$

$$\epsilon_{zz} = \frac{\partial u_z}{\partial z}$$

$$\epsilon_{xy} = \frac{1}{2}\left(\frac{\partial u_x}{\partial y} + \frac{\partial u_y}{\partial x}\right)$$

$$\epsilon_{xz} = \frac{1}{2}\left(\frac{\partial u_x}{\partial z} + \frac{\partial u_z}{\partial x}\right)$$

$$\epsilon_{yz} = \frac{1}{2}\left(\frac{\partial u_y}{\partial z} + \frac{\partial u_z}{\partial y}\right)$$

u_x, u_y, u_z, = particle displacement in x-, y-, z-direction, respectively

The "engineering shear strain," denoted by γ, is defined as two times the tensor shear strain, i.e., $\gamma_{xy} = 2\epsilon_{xy}$.

The extreme fiber bending strain, ϵ_b, induced in the liner by the passage of waves is defined by:

$$\epsilon_b = R \kappa$$

where R = Radius of the liner

κ = Curvature of the shaft axis

Along the ray paths, a P-wave generates axial strain given by

$$\epsilon = \frac{v_p}{C_p}$$

while a shear wave generates pure shear strain given by

$$\gamma = \frac{v_s}{C_s}$$

Transforming these strains to the xyz-coordinate system yields the expressions for free-field strains shown on Table 5-1.

Curvature along an axis is given by the acceleration normal to the axis divided by the square of the apparent wave speed along that axis. This relationship is used to derive the expressions for bending strain, also shown on Table 5-1.

For the case of earthquakes, the particle motions in the P-, SV- and SH-waves will be controlled by the ground motion control parameters in the z-, x-, and y-directions, respectively. Comparing the components shown in Figure 5-2a with those in Figure 5-2b, the particle velocities are given as follows:

$$v_p = v_v/\cos\theta$$

$$v_{sv} = v_h/\cos\theta$$

$$v_{sh} = v_h$$

The same relations hold for acceleration, where a is substituted for v. The substitution of these relations into the expressions on Table 5-1 yields the expressions on Table 5-2.

5.2 Strain Tensors for UNEs

It is not known at this time how much of the incident wave energy impinging on the shaft from a UNE will be associated with shallow incidence angles versus energy associated steeper angles. However, it is not necessary to know the distribution of the incident wave energy with incidence angle, because the strains due to earthquakes will be an upper bound on the strains due to UNEs, as demonstrated in Section 5-3 below.

The maximum strains generated by earthquake waves emerging with θ between 0° and 30° are compared to the maximum strains due to UNE waves emerging with θ between 0° and 90°. The strains due to steeply emerging waves (i.e., between θ = 0° and 30°), be they generated by earthquakes or UNEs, are computed from the expressions on Table 5-2. New expressions are derived for shallow emerging waves (i.e., between θ = 60° and 90°).

For UNE waves emerging at shallow angles (say, θ = 60° to 90°) P-, SV-, and SH-waves will be controlled by the ground motion control parameters in the x-, z-, and y-directions, respectively. Comparing Figures 6-1a and 6-2c, the particle velocities are given as follows (for shallow emerging waves):

$$v_p = v_h/\sin\theta$$

$v_{sv} = v_v/\sin \phi$

$v_{sh} = v_h$

The same relations hold for acceleration, where a is substituted for v. Substitution of these relations into the expressions on Table 5-1 yields the expressions on Table 5-3.

5.3 Controlling Strain Combinations Due to Earthquakes and UNEs

For the design basis parameters recommended in Sections 2.0 and 3.0 for earthquakes and UNEs, it can be shown (see Appendix A-3) that of all the various incidence angles (0° to 30° for earthquakes and 0° to 90° for UNEs) that need to be evaluated with three possible combinations of P, S_v and S_h waves for design, only one case controls all aspects of the shaft design:

- Earthquake control motion
- 30° incidence angle
- 100 percent S_v peak effects plus 40 percent P and S_h peak effects (using the probabilistic combination rule specified in Section 4.0).

Both hoop stress or strain and total axial strain are controlled by earthquake waves emerging at an angle of 30° from the vertical. For the specified design basis motions, UNEs will never control the design. Hence, it is recommended that the designer use only the above combination for design evaluation of the ES.

Table 5-1

Free Field and Bending Strains for Body Waves With Angle of Incidence θ

Wave Type	Free Field Strains						Bending Strains
	ϵ_{xx}	ϵ_{yy}	ϵ_{zz}	γ_{xy}	γ_{yz}	γ_{xz}	ϵ_b
P	$\frac{v_p}{C_p}\sin^2\theta$	0	$\frac{v_p}{C_p}\cos^2\theta$	0	0	$\frac{v_p}{C_p}\sin 2\theta$	$\frac{R\ a_p}{C_p^2}\sin\theta\cos^2\theta$ (in x-z plane)
SV	$\frac{v_{sv}}{C_s}\sin\theta\cos\theta$	0	$\frac{v_{sv}}{C_p}\sin\theta\cos\theta$	0	0	$\frac{v_{sv}}{C_s}\cos 2\theta$	$\frac{R\ a_{sv}}{C_s^2}\cos^3\theta$ (in x-z plane)
SH	0	0	0	$\frac{v_{sh}}{C_s}\sin\theta$	$\frac{v_{sh}}{C_s}\cos\theta$	0	$\frac{R\ a_{sh}}{C_s^2}\cos^2\theta$ (in y-z plane)

Table 5-2

Free Field and Bending Strains in Terms of Ground Motion Control Parameters for Earthquakes

Wave Type	Free Field Strains						Bending Strains
	ϵ_{xx}	ϵ_{yy}	ϵ_{zz}	γ_{xy}	γ_{yz}	γ_{xz}	ϵ_b
P	$\frac{V_v}{C_P} \frac{\sin^2 \theta}{\cos \theta}$	0	$\frac{V_v}{C_P} \cos \theta$	0	0	$\frac{V_v}{C_P} 2 \sin \theta$	$\frac{R\, a_v}{C_P^2} \sin \theta \cos \theta$ (in x-z plane)
SV	$\frac{V_h}{C_s} \sin \theta$	0	$\frac{V_h}{C_s} \sin \theta$	0	0	$\frac{V_h}{C_s} \frac{\cos 2\theta}{\cos \theta}$	$\frac{R\, a_h}{C_s^2} \cos^2 \theta$ (in x-z plane)
SH	0	0	0	$\frac{V_h}{C_s} \sin \theta$	$\frac{V_h}{C_s} \cos \theta$	0	$\frac{R\, a_h}{C_s^2} \cos^2 \theta$ (in y-z plane)

Note: These expressions are valid only for steeply emerging body waves, i.e., θ = 30° or less.

Table 5-3

Free Field and Bending Strains in Terms of Ground Motion Control Parameters for Body Waves With Shallow Angles of Incidence

Wave Type	Free Field Strains						Bending Strains
	ϵ_{xx}	ϵ_{yy}	ϵ_{zz}	γ_{xy}	γ_{yz}	γ_{xz}	ϵ_b
P	$\frac{v_h}{C_P} \sin \theta$	0	$\frac{v_h}{C_P} \frac{\cos^2 \theta}{\sin \theta}$	0	0	$\frac{v_h}{C_P} 2 \cos \theta$	$\frac{R\, a_h}{C_P^2} \cos \theta^2 \cos \theta$ (in x-z plane)
SV	$\frac{v_v}{C_s} \cos \theta$	0	$\frac{v_v}{C_s} \cos \theta$	0	0	$\frac{v_v}{C_s} \frac{\cos 2\theta}{\sin \theta}$	$\frac{R\, a_v}{C_s^2} \frac{\cos^3 \theta}{\sin \theta}$ (in x-z plane)
SH	0	0	0	$\frac{v_h}{C_s} \sin \theta$	$\frac{v_h}{C_s} \cos \theta$	0	$\frac{R\, a_h}{C_s^2} \cos^2 \theta$ (in y-z plane)

Note: These expressions are valid only for $\theta = 60°$ or $\theta = 90°$.

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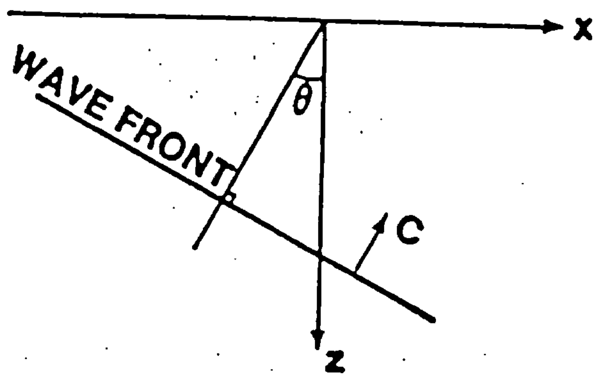

Figure 5-1. Orientation of Incident Waves with Respect to the Coordinate System

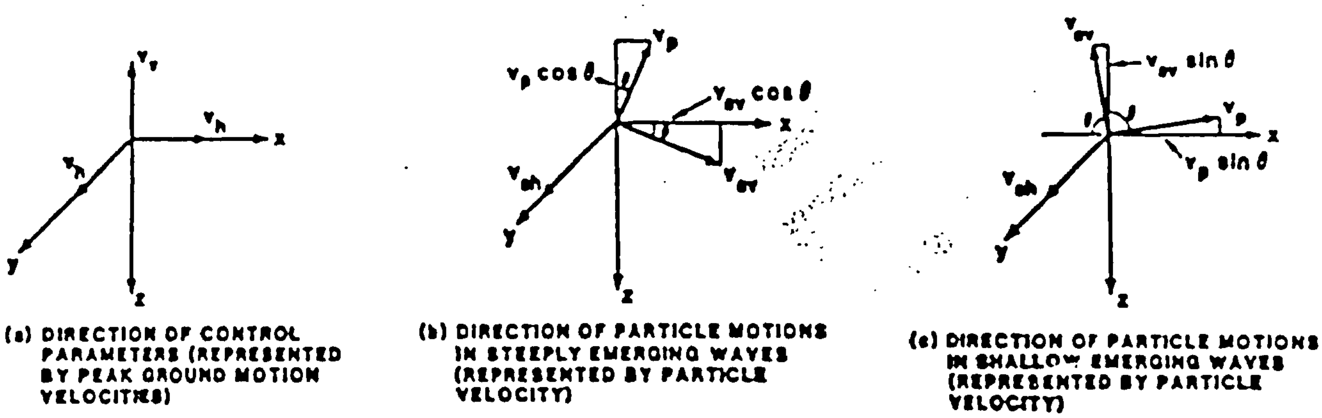

Figure 5-2. Relationship Between Peak Ground Motion Control Parameters and Particle Motions Due to Each Wave Type

6.0 DYNAMIC ROCK PROPERTIES

This section describes the procedure used to determine dynamic rock properties for use in analyses of underground openings at the ESF when subjected to transient free field strains caused by either earthquakes or underground nuclear explosions. The properties important to such analyses are as follows:

Velocity of compression waves, C_p
Velocity of shear waves, C_s
Dynamic deformation modulus, E_d
Dynamic Poisson's ratio, ν_d

These properties should be determined for each rock unit in which underground openings are located. Analyses of the openings for transient free field strains, based on the relative ground support to rock mass stiffness, must utilize the corresponding dynamic material properties. Static loadings may be analyzed independently, using static material properties, and the result superimposed over the results of the dynamic analyses.

Figure 6-1 illustrates the stratigraphy of the borehole nearest the ESF site (USW G-4), and includes plots of the measured in situ P-wave velocities, as presented in Reference 17, and of the measured laboratory P-wave velocities, as presented in Reference 18. The plot of in situ values also shows a smooth curve which represents the average of the measured values over each identified rock unit. The remaining plots on this figure represent the recommended P-wave and S-wave velocities as determined by the evaluation described herein.

The most recent Reference Information Base (RIB) for the NNWSI project (Reference 27) recommends the following rock mass bulk densities, rock mass Poisson's ratios, and intact Poisson's ratios.

Rock Unit	Bulk Density (g/cm^3)	Rock Mass Poisson's Ratio	Intact Rock Poisson's Ratio
TCw	2.31	0.10	0.24
PTn	1.58	0.19	0.16
TSw1[b]	1.84[c]	0.16	0.16
TSw1[a]	2.25	0.22	0.25
TSw2	2.32	0.22	0.24
TSw3	2.32	0.22[c]	0.24[c]
CHnlv	1.82	0.15	0.15
CHnlz	1.92	0.16	0.16

a. Lithophysal rich, devitrified.
b. Lithophysal rich, vapor phase.
c. Value shown is assumed, RIB indicates that value is not available.

The S-wave velocity (C_s) and the dynamic deformation modulus (E_d) can be determined from the bulk density (D), dynamic Poisson's ratio (v_d), and P-wave velocity (C_p) by the following elastic relationships:

$$C_s = C_p((1 - 2v_d)/(2 - 2v_d))^{0.5}$$
$$E_d = DC_p^2(1 + v_d)(1 - 2v_d)/(1 - v_d)$$

Based on the current, relatively limited, data on the rock properties, it is recommended that the rock mass Poisson's ratio, as given in the RIB, be used as the dynamic Poisson's ratio, and that the bulk density at in-situ saturation, as given in the RIB, be used.

The recommended P-wave velocities were determined as follows:

TCw: The in situ measurements differ significantly from the laboratory values. It is not possible to resolve this conflict with the data presently available. Therefore, the only recommendation provided for this unit is that the P-wave velocity of the underlying PTn unit represents a reasonable lower bound to the P-wave velocity of the TCw unit (i.e., PTn values are conservative for TCw unit).

PTn: The average of the in situ measurements over this unit is approximately 85 percent of the single laboratory measurement. This is considered to be a very reasonable correlation and the recommended P-wave velocity is specified as the average of the in situ measurements and equal to 1680 m/s.

TSw1[b], TSw1[a] and TSw2:

The average of the in situ measurements over each of these units varies between 75 and 90 percent of the corresponding laboratory measurements. As with the PT unit, the relative magnitude of the average in situ measurements as compared to the laboratory measurements is reasonable. Both sets of measurements indicate a slight increase in P-wave velocity with depth. Therefore, the recommended P-wave velocity is specified as a linear variation between the average in situ measurement for the TSw1[b] unit (2860 m/s) at the top of the TSw1 unit to the average in situ measurement for the TSw2 unit (3400 m/s) at the bottom of the TSw2 unit. This linear variation is further extended through the unnamed transition layer between the TSw2 and TSw3 units.

TSw3: There are no laboratory P-wave velocity measurements in the TSw3 material to use as confirmation of the in situ measurements. In addition, the thickness of the unit is less than the interval tested in situ, so the in situ measurement may be biased. Since the measured in situ value of P-wave velocity is the fastest recorded in the rock units of interest, it seems reasonable to assume that the actual unit velocity is greater than the recorded value. Therefore, the average in situ P-wave velocity measurement (5100 m/s) for the TSw3 unit is recommended as a conservative value.

CHnlv: The in situ measurement for this unit differs significantly from the single laboratory value. The in situ measurements of P-wave velocity for this thin unit appear to be biased by the underlying Chnlz unit. In lieu of better data, a value equal to the laboratory measurement (3850 m/s) is recommended.

CHnlz: The average in situ measurement for this unit is greater than the laboratory measurements. It seems reasonable that this nonwelded material is very sensitive to disturbance and/or confining pressure. Therefore, the average of in situ P-wave velocity (3010 m/s) is recommended.

Applying the aforementioned equations for S-wave velocity and dynamic deformation modulus to the recommended P-wave velocities, and summarizing the dynamic properties at the base of each unit yields the results given in Table 6-1.

As indicated earlier, these recommended properties are based on the currently available, but limited, site data, which have significant uncertainties. Hence, the WG recommends that additional data be obtained from the site at the earliest opportunity to supplement and confirm the available data and recommended properties.

Table 6.1

Recommended Rock Properties for the Different Rock Layers

Rock Unit	Dynamic Poisson's Ratio	P-wave Velocity (m/s)	S-wave Velocity (m/s)	Dynamic Deformation Modulus GPa
TCw	0.10	--	--	--
PTn	0.19	1680	1040	4.1
TSw1[b]	0.16	2940	1870	14.9
TSw1[a]	0.22	3078	1840	18.6
TSw2	0.22	3400	2040	23.5
TSw3	0.22	5100	3060	53.0
CHn1v	0.15	3850	2470	25.5
CHn1z	0.16	3010	1910	16.3

Table 4.1

Recommended Rock Properties for the Different Rock Layers

Rock Unit	Dynamic Poisson's Ratio	P-wave Velocity (m/s)	S-wave Velocity (m/s)	Dynamic Deformation Modulus GPa
TCw	0.10	--	--	--
PTn	0.19	1680	1040	4.1
TSw1[b]	0.16	2940	1870	14.9
TSw1[a]	0.22	3078	1840	18.6
TSw2	0.22	3400	2040	23.5
TSw3	0.22	5100	3060	53.0
CHn1v	0.15	3850	2470	23.5
CHn1z	0.16	3010	1910	16.3

7.0 FAULTING CONSIDERATIONS

7.1 Objectives

Several faults have been identified in the area of Yucca Mountain with evidence of movement during the Quaternary period. Hence, the possibility of faulting at the ES location and vicinity must be considered. None of the known faults with evidence of Quaternary movement intersect the exploratory shaft facilities. The potential hazard of a fault that may have thus far gone undetected can be assessed and bounded within reasonable limits. This assessment requires consideration of what is currently known about the characteristics of faulting in the surrounding area, including uncertainties. Considerations of the potential impact of faulting on the ESF provides a basis for assessing the relevance of possible undetected faults.

As discussed in Section 1.0, the exploratory shafts will not at any time be used to transport any high level waste materials. During the repository operations, the ESF shafts will be converted to serve as ventilation supply shafts. Exhausting fans on the emplacement exhaust shaft will at all times maintain negative pressure in the emplacement area relative to the development area, which is ventilated with forced ventilation. Hence, there is no potential for exploratory shafts to become an exhaust shaft rather than an intake shaft. Based on these discussions, any fault displacement through the ESF does not appear to impact public safety. It does not also seem to be a serious threat to operations or worker safety unless the fault offsets are significant. Fault displacements in excess of about 5 cm could possibly pose a threat to workers' safety during ESF operations.

The faulting hazard does not merit special design, provided there is reasonable assurance that fault displacement in excess of 5 cm is not likely to occur during the preclosure period. Limiting the possibility to less than one chance in 10 during the preclosure period is judged to be adequate to provide such an assurance. However, because of uncertainties in our present understanding of how the ESF would perform if subjected to significant fault displacement and because of uncertainties in our present understanding of the local tectonic conditions, the measure for adequate assurance is made more stringent by an additional factor of 10. Accordingly, faulting hazards need not be considered in the design of the ESF (which has a 100 year maintainable design life) if the annual probability for exceeding 5 cm of displacement is no greater than 10^{-4}/year. The characteristics of a fault that might pose a hazard can then be expressed as one that has moved during the Quaternary or late Quaternary at an average rate greater than 5 cm per 10,000 years or 0.005 mm per year.

7.2 Faulting Potential

Evidence of Quaternary displacement has not been identified on any fault that intersects the ESF or the underground area of waste storage. Except for the Ghost Dance fault, recognized offsets of faults within the repository block do not exceed 5 m (Reference 12, pp. 1-127). The Ghost Dance fault, which intersects the repository block but not the ESF, displaces Tertiary tuff units by 38 m and has a mapped length of 6 km (Reference 12). While evidence for movement on this fault during the Quaternary period has not been identified, the possibility cannot be ruled out from available data. However, it appears unlikely that repeated movements during the late Quaternary could have gone undetected.

The Ghost Dance fault is an obvious geologic feature, yet its potential for movement appears to be insignificant as compared with the faulting characteristics identified above in Section 7.1 to be of primary concern to the ESF. While the more significant faults that bound Yucca Mountain to the east and west do not intersect the ESF, their rates of movement are closer to the threshold of concern for the ESF. The Paintbrush Canyon fault appears to have the highest average rate of displacement during the late Quaternary, about 0.006 mm per year (Reference 12, Table 1-8). The average rate of late Quaternary displacement for the Windy Wash fault is estimated to be about 0.0015 mm per year. Similar faults in the proximity of the ESF would have been easily detected as they displace Tertiary tuff units by 200 m or more (Reference 12, Table 1-8).

7.3 Design Basis Faulting

No faults with evidence of Quaternary movement have been found in the immediate area of the ESF or in the larger area of the repository block. More distant faults that bound Yucca Mountain along the east and west flanks have moved repeatedly during the Quaternary period. Significant movement on these faults appears unlikely during a typical 100-year time period, and sympathetic displacement in excess of a few centimeters through the shaft is an unlikely response to a local earthquake. The annual probability that faulting in excess of a few centimeters will occur in the ESF shafts is judged to be well below 10^{-4} per year. Therefore, faulting need not be considered in the design of the ESF.

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APPENDIX A-1: INCIDENCE ANGLE OF SEISMIC BODY WAVES

INTRODUCTION

Strong ground shaking is primarily the result of seismic body waves that propagate through the earth along ray paths. The ray paths curve or refract in response to gradual or abrupt changes in material velocity. As illustrated in Figure A1-1, the inherent velocity of materials in the earth generally increases with depth. This causes the ray paths for emerging seismic waves to steepen as they approach the earth's surface. The curvature of ray paths is explained by Snell's Law which requires a constant phase velocity in directions that are parallel to the interface of two different materials as waves pass from one material to the other. Snell's Law is used to examine the range of incidence angles to be expected at the ESF from local earthquakes.

EARTH PROPERTIES

The velocity structure in the Great Basin increases rather dramatically with depth (Figure A1-1). The average P and S wave velocities for the Tertiary tuff units at Yucca Mountain are about 3 km/s and 1.8 km/s, respectively (see Section 6.0). At a depth of about 3 km below mean sea level, the respective values have increased to about 6.15 km/s and 3.6 km/s (Rogers, et al., 1983-References A1-1).

This increase of a factor of two or more in the velocity of rock with depth is indicative of significant increases in the stiffness and strength properties of rock with depth. The capacity of rock to support large tectonic stresses also increases with depth, at least to a depth of several kilometers. Consequently, earthquake rupture of most importance to ground motion hazards originates at a depth of a few kilometers or more. Also, the relatively large stiffness and strength properties of rock at these depths are required to efficiently transmit the largest amplitude waves away from the immediate source area.

INCIDENCE ANGLE

A local earthquake of unspecified location is postulated for estimating the range of incidence angles that would be expected for the largest amplitude body waves. As illustrated in Figure A1-2, the analysis uses the following notation:

V_S - Velocity of rock at the source depth responsible for the largest amplitude waves.

V_{ESF} - Velocity of rock at the ESF (approximately = 1/2 V_s).

θ_S - Take off angle at the source, measured from vertical, for body waves enroute to the ESF.

θ_{ESF} - Incidence angle at the ESF, measured from vertical.

The largest variations in velocity occur with depth. For simplicity, the earth is assumed to be comprised of horizontal layers of homogeneous material, i.e., vertically stratified. Repetitious application of Snell's Law to ray paths passing from one layer to the next indicates that the horizontal phase velocity would be constant along the entire ray path (Richter, 1958, Reference A1-2). Equating the horizontal phase velocity for waves transmitted at the source with those emerging at the ESF location gives:

$$\frac{V_S}{\sin\theta_S} = \frac{V_{ESF}}{\sin\theta_{ESF}}$$

The incidence angle at the ESF is then obtained from:

$$\sin\theta_{ESF} = \frac{V_{ESF}}{V_S}\sin\theta_S$$

$$\leq 1/2$$

assuming $V_S = 2\ V_{ESF}$ for both P and S waves at the source depth responsible for the predominant earthquake waves was noticed previously.

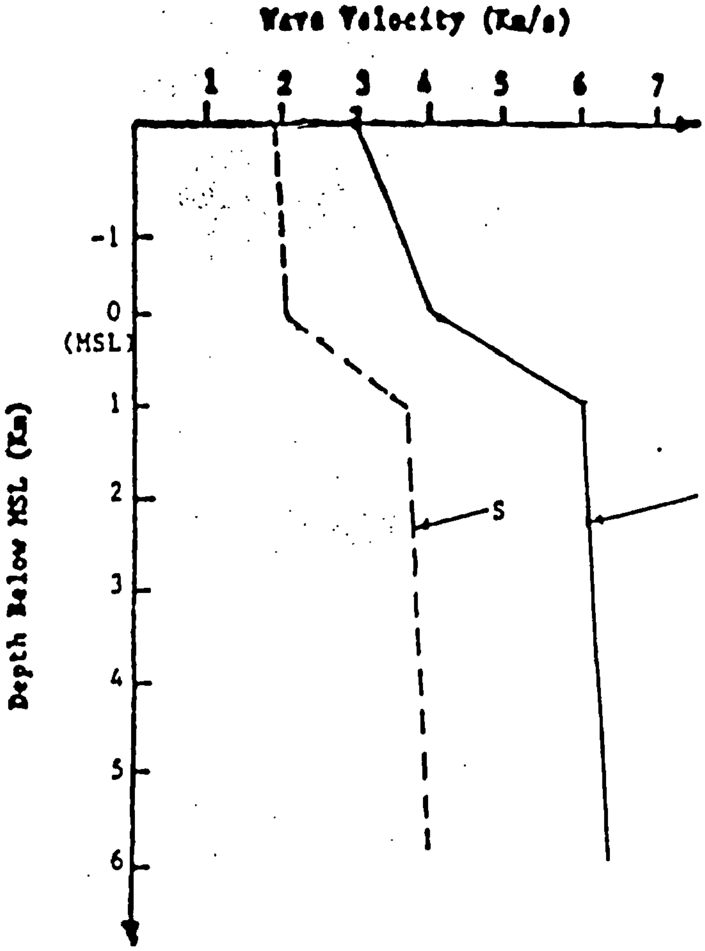

Figure A1-1: Approximate Velocity Structure for the Southern Great Basin, after Rogers et al. (1981).

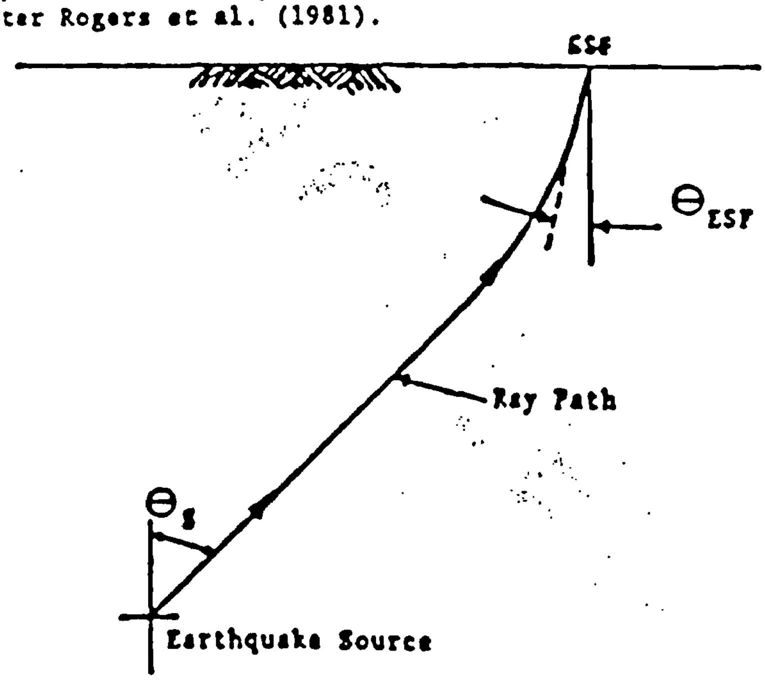

Figure A1-2: Depiction of the Ray Path for the Largest Amplitude Waves to Emerge at the ESF From a Potential Earthquake Source.

Thus, the largest amplitude body waves are expected to emerge at the ESF steeper than about 30° from vertical. Intervening heterogeneities and alternate wave paths are not expected to significantly alter this conclusion.

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APPENDIX A-2: DISCUSSION OF THE PREDICTION OF UNE GROUND MOTIONS

This appendix summarizes the background information concerning the prediction equations given in Table A2-1 and used for the prediction of UNE ground motions. This background information includes discussions on how the design basis UNE was selected, the data used in the development of the equations (including the rationale used in the analysis of the data and the recommended prediction equations) and a brief discussion on wave propagation from a UNE. Additional detail on the development of the prediction equations may be found in References A2-1 through A2-3.

Table A2-1: Prediction Equations for Stations on Rock(1)

Component	Equation	Mean Value	1.65 σ Value
Vert. Accel. (g)	$0.487\ W^{0.491}\ R^{-1.792}$	0.05	0.2
Rad. Accel. (g)	$0.239\ W^{0.382}\ R^{-1.425}$	0.03	0.1
Trans. Accel. (g)	$0.246\ W^{0.326}\ R^{-1.371}$	0.03	0.1
Vector Accel. (g)	$0.511\ W^{0.482}\ R^{-1.717}$	0.06	0.2
Vert. Vel. (cm/s)	$8.390\ W^{0.679}\ R^{-1.684}$	4	9
Rad. Vel. (cm/s)	$6.861\ W^{0.544}\ R^{-1.352}$	4	12
Trans. Vel. (cm/s)	$5.873\ W^{0.458}\ R^{-1.208}$	3	12
Vector Vel. (cm/s)	$12.04\ W^{0.628}\ R^{-1.593}$	5	10
Vert. Disp. (cm)	$1.319\ W^{0.737}\ R^{-1.699}$	1	2
Rad. Disp. (cm)	$1.024\ W^{0.719}\ R^{-1.486}$	1	3
Trans. Disp. (cm)	$0.598\ W^{0.603}\ R^{-1.165}$	1	4
Vector Disp. (cm)	$2.683\ W^{0.675}\ R^{-1.640}$	1	2

Note 1: The vector values at the 1.65 σ level for acceleration, velocity and displacement are less than the maximum individual component because (i) the standard deviation for the vector quantities are much smaller than that of the individual components, and (ii) of the round-off effects.

Selection of the Design Basis UNE

Locations of present and proposed testing areas were shown in Figure 3-1. Testing areas in present use are those at Pahute Mesa, Rainier Mesa and Yucca Flats. Possible future sites have been defined (Reference A2-4) as they are required in the event that existing sites are consumed. The two possible future sites of concern are the Buckboard area and Mid Valley.

The upper limits on yield for each of the testing areas have been defined (Reference A2-5) based on offsite damage with special emphasis on potential damage in Las Vegas. These limits are:

Pahute Mesa	1300 kt
Yucca Flats	300 kt
Frenchman's Flat	300 kt
Buckboard Area	750 kt
Mid Valley	*

(Note, the yield limit for Mid Valley was not specifically addressed because the geology will restrict yields to well below the other sites.)

Using the information given above, predictions were made for UNEs in the closest testing area (to the Yucca Mountain) with the highest yield limits (Pahute Mesa and Buckboard Area - Reference A2-6). The smallest possible distance between these particular testing areas and Yucca Mountain were scaled from a map at this distance and was used in the prediction equations. The design basis UNE was selected as the UNE which produced the largest ground motions at Yucca Mountain. This was a 700 kt event in the Buckboard area at 22.8 km away (note 700 kt was used instead of 750 kt because of the small differences in the predicted values and the already conservative approach of assuming the closest point for the largest yield). Although the yield limit for Pahute Mesa is greater, it is sufficiently far away that the ground motion at the repository site would be less than that from the nearest location in the Buckboard area.

Development of the UNE Prediction Equations

The major objectives for the analyses included in References A2-1 through A2-3 were: (1) to develop a regional prediction model for the Nevada Test Site alone; and (2) to identify and quantify the differences in ground motion behavior at Yucca Mountain when compared to NTS. To this end, data from a number of UNEs were analyzed.

The data set used to develop the prediction equations includes ground motions recorded from a total of 34 UNEs. These events were conducted between 1966 and 1984. The yield variation in the data set is from 80 kt to 1400 kt (9 UNEs had yields > 500 kt; 7 UNEs had yields between 150 and 500 kt; 18 UNEs had yields between 80 and 150 kt). Ground motion has been recorded at about 50 different locations. Of these 50 locations, ten have been located in the Yucca Mountain area. Ground motion from a total of eight of these events were recorded at Yucca Mountain stations. This data set was chosen based on the need for a reasonable variation in yield and distance (from the source) to obtain general prediction equations. The fact that there are a limited number of events recorded at Yucca Mountain included in the data set is due to the fact that these stations were first installed in only mid 1980. All events were conducted in the Pahute Mesa testing area of NTS (see Fig. 3-1). Station geologies may be placed in two broad categories - rock and alluvium.

The prediction equations that were developed in References A2-1 and A2-2 are empirical. The major assumptions made in the development of these equations are: (1) source geology is considered to be the same; (2) differences in travel path geology are ignored; and (3) station geology differences are accounted for by providing separate equations for rock and alluvium. In addition, the data are assumed to be lognormally distributed and linearly correlated in a log-log space (i.e., fit with a power curve). These assumptions and approach are not original. Past studies (Reference A2-7) have shown this to be a reasonable approach in describing the behavior of UNE ground motions. The equations are developed from multiple linear regressions in which yield and distance are considered to be the independent variables and the ground motion parameter (acceleration, velocity or displacement) is the dependent variable. The data were subdivided into three major groups (Reference A2-1). Group I included all data in the data set. Data from known anomalous stations (e.g., NRDS area, Rainier Mesa, Climax Stock, etc.)(Reference A2-8) were excluded to form Group II. The Group III data set was Group II minus the data from the Yucca Mountain stations available at the time of the analyses. In addition to these three major groups, three subdivisions of these groups were made based on the station geology. These subdivisions were: (i) all stations regardless of geology; (ii) only stations on rock; and (iii) only stations on alluvium.

The recommendations from References A2-1 and A2-2 were to use the Group III equations for the appropriate station geology as the prediction equations at NTS. These recommendations were based on the fact that inclusion of the anomalous stations would bias the predictions in an unfavorable fashion for a procedure that is meant to predict general NTS ground motions. Inclusion of the Yucca Mountains stations would bias the predictions to lower yields and greater distances (most UNEs are between 40 and 50 km away from Yucca Mountain).

The recommended prediction equations from References A2-1 and A2-2 were evaluated in Reference A2-3. This study used all data recorded at Yucca Mountain stations between mid-1980 and the end of FY 1986. These events were "predicted" with the recommended equations and these predicted values were compared to the measured values at Yucca Mountain. Ratios of measured/predicted ground motions were calculated for each event at each Yucca Mountain station and average ratios for each station were determined. In the analysis of these average station ratios, it was observed that the predicted values were generally less than those measured. The average ratios calculated for each station were always less than the 1σ value of the prediction equation. The individual ratios calculated for each event at a particular station seldom exceeded the 2σ values calculated from the equations (1σ corresponds to the 68% confidence interval for the mean of all the observations at the site or the 84% nonexceedance probability level while 2σ corresponds to the 95% confidence interval or the 98% nonexceedance probability level). The conclusion of this analysis was that the prediction equations from References A2-1 and A2-2 provided reasonably accurate results given the statistics of the fits. To attempt to correct for possible site effects with this data set, would imply a level of accuracy that does not exist in the data.

As discussed in Section 3.0 of the main body of this report, the predicted ground motions provided for the design of the exploratory shaft were specified at the 95% nonexceedance probability level. This corresponds to 1.65σ. These values are also listed in Table A2-1 with the equations.

Wave Propagation from UNEs

The UNE produces a radially expanding compressional shock front at the point of the explosion. As the distance increases from the source, this compressional front is converted to a complex wave train of various seismic signals. These signals are the result of tectonic release, rarefactions from layering in the earth, free surface effects at the ground surface and material anisotropies. At distances of interest to the exploratory shaft, the primary wave types present in the ground motions are the body waves and surface waves. Body waves are composed of compression (P) waves, horizontally polarized shear waves (S_h) and the vertically polarized shear waves (S_v). Surface waves are composed of Rayleigh and Love waves. The wave types that carry the majority of the energy are the P, S_h and S_v waves. Because of the depth of the UNE and the radial nature of the explosion, the following assumptions are made about which wave types are responsible for the component acceleration and velocities observed at distances of interest to the exploratory shaft.

- Peak radial motions are the result of the P wave.

- Peak transverse motions are the result of the S_h wave.

- Peak vertical motions are the result of the S_V wave.

The peak displacements observed at these distancos from a UNE are associated with the surface waves.

References

A2-1. Vortman, L. J., Ground Motion Produced at Yucca Mountain from Pahute Mesa Underground Nuclear Explosions, SAND85-1605, Sandia National Laboratories, February 1986.

A2-2. Long, J. W., Component Ground Motion at the Nevada Test Site from Pahute Mesa Underground Nuclear Explosions, SAND86-0439, Sandia National Laboratories, October 1986, In Review.

A2-3. Phillips, J. S., Evaluation of Equations Used for the Prediction of Peak Ground Motions at Yucca Mountain from Underground Nuclear Explosions in Pahute Mesa, SAND87-1811, Sandia National Laboratories, October 1987, In Review.

A2-4. Fernald, A. T., Coordinator, Real Estate Availability Study, Potential New Test Areas, Nevada Test Site, USGS, January 1977.

A2-5. Minutes of the Ground Motion and Seismic Evaluation Subcommittee of October 11, 1977, dated October 19, 1977.

A2-6. Vortman, L. J., "Prediction of Ground Motion From Underground Nuclear Weapons Test as It Relates to Siting a Nuclear Waste Storage Facility at NTS and Compatibility With the Weapons Test Program," SAND80-1020/1, Sandia Naitonal Laboratories, April 1980.

A2-7. Environmental Research Corporation, Prediction of Ground Motion Characteristics of Underground Nuclear Detonations, NVO-1163-239, U.S. Atomic Energy Commission, Nevada Operations Office, March 1974.

A2-8. Vortman, L. J., Long, J. W., "Effects of Repository Depths on Ground Motion - Pahute Mesa Data," SAND82-0174, Sandia National Laboratories, May, 1982

APPENDIX A-3: DETERMINATION OF CONTROLLING STRAIN COMBINATION FOR DESIGN

CONDITIONS AND ASSUMPTIONS

1. Earthquake C ntrol Motion

   Horizontal: $V = 30$ cm/sec $\quad a = 0.3$ g

   Vertical : $V_V = 2/3\ V$ $\quad a_V = a$

2. UNE Control Motion

   Horizontal: $V' = 12$ cm/sec $= 0.40\ V$ $\quad a' = 0.1\ g = 0.33\ a$

   Vertical : $V'_v = 9$ cm/sec $= 0.30\ V$ $\quad a'_v = 0.2\ g = 0.67\ a$

   Note 1: All results will be normalized in terms of V and a.

3. Earthquake incident angles between 0° (vertical) and 30° (maximum) and free field strains are given by Table A3-2 which was derived from Table A3-1 using:

   $$V_P = V_V/\cos\theta \qquad V_{SV} = V/\cos\theta \qquad V_{SH} = V$$
   $$a_P = a_V/\cos\theta \qquad a_{SV} = a/\cos\theta \qquad a_{SH} = a$$

4. UNE incident angles can range from 0° (vertical) to 90° (horizontal).

   For $0° \leq \theta \leq 45°$: Use same assumptions as for Condition 3 and Table A3-2

   For $45° < \theta \leq 90°$: Use Table A3-3 derived from Table A3-1 using:

   $$V_P = V'/\sin\theta \qquad V_{SV} = V'_V/\sin\theta \qquad V_{SH} = V'$$

These assumptions are very conservative for $30° \leq \theta \leq 60°$ as they lead to the following wave particle velocities and accelerations.

CSCR ______'89 004

Table A3-1

Free Field and Bending Strains Due to Earthquakes

Wave Type	Free Field Strains						Bending Strains
	ϵ_{xx}	ϵ_{yy}	ϵ_{zz}	γ_{xy}	γ_{yz}	γ_{xz}	ϵ_b
P	$\frac{v_p}{C_p} \sin^2 \theta$	0	$\frac{v_p}{C_p} \cos^2 \theta$	0	0	$\frac{v_p}{C_p} \sin 2\theta$	$\frac{R\, a_p}{C_p^2} \sin \theta \cos^2 \theta$ (in x-z plane)
SV	$\frac{v_{sv}}{C_s} \sin \theta \cos \theta$	0	$\frac{v_{sv}}{C_p} \sin \theta \cos \theta$	0	0	$\frac{v_{sv}}{C_s} \cos 2\theta$	$\frac{R\, a_{sh}}{C_s^2} \cos^3 \theta$ (in x-z plane)
SH	0	0	0	$\frac{v_{sh}}{C_s} \sin \theta$	$\frac{v_{sh}}{C_s} \cos \theta$	0	$\frac{R\, a_{sh}}{C_s^2} \cos^2 \theta$ (in y-z plane)

CSCR ____'89 004

Table A3-2

Free Field and Bending Strains in Terms of Ground Motion Control Parameters for Earthquakes

Wave Type	Free Field Strains						Bending Strains
	ε_{xx}	ε_{yy}	ε_{zz}	γ_{xy}	γ_{yz}	γ_{xz}	ε_b
P	$\frac{V_v}{C_p}\frac{\sin^2\theta}{\cos\theta}$	0	$\frac{V_v}{C_p}\cos\theta$	0	0	$\frac{V_v}{C_p}2\sin\theta$	$\frac{R\,a_v}{C_p^2}\sin\theta\cos\theta$ (in x-z plane)
SV	$\frac{V_h}{C_s}\sin\theta$	0	$\frac{V_h}{C_p}\sin\theta$	0	0	$\frac{V_h}{C_s}\frac{\cos 2\theta}{\cos\theta}$	$\frac{R\,a_h}{C_s^2}\cos^2\theta$ (in x-z plane)
SH	0	0	0	$\frac{V_h}{C_s}\sin\theta$	$\frac{V_h}{C_s}\cos\theta$	0	$\frac{R\,a_h}{C_s^2}\cos^2\theta$ (in y-z plane)

Note: These expressions are valid only for steeply emerging body waves, i.e., θ – 30° or less.

	cm/sec				"g"			
θ	V_P	V_{SV}	V' (1)	V'_v (1)	a_P	a_{SV}	a' (1)	a'_v (1)
0°	9.0	12.0	12.0	9.0	0.2	0.1	0.1	0.2
37°	11.3	15.0	14.7	12.6	0.25	0.125	0.19	0.23
45°	12.7	17.0	15.6	15.6	0.282	0.141	0.24	0.24
53°	15.0	11.3	14.7	12.6	0.125	0.25	0.19	0.23
90°	12.0	9.0	12.0	9.0	0.1	0.2	0.1	0.2

(1) - Probabilistic combination rule of 100% to 40% used to generate these values.

The table above shows that the computed values of V and a are very conservative as compared to the design basis UNE values. Despite this excessive conservatism, UNE will not govern.

5. Effects of P, S_V, and S_H will be vector summed using 100%-40%-40% combination rule based on random phasing. For instance bending strain ϵ_b due to S_H wave is 90° to ϵ_b from P and S_V waves.

   Thus, $\epsilon_b = \sqrt{(\epsilon_{b_P} + 0.4\ \epsilon_{b_{SV}})^2 + 0.4\ \epsilon_{b_{SH}}{}^2}$, etc.

6. Designer is concerned with total axial strain and either maximum hoop strain or maximum hoop stress.

   a) Elastic computed maximum hoop stress σ_h at unlined opening will serve as a measure of hoop effects.

   b) Total axial strain, ϵ_a, is given by:

$\epsilon_a = \epsilon_{zz} + \epsilon_b$

c) Earthquake and UNE incident angles and component combinations which maximize σ_h and ϵ_a must be determined.

7. Properties Used:

Poisson's Ratio: $\nu = 0.19$ (Results insensitive for $0.13 \leq \nu \leq 0.24$)

Wave Speed Ratios: $C_p/C_s = 1.62$ (Results insensitive for $1.53 \leq C_p/C_s \leq 1.71$)

Shear Wave Speed: $C_S \geq 800$ m/sec

Shaft Radius: $R \leq 5$ m

References

A3-1. Timoshenko, S. and Goodier, J. N., "Theory of Elasticity," McGraw-Hill Publication, 1951.

Table A3-3

Wave Type	ϵ_{xx}	ϵ_{zz}	γ_{xy}	ϵ_b
P	$\frac{V'}{C_p}\sin\theta$	$\frac{V'}{C_p}\frac{\cos^2\theta}{\sin\theta}$	0	$\frac{R\,a'}{C_p^2}\cos^2\theta$ (x-z plane)
SV	$\frac{V'_v}{C_s}\cos\theta$	$\frac{V'_v}{C_s}\cos\theta$	0	$\frac{R\,a'_v}{C_s^2}\frac{\cos^3\theta}{\sin\theta}$ (x-z plane)
SH	0	0	$\frac{V'}{C_s}\sin\theta$	$\frac{R\,a'}{C_s^2}\cos^2\theta$ (y-z plane)

ELASTIC HOOP STRESS FOR UNLINED OPENING

Free Field:

$$(\sigma_x/G) = 2\epsilon_{xx} + (\lambda/G)(\epsilon_{xx} + \epsilon_{zz})$$
$$(\sigma_y/G) = (\lambda/G)(\epsilon_{xx} + \epsilon_{zz})$$
$$(\tau_{xy}/G) = \gamma_{xy}$$

-- Lame's Equation (Reference A3-1)

Principal Stresses $\sigma_{1,3} = \dfrac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left[\dfrac{\sigma_x - \sigma_y}{2}\right]^2 + \tau_{xy}^2}$

$$\therefore (\sigma_{1,3}/G) = \epsilon_{xx} + (\lambda/G)(\epsilon_{xx} + \epsilon_{zz}) \pm \sqrt{\epsilon_{xx}^2 + \gamma_{xy}^2}$$

Maximum Hoop Stress: $(\sigma_h/G) = 3\,(\sigma_1/G) - (\sigma_3/G)$ -- Kirsch's Equation (Reference A3-1)

$$\therefore (\sigma_h/2G) = \epsilon_{xx} + (\lambda/G)(\epsilon_{xx} + \epsilon_{zz}) + 2\sqrt{\epsilon_{xx}^2 + \gamma_{xy}^2} \qquad \text{Equ. 1}$$

where $(\lambda/G) = \dfrac{2\nu}{1-2\nu} = \dfrac{2(0.19)}{1-2(0.19)} = 0.61$ for $\nu = 0.19$

Note 2: For both earthquake and UNE, incident angle, and component combination which maximizes $(\sigma_h/2G)$ will maximize hoop effects on shaft

Note 3: Normalize all results in terms of $\epsilon_N = \dfrac{V}{C_s}$

Axial Strain: $\epsilon_a = \epsilon_{zz} + \epsilon_b$

Normalize ϵ_b by $\epsilon_{BN} = \left(\dfrac{Ra}{C_s^2}\right)$

$$\therefore (\epsilon_a/\epsilon_N) = \left(\frac{\epsilon_{zz}}{\epsilon_N}\right) + \left(\frac{\epsilon_b}{\epsilon_{BN}}\right)\left(\frac{\epsilon_{BN}}{\epsilon_N}\right)$$

For $R \leq 5$ m and $C_s \geq 800$ m/s

$$(\epsilon_{BN}/\epsilon_N) = \frac{Ra}{VC_s} \leq \frac{(5_m)(0.3g)(980\ \text{cm/sec}^2 g)}{30\ \text{cm/sec}\ (800\ \text{cm/sec})} = 0.061$$

$$\therefore (\epsilon_a/\epsilon_N) \leq (\epsilon_{zz}/\epsilon_N) + 0.061\ (\epsilon_b/\epsilon_{BN}) \qquad \text{Equ. 2}$$

Note 4: Axial effects on shaft will be maximized when (ϵ_a/ϵ_N) maximized

FOR EARTHQUAKE CONTROL MOTION

$\theta = 0°$	ϵ_{xx}/ϵ_N	ϵ_{zz}/ϵ_N	λ_{xy}/ϵ_N	ϵ_b/ϵ_{BN} (*)	$\sigma_h/2G\epsilon_N$	ϵ_a/ϵ_N
P	0	0.41	0	0		
SV	0	0	0	1.0		
SV	0	0	0	1.0		
100% P+40% (S_v+S_H)	0	0.41	0	0.57	0.25	0.44
100% S_v+40% (P+S_H)	0	0.16	0	1.08	0.10	0.23
100% S_H+40% (P+S_v)	0	0.16	0	1.08	0.10	0.23
$\theta = 30°$						
P	0.12	0.36	0	0.16		
SV	0.50	0.50	0	0.75		
SH	0	0	0.50	0.75		
100% P + 40% (S_v+S_H)	0.32	0.56	0.20	0.55	0.61	0.59
100% S_v + 40% (P+S_H)	0.55	0.64	0.20	0.87	2.45**	0.69**
100% S_H + 40% (P+S_v)	0.25	0.34	0.50	0.83	1.73	0.39

*Vectorially combined per Condition 5.

**Controls

CSCR '89 004

FOR UHE CONTROL MOTION:

1 - 100% $\underline{P}$ + 40% ($\underline{S}_V$ + $\underline{S}_H$)

2 - 100% $\underline{S}_V$ + 40% ($\underline{P}$ + $\underline{S}_H$)

3 - 100% $\underline{S}_H$ + 40% ($\underline{P}$ + $\underline{S}_V$)

θ = 0°	ϵ_{xx}/ϵ_N	ϵ_{zz}/ϵ_N	λ_{xy}/ϵ_N	ϵ_b/ϵ_N	$\sigma/2G\epsilon_N$	ϵ_a/ϵ_N
P	0	0.19	0	0		
SV	0	0	0	0.33		
SH	0	0	0	0.33		
1	0	0.19	0	--	0.12	0.19
2	--	0.08	--	0.36	--	0.10
3	--	0.08	--	0.36	--	0.10

θ = 37°	ϵ_{xx}/ϵ_N	ϵ_{zz}/ϵ_N	λ_{xy}/ϵ_N	ϵ_b/ϵ_{BN}	$\sigma_h/2G\epsilon_N$	ϵ_a/ϵ_N
P	0.09	0.15	0	0.12		
SV	0.24	0.24	0	0.21		
SH	0	0	0.24	0.21		
1	0.19	0.25	0.10	--	--	--
2	0.28	0.30	0.10	0.27	1.23	0.32
3	0.13	0.16	0.24	--	--	--

θ = 45°	ϵ_{xx}/ϵ_N	ϵ_{zz}/ϵ_N	λ_{xy}/ϵ_N	ϵ_b/ϵ_{BN}	$\sigma_h/2G\epsilon_N$	ϵ_a/ϵ_N
P	0.08	0.08	0	0.13		
SV	0.28	0.28	0	0.17		
SH	0	0	0.28	0.17		
1	0.19	0.19	0.11	--	0.86	--
2	0.31	0.31	0.11	0.23	1.35*	0.32*
3	0.14	0.14	0.28	--	0.94	--

$\theta = 53°$	ϵ_{xx}/ϵ_N	ϵ_{zz}/ϵ_N	λ_{xy}/ϵ_N	ϵ_b/ϵ_{BN}	$\sigma_h/2G\epsilon_N$	ϵ_a/ϵ_N
P	0.20	0.11	0	0.05		
SV	0.18	0.18	0	0.18		
SH	0	0	0.32	0.12		
1	0.27	0.18	0.13	--	1.14	--
2	0.26	0.22	0.13	--	--	--
3	0.15	0.12	0.32	--	1.02	--

$\theta = 90°$	ϵ_{xx}/ϵ_N	ϵ_{zz}/ϵ_N	λ_{xy}/ϵ_N	ϵ_b/ϵ_{BN}	$\sigma_h/2G\epsilon_N$	ϵ_a/ϵ_N
P	0.25	0	0	0		
SV	0	0	0	0		
SH	0	0	0.40	0		
1	0.25	0	0.16	0	1.00	0
2	--	0	--	0	--	0
3	0.10	0	0.40	0	0.99	0

---

*Controls

--By observation, this cannot control; so not computed.

Conclusions

1. Earthquake Control Motion, with $\theta = 30°$ and a combination of 100% S_V + 40% (P + S_H) } Controls

   For this case, $\sigma_h/2G\epsilon_N = 2.45$ and

$$\epsilon_a/\epsilon_N \leq 0.65$$

2. Largest UNE effect is at $\theta = 45^{\circ}$, for 100% S_V + 40% (P + S_H)

For this case, $\sigma_h/2G\epsilon_N = 1.35 - (0.55 *$ value for earthquake control motion)

$\epsilon_a/\epsilon_N = 0.32 - (0.46 *$ value for earthquake control motion)

3. Need to double UNE Control Motion for UNE to govern.

NNWSI PROJECT
COST/SCHEDULE CHANGE REQUEST (C/SCR)

N AD-036
9 87

Change No:	Organization:	Originator:	Origination Date:
89/005	SAIC	M. E. Spaeth	11/15/88

Title:
Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in accordance with the Approved ESF Engineering Change Request (ECR) 013

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 013.

REASON: See the "Basis for Change" on ESF ECR 013.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:
1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010 through 027.
2. ESF ECR 013.

Responsible Organization M. E. Spaeth [signature] Date 11/22/88
CCB Secretary P. C. Merkley [signature] Date 12/13/88
Approval: Project Manager, WMPO for C. P. Gertz [signature] Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF-ECR 012.

C/SCR No: 89/005

Summary of Recommended Actions:

	Project Office				T&MSS			
	R&SE	E&D	P&CC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☒	☒	☒	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☐	☐	☐	☐
Non Concurrence	☐	☐	☐	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation:

Impact Analyses:

CCB Secretary P. C. Merklev (signature) Date 12/12/88

Page 1 of 1

CSCR ____ '89 005

Department of Energy
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PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

Received In Configuration
Management Division

JUN 22 1988

SAIC/T&MSS

JUL 21 1988

CCF RECEIVED

CSCR ____'89 005

cc w/o encl:
V. J. Cassella, HQ (RW-123) FORS
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CSCR '89 005

ESF ENGINEERING CHANGE REQUEST

ESF 11.FMB-12/21

ECR NO. 013 PAGE 1 OF 1

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL N/A
SOURCE ESF SDRD
WBS DESIGNATION 1.2.6
TITLE 1.2.6.3 Surface Facilities
DESCRIPTION OF CHANGE

PARTICIPANT SAIC
DATE 6/10/88
ORIGINATOR SAIC
REV. NO. 1 DATE 12/18/87

In the ESF SDRD, 1.2.6.3 Surface Facilities Functional Requirements A/E building (Area 25) (page 3-2) delete all information under " A/E Building (Area 25)."

SEE CONTINUATION PAGE

BASIS FOR CHANGE These facilities are no longer under the jurisdiction of the ES

SEE CONTINUATION PAG

PARTICIPANT QA REP [signature] DATE 6/20/88
ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 6/21/88

SECTION 2. ICWG CHAIRMAN ACTION ____ NOT APPLICABLE

1. PROCEED WITH ECR EVALUATION ✓ YES ____ NO SCOPE CHANGE ____ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO CONSTRUCTION IMPACT ____ YES ____

3. TOTAL COSTS (increase/decrease) ____ NOT APPLICABLE

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT ____ NOT APPLICABLE
ENGINEERING ____ WE
CONSTRUCTION ____ WE

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

6. FUNDING:
____ NOT APPLICABLE ✓ NOT FUNDED, PROJECTED ONLY
____ CHANGE ORDER ____ SPECIAL STUDIES

[signature] 7/8/88
ICWG CHAIRMAN/DATE

7. APPROVED

[signature] 7/8/8
ICWG CHAIRMAN/DATE

1.2.6.3 SURFACE FACILITIES

Subparts are:

Definition of Subsystem Elements

The surface facilities system and subsystem includes all the facilities, systems, and services for the surface buildings and trailers that are required for the support of ESF operations and in situ site characterization.

Applicable Regulations, Codes, and Specifications

The designs shall be in accordance with:

1. DOE 6430.1

In addition, see Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

Functional Requirements

1. Provide buildings and supporting equipment for the following functions:

   a. Ventilation system
   b. Test support facilities
      1) Test apparatus assembly pad
   c. Trailer spaces
   d. Parking areas
      1) Surface mobile equipment
      2) Personnel parking

3) Visitor parking
e. Materials storage facilities
f. Shop
g. Warehouse
h. Trailers
1) Offices for Principal Investigators (PIs)
2) Offices for site security
3) Offices for site operations staff
4) Offices for site administration and training
5) Offices for Quality Assurance
6) Offices for support of shaft and facility construction
7) Laboratories, etc.
8) Change trailers
9) First aid trailer
10) Test support trailer
11) NRC and State offices
i. A&E building (Area 25)
1) DELETED
2) DELETED
3) DELETED
4) DELETED
5) DELETED
6) DELETED
7) DELETED
8) DELETED
9) DELETED
j. Communications and data building
1) Computer/control system
2) Data acquisition (IDS)
3) Communications equipment

2. Provide air quality monitoring.

3. Provide water quality monitoring (including the physical, chemical, and biological characteristics of ESF wastewater, the receiving water body, and any other water bodies that could be affected by ESF operations).

4. Provide dust control and/or collection facilities.

5. Provide for the detection of and protection from fires and explosions.

6. Provide onsite transportation facilities for equipment, materials, and rock.

Performance Criteria

1. The surface facilities shall meet the operational requirements of the users.

2. The surface facilities shall be designed and constructed for a nominal 5-year life, unless otherwise noted.

3. The surface facilities and their locations shall (a) facilitate the flow of material and personnel within the ESF site and (b) provide adequate ESF site security, including controlled access and emergency response.

4. The facilities shall be complete with Heating Ventilation and Air Conditioning (HVAC), compressed air, plumbing and sanitary facilities, lighting, communications, and fire protection systems, as appropriate for the intended use.

5. Surface facilities shall combine functions when the combinations are cost effective.

6. The surface facilities shall be located away from potential dust generating areas to the extent practicable.

Interface Control Requirements

See Section 1.2.6.0, Interface Control Requirements.

Constraints

1. The general layout of the surface facilities shall be designed to minimize disturbance to the existing area.

2. To the extent practicable and economical, modular, relocatable, or portable structures shall be considered for surface facilities.

3. To the extent practicable and consistent with procurement regulations, consideration of surplus government equipment shall be given to fulfill the requirements for the surface facilities and equipment.

4. Each inhabited structure shall have rest rooms, water heating, space heating, and air conditioning, as required for the intended use.

Assumptions

None.

1.2.6.3 SURFACE FACILITIES

Subparts are:

Definition of Subsystem Elements

The surface facilities system and subsystem includes all the facilities, systems, and services for the surface buildings and trailers that are required for the support of ESF operations and in situ site characterization.

Applicable Regulations, Codes, and Specifications

The designs shall be in accordance with:

1. DOE 6430.1

In addition, see Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

Functional Requirements

1. Provide buildings and supporting equipment for the following functions:

   a. Ventilation system
   b. Test support facilities
      1) Test apparatus assembly pad
   c. Trailer spaces
   d. Parking areas
      1) Surface mobile equipment
      2) Personnel parking
      3) Visitor parking
   e. Materials storage facilities
   f. Shop
   g. Warehouse
   h. Trailers

1) Offices for Principal Investigators (PIs)
2) Offices for site security
3) Offices for site operations staff
4) Offices for site administration and training
5) Offices for Quality Assurance
6) Offices for support of shaft and facility construction
7) Laboratories, etc.
8) Change trailers
9) First aid trailer
10) Test support trailer
11) NRC and State offices

i. A&E building (Area 25)
1) Administration
2) Visitors
3) Training
4) Engineering staff
5) Security
6) Labs (as required)
7) Sleeping quarters (as required)
8) Offices for PIs
9) NRC and State offices

j. Communications and data building
1) Computer/control system
2) Data acquisition (IDS)
3) Communications equipment

2. Provide air quality monitoring.

3. Provide water quality monitoring (including the physical, chemical, and biological characteristics of ESF wastewater, the receiving water body, and any other water bodies that could be affected by ESF operations).

4. Provide dust control and/or collection facilities.

5. Provide for the detection of and protection from fires and explosions.

6. Provide onsite transportation facilities for equipment, materials, and rock.

Performance Criteria

1. The surface facilities shall meet the operational requirements of the users.

2. The surface facilities shall be designed and constructed for a nominal 5-year life, unless otherwise noted.

3. The surface facilities and their locations shall (a) facilitate the flow of material and personnel within the ESF site and (b) provide adequate ESF site security, including controlled access and emergency response.

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5. Surface facilities shall combine functions when the combinations are cost effective.

6. The surface facilities shall be located away from potential dust generating areas to the extent practicable.

Interface Control Requirements

See Section 1.2.6.0, Interface Control Requirements.

Constraints

1. The general layout of the surface facilities shall be designed to minimize disturbance to the existing area.

2. To the extent practicable and economical, modular, relocatable, or portable structures shall be considered for surface facilities.

3. To the extent practicable and consistent with procurement regulations, consideration of surplus government equipment shall be given to fulfill the requirements for the surface facilities and equipment.

4. Each inhabited structure shall have rest rooms, water heating, space heating, and air conditioning, as required for the intended use.

Assumptions

None.

NNWSI PROJECT COST/SCHEDULE CHANGE REQUEST (C/SCR)	Page 1 of 1	N AD-036 9/87

Change No.:	Organization:	Originator:	Origination Date.
89-006	SAIC	M. E. Spaeth	11/15/88

Title:

Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Request (ECR) 014

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 014.

REASON: See the "Basis for Change" on ESF ECR 014.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:
1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010 through 027.
2. ESF ECR 014.

Responsible Organization M. E. Spaeth [signature] Date 11/22/88

CCB Secretary P. C. Merkley [signature] Date 12/13/88

Approval: Project Manager, WMPO C. P. Gertz [signature] Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF-ECR 014.	C/SCR No: 89/006

Summary of Recommended Actions:

	Project Office				T&MSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☒	☒	☒	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☐	☐	☐	☐
Non Concurrence	☐	☐	☐	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation:

Impact Analyses:

CCB Secretary P. C. Merkley [signature] Date 12/12/88

Page 1 of 1

CSCR ____'89 006

Department of Energy

Nevada Operations Office
P. O. Box 98518
Las Vegas, NV 89193-8518

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Las Vegas, NV 89109

PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

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CSCR ——'89 006

JUL 20 1989

cc w/o encl:
V. J. Cassella, HQ (RW-123) FORS
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S. H. Klein, SAIC, Las Vegas, NV
W. E. Narrows, SAIC, Las Vegas, NV
James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

CSCR ____'89 006

ESF ENGINEERING CHANGE REQUEST

ESF11.FMB-12/2

ECR NO. 014

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL N/A
SOURCE ESF SDRD
WBS DESIGNATION 1.2.6
TITLE 1.2.6.3.9 A/E Building (Area 25)

PARTICIPANT SAIC
DATE 6/10/88
ORIGINATOR SAIC
REV. NO. 1 DATE 12/18/87

DESCRIPTION OF CHANGE

In the ESF SDRD delete the entire section 1.2.6.3.9 A/E Building (Area 25) (pages 3.9-1 and 3.9-2).

SEE CONTINUATION PAGE

BASIS FOR CHANGE The facilities are no longer under the jurisdiction of the ESF.

SEE CONTINUATION PAGE

PARTICIPANT QA REP [signature] DATE 6/20/88

ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 6/21/88

SECTION 2. ICWG CHAIRMAN ACTION ____ NOT APPLICABLE

1. PROCEED WITH ECR EVALUATION ✓ YES ____ NO SCOPE CHANGE ____ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO CONSTRUCTION IMPACT ____ YES ____ N

3. TOTAL COSTS (increase/decrease) ____ NOT APPLICABLE

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT ____ NOT APPLICABLE

ENGINEERING ____ WEEK
CONSTRUCTION ____ WEEK

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

6. FUNDING:

____ NOT APPLICABLE ✓ NOT FUNDED, PROJECTED ONLY

____ CHANGE ORDER ____ SPECIAL STUDIES

[signature] 7/8/88
ICWG CHAIRMAN/DATE

7. APPROVED

[signature] 7/8/88
ICWG CHAIRMAN/DATE

CSCR ______'89 006
PROPOSED MODIFICATION

1.2.6.3.9 A&E BUILDING (AREA 25)

Section Deleted

1.2.6.3.9 A&E BUILDING (AREA 25)

Definition of Subsystem Elements

The Administrative and Engineering (A&E) building includes all the facilities for the support functions that are required to support the ESF construction and operations. As a minimum. this includes: offices and administrative support facilities; the facilities and systems for storing, preserving, and retrieving of ESF information and documents during the design, construction, and testing phases of the facility; the facilities and systems for personnel training; the facilities and systems for visitors; and the facilities and systems for showers and a change room.

Functional Requirements

The A&E building shall provide support for personnel and services during the ESF construction, and operation for the site characterization program. This facility shall accommodate the following types of activities and services:

1. Administrative services
2. Multipurpose conference, training, and visitor's area
3. Engineering services
4. Testing support services (personnel offices)
5. Industrial safety
6. Environmental health and safety
7. Laboratory
8. Required on site administrative, environmental, and safety records
9. Training
10. Visitors orientation and processing

Performance Criteria

1. A&E building facilities shall have space, supporting equipment, and furniture as necessary and appropriate to satisfy the needs of ESF operations and underground site characterization.

2. Space and facilities shall support the training, certification, and requalification of operation and supervisory personnel.

3. During ESF construction and testing, visitor facilities shall be available. The facilities shall support a minimum of 50 visitors on the surface and 10 visitors underground at any one time.

4. A multi-purpose room which will seat a minimum of 50 people shall be provided as part of the administrative area. This room shall be used for mine training, visitors, and conferences.

Constraints

None.

Assumptions

None.

NNWSI PROJECT
COST/SCHEDULE CHANGE REQUEST (C/SCR)

N-AD-036
9/87

Change No.:	Organization:	Originator:	Origination Date:
89/007	SAIC	M. E. Spaeth	11/15/88

Title:
Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Request (ECR) 015

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 015.

REASON: See the "Basis for Change" on ESF ECR 015.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:
1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010 through 027.
2. ESF ECR 015.

Responsible Organization M. E. Spaeth [signature] Date 11/22/88

CCB Secretary P. C. Merkley [signature] Date 12/13/88

Approval: Project Manager, WMPO for C. P. Gertz [signature] Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF-ECR 015.

C/SCR No: 89/007

Summary of Recommended Actions:

	Project Office				T&MSS			
	R&SE	E&D	P&CC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☒	☒	☒	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☐	☐	☐	☐
Non Concurrence	☐	☐	☐	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation:

Impact Analyses:

CCB Secretary P. C. Merklev (signature) Date 2/12/88

Page 1 of 1

CSCR ____'89 007

Department of Energy
Nevada Operations Office
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International Corporation
Suite 407
101 Convention Center Drive
Las Vegas, NV 89109

PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

Received In Configuration
Management Division
JUL 22 1988

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JUL 21 1988
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JUL 20 1988

cc w/o encl:
V. J. Cassella, HQ (RW-123) FORS
Dean Stucker, HQ (RW-223) FORS
G. K. Beall, SAIC, Las Vegas, NV
M. C. Brake, SAIC, Las Vegas, NV
R. R. Reust, SAIC, Las Vegas, NV
John Nimmo, SAIC, Las Vegas, NV
S. H. Klein, SAIC, Las Vegas, NV
W. E. Narrows, SAIC, Las Vegas, NV
James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

CSCR ____ '89 007

ESF ENGINEERING CHANGE REQUEST

ESF 11.FM8-12/21

ECR NO. 015 PAGE 1 OF 1

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL N/A
SOURCE ESF SDRD
WBS DESIGNATION 1.2.6.0
TITLE 1.2.6.0 General Exploratory
DESCRIPTION OF CHANGE Shaft Facility

PARTICIPANT SAIC
DATE 6/10/88
ORIGINATOR SAIC
REV. NO. 1 DATE 12/18/87

In the ESF SDRD 1.2.6.0, General Exploratory Shaft Facility, Applicable Regulations, Codes, and Specifications (page 0-1), change "The latest edition or revision of a regulation, code, or standard in effect as of October 1, 1987, is to be used." to "Except for the 12/25/87 Draft Department of Energy Order DOE 6430.1A, the latest edition or revision of a regulation, code or standard in effect as of October 1, 1987 is to be used."

SEE CONTINUATION PAGE

BASIS FOR CHANGE Lester P. Skousen letter dated March 23, 1988.

SEE CONTINUATION PAGE

PARTICIPANT QA REP [signature] DATE 6/22/88
ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 6/21/88

SECTION 2. ICWG CHAIRMAN ACTION ____ NOT APPLICABLE

1. PROCEED WITH ECR EVALUATION ✓ YES ____ NO SCOPE CHANGE ____ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO CONSTRUCTION IMPACT ____ YES ____ NO

3. TOTAL COSTS (increase/decrease) ____ NOT APPLICABLE

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT ____ NOT APPLICABLE
ENGINEERING ____ WEEKS
CONSTRUCTION ____ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

6. FUNDING:
____ NOT APPLICABLE ✓ NOT FUNDED, PROJECTED ONLY
____ CHANGE ORDER ____ SPECIAL STUDIES

[signature] 7/8/88
ICWG CHAIRMAN/DATE

7. APPROVED

[signature] 7/8/88
ICWG CHAIRMAN/DATE

1.2.6.0 GENERAL EXPLORATORY SHAFT FACILITY

Subparts are:

1.2.6.1 Site
1.2.6.2 Utilities
1.2.6.3 Surface Facilities
1.2.6.4 First Shaft
1.2.6.5 Second Shaft
1.2.6.6 Underground Excavations
1.2.6.7 Underground Utility Systems
1.2.6.8 Underground Tests

Definition of Subsystem Elements

The Exploratory Shaft Facility (ESF) is defined by those systems, subsystems, and components used for in situ site characterization and performance confirmation testing of a candidate site for a repository. The ESF is defined as the surface and underground facilities (including shafts and connecting drifts) and supporting systems required to support site characterization testing at depth. (See Appendix A, Sketches 1, 2, 3, 4, and 5.)

Applicable Regulations, Codes, and Specifications

It is the responsibility of the Architect-Engineer (A/E) to identify which specific regulations, codes, and standards apply from the regulations, orders, codes, and specifications listed in this document. Citations can be found in each section of this document as applicable. Specific citations for the applicable regulations, codes, and specifications can be found in the ESF Basis for Design Documents. Appendix E contains a listing of some additional commonly used regulations, codes, and standards. Except for the 12/25/87 Draft Department of Energy Order DOE 6430.1A, the latest edition or revison of a regulation, code or standard in effect as of October 1, 1987, is to be used. In the event of conflicting requirements, the most stringent shall be applied. The Director of the Waste Management Project Office (WMPO), or his designee, shall be requested in writing to approve or obtain any required waivers.

Functional Requirements

1. Support in situ site characterization for the Mined Geologic Disposal System and provide testing facilities for in situ site characterization as required by DOE/OGR milestones and the Site Characterization Plan.

2. Provide an ESF whose permanent items can be incorporated into the repository and which can be used to support phase I repository construction. Those items, listed below, are the ESF permanent systems, structures, and components that shall be designed, procured, and constructed to be incorporated into the repository. The

permanent items must be designed to have a maintainable life and quality as specified for the repository.

a. Underground Opening(s) — space created by mining or drilling, including those zones within the rock altered by that process.

b. Shaft Liner(s) — all components placed between the inside limits of the shaft and the accessible extent of the underground opening.

c. Ground Support — any means used to reinforce rock and/or control the movement of rock except for removable or replaceable hardware.

3. Provide a suitable location for in situ site characterization.

4. Provide equipment and facilities for ensuring a safe, healthful, and productive working environment.

5. Provide the facilities to alert on-site personnel of possibly dangerous situations.

6. Provide design and construction methods that will demonstrate licensability and constructability for the candidate repository.

Performance Criteria

1. The ESF shall be designed to support site characterization by providing facilities to meet the needs of in situ site characterization testing.

2. Underground openings shall be developed to meet the needs of in situ site characterization, including basic needs for the initially planned tests. Additionally an allowance for uncertainties for the test area needs at the main test level has been set at 100 percent; i.e., all major systems for ventilation, utilities, emergency egress, rock handling, personnel support, and others shall be analyzed to determine the need for and the impact associated with this uncertainty allowance. If it can be demonstrated that critical parts of the allowance would require excessive costs, schedule, test disruption, or other program impacts to design, procurement, and/or construction later (after the basic test plan needs are completed), consideration shall be given to designing, procuring, and/or constructing these critical items as part of the initial facility. The uncertainty allowance for each of the major ESF systems shall be determined by an analysis of the following systems:

Description	Uncertainty Allowance
Underground test area at the main test level	100 percent
Systems • Site • Utilities • Surface facilities • First shaft • Second shaft • Underground excavations	DETERMINED BY ANALYSES IN THE TITLE I DESIGN PHASE

- Underground utility systems
- Underground tests

Specific allowances for each major system shall be identified and incorporated prior to the start of Title II design (detailed design).

3. in situ and in-shaft testing shall satisfy the requirements of the DOE/OGR milestones and the Site Characterization Plan (SCP).

4. Those ESF structures, systems, and components that are incorporated into the repository shall be designed and constructed to meet the requirements of 10 CFR Part 60. Compliance with the requirements of 10 CFR Part 60 will be demonstrated in the license application.

5. ESF permanent structures, systems, and components that will be incorporated into the repository shall be designed and constructed with the same criteria, standards, and Quality Assurance levels as required for the repository, to the extent known at the time of ESF design.

6. Drill cores from USW G-4 and other existing geologic data shall be used to design the ESF shafts and underground openings.

7. Quality and quantity of uncontaminated ventilation air supplied to the subsurface facilities of the ESF system shall provide a safe, healthy, and productive working environment to operating personnel.

8. Alarm systems shall indicate when the various monitored conditions exceed predetermined specified limits. Redundant systems shall be installed as required by applicable regulations.

9. Monitoring of conditions such as noise, noxious or flammable gas, and radon shall be conducted in accordance with applicable federal, state, and local regulations.

10. ESF openings, boreholes, and their seals shall be designed so that they do not become pathways that compromise the repository's ability to meet the performance objectives of 10 CFR Part 60. Compliance with this criterion will be demonstrated in the license application.

11. Shafts and other underground excavations shall be designed and constructed with reasonably available technology similar to or corresponding with the techniques planned for the candidate repository.

12. All geotechnical information and assumptions used in the design of underground features (including seismic criteria) shall be consistent with information contained in the baselined repository Reference Information Base (RIB) or traceable to NNWSI Project published information. See Appendix D for the indexes and cross references to other applicable and referenceable Project documentation.

13. The ESF shall be designed to include on-site facilities and services that ensure a safe and timely response to emergency conditions and that facilitate the use of available off-site services (such as fire, police, medical, and ambulance service) that may aid in recovery from emergencies.

Interface Control Requirements

1. The basic interface control requirements are established by the NNWSI Project ESF Interface Control Procedure (ICP), Standard Operating Procedure (SOP) 03-05. This procedure is applicable to all work to be performed by participating organizations and contractors during the engineering phases for the ESF. This is an interim procedure and, as such, shall apply until the NNWSI Project Systems Engineering Management Plan (SEMP) and the NNWSI Project Configuration Management Plan (CMP) with appropriate implementing procedures have been finalized, approved, and implemented within the NNWSI Project. Specific working groups may be formed, as required, to coordinate Project-specific interfaces.

Constraints

1. The ESF system shall comply with all applicable federal environmental regulations and with state and local environmental regulations consistent with the DOE's responsibilities under the Nuclear Waste Policy Act of 1982 (NWPA). Such compliance could include the following:

   a. The designs for systems which contain point-source discharges of treated waste waters into surface-water systems shall comply with the provisions of the Clean Water Act (as amended) as implemented through the National Pollutant Discharge Elimination System (NPDES) permit process.

   b. The design for the management and disposal of solid and any hazardous wastes (excluding any radioactive wastes) shall be conducted in accordance with the requirements of the Resource Conservation and Recovery Act (RCRA) (as amended) which could include RCRA permitting for the hazardous wastes.

   c. The design for systems which handle, use, and/or dispose of any toxic substances shall comply with the requirements of the Toxic Substances Control Act (TSCA), as amended. Federal regulations implementing TSCA are coded in Title 40, Chapter I, Subchapter R.

   d. The design of systems shall ensure that the noise levels of those systems shall be controlled in accordance with the requirements of the Noise Control Act of 1972.

   e. The design for any system or activity involving underground injections shall comply with the provision of the Safe Drinking Water Act (as amended) which could require an Underground Injection Control (UIC) permit.

2. The ESF shall be designed so that the effects of credible disruptive events as defined in the RIB (e.g., flooding, fires, and explosions) shall be limited from spreading through the facility.

3. The engineered barrier system must be designed such that other systems, structures, and components of the ESF and the candidate repository do not eventually become

ground-water flow paths and do not promote the release of radionuclides to the accessible environment.

4. The structures, systems, and components important to safety shall be designed so that natural phenomena and environmental conditions anticipated at the ESF and candidate repository will not interfere with necessary safety functions.

5. The structures, systems, and components important to safety shall be designed and located to withstand the effects of credible fires and explosions as well as all other postulated design basis accidents as defined in the RIB.

6. The ESF permanent systems, structures, and components important to safety shall be designed to ensure continued safe repository operation or safe repository shutdown and personnel evacuation, if necessary, under conditions resulting from the effects of natural phenomena and design-basis accidents.

7. To the extent practicable, the ESF shall be designed to incorporate the use of non-combustible and heat-resistant materials.

8. The predicted thermal and thermomechanical response of the host rock and surrounding strata, and the ground-water system shall be considered in the ESF design.

9. To the extent practicable and consistent with procurement regulations, consideration of surplus government equipment shall be given to fulfill the requirements for the support services and equipment.

10. The ESF shall be designed, constructed, and operated to meet decommissioning and closure requirements of applicable federal, state, and local codes.

11. The design shall allow for fugitive and stationary source dust control at potential dust generation areas such as roads and earth moving sites to minimize airborne particulates, as required by applicable federal, state, and local codes.

Assumptions

1. The site shall be located such that, based on expected ground-water conditions, it will be unlikely that engineering measures beyond reasonably available technology will be required for ESF construction, operation, or closure.

2. The responsibilities of the NNWSI Project ESF participants are defined in the ESF Project Management Plan.

3. The design shall assume that the shaft subcontractor will be totally self-sufficient with respect to the physical mine plant, except for government-furnished utilities, equipment, and facilities.

1.2.6.0 GENERAL EXPLORATORY SHAFT FACILITY

Subparts are:

1.2.6.1 Site
1.2.6.2 Utilities
1.2.6.3 Surface Facilities
1.2.6.4 First Shaft
1.2.6.5 Second Shaft
1.2.6.6 Underground Excavations
1.2.6.7 Underground Utility Systems
1.2.6.8 Underground Tests

Definition of Subsystem Elements

The Exploratory Shaft Facility (ESF) is defined by those systems, subsystems, and components used for in situ site characterization and performance confirmation testing of a candidate site for a repository. The ESF is defined as the surface and underground facilities (including shafts and connecting drifts) and supporting systems required to support site characterization testing at depth. (See Appendix A, Sketches 1, 2, 3, 4, and 5.)

Applicable Regulations, Codes, and Specifications

It is the responsibility of the Architect-Engineer (A/E) to identify which specific regulations, codes, and standards apply from the regulations, orders, codes, and specifications listed in this document. Citations can be found in each section of this document as applicable. Specific citations for the applicable regulations, codes, and specifications can be found in the ESF Basis for Design Documents. Appendix E contains a listing of some additional commonly used regulations, codes, and standards. The latest edition or revision of a regulation, code, or standard in effect as of October 1, 1987, is to be used. In the event of conflicting requirements, the most stringent shall be applied. The Director of the Waste Management Project Office (WMPO), or his designee, shall be requested in writing to approve or obtain any required waivers.

Functional Requirements

1. Support in situ site characterization for the Mined Geologic Disposal System and provide testing facilities for in situ site characterization as required by DOE/OGR milestones and the Site Characterization Plan.

2. Provide an ESF whose permanent items can be incorporated into the repository and which can be used to support phase I repository construction. Those items, listed below, are the ESF permanent systems, structures, and components that shall be designed, procured, and constructed to be incorporated into the repository. The permanent items must be designed to have a maintainable life and quality as specified for the repository.

a. Underground Opening(s) — space created by mining or drilling, including those zones within the rock altered by that process.

b. Shaft Liner(s) — all components placed between the inside limits of the shaft and the accessible extent of the underground opening.

c. Ground Support — any means used to reinforce rock and/or control the movement of rock except for removable or replaceable hardware.

3. Provide a suitable location for in situ site characterization.

4. Provide equipment and facilities for ensuring a safe, healthful, and productive working environment.

5. Provide the facilities to alert on-site personnel of possibly dangerous situations.

6. Provide design and construction methods that will demonstrate licensability and constructability for the candidate repository.

Performance Criteria

1. The ESF shall be designed to support site characterization by providing facilities to meet the needs of in situ site characterization testing.

2. Underground openings shall be developed to meet the needs of in situ site characterization, including basic needs for the initially planned tests. Additionally an allowance for uncertainties for the test area needs at the main test level has been set at 100 percent; i.e., all major systems for ventilation, utilities, emergency egress, rock handling, personnel support, and others shall be analyzed to determine the need for and the impact associated with this uncertainty allowance. If it can be demonstrated that critical parts of the allowance would require excessive costs, schedule, test disruption, or other program impacts to design, procurement, and/or construction later (after the basic test plan needs are completed), consideration shall be given to designing, procuring, and/or constructing these critical items as part of the initial facility. The uncertainty allowance for each of the major ESF systems shall be determined by an analysis of the following systems:

Description	Uncertainty Allowance
Underground test area at the main test level	100 percent
Systems	
- Site - Utilities - Surface facilities - First shaft - Second shaft - Underground excavations - Underground utility systems - Underground tests	DETERMINED BY ANALYSES IN THE TITLE I DESIGN PHASE

Specific allowances for each major system shall be identified and incorporated prior to the start of Title II design (detailed design).

3. in situ and in-shaft testing shall satisfy the requirements of the DOE/OGR milestones and the Site Characterization Plan (SCP).

4. Those ESF structures, systems, and components that are incorporated into the repository shall be designed and constructed to meet the requirements of 10 CFR Part 60. Compliance with the requirements of 10 CFR Part 60 will be demonstrated in the license application.

5. ESF permanent structures, systems, and components that will be incorporated into the repository shall be designed and constructed with the same criteria, standards, and Quality Assurance levels as required for the repository, to the extent known at the time of ESF design.

6. Drill cores from USW G-4 and other existing geologic data shall be used to design the ESF shafts and underground openings.

7. Quality and quantity of uncontaminated ventilation air supplied to the subsurface facilities of the ESF system shall provide a safe, healthy, and productive working environment to operating personnel.

8. Alarm systems shall indicate when the various monitored conditions exceed predetermined specified limits. Redundant systems shall be installed as required by applicable regulations.

9. Monitoring of conditions such as noise, noxious or flammable gas, and radon shall be conducted in accordance with applicable federal, state, and local regulations.

10. ESF openings, boreholes, and their seals shall be designed so that they do not become pathways that compromise the repository's ability to meet the performance objectives of 10 CFR Part 60. Compliance with this criterion will be demonstrated in the license application.

11. Shafts and other underground excavations shall be designed and constructed with reasonably available technology similar to or corresponding with the techniques planned for the candidate repository.

12. All geotechnical information and assumptions used in the design of underground features (including seismic criteria) shall be consistent with information contained in the baselined repository Reference Information Base (RIB) or traceable to NNWSI Project published information. See Appendix D for the indexes and cross references to other applicable and referenceable Project documentation.

13. The ESF shall be designed to include on-site facilities and services that ensure a safe and timely response to emergency conditions and that facilitate the use of available off-site services (such as fire, police, medical, and ambulance service) that may aid in recovery from emergencies.

Interface Control Requirements

1. The basic interface control requirements are established by the NNWSI Project ESF Interface Control Procedure (ICP), Standard Operating Procedure (SOP) 03-05. This procedure is applicable to all work to be performed by participating organizations and contractors during the engineering phases for the ESF. This is an interim procedure and, as such, shall apply until the NNWSI Project Systems Engineering Management Plan (SEMP) and the NNWSI Project Configuration Management Plan (CMP) with appropriate implementing procedures have been finalized, approved, and implemented within the NNWSI Project. Specific working groups may be formed, as required, to coordinate Project-specific interfaces.

Constraints

1. The ESF system shall comply with all applicable federal environmental regulations and with state and local environmental regulations consistent with the DOE's responsibilities under the Nuclear Waste Policy Act of 1982 (NWPA). Such compliance could include the following:

   a. The designs for systems which contain point-source discharges of treated waste waters into surface-water systems shall comply with the provisions of the Clean Water Act (as amended) as implemented through the National Pollutant Discharge Elimination System (NPDES) permit process.

   b. The design for the management and disposal of solid and any hazardous wastes (excluding any radioactive wastes) shall be conducted in accordance with the requirements of the Resource Conservation and Recovery Act (RCRA) (as amended) which could include RCRA permitting for the hazardous wastes.

   c. The design for systems which handle, use, and/or dispose of any toxic substances shall comply with the requirements of the Toxic Substances Control Act (TSCA), as amended. Federal regulations implementing TSCA are coded in Title 40, Chapter I, Subchapter R.

   d. The design of systems shall ensure that the noise levels of those systems shall be controlled in accordance with the requirements of the Noise Control Act of 1972.

   e. The design for any system or activity involving underground injections shall comply with the provision of the Safe Drinking Water Act (as amended) which could require an Underground Injection Control (UIC) permit.

2. The ESF shall be designed so that the effects of credible disruptive events as defined in the RIB (e.g., flooding, fires, and explosions) shall be limited from spreading through the facility.

3. The engineered barrier system must be designed such that other systems, structures, and components of the ESF and the candidate repository do not eventually become

ground-water flow paths and do not promote the release of radionuclides to the accessible environment.

4. The structures, systems, and components important to safety shall be designed so that natural phenomena and environmental conditions anticipated at the ESF and candidate repository will not interfere with necessary safety functions.

5. The structures, systems, and components important to safety shall be designed and located to withstand the effects of credible fires and explosions as well as all other postulated design basis accidents as defined in the RIB.

6. The ESF permanent systems, structures, and components important to safety shall be designed to ensure continued safe repository operation or safe repository shutdown and personnel evacuation, if necessary, under conditions resulting from the effects of natural phenomena and design-basis accidents.

7. To the extent practicable, the ESF shall be designed to incorporate the use of non-combustible and heat-resistant materials.

8. The predicted thermal and thermomechanical response of the host rock and surrounding strata, and the ground-water system shall be considered in the ESF design.

9. To the extent practicable and consistent with procurement regulations, consideration of surplus government equipment shall be given to fulfill the requirements for the support services and equipment.

10. The ESF shall be designed, constructed, and operated to meet decommissioning and closure requirements of applicable federal, state, and local codes.

11. The design shall allow for fugitive and stationary source dust control at potential dust generation areas such as roads and earth moving sites to minimize airborne particulates, as required by applicable federal, state, and local codes.

Assumptions

1. The site shall be located such that, based on expected ground-water conditions, it will be unlikely that engineering measures beyond reasonably available technology will be required for ESF construction, operation, or closure.

2. The responsibilities of the NNWSI Project ESF participants are defined in the ESF Project Management Plan.

3. The design shall assume that the shaft subcontractor will be totally self-sufficient with respect to the physical mine plant, except for government-furnished utilities, equipment, and facilities.

COST/SCHEDULE CHANGE REQUEST (C/SCR)

Change No.:	Organization:	Originator:	Origination Date:
89/008	SAIC	M. E. Spaeth	11/15/88

Title:

Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Request (ECR) 016

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 016.

REASON: See the "Basis for Change" on ESF ECR 016.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:

1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010 through 027.
2. ESF ECR 016

Responsible Organization M. E. Spaeth [signature] Date 11/22/88

CCB Secretary P. C. Merkley [signature] Date 12/13/88

Approval: Project Manager, WMPO C. P. Gertz [signature] Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF-ECR 016.	C/SCR No: 89/008

Summary of Recommended Actions:

	Project Office				TSMSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☒	☒	☒	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☐	☐	☐	☐
Non Concurrence	☐	☐	☐	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation:

Impact Analyses:

CCB Secretary P. C. Merkley Date 12/12/88

Page 1 of 1

CSCR ____'89 008

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JUL 20 1988

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Technical Project Officer
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PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

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Management Division

JUL 22 1988

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JUL 20 1988

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CSCR ____'89 008

ESF ENGINEERING CHANGE REQUEST

ESF11.FMB-12/2?

ECR NO. 016 PAGE 1 OF 2

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL N/A
SOURCE ESF SDRD
WBS DESIGNATION 1.2.6
TITLE 1.2.6.2 Utilities
DESCRIPTION OF CHANGE

PARTICIPANT SAIC
DATE 6/10/88
ORIGINATOR SAIC
REV. NO. 1 DATE 12/18/87

In the ESF SDRD 1.2.6.2 Utilities Applicable Regulations, Codes, and Specifications (page 2-1 and 2-2) make the following changes: 1) Electrical Power change "DOE 6430.1 Chapter VI" to "Draft DOE 6430.1A dated 12/25/87 Division 16 Electrical." 2) Lighting change "DOE 6430.1, Chapter VIII, Lighting Design Standards" to "Draft DOE 6430.1A dated 12/25/87, Division 16; Electrical." 3) Standby power change "DOE 6430.1, Chapter VIII" to "Draft DOE 6430.1A dated 12/25/87, Division 16 Electric. 4) Uninterruptible Power change "DOE 6430.1 Chapter VI" to "Draft DOE 6430.1A dated 12/25/87 Division 16, Electrical." 5) Water system change "DOE 6430.1 Chapter V, X, and XII" to "Draft DOE 6430.1A dated 12/25/87 Division 2 Site and Civil Engineering and Division 15, Mechanical." 6) Sewage System change "DOE 6430.1 Chapter XII" to Draft DOE 6430.1A dated 12/25/87 Division 2, Site and Civil SEE CONTINUATION PAGE

BASIS FOR CHANGE Lester P. Skousen letter dated March 23, 1988.

SEE CONTINUATION PAGE

PARTICIPANT QA REP [signature] DATE 6/21/88
ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 6/21/88

SECTION 2. ICWG CHAIRMAN ACTION ____ NOT APPLICABLE

1. PROCEED WITH ECR EVALUATION ✓ YES ____ NO SCOPE CHANGE ____ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO CONSTRUCTION IMPACT ____ YES ____ NO

3. TOTAL COSTS (increase/decrease) ____ NOT APPLICABLE

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT ____ NOT APPLICABLE
ENGINEERING ____ WEEKS
CONSTRUCTION ____ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

6. FUNDING:
____ NOT APPLICABLE ____ NOT FUNDED, PROJECTED ONLY
____ CHANGE ORDER ____ SPECIAL STUDIES

ICWG CHAIRMAN/DATE

7. APPROVED

[signature] 7/8/88
ICWG CHAIRMAN/DATE

CSCR '89 008

ESF ENGINEERING CHANGE REQUEST

ESF 12-FM8-11/2

ECR NO. 016

Continuation Page

TITLE ESF SDRD 1.2.6.2 Utilities

CONTINUATION DATA Engineering." 7) Communications System change "DOE 6430.1 Chapter VII to "Draft DOE 6430.1A dated 12/25/87 Division 16 Electrical." 8) Compressed Air System change "DOE 6430.1" to "Draft DOE 6430.1A dated 12/25/87 Division 2 Site and Civil Engineering."

OTHER INFORMATION

1.2.6.2 UTILITIES

Subparts are:
1.2.6.2.1 Power systems
1.2.6.2.2 Water Systems
1.2.6.2.3 Sewage Systems
1.2.6.2.4 Communication System
1.2.6.2.5 Mine Wastewater System
1.2.6.2.6 Compressed Air System

Definition of Subsystem Elements

The utilities systems, subsystems, structures, and components include provisions for power, water, sewage, communications, mine wastewater, and compressed air.

Applicable Regulations, Codes, and Specifications

The power systems shall be designed in accordance with the following:

Electrical Power

1. Draft DOE 6430.1A dated 12/25/87 Division 16 Electrical
2. ANSI NFPA-70
3. ANSI C-2

Lighting

1. Draft DOE 6430.1A dated 12/25/87, Division 16, Electrical

Stand-by Power

1. Draft DOE 6430.1A dated 12/25/87 Division 16 Electrical

Uninterruptible Power

1. Draft DOE 6430.1A dated 12/25/87 Division 16 Electrical
2. IEEE-485
3. IEEE-650

The water systems shall be designed in accordance with the following:

1. Draft DOE 6430.1A dated 12/25/87 Division 2 Site and Civil Engineering and Division 15, Mechanical
2. Nevada Revised Statutes, Chapter 445, paragraphs .121 through .139
3. NEPA 20.22, 24

The sewage systems shall be designed in accordance with the following:

1. Draft DOE 6430.1A dated 12/25/87 Division 2, Site and Civil Engineering
2. Nevada Revised Statutes, Chapter 445, paragraph .121 through .139

The communications system design shall be in accordance with the following:

1. Draft DOE 6430.1A dated 12/25/87 Division 16 Electrical

The mine wastewater system shall be designed in accordance with the following:

1. 30 CFR, Chapter 1
2. Nevada mining law and California mine and tunnel safety orders
3. Nevada Revised Statutes, Chapter 445
4. DOE order 5480.1A

The compressed air system shall be designed in accordance with the following:

1. Draft DOE 6430.1A dated 12/25/87 Division 2 Site and Civil Engineering
2. 30 CFR, Chapter 1
3. Nevada mining law
4. California mine and tunnel safety orders

In addition, see Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

Functional Requirements

1. The utility systems, subsystems, and facilities shall provide electrical power, water, sewer, mine wastewater disposal, telephone, communications, compressed air, and area lighting to the ESF adequate to support construction and operation of the shafts, underground workings, and the ESF testing program during site characterization.

Performance Criteria

1. The utility services, such as power, water, and communications, shall have the capability of meeting ESF needs and be constructed and made available to meet all of the requirements for construction and operation of the ESF.

2. Utilities such as electric power, compressed air, and water systems shall be provided to underground construction, operations, and in situ site characterization areas. When installed, these systems shall not restrict foot, vehicular, or shaft conveyance traffic; obstruct ventilation; or cause health and safety concerns.

Interface Control Requirements

1. The A E must recognize that interfaces with Central Telephone Company of Nevada for communications and the Nevada Test Site (NTS) for utility supply will be required. Also see Section 1.2.6.0. Interface Control Requirements.

Constraints

1. The offsite utilities shall be considered as extending from the closest tie-in point off the ESF site to its designated point on the ESF site.

Assumptions

1. Solid refuse will be hauled to an existing landfill on the NTS.

1.2.6.2 UTILITIES

Subparts are:

Definition of Subsystem Elements

The utilities systems, subsystems, structures, and components include provisions for power, water, sewage, communications, mine wastewater, and compressed air.

Applicable Regulations, Codes, and Specifications

The power systems shall be designed in accordance with the following:

Electrical Power

1. DOE 6430.1, Chapter VI
2. ANSI NFPA-70
3. ANSI C-2

Lighting

1. DOE 6430.1, Chapter VIII, Lighting Design Standards

Stand-by Power

1. DOE 6430.1, Chapter VIII

Uninterruptible Power

1. DOE 6430.1, Chapter VI
2. IEEE-485
3. IEEE-650

The water systems shall be designed in accordance with the following:

1. DOE 6430.1, Chapters V, X, and XII
2. Nevada Revised Statutes, Chapter 445, paragraphs .121 through .139
3. NEPA 20.22, 24

The sewage systems shall be designed in accordance with the following:

1. DOE 6430.1, Chapter XII
2. Nevada Revised Statutes, Chapter 445, paragraph .121 through .139

The communications system design shall be in accordance with the following:

1. DOE 6430.1, Chapter VII

The mine wastewater system shall be designed in accordance with the following:

1. 30 CFR, Chapter 1
2. Nevada mining law and California mine and tunnel safety orders
3. Nevada Revised Statutes, Chapter 445
4. DOE order 5480.1A

The compressed air system shall be designed in accordance with the following:

1. DOE 6430.1
2. 30 CFR, Chapter 1
3. Nevada mining law
4. California mine and tunnel safety orders

In addition, see Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

Functional Requirements

1. The utility systems, subsystems, and facilities shall provide electrical power, water, sewer, mine wastewater disposal, telephone, communications, compressed air, and area lighting to the ESF adequate to support construction and operation of the shafts, underground workings, and the ESF testing program during site characterization.

Performance Criteria

1. The utility services, such as power, water, and communications, shall have the capability of meeting ESF needs and be constructed and made available to meet all of the requirements for construction and operation of the ESF.

2. Utilities such as electric power, compressed air, and water systems shall be provided to underground construction, operations, and in situ site characterization areas. When installed, these systems shall not restrict foot, vehicular, or shaft conveyance traffic; obstruct ventilation; or cause health and safety concerns.

EXISTING

Rev. 1

Interface Control Requirements

1. The A/E must recognize that interfaces with Central Telephone Company of Nevada for communications and the Nevada Test Site (NTS) for utility supply will be required. Also see Section 1.2.6.0, Interface Control Requirements.

Constraints

1. The offsite utilities shall be considered as extending from the closest tie-in point off the ESF site to its designated point on the ESF site.

Assumptions

1. Solid refuse will be hauled to an existing landfill on the NTS.

NNWSI PROJECT Page 1 of 1 N-AD-036 9/87

COST/SCHEDULE CHANGE REQUEST (C/SCR)

Change No.:	Organization:	Originator:	Origination Date:
89/009	SAIC	M. E. Spaeth	11/15/88

Title:

Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Request (ECR) 017

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 017.

REASON: See the "Basis for Change" on ESF ECR 017.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:

1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010 through 027.
2. ESF ECR 017.

Responsible Organization M. E. Spaeth [signature] Date 11/22/88

CCB Secretary P. C. Verkley [signature] Date 12/13/88

Approval: Project Manager, WMPO C. P. Gertz [signature] Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF-ECR 017.

C/SCR No: 89/009

Summary of Recommended Actions:

	Project Office				TSMSS			
	R&SE	E&D	P&CC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☒	☒	☒	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☐	☐	☐	☐
Non Concurrence	☐	☐	☐	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation:

Impact Analyses:

CCB Secretary P. C. Merkley (signature) Date 12/12/88

Page 1 of 1

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PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

Received In Configuration
Management Division
JUL 22 1988

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JUL 21 1988
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cc w/o encl:
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James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

CSCR ___'89 009

ESF ENGINEERING CHANGE REQUEST

ESF11.FMB-12/21

ECR NO. 017

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL N/A

SOURCE ESF SDRD

WBS DESIGNATION 1.2.6

TITLE 1.2.6.7 Underground Utility

DESCRIPTION OF CHANGE Systems

PARTICIPANT SAIC

DATE 6/10/88

ORIGINATOR SAIC

REV. NO. 1 DATE 12/18/88

In the ESF SDRD 1.2.6.7 Underground Utility Systems Applicable Codes, Regulations, and Specifications (page 7-1 and 7-2) make the following changes: 1) Electrical change DOE 6430.1 Chapter VI" to "Draft DOE 6430.1A dated 12/25/87 Division 16 Electrical." 2) Lighting change "DOE 6430.1 Chapter VIII, Lighting Design Standards" to "Draft DOE 6430.1A dated 12/25/87, Division 16 Electrical." 3) Standby power change "DOE 6430.1 Chapter VIII" to "Draft DOE 6430.1A dated 12/25/87, Division 16 Electrical." 4) Uninterruptible power change "DOE 6430.1 Chapter VI" to "Draft DOE 6430.1A dated 12/25/87 Division 16 Electrical." 5) Water systems change "DOE 6430.1 Chapters V, X, XII" to "Draft DOE 6430.1A dated 12/25/87 Division 2 Site and Civil Engineering and Divison 15 Mechanical." 6) Mine wastewater system change "DOE 6430.1 Chapter XII" to "Draft DOE 6430.1A dated 12/25/87 Division 2 SEE CONTINUATION PAGE

BASIS FOR CHANGE Lester P. Skousen letter dated March 23, 1988

SEE CONTINUATION PAGE

PARTICIPANT QA REP [signature] DATE 6/21/88

ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 6/21/88

SECTION 2 ICWG CHAIRMAN ACTION ___ NOT APPLICABLE

1. PROCEED WITH ECR EVALUATION ✓ YES ___ NO SCOPE CHANGE ___ YES ___ NO
2. PROCEED WITH WORK ___ YES ___ NO CONSTRUCTION IMPACT ___ YES ___ N

3. TOTAL COSTS (increase/decrease) ___ NOT APPLICABLE

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT ___ NOT APPLICABLE

ENGINEERING ___ WEEKS
CONSTRUCTION ___ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ___ YES ___ NO
PROCEED WITH DETAIL ESTIMATE ___ YES ___ NO

6. FUNDING:

___ NOT APPLICABLE ___ NOT FUNDED, PROJECTED ONLY

___ CHANGE ORDER ___ SPECIAL STUDIES

ICWG CHAIRMAN/DATE

7. APPROVED

[signature] 7/1/88

ICWG CHAIRMAN/DATE

CSCR ____'89 009

ESF ENGINEERING CHANGE REQUEST

ESF12.FMB-11/

ECR NO. 017

Continuation Page

TITLE ESF SDRD 1.2.6.7 Underground Utility Systems

CONTINUATION DATA Site and Civil Engineering."

OTHER INFORMATION

1.2.6.7 UNDERGROUND UTILITY SYSTEMS

Subparts are:

1.2.6.7.1 Power Distribution System
1.2.6.7.2 Communications System
1.2.6.7.3 Lighting System
1.2.6.7.4 Ventilation System
1.2.6.7.5 Water Distribution System
1.2.6.7.6 Mine Wastewater Collection System
1.2.6.7.7 Compressed Air Distribution System
1.2.6.7.8 Fire Protection System
1.2.6.7.9 Muck Handling Systems
1.2.6.7.10 Sanitary Facilities
1.2.6.7.11 Monitoring and Warning Systems

Definition of Subsystem Elements

The underground utility systems, subsystems, and components include provisions for power, communications, lighting, ventilation, water, mine wastewater, compressed air, fire protection, excavation and muck handling, sanitary, and monitoring and warning systems required to meet the needs of the underground site characterization testing program during construction and operation.

Applicable Codes, Regulations, and Specifications

General

1. 30 CFR Part 57
2. Nevada Mining Law
3. California Mine and Tunnel Safety Orders

Electrical

1. Draft DOE 6430.1A dated 12/25/87 Division 16 Electrical
2. ANSI/NFPA-70
3. ANSI C-2

Lighting

1. Draft DOE 6430.1A dated 12/25/87, Division 16 Electrical

Stand-by power

1. Draft DOE 6430.1A dated 12/25/87, Division 16 Electrical

Uninterruptible power

1. Draft DOE 6430.1A dated 12/25/87, Division 16 Electrical
2. IEEE-485
3. IEEE-650

Water systems

1. Draft DOE 6430.1A dated 12/25/87, Division 2 Site and Civil Engineering and Division 15 Mechanical
2. NRS Chapter 445, paragraphs .121 through .139

Mine wastewater system

1. Draft DOE 6430.1A dated 12/25/87 Division 2 Site and Civil Engineering

Ventilation system and dust control

1. American Institute of Government Hygienists, Industrial Ventilation, Manual of Recommended Practice

In addition, see Section 1.2.6.0, Applicable Codes, Regulations, and Specifications.

Functional Requirements

1. Provide utilities for underground ESF operations, in situ site characterization, and monitoring activities.

2. Provide facilities and equipment for the installation and maintenance of the underground utilities.

3. Provide for the distribution of utilities around the operations area of the Main Test Level in such a manner to allow for flexibility in the siting and construction of the final testing locations.

Performance Criteria

1. The underground utility systems and service facilities shall have suitable utilities, including power, lights, water and compressed air, as required for construction, operations, and in situ site characterization, and shall be capable of supporting the uncertainty allowances as defined in Section 1.2.6.0, Performance Criteria item #2.

2. The utility services shall include minimal backup units for primary power lines, primary pumps, shaft conveyances, primary ventilation fans, and primary communications and testing equipment to allow testing continuity based upon NNWSI Project analysis.

3. Cranes, lifting equipment, and shop machinery shall be consistent with maintenance needs.

Interface Control Requirements

See Section 1.2.6.0, Interface Control Requirements.

Constraints

1. Utility systems (i.e., electric power, air, water, etc.), when installed, shall not restrict foot, vehicular, or shaft conveyance traffic; obstruct ventilation; or cause safety hazards.

2. In the selection of equipment that will require maintenance, consideration shall be given to:

   a. The availability and cost of replacement materials and parts.

   b. The need for equipment manufacturer's technical services.

Assumptions

None.

1.2.6.7 UNDERGROUND UTILITY SYSTEMS

Subparts are:

1.2.6.7.1 Power Distribution System
1.2.6.7.2 Communications System
1.2.6.7.3 Lighting System
1.2.6.7.4 Ventilation System
1.2.6.7.5 Water Distribution System
1.2.6.7.6 Mine Wastewater Collection System
1.2.6.7.7 Compressed Air Distribution System
1.2.6.7.8 Fire Protection System
1.2.6.7.9 Muck Handling Systems
1.2.6.7.10 Sanitary Facilities
1.2.6.7.11 Monitoring and Warning Systems

Definition of Subsystem Elements

The underground utility systems, subsystems, and components include provisions for power, communications, lighting, ventilation, water, mine wastewater, compressed air, fire protection, excavation and muck handling, sanitary, and monitoring and warning systems required to meet the needs of the underground site characterization testing program during construction and operation.

Applicable Codes, Regulations, and Specifications

General

1. 30 CFR Part 57
2. Nevada Mining Law
3. California Mine and Tunnel Safety Orders

Electrical

1. DOE 6430.1, Chapter VI
2. ANSI/NFPA-70
3. ANSI C-2

Lighting

1. DOE 6430.1, Chapter VIII, Lighting Design Standards

Stand-by power

1. DOE 6430.1, Chapter VIII

Uninterruptible power

1. DOE 6430.1, Chapter VI
2. IEEE-485
3. IEEE-650

Water systems

1. DOE 6430.1, Chapters V, X, XII
2. NRS Chapter 445, paragraphs .121 through .139

Mine wastewater system

1. DOE 6430.1, Chapter XII

Ventilation system and dust control

1. American Institute of Government Hygienists, Industrial Ventilation, Manual of Recommended Practice

In addition, see Section 1.2.6.0, Applicable Codes, Regulations, and Specifications.

Functional Requirements

1. Provide utilities for underground ESF operations, in situ site characterization, and monitoring activities.
2. Provide facilities and equipment for the installation and maintenance of the underground utilities.
3. Provide for the distribution of utilities around the operations area of the Main Test Level in such a manner to allow for flexibility in the siting and construction of the final testing locations.

Performance Criteria

1. The underground utility systems and service facilities shall have suitable utilities, including power, lights, water and compressed air, as required for construction, operations, and in situ site characterization, and shall be capable of supporting the uncertainty allowances as defined in Section 1.2.6.0, Performance Criteria item #2.
2. The utility services shall include minimal backup units for primary power lines, primary pumps, shaft conveyances, primary ventilation fans, and primary communications and testing equipment to allow testing continuity based upon NNWSI Project analysis.
3. Cranes, lifting equipment, and shop machinery shall be consistent with maintenance needs.

Interface Control Requirements

See Section 1.2.6.0, Interface Control Requirements.

Constraints

1. Utility systems (i.e., electric power, air, water, etc.), when installed, shall not restrict foot, vehicular, or shaft conveyance traffic; obstruct ventilation; or cause safety hazards.

2. In the selection of equipment that will require maintenance, consideration shall be given to:

   a. The availability and cost of replacement materials and parts.

   b. The need for equipment manufacturer's technical services.

Assumptions

None.

NNWSI PROJECT
COST/SCHEDULE CHANGE REQUEST (C/SCR)

N-AD-036
9/87

Change No:	Organization:	Originator:	Origination Date:
89/010	SAIC	M. E. Spaeth	11/15/88

Title:
Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the with the Approved ESF Engineering Change Request (ECR) 018

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 018.

REASON: See the "Basic for Change" on ESF ECR 018.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:
1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988 Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010 through 027.
2. ESF ECR 018.

Responsible Organization M. E. Spaeth [signature] Date 11/22/88
CCB Secretary P. C. Merkley [signature] Date 12/13/88
Approval: Project Manager, WMPO C. P. Gertz [signature] Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF-ECR 018.	C/SCR No: 89/010

Summary of Recommended Actions:

	Project Office				T&MSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☒	☒	☒	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☐	☐	☐	☐
Non Concurrence	☐	☐	☐	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation:

Impact Analyses:

CCB Secretary P. C. Merkley [signature] Date 12/12/88

Page 1 of 1

CSCR ____'89 010

Department of Energy
Nevada Operations Office
P. O. Box 98518
Las Vegas, NV 89193-8518

JUL 20 1988

RECEIVED
M. E. SPAETH
JUL 21 1988
Route Merkley - XTIKA
Copies ____

Michael E. Spaeth
Technical Project Officer
for NNWSI
ATTN: Phil Merkley
Science Applications
International Corporation
Suite 407
101 Convention Center Drive
Las Vegas, NV 89109

PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

Received In Configuration Management Division
JUL 22 1988

SAIC/T&MSS
JUL 21 1988
CCF RECEIVED

CSCR ____'89 010

cc w/o encl:
V. J. Cassella, HQ (RW-123) FORS
Dean Stucker, HQ (RW-223) FORS
G. K. Beall, SAIC, Las Vegas, NV
M. C. Brake, SAIC, Las Vegas, NV
R. R. Reust, SAIC, Las Vegas, NV
John Nimmo, SAIC, Las Vegas, NV
S. H. Klein, SAIC, Las Vegas, NV
W. E. Narrows, SAIC, Las Vegas, NV
James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

CSCR ____'89 010

ESF ENGINEERING CHANGE REQUEST

ESF11.FMB-12/21

ECR NO. 018 PAGE 1 OF 1

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL	N/A	PARTICIPANT	SAIC
SOURCE	ESF SDRD	DATE	6/10/88
WBS DESIGNATION	1.2.6	ORIGINATOR	SAIC
TITLE	1.2.6.1 Site	REV. NO. 1 DATE	12/18/87
DESCRIPTION OF CHANGE			

In the ESF SDRD, 1.2.6.1 Site Application Regulations, Codes, and Specifications (page 1-1), change "DOE 6430.1, Chapters, I, II, XI, XII" to "Draft DOE 6430.1A dated 12/25/87, Division 1 General Requirements except for the seismic requirements in 0111.2.7, Earthquake Loads, Division 2, Site and Civil Engineering, Division 3, Concrete and Division 5, Metals."

SEE CONTINUATION PAGE

BASIS FOR CHANGE

Lester P. Skousen, letter dated 3/23/88. WMPO:MBB-2016, dtd. 5/9/88 and WMPO:MBB-2051, dtd. 5/12/88

SEE CONTINUATION PAGE

PARTICIPANT QA REP [signature] DATE 6/21/88 ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 6/21/88

SECTION 2 ICWG CHAIRMAN ACTION ____ NOT APPLICABLE

1. PROCEED WITH ECR EVALUATION ✓ YES ____ NO SCOPE CHANGE ____ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO CONSTRUCTION IMPACT ____ YES ____ NO

3. TOTAL COSTS (increase/decrease) ____ NOT APPLICABLE

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT ____ NOT APPLICABLE

ENGINEERING ____ WEEKS
CONSTRUCTION ____ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
   PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

6. FUNDING:

____ NOT APPLICABLE ____ NOT FUNDED, PROJECTED ONLY

____ CHANGE ORDER ____ SPECIAL STUDIES

ICWG CHAIRMAN/DATE

7. APPROVED

[signature] 7/8/88

ICWG CHAIRMAN/DATE

1.2.6.1 SITE

Subparts are:

1.2.6.1.1 Main Pad
1.2.6.1.2 Auxiliary Pads
1.2.6.1.3 Access Roads
1.2.6.1.4 Site Drainage

Definition of Subsystem Elements

The ESF site is defined as the systems, subsystems and components located on Government-owned land necessary for the development of the surface and underground facilities and supporting systems required to support site characterization testing at depth. The site is comprised of the main pad, auxiliary pads, access roads, and drainage system contained within the boundaries of the ESF.

The ESF will be located in Coyote Wash on the eastern side of Yucca Mountain at an elevation of about 4,130 feet and placed on a cut-and-fill rock shelf located on the side of the hill that bounds the wash on the northeast.

Applicable Regulations, Codes, and Specifications

The design shall be in accordance with:

1. Draft DOE 6430.1A dated 12/25/87, Division 1 General Requirements except for the seismic requirements in 0111 2.7, Earthquake Loads, Division 2, Site and Civil Engineering, Division 3, Concrete and Division 5, Metals.
2. Nevada Revised Statues - Chapter 445, para. 705, item 8.
3. State of Nevada Department of Highways Section 201 through 212.

In addition, see Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

Functional Requirements

1. Site systems, subsystems, and components are composed of general civil improvements. This includes but is not limited to clearing, grading, excavations, filling, parking areas, flood protection, drainage systems, temporary roads, laydown areas, and top soil storage areas adequate to support construction and operation of the shafts, underground workings, and testing program.

2. Roads, building pads, utility corridors, and rock-storage areas shall be cleared, graded, and stabilized.

3. The surface layout (site plan) must accommodate future expansion as determined by the uncertainty allowance (see Section 1.2.6.0, Performance Criteria item #2).

Performance Criteria

1. The site systems, subsystems, and components shall provide a safe, healthful, and productive working environment.

2. Site systems, subsystems, and features related to drainage ponds and rock storage areas shall be designed and constructed for a maintainable 25-year life.

3. Site preparation for shaft collars shall be designed and constructed for a maintainable 100-year life.

4. Dust control shall be provided at potential dust-generation areas such as roads and earth moving sites in order to minimize airborne particulates, as required by federal, state, and local codes.

5. The shafts and shaft collar areas shall be located and/or graded to protect them from the probable maximum flood as defined in the RIB.

Interface Control Requirements

The ESF designers shall coordinate with repository designers on ESF site location and layout and on permanent ESF structures, systems, and components, and shall make available all design information pertaining to the permanent ESF components during formal program design reviews.

In addition, see Section 1.2.6.0, Interface Control Requirements.

Constraints

1. The design and construction of the site (civil improvements) for the permanent ESF structures, systems, and components shall not significantly increase the preferential pathways for groundwater or radioactive waste migration to the accessible environment.

2. The site systems, subsystems, and components shall incorporate environmental impact considerations with respect to ground disturbance, dust control, etc. (See Section 1.2.6.0, Constraints item #1.)

3. All storm-water runoff shall be controlled in an environmentally acceptable manner.

4. The design life for all ESF systems, components, and structures shall be as follows:

a. Permanent ESF structures, systems, and components shall be designed and constructed for a 100-year maintainable life.

b. Drainage ponds and rock storage (muck pile) liners shall be designed and constructed for a maintainable 25-year life.

c. The design life for all other ESF systems, components, and structures shall be maintainable for 5 years unless otherwise specified.

5. The first shaft, ES-1, shall be located at the intersection of the following coordinates: E563,630 and N766,255, as defined by the Nevada Coordinate System.

6. The second shaft, ES-2, shall be located at the intersection of the following coordinates: E563,918 and N766,337, as defined by the Nevada Coordinate System.

7. Access to the ESF site pad from the east shall be controlled by a chain-link fence and gates.

8. Existing roads, utilities, and structures shall be incorporated into the ESF if this incorporation can be shown to be cost effective.

9. The area within the site boundaries shall be cleared of unusable roads, utilities, and structures that interfere with the ESF.

10. The designs for site preparation shall ensure that construction activities disturb only the minimum amount of land necessary to accomplish the project.

11. Topsoil shall be stored in an environmentally acceptable manner.

12. The ESF shall be designed to operate on a 3-shift-per-day, 7-days-per- week schedule throughout both the ESF construction and operation phases.

13. Lighting in operations areas shall support security requirements.

14. The design shall include considerations for site restoration.

Assumptions

1. Surface characteristics such as topography, meteorological conditions, and flood potential are important factors in the process of designing surface facilities. It is incumbent upon the designers to include these factors during the design process.

2. All necessary civil work to support the site systems, subsystems, and components will be completed in order to meet the schedule of approved in situ site characterization activities.

3. The natural terrain will provide a barrier to vehicle access from elsewhere on the site.

1.2.6.1 SITE

Subparts are:
1.2.6.1.1 Main Pad
1.2.6.1.2 Auxiliary Pads
1.2.6.1.3 Access Roads
1.2.6.1.4 Site Drainage

Definition of Subsystem Elements

The ESF site is defined as the systems, subsystems and components located on Government-owned land necessary for the development of the surface and underground facilities and supporting systems required to support site characterization testing at depth. The site is comprised of the main pad, auxiliary pads, access roads, and drainage system contained within the boundaries of the ESF.

The ESF will be located in Coyote Wash on the eastern side of Yucca Mountain at an elevation of about 4,130 feet and placed on a cut-and-fill rock shelf located on the side of the hill that bounds the wash on the northeast.

Applicable Regulations, Codes, and Specifications

The design shall be in accordance with:

1. DOE 6430.1, Chapters I, II, XI, XII.
2. Nevada Revised Statues - Chapter 445, para. 705, item 8.
3. State of Nevada Department of Highways Section 201 through 212.

In addition, see Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

Functional Requirements

1. Site systems, subsystems, and components are composed of general civil improvements. This includes but is not limited to clearing, grading, excavations, filling, parking areas, flood protection, drainage systems, temporary roads, laydown areas, and top soil storage areas adequate to support construction and operation of the shafts, underground workings, and testing program.

2. Roads, building pads, utility corridors, and rock-storage areas shall be cleared, graded, and stabilized.

3. The surface layout (site plan) must accommodate future expansion as determined by the uncertainty allowance (see Section 1.2.6.0, Performance Criteria item #2).

Performance Criteria

1. The site systems, subsystems, and components shall provide a safe, healthful, and productive working environment.
2. Site systems, subsystems, and features related to drainage ponds and rock storage areas shall be designed and constructed for a maintainable 25-year life.
3. Site preparation for shaft collars shall be designed and constructed for a maintainable 100-year life.
4. Dust control shall be provided at potential dust-generation areas such as roads and earth moving sites in order to minimize airborne particulates, as required by federal, state, and local codes.
5. The shafts and shaft collar areas shall be located and/or graded to protect them from the probable maximum flood as defined in the RIB.

Interface Control Requirements

The ESF designers shall coordinate with repository designers on ESF site location and layout and on permanent ESF structures, systems, and components, and shall make available all design information pertaining to the permanent ESF components during formal program design reviews.

In addition, see Section 1.2.6.0, Interface Control Requirements.

Constraints

1. The design and construction of the site (civil improvements) for the permanent ESF structures, systems, and components shall not significantly increase the preferential pathways for groundwater or radioactive waste migration to the accessible environment.
2. The site systems, subsystems, and components shall incorporate environmental impact considerations with respect to ground disturbance, dust control, etc. (See Section 1.2.6.0, Constraints item #1.)
3. All storm-water runoff shall be controlled in an environmentally acceptable manner.
4. The design life for all ESF systems, components, and structures shall be as follows:
   a. Permanent ESF structures, systems, and components shall be designed and constructed for a 100-year maintainable life.
   b. Drainage ponds and rock storage (muck pile) liners shall be designed and constructed for a maintainable 25-year life.

c. The design life for all other ESF systems, components, and structures shall be maintainable for 5 years unless otherwise specified.

5. The first shaft, ES-1, shall be located at the intersection of the following coordinates: E563,630 and N766,255, as defined by the Nevada Coordinate System.

6. The second shaft, ES-2, shall be located at the intersection of the following coordinates: E563,918 and N766,337, as defined by the Nevada Coordinate System.

7. Access to the ESF site pad from the east shall be controlled by a chain-link fence and gates.

8. Existing roads, utilities, and structures shall be incorporated into the ESF if this incorporation can be shown to be cost effective.

9. The area within the site boundaries shall be cleared of unusable roads, utilities, and structures that interfere with the ESF.

10. The designs for site preparation shall ensure that construction activities disturb only the minimum amount of land necessary to accomplish the project.

11. Topsoil shall be stored in an environmentally acceptable manner.

12. The ESF shall be designed to operate on a 3-shift-per-day, 7-days-per-week schedule throughout both the ESF construction and operation phases.

13. Lighting in operations areas shall support security requirements.

14. The design shall include considerations for site restoration.

Assumptions

1. Surface characteristics such as topography, meteorological conditions, and flood potential are important factors in the process of designing surface facilities. It is incumbent upon the designers to include these factors during the design process.

2. All necessary civil work to support the site systems, subsystems, and components will be completed in order to meet the schedule of approved in situ site characterization activities.

3. The natural terrain will provide a barrier to vehicle access from elsewhere on the site.

N-AD-036
9/87

NNWSI PROJECT
COST/SCHEDULE CHANGE REQUEST (C/SCR)

Change No.:	Organization:	Originator:	Origination Date:
89/011	SAIC	M. E. Spaeth	11/15/88

Title:

Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Request (ECR) 019

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 019.

REASON: See the "Basis for Change" on ESF ECR 019.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:

1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010 through 027.
2. ESF ECR 019.

Responsible Organization M. E. Spaeth [signature] Date 11/22/88

CCB Secretary P. C. Merkley [signature] Date 12/13/88

Approval: Project Manager, WMPO C. P. Gertz [signature] Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESD SDRD in accordance with approved ESF-ECR 019.

C/SCR No: 89/011

Summary of Recommended Actions:

	Project Office				T&MSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☒	☒	☒	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☐	☐	☐	☐
Non Concurrence	☐	☐	☐	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation:

Impact Analyses:

CCB Secretary P. C. Merkley [signature] Date 12/12/88

Page 1 of 1

CSCR ——'89 011

Department of Energy
Nevada Operations Office
P. O. Box 98518
Las Vegas, NV 89193-8518

JUL 20 1988

RECEIVED
M. E. SPAETH
JUL 21 1988
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Michael E. Spaeth
Technical Project Officer
for NNWSI
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Science Applications
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101 Convention Center Drive
Las Vegas, NV 89109

PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

Received In Configuration
Management Division
JUL 22 1988

SAIC/T&MSS
JUL 21 1988
CCF RECEIVED

CSCR ____'89 011

JUL 20 1989

cc w/o encl:
V. J. Cassella, HQ (RW-123) FORS
Dean Stucker, HQ (RW-223) FORS
G. K. Beall, SAIC, Las Vegas, NV
M. C. Brake, SAIC, Las Vegas, NV
R. R. Reust, SAIC, Las Vegas, NV
John Nimmo, SAIC, Las Vegas, NV
S. H. Klein, SAIC, Las Vegas, NV
W. E. Narrows, SAIC, Las Vegas, NV
James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

CSCR ____'89 011

ESF ENGINEERING CHANGE REQUEST

ESF 11.FMB-12/21

ECR NO. 019 PAGE 1 OF 1

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL N/A
SOURCE ESF SDRD
WBS DESIGNATION 1.2.6
TITLE 1.2.6.3 Surface Facilities
DESCRIPTION OF CHANGE

PARTICIPANT SAIC
DATE 6/10/88
ORIGINATOR SAIC
REV. NO. 1 DATE 12/18/87

In the ESF SDRD 1.2.6.3, Surface Facilities Applicable Regulations, Codes, and Specifications (page 3-1) change "DOE 6430.1" to "Draft DOE 6430.1A dated 12/25/87 except for seismic requirements 0111-2.7 Earthquake Loads."

SEE CONTINUATION PAGE

BASIS FOR CHANGE Lester P. Skousen letter dated March 23, 1988.
WMPO:MBB-2051, dtd. 5/12/88 and WMPO:MBB-2016, dtd. 5/9/88

SEE CONTINUATION PAGE

PARTICIPANT QA REP [signature] DATE 6/21/88
ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 6/21/88

SECTION 2. ICWG CHAIRMAN ACTION ____ NOT APPLICABLE

1. PROCEED WITH ECR EVALUATION ✓ YES ____ NO SCOPE CHANGE ____ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO CONSTRUCTION IMPACT ____ YES ____ NO

3. TOTAL COSTS (increase/decrease) ____ NOT APPLICABLE

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT ____ NOT APPLICABLE

ENGINEERING ____ WEEKS
CONSTRUCTION ____ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

6. FUNDING:

____ NOT APPLICABLE ✓ NOT FUNDED, PROJECTED ONLY

____ CHANGE ORDER ____ SPECIAL STUDIES

ICWG CHAIRMAN/DATE

7. APPROVED

[signature] 7/8/88
ICWG CHAIRMAN/DATE

1.2.6.3 SURFACE FACILITIES

Subparts are.

1.2.6.3.1 Ventilation System
1.2.6.3.2 Test Support Facilities
1.2.6.3.3 Trailer Spaces
1.2.6.3.4 Parking Areas
1.2.6.3.5 Materials Storage Facilities
1.2.6.3.6 Shop
1.2.6.3.7 Warehouse
1.2.6.3.8 Trailers
1.2.6.3.9 A&E Building (Area 25)
1.2.6.3.10 Communications/Data Building

Definition of Subsystem Elements

The surface facilities system and subsystem includes all the facilities. systems. and services for the surface buildings and trailers that are required for the support of ESF operations and in situ site characterization.

Applicable Regulations, Codes, and Specifications

The designs shall be in accordance with:

1. DOE 6430.1A dated 12/25/87 except for seismic requirements 0111-2.7 Earthquake loads.

In addition. see Section 1.2 6.0. Applicable Regulations. Codes. and Specifications.

Functional Requirements

1 Provide buildings and supporting equipment for the following functions:

a. Ventilation system
b. Test support facilities
   1) Test apparatus assembly pad
c. Trailer spaces
d. Parking areas
   1) Surface mobile equipment

2) Personnel parking
3) Visitor parking

e. Materials storage facilities
f. Shop
g. Warehouse
h. Trailers
1) Offices for Principal Investigators (PIs)
2) Offices for site security
3) Offices for site operations staff
4) Offices for site administration and training
5) Offices for Quality Assurance
6) Offices for support of shaft and facility construction
7) Laboratories, etc.
8) Change trailers
9) First aid trailer
10) Test support trailer
11) NRC and State offices

i. A&E building (Area 25)
1) Administration
2) Visitors
3) Training
4) Engineering staff
5) Security
6) Labs (as required)
7) Sleeping quarters (as required)
8) Offices for PIs
9) NRC and State offices

j. Communications and data building
1) Computer control system
2) Data acquisition (IDS)
3) Communications equipment

2 Provide air quality monitoring

3 Provide water quality monitoring (including the physical, chemical, and biological characteristics of ESF wastewater, the receiving water body, and any other water bodies that could be affected by ESF operations).

4 Provide dust control and or collection facilities.

5 Provide for the detection of and protection from fires and explosions

6. Provide onsite transportation facilities for equipment, materials, and rock.

Performance Criteria

1. The surface facilities shall meet the operational requirements of the users.

2 The surface facilities shall be designed and constructed for a nominal 5-year life, unless otherwise noted.

3 The surface facilities and their locations shall (a) facilitate the flow of material and personnel within the ESF site and (b) provide adequate ESF site security, including controlled access and emergency response.

4. The facilities shall be complete with Heating Ventilation and Air Conditioning (HVAC), compressed air, plumbing and sanitary facilities, lighting, communications, and fire protection systems, as appropriate for the intended use.

5. Surface facilities shall combine functions when the combinations are cost effective.

6. The surface facilities shall be located away from potential dust generating areas to the extent practicable.

Interface Control Requirements

See Section 1.2.6.0, Interface Control Requirements.

Constraints

1. The general layout of the surface facilities shall be designed to minimize disturbance to the existing area.

2. To the extent practicable and economical, modular, relocatable, or portable structures shall be considered for surface facilities.

3 To the extent practicable and consistent with procurement regulations, consideration of surplus government equipment shall be given to fulfill the requirements for the surface facilities and equipment.

4 Each inhabited structure shall have rest rooms, water heating, space heating, and air conditioning, as required for the intended use.

Assumptions

None.

1.2.6.3 SURFACE FACILITIES

Subparts are:

Definition of Subsystem Elements

The surface facilities system and subsystem includes all the facilities, systems, and services for the surface buildings and trailers that are required for the support of ESF operations and in situ site characterization.

Applicable Regulations, Codes, and Specifications

The designs shall be in accordance with:

1. DOE 6430.1

In addition, see Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

Functional Requirements

1. Provide buildings and supporting equipment for the following functions:

   a. Ventilation system
   b. Test support facilities
      1) Test apparatus assembly pad
   c. Trailer spaces
   d. Parking areas
      1) Surface mobile equipment
      2) Personnel parking
      3) Visitor parking
   e. Materials storage facilities
   f. Shop
   g. Warehouse
   h. Trailers

1) Offices for Principal Investigators (PIs)
2) Offices for site security
3) Offices for site operations staff
4) Offices for site administration and training
5) Offices for Quality Assurance
6) Offices for support of shaft and facility construction
7) Laboratories, etc.
8) Change trailers
9) First aid trailer
10) Test support trailer
11) NRC and State offices

i. A&E building (Area 25)
1) Administration
2) Visitors
3) Training
4) Engineering staff
5) Security
6) Labs (as required)
7) Sleeping quarters (as required)
8) Offices for PIs
9) NRC and State offices

j. Communications and data building
1) Computer/control system
2) Data acquisition (IDS)
3) Communications equipment

2. Provide air quality monitoring.

3. Provide water quality monitoring (including the physical, chemical, and biological characteristics of ESF wastewater, the receiving water body, and any other water bodies that could be affected by ESF operations).

4. Provide dust control and/or collection facilities.

5. Provide for the detection of and protection from fires and explosions.

6. Provide onsite transportation facilities for equipment, materials, and rock.

Performance Criteria

1. The surface facilities shall meet the operational requirements of the users.

2. The surface facilities shall be designed and constructed for a nominal 5-year life, unless otherwise noted.

3. The surface facilities and their locations shall (a) facilitate the flow of material and personnel within the ESF site and (b) provide adequate ESF site security, including controlled access and emergency response.

4. The facilities shall be complete with Heating Ventilation and Air Conditioning (HVAC), compressed air, plumbing and sanitary facilities, lighting, communications, and fire protection systems, as appropriate for the intended use.

5. Surface facilities shall combine functions when the combinations are cost effective.

6. The surface facilities shall be located away from potential dust generating areas to the extent practicable.

Interface Control Requirements

See Section 1.2.6.0, Interface Control Requirements.

Constraints

1. The general layout of the surface facilities shall be designed to minimize disturbance to the existing area.

2. To the extent practicable and economical, modular, relocatable, or portable structures shall be considered for surface facilities.

3. To the extent practicable and consistent with procurement regulations, consideration of surplus government equipment shall be given to fulfill the requirements for the surface facilities and equipment.

4. Each inhabited structure shall have rest rooms, water heating, space heating, and air conditioning, as required for the intended use.

Assumptions

None.

NNWSI PROJECT
COST/SCHEDULE CHANGE REQUEST (C/SCR)

Page 1 of 1

N-AD-036
9/87

Change No.:	Organization:	Originator:	Origination Date:
89/012	SAIC	M. E. Spaeth	11/15/88

Title:

Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Request (ECR) 020

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 020.

REASON: See the "Basis for Change" on ESF ECR 020.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:
1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engi ering Change Requests (ECRs) 010 through 027.
2. ESF ECR 020.

Responsible Organization M. E. Spaeth [signature] Date 11/22/88

CCB Secretary P. C. Merkley [signature] Date 12/13/88

Approval: Project Manager, WMPO C. P. Gertz [signature] Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF-ECR 020.	C/SCR No: 89/012

Summary of Recommended Actions:

	Project Office				TSMSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☐	☐	☐	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☒(1)	☐	☐	☐
Non Concurrence	☐	☐	☒(2)	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation: (1) "This will have a Cost Impact but no Schedule Impact".

(2) "This request for an additional safety ground system to be designed by H&N for the main ESF Substation is "New Work". As a result, there is no data/analysis to substantiate the added cost and schedule impacts. This must be provided".

Impact Analyses: Data was not provided to indicate impact relating to the cost.

CCB Secretary P. C. Merkley [signature] Date 12/12/88

Page 1 of 1

CSCR ____'89 012

Department of Energy
Nevada Operations Office
P. O. Box 98518
Las Vegas, NV 89193-8518

JUL 20 1988

RECEIVED
M. E. SPAETH
JUL 21 1988
Route Merkley - XTRA
Copies ____

Michael E. Spaeth
Technical Project Officer
for NNWSI
ATTN: Phil Merkley
Science Applications
International Corporation
Suite 407
101 Convention Center Drive
Las Vegas, NV 89109

PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

Received In Configuration
Management Division
JUL 22 1988

SAIC/T&MSS
JUL 21 1988
CCF RECEIVED

CSJR ____'89 012

JUL 20 1988

cc w/o encl:
V. J. Cassella, HQ (RW-123) FORS
Dean Stucker, HQ (RW-223) FORS
G. K. Beall, SAIC, Las Vegas, NV
M. C. Brake, SAIC, Las Vegas, NV
R. R. Reust, SAIC, Las Vegas, NV
John Nimmo, SAIC, Las Vegas, NV
S. H. Klein, SAIC, Las Vegas, NV
W. E. Narrows, SAIC, Las Vegas, NV
James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

CSCB '89 012

ESF ENGINEERING ~~CHANGE~~ REQUEST

ESTP11.FMB-12/28/8

ECR NO. 020

PAGE 1 OF 2

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL	II	PARTICIPANT	Fenix & Scisson
SOURCE	Fenix & Scisson, Inc.	DATE	6-21-88
WBS DESIGNATION	1.2.6.2.1	ORIGINATOR	Tom Greiner
TITLE	Electrical Grounding System	REV. NO. ____	DATE ____
DESCRIPTION		REV. NO. ____	DATE ____

A safety ground system will be designed and specified by Holmes and Narver at the main substation for the ESF. The 4,160 volt system will have the neutral grounded through a 25 amp resisto: and connected to a safety ground bed separated by a minimum of 50 ft. The SDRD Sections 1.2.6.2.1, 1.2.6.4 and 1.2.6.5 need to be revised.

SEE CONTINUATION PAGE

BASIS FOR CHANGE

1. Provide highest degree of personnel safety using mobile equipment.
2. Agrees with the current trend at the NTS for a safety ground system for subsurface activities.

SEE CONTINUATION PAGE

SCOPE CHANGE X YES ____ NO   CONSTRUCTION IMPACT X YES ____ NO

PARTICIPANT QA REP [signature] DATE 6/27/88   ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 6/27/88

SECTION 2. ACTION

1. PROCEED WITH ECR EVALUATION ✓ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO

[signature]
ESF ICWG CHAIRMAN

3. TOTAL COSTS (Increase/decrease)

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT

ENGINEERING ____ ____ WEEKS
CONSTRUCTION ____ ____ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

ESF CHAIRMAN ICWG

6. FUNDING:

____ CHANGE ORDER ____ SPECIAL STUDIES

✓ NOT FUNDED, PROJECTED ONLY

[signature]
ESF CHAIRMAN ICWG

7. APPROVED FOR BASELINING

[signature]
ESF CHAIRMAN ICWG

ATTACHMENT TO FSECR-003

A. Revisions to the subsystems Design Requirements Document:

1. Section 1.2.6.2.1, power systems - refer to the last sentence of paragraph 2 under performance criteria.

   Present wording = "Adequate surge protection and a well-engineered grounding system shall be provided in order to maximize personnel and equipment safety."

   Revision: "Adequate primary surge protection and a well-engineered, separate "safety" grounding system shall be provided in order to maximize personnel and equipment safety."

2. Section 1.2.6.4, First Shaft - Constraint No. 11.

   Present Wording: "Utility lines, shaft steel, etc., shall be designed such that the integrity of the underground electrical grounding system is electrically isolated from the surface electrical grounding system."

   Revision: "Utility lines, shaft steel, etc., shall be designed such that the underground electrical grounding system is electrically bonded to the surface electrical "safety" grounding system."

3. Section 1.2.6.5, Second Shaft - Constraint No. 13.

   Present wording and the revisions are exactly the same as stated in number A2 above for 1.2.6.4.

1.2.6.2.1 POWER SYSTEMS

Definition of Subsystem Elements

The power systems are defined as those systems, subsystems, components, and structures that supply electrical power to the ESF site. These systems include, but are not limited to, the ESF site substation, extension of the existing 69-kV overhead power line, a secondary power line (to the booster pump station), surface lighting, a stand-by power generation system, and an uninterruptable power system (UPS).

Functional Requirements

Electrical power systems shall provide all of the necessary power, during both normal and peak demands, for the construction and operation of the ESF.

Standby power systems shall provide all of the necessary power to systems and subsystems that have been identified as required to operate in the event of a power outage based on safety, operational, or security requirements, for the construction and operation of the ESF.

The UPS shall provide all of the necessary power to systems and subsystems that cannot tolerate a loss of power incident.

Performance Criteria

1. The UPS, consisting of standby batteries and inverter, shall ensure continuity of power to the Integrated Data System (IDS), safety instruments and controls, and communications that cannot tolerate a power interruption.

2. Power distribution for the ESF, including the primary and secondary substations, transmission lines, and feeder cables, shall be adequately designed, with sufficient redundancy to meet load requirements at points of usage throughout the operations areas. Suitable switching and protective devices shall be provided in the electrical system to prevent damage to the equipment in case of power failure or faults. Sufficient metering shall be provided to establish the demand and consumption of power Adequate primary surge protection and a well-engineered separate "safety" grounding system shall be provided in order to maximize personnel and equipment safety.

3. A 69-kV overhead power line shall be designed to be routed from the existing 69-kV line (at the NTS boundary) to a main substation at the ESF site to accommodate all of the anticipated electrical loads during the construction and operation of the ESF. In addition, the main substation at the ESF site shall be designed to accommodate all of the anticipated electrical loads during the construction and operations of the ESF.

4. The power distribution system shall provide adequate services from the main ESF substation to the surface and subsurface facilities.

5. The surface facilities power distribution system shall include the appropriate services to surface-mounted equipment. Surface-mounted equipment (permanent and temporary) includes, but is not limited to:

   a. Hoists and controls
   b. Air compressor(s)
   c. Ventilation fans
   d. Communication equipment, as required
   e. Main water supply pump(s)
   f. Shaft-work-deck winches and miscellaneous motors
   g. Trailers
   h. Shops
   i. Lights

6. The electrical system shall be designed to withstand windblown dust and other natural phenomena.

7. The subsurface facilities power distribution system shall be defined in Section 1.2.6.7 1

8. The standby power system shall provide standby power for safety and security lighting.

9. The standby power system shall include generators, fuel tanks, transfer switches, necessary fuel piping, conduit and wire, cutouts, concrete work, and weatherproof enclosures. The generators shall have sufficient output to provide power for the hoists (to allow for evacuation of all underground personnel within the time allowed), ventilation, area lighting, and surface computer equipment that would be damaged by a power failure. The allowable delay time between the loss of primary power and the availability of standby power will be dictated by safety considerations of the mining operation.

10. Standby generators shall be installed and have the capability to support the hoisting systems when the hoist(s) become operational.

Constraints

1. The normal supply of electrical power shall be provided by a substation to be constructed at the ESF site. Power for this substation shall be supplied from an existing 69-kV overhead power line extending from Canyon Substation in Jackass Flats to the NTS boundary 6.2 miles away.

2. The design of the electrical system shall include the modifications that are required to accommodate the tie-in of the proposed 69-kV transmission line between the Canyon Substation and the main substation to be located at the ESF site.

3. The design shall incorporate existing NNWSI Project transformers and switch gear as much as practicable.

4. A power supply shall be available as soon as possible but no later than the start of shaft construction.

Assumptions

None.

1.2.6.4 FIRST SHAFT

Subparts are:

1.2.6.4.1 Collar
1.2.6.4.2 Lining
1.2.6.4.3 Stations
1.2.6.4.4 Furnishings
1.2.6.4.5 Hoist System
1.2.6.4.6 Sump

Definition of Subsystem Elements

The first shaft system is defined by the vertical engineered openings, within an 11-foot radius of the shaft centerline, that connect the surface with the targeted horizons, provide safe and controlled access to the targeted horizons for personnel, equipment, underground service systems, and includes the materials required for development of the underground drifts and excavations, as well as underground testing operations.

Applicable Regulations, Codes, and Specifications

See Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

Functional Requirements

1. Provide safe access between the ESF surface and the underground portion of the ESF to meet the needs of underground site characterization testing (at two levels). The flexibility to sink shafts in Calico Hills will be maintained.
2. Provide for testing in the shaft as required.
3. Provide for water drainage and/or control in the shaft.
4. Provide means for emergency egress.

Performance Criteria

1. The shaft shall be designed and constructed such that it meets the requirements of personnel, equipment, materials, utilities, excavated rock, and ventilation.
2. Permanent shaft structures, systems, and components shall be designed and constructed for a maintainable 100-year design life.

3. Structures, systems, and components shall be provided for effective water and ground control.

4. Muck handling systems shall be sized and designed for operation and in-situ site characterization needs and shall minimize the spillage of rock during rock handling. This system shall provide capabilities for gathering and cleaning out rock spillage from the shaft bottom.

5. The location of openings for rock handling shall be selected to minimize effects on the integrity of any other openings.

6. Appropriate gravity drainage and/or pumping systems shall be incorporated into the shaft for draining water away from testing and other working areas to suitable collection point(s) for further treatment and/or disposal.

7. The shaft and its drainage systems shall control standing water and air water contact surfaces where ventilation air will be flowing through in order to control the humidity in the air and to maintain the quality of the ventilation air being supplied.

8. The size and shape of the shaft shall be adequate to supply and exhaust the required volumes of air for underground construction, operation, and in situ site characterization.

9. The size and depth of the shaft shall be sufficient for in situ site characterization needs in terms of testing, personnel, materials, equipment, utilities, and schedule.

10. The size and layout of the shaft shall be adequate for in-situ site characterization needs and capable of supporting the excavation allowances determined under General Exploratory Shaft Facility requirements, Section 1.2.6.0, Performance Criteria item #2.

11. Shaft design and construction shall provide for ESF design and construction testing, performance confirmation, and in situ site characterization testing to the extent necessary.

12. Necessary shaft facilities and equipment required for handling excavated rock, materials, equipment, and supplies shall support construction, operations, and in situ site characterization testing.

13. Water handling and control in the shaft shall be sized for credible water inflows.

14. Support facilities, utilities, and equipment shall be designed and constructed to accommodate conventional shaft sinking techniques (i.e., drill and blast).

15. Shaft instrumentation will be protected from physical damage.

16. The shaft shall be excavated and structurally lined using methods and materials based upon conventional shaft construction technology for the shaft diameter and depth under consideration.

17. Functional requirements of the shafts may be assigned to either of the shafts.

Interface Control Requirements

See Section 1.2.6.0, Interface Control Requirements.

Constraints

1. The shaft and its furnishings shall be designed to minimize air resistance to the extent practicable.
2. Techniques used for shaft excavation shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass.
3. The shaft will be designed to provide stability and to minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration.
4. The use of blasting agents, explosives, and water shall be controlled so that in situ site characterization is not adversely affected.
5. Rock support and other structural anchoring materials shall be compatible with waste isolation and shall neither interfere with radionuclide containment nor enhance radionuclide migration.
6. Ventilation air velocities in the shaft shall not exceed 2,000 feet per minute.
7. Ventilation capacity, shaft design, and air velocities in the shaft shall be optimized with respect to the NNWSI Project objectives.
8. The predicted thermal and thermomechanical response of the host rock and surrounding strata and groundwater system shall be designed to withstand the anticipated effects.
9. The centerline coordinate location of ES-1 (science shaft) shall be N766,255, E563,630 as defined by the Nevada Coordinate System.
10. The shaft shall be connected with ES-2 (second shaft) prior to full-scale in situ testing on the Main Test Level (1020 level).
11. Utility lines, shaft steel, etc., shall be designed such that the underground electrical grounding system is electrically bonded to the surface electrical "safety" grounding system.
12. The shaft shall be designed and constructed such that its nominal finished inside diameter is 12 feet.
13. Shaft permanent structures shall be designed and constructed to withstand the effects of the seismic events as defined in the RIB.

Assumptions

None.

1.2.6.5 SECOND SHAFT

Subparts are:

Definition of Subsystem Elements

The second shaft system is defined by those systems, subsystems, and components that are comprised of vertical engineered openings, within 11 feet of the shaft centerline, that connects the surface with the targeted repository horizon. The system provides safe and controlled access to the targeted repository horizon for personnel, equipment, underground service systems, and materials required for development of the underground drifts and excavations, as well as underground testing operations. The second shaft will serve as the primary muck hoisting shaft for test area development.

Applicable Regulations, Codes, and Specifications

See Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

Functional Requirements

1. Provide safe access between the ESF surface and the candidate repository horizon to meet the needs of site characterization testing, emergency egress, ventilation intake and exhaust, major muck handling, and primary transport of heavy equipment.

2. Provide for water drainage and/or control in the shaft.

3. Provide for testing in the shaft as required.

Performance Criteria

1. The shaft shall be designed and constructed such that it meets the emergency egress, ventilation, mining and testing requirements.

2. Permanent shaft structures, systems, and components shall be designed and constructed for a maintinable 100-year design life.

3 The shaft shall serve as the primary rock hoisting and construction support shaft

4. Muck handling systems shall be sized and designed for ESF operations and in situ site characterization needs and shall minimize the spillage of rock during rock handling. This system shall provide capabilities for gathering and cleaning out rock spillage from the shaft bottom.

5. Structures, systems, and components shall be provided for effective water and ground control

6. Appropriate gravity drainage and/or pumping systems shall be incorporated into the shaft for draining water away from testing and other working areas to suitable collection point(s) for further treatment and/or disposal.

7. The shaft and its drainage systems shall control standing water and air water contact surfaces where ventilation air will be flowing through in order to control the humidity in the air and to maintain the quality of the ventilation air being supplied.

8. The size and shape of the shaft shall be adequate to supply and exhaust the required volumes of air for underground construction, operation, and in situ site characterization.

9. The shaft and its furnishings shall be designed to minimize air resistance to the extent practicable.

10. The size and depth of the shaft shall be sufficient for in-situ site characterization needs in terms of testing, personnel, materials, equipment, utilities, and schedule.

11. The size and layout of the shaft shall be adequate for in-situ site characterization needs and capable of supporting the excavation allowances determined under General Exploratory Shaft Facility requirements Section 1.2.6.0, Performance Criteria 2.

12. Shaft design and construction shall provide for ESF design and construction testing, performance confirmation, and in situ site characterization testing to the extent necessary.

13. Shaft design and construction shall provide for ESF design and construction testing, performance confirmation, and in situ site characterization testing to the extent necessary.

14. Necessary shaft facilities and equipment required for handling excavated rock, materials, equipment, and supplies shall support construction, operations, and in situ site characterization testing.

15. Water handling and control in the shaft shall be sized for credible water inflows.

16. Support facilities, utilities, and equipment shall be designed and constructed to accommodate conventional shaft sinking techniques (i.e., drill and blast).

17. The shaft shall be excavated and structurally lined using methods and materials based upon conventional shaft construction technology for the shaft diameter and depth under consideration.

Interface Control Requirements

See Section 1.2.6.0, Interface Control Requirements.

Constraints

1. The functional requirements of the shafts may be assigned to either of the shafts.
2. Techniques used for shaft excavation shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass.
3. The shaft will be designed to provide stability and to minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration.
4. The use of blasting agents, explosives and water shall be controlled so that in situ site characterization is not adversely affected.
5. Rock support and other structural anchoring materials shall be compatible with waste isolation and shall neither interfere with radionuclide containment nor enhance radionuclide migration.
6. Ventilation air velocities in the shaft shall not exceed 2,000 feet per minute.
7. Ventilation capacity, shaft design, and air velocities in the shaft shall be optimized with respect to the NNWSI Project objectives.
8. The predicted thermal and thermomechanical response of the host rock and surrounding strata and groundwater system shall be considered in the ESF design as defined in the RIB. Phased construction techniques shall be employed to accommodate post-construction thermal stresses.
9. The shaft shall be designed and constructed such that its nominal finished diameter is 12 feet.
10. The centerline coordinate location of the ES-2 (second shaft), in the Nevada Coordinate System, shall be N766,337; E 563,918.
11. The shaft shall be connected with ES-1 (science shaft) prior to full-scale in situ testing on the Main Test Level (1020-level).
12. The location of openings for rock handling shall be selected to minimize effects on the integrity of any other openings.
13. Utility lines, shaft steel, etc., shall be designed such that the the underground electrical grounding system is electrically bonded to the surface electrical "safety" grounding system."
14. Shaft permanent structures shall be designed and constructed to accommadate seismic events as defined in the RIB.

Assumptions

None.

1.2.6.2.1 POWER SYSTEMS

Definition of Subsystem Elements

The power systems are defined as those systems, subsystems, components, and structures that supply electrical power to the ESF site. These systems include, but are not limited to, the ESF site substation, extension of the existing 69-kV overhead power line, a secondary power line (to the booster pump station), surface lighting, a stand-by power generation system, and an uninterruptable power system (UPS).

Functional Requirements

Electrical power systems shall provide all of the necessary power, during both normal and peak demands, for the construction and operation of the ESF.

Standby power systems shall provide all of the necessary power to systems and subsystems that have been identified as required to operate in the event of a power outage based on safety, operational, or security requirements, for the construction and operation of the ESF.

The UPS shall provide all of the necessary power to systems and subsystems that cannot tolerate a loss of power incident.

Performance Criteria

1. The UPS, consisting of standby batteries and inverter, shall ensure continuity of power to the Integrated Data System (IDS), safety instruments and controls, and communications that cannot tolerate a power interruption.

2. Power distribution for the ESF, including the primary and secondary substations, transmission lines, and feeder cables, shall be adequately designed, with sufficient redundancy to meet load requirements at points of usage throughout the operations areas. Suitable switching and protective devices shall be provided in the electrical system to prevent damage to the equipment in case of power failure or faults. Sufficient metering shall be provided to establish the demand and consumption of power. Adequate surge protection and a well-engineered grounding system shall be provided in order to maximize personnel and equipment safety.

3. A 69-kV overhead power line shall be designed to be routed from the existing 69-kV line (at the NTS boundary) to a main substation at the ESF site to accommodate all of the anticipated electrical loads during the construction and operation of the ESF. In addition, the main substation at the ESF site shall be designed to accommodate all of the anticipated electrical loads during the construction and operations of the ESF.

4. The power distribution system shall provide adequate services from the main ESF substation to the surface and subsurface facilities.

5. The surface facilities power distribution system shall include the appropriate services to surface-mounted equipment. Surface-mounted equipment (permanent and temporary) includes, but is not limited to:

   a. Hoists and controls
   b. Air compressor(s)
   c. Ventilation fans
   d. Communication equipment, as required
   e. Main water supply pump(s)
   f. Shaft-work-deck winches and miscellaneous motors
   g. Trailers
   h. Shops
   i. Lights

6. The electrical system shall be designed to withstand windblown dust and other natural phenomena.

7. The subsurface facilities power distribution system shall be defined in Section 1.2.6.7.1.

8. The standby power system shall provide standby power for safety and security lighting.

9. The standby power system shall include generators, fuel tanks, transfer switches, necessary fuel piping, conduit and wire, cutouts, concrete work, and weatherproof enclosures. The generators shall have sufficient output to provide power for the hoists (to allow for evacuation of all underground personnel within the time allowed), ventilation, area lighting, and surface computer equipment that would be damaged by a power failure. The allowable delay time between the loss of primary power and the availability of standby power will be dictated by safety considerations of the mining operation.

10. Standby generators shall be installed and have the capability to support the hoisting systems when the hoist(s) become operational.

Constraints

1. The normal supply of electrical power shall be provided by a substation to be constructed at the ESF site. Power for this substation shall be supplied from an existing 69-kV overhead power line extending from Canyon Substation in Jackass Flats to the NTS boundary 6.2 miles away.

2. The design of the electrical system shall include the modifications that are required to accommodate the tie-in of the proposed 69-kV transmission line between the Canyon Substation and the main substation to be located at the ESF site.

3. The design shall incorporate existing NNWSI Project transformers and switch gear as much as practicable.

4. A power supply shall be available as soon as possible but no later than the start of shaft construction.

Assumptions

None.

1.2.6.4 FIRST SHAFT

Subparts are:

1.2.6.4.1 Collar
1.2.6.4.2 Lining
1.2.6.4.3 Stations
1.2.6.4.4 Furnishings
1.2.6.4.5 Hoist System
1.2.6.4.6 Sump

Definition of Subsystem Elements

The first shaft system is defined by the vertical engineered openings, within an 11-foot radius of the shaft centerline, that connect the surface with the targeted horizons, provide safe and controlled access to the targeted horizons for personnel, equipment, underground service systems, and includes the materials required for development of the underground drifts and excavations, as well as underground testing operations.

Applicable Regulations, Codes, and Specifications

See Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

Functional Requirements

1. Provide safe access between the ESF surface and the underground portion of the ESF to meet the needs of underground site characterization testing (at three levels).
2. Provide for testing in the shaft as required.
3. Provide for water drainage and/or control in the shaft.
4. Provide means for emergency egress.

Performance Criteria

1. The shaft shall be designed and constructed such that it meets the requirements of personnel, equipment, materials, utilities, excavated rock, and ventilation.
2. Permanent shaft structures, systems, and components shall be designed and constructed for a maintainable 100-year design life.

3. Structures, systems, and components shall be provided for effective water and ground control.

4. Muck handling systems shall be sized and designed for operation and in-situ site characterization needs and shall minimize the spillage of rock during rock handling. This system shall provide capabilities for gathering and cleaning out rock spillage from the shaft bottom.

5. The location of openings for rock handling shall be selected to minimize effects on the integrity of any other openings.

6. Appropriate gravity drainage and/or pumping systems shall be incorporated into the shaft for draining water away from testing and other working areas to suitable collection point(s) for further treatment and/or disposal.

7. The shaft and its drainage systems shall control standing water and air/water contact surfaces where ventilation air will be flowing through in order to control the humidity in the air and to maintain the quality of the ventilation air being supplied.

8. The size and shape of the shaft shall be adequate to supply and exhaust the required volumes of air for underground construction, operation, and in situ site characterization.

9. The size and depth of the shaft shall be sufficient for in situ site characterization needs in terms of testing, personnel, materials, equipment, utilities, and schedule.

10. The size and layout of the shaft shall be adequate for in-situ site characterization needs and capable of supporting the excavation allowances determined under General Exploratory Shaft Facility requirements, Section 1.2.6.0, Performance Criteria item #2.

11. Shaft design and construction shall provide for ESF design and construction testing, performance confirmation, and in situ site characterization testing to the extent necessary.

12. Necessary shaft facilities and equipment required for handling excavated rock, materials, equipment, and supplies shall support construction, operations, and in situ site characterization testing.

13. Water handling and control in the shaft shall be sized for credible water inflows.

14. Support facilities, utilities, and equipment shall be designed and constructed to accommodate conventional shaft sinking techniques (i.e., drill and blast).

15. Shaft instrumentation will be protected from physical damage.

16. The shaft shall be excavated and structurally lined using methods and materials based upon conventional shaft construction technology for the shaft diameter and depth under consideration.

17. Functional requirements of the shafts may be assigned to either of the shafts.

Interface Control Requirements

See Section 1.2.6.0, Interface Control Requirements.

Constraints

1. The shaft and its furnishings shall be designed to minimize air resistance to the extent practicable.
2. Techniques used for shaft excavation shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass.
3. The shaft will be designed to provide stability and to minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration.
4. The use of blasting agents, explosives, and water shall be controlled so that in situ site characterization is not adversely affected.
5. Rock support and other structural anchoring materials shall be compatible with waste isolation and shall neither interfere with radionuclide containment nor enhance radionuclide migration.
6. Ventilation air velocities in the shaft shall not exceed 2,000 feet per minute.
7. Ventilation capacity, shaft design, and air velocities in the shaft shall be optimized with respect to the NNWSI Project objectives.
8. The predicted thermal and thermomechanical response of the host rock and surrounding strata and groundwater system shall be designed to withstand the anticipated effects.
9. The centerline coordinate location of ES-1 (science shaft) shall be N766,255, E563,630 as defined by the Nevada Coordinate System.
10. The shaft shall be connected with ES-2 (second shaft) prior to full-scale in situ testing on the Main Test Level (1020 level).
11. Utility lines, shaft steel, etc., shall be designed such that the integrity of the underground electrical grounding system is electrically isolated from the surface electrical grounding system.
12. The shaft shall be designed and constructed such that its nominal finished inside diameter is 12 feet.
13. Shaft permanent structures shall be designed and constructed to withstand the effects of the seismic events as defined in the RIB.

Assumptions

None.

1.2.6.5 SECOND SHAFT

Subparts are:

Definition of Subsystem Elements

The second shaft system is defined by those systems, subsystems, and components that are comprised of vertical engineered openings, within 11 feet of the shaft centerline, that connects the surface with the targeted repository horizon. The system provides safe and controlled access to the targeted repository horizon for personnel, equipment, underground service systems, and materials required for development of the underground drifts and excavations, as well as underground testing operations. The second shaft will serve as the primary muck hoisting shaft for test area development.

Applicable Regulations, Codes, and Specifications

See Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

Functional Requirements

1. Provide safe access between the ESF surface and the candidate repository horizon to meet the needs of site characterization testing, emergency egress, ventilation intake and exhaust, major muck handling, and primary transport of heavy equipment.

2. Provide for water drainage and/or control in the shaft.

3. Provide for testing in the shaft as required.

Performance Criteria

1. The shaft shall be designed and constructed such that it meets the emergency egress, ventilation, mining and testing requirements.

2. Permanent shaft structures, systems, and components shall be designed and constructed for a maintinable 100-year design life.

3. The shaft shall serve as the primary rock hoisting and construction support shaft.

4. Muck handling systems shall be sized and designed for ESF operations and in situ site characterization needs and shall minimize the spillage of rock during rock handling. This system shall provide capabilities for gathering and cleaning out rock spillage from the shaft bottom.

5. Structures, systems, and components shall be provided for effective water and ground control

6. Appropriate gravity drainage and/or pumping systems shall be incorporated into the shaft for draining water away from testing and other working areas to suitable collection point(s) for further treatment and/or disposal.

7. The shaft and its drainage systems shall control standing water and air/water contact surfaces where ventilation air will be flowing through in order to control the humidity in the air and to maintain the quality of the ventilation air being supplied.

8. The size and shape of the shaft shall be adequate to supply and exhaust the required volumes of air for underground construction, operation, and in situ site characterization.

9. The shaft and its furnishings shall be designed to minimize air resistance to the extent practicable.

10. The size and depth of the shaft shall be sufficient for in-situ site characterization needs in terms of testing, personnel, materials, equipment, utilities, and schedule.

11. The size and layout of the shaft shall be adequate for in-situ site characterization needs and capable of supporting the excavation allowances determined under General Exploratory Shaft Facility requirements Section 1.2.6.0, Performance Criteria 2.

12. Shaft design and construction shall provide for ESF design and construction testing, performance confirmation, and in situ site characterization testing to the extent necessary.

13. Shaft design and construction shall provide for ESF design and construction testing, performance confirmation, and in situ site characterization testing to the extent necessary.

14. Necessary shaft facilities and equipment required for handling excavated rock, materials, equipment, and supplies shall support construction, operations, and in situ site characterization testing.

15. Water handling and control in the shaft shall be sized for credible water inflows.

16. Support facilities, utilities, and equipment shall be designed and constructed to accommodate conventional shaft sinking techniques (i.e., drill and blast).

17. The shaft shall be excavated and structurally lined using methods and materials based upon conventional shaft construction technology for the shaft diameter and depth under consideration.

Interface Control Requirements

See Section 1.2.6.0, Interface Control Requirements.

Constraints

1. The functional requirements of the shafts may be assigned to either of the shafts.
2. Techniques used for shaft excavation shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass.
3. The shaft will be designed to provide stability and to minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration.
4. The use of blasting agents, explosives and water shall be controlled so that in situ site characterization is not adversely affected.
5. Rock support and other structural anchoring materials shall be compatible with waste isolation and shall neither interfere with radionuclide containment nor enhance radionuclide migration.
6. Ventilation air velocities in the shaft shall not exceed 2,000 feet per minute.
7. Ventilation capacity, shaft design, and air velocities in the shaft shall be optimized with respect to the NNWSI Project objectives.
8. The predicted thermal and thermomechanical response of the host rock and surrounding strata and groundwater system shall be considered in the ESF design as defined in the RIB. Phased construction techniques shall be employed to accommodate post-construction thermal stresses.
9. The shaft shall be designed and constructed such that its nominal finished diameter is 12 feet.
10. The centerline coordinate location of the ES-2 (second shaft), in the Nevada Coordinate System, shall be N766,337; E 563,918.
11. The shaft shall be connected with ES-1 (science shaft) prior to full-scale in situ testing on the Main Test Level (1020-level).
12. The location of openings for rock handling shall be selected to minimize effects on the integrity of any other openings.
13. Utility lines, shaft steel, etc., shall be designed such that the integrity of the underground electrical grounding system is electrically isolated from the surface electrical grounding system.
14. Shaft permanent structures shall be designed and constructed to accommadate seismic events as defined in the RIB.

Assumptions

None.

NNWSI PROJECT COST/SCHEDULE CHANGE REQUEST (C/SCR)	Page 1 of 1	N-AD-036 9/87	
Change No.: 89/013	Organization: SAIC	Originator: M. E. Spaeth	Origination Date: 11/15/88

Title:
Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Request (ECR) 021

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 021.

REASON: See the "Basis for Change" on ESF ECR 021.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:
1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010 through 027.
2. ESF ECR 021.

Responsible Organization M. E. Spaeth *[signature]* Date 11/22/88

CCB Secretary P. C. Merkley *[signature]* Date 12/13/88

Approval: Project Manager, WMPO C. P. Gertz *[signature]* Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF-SDRD in accordance with approved ESF-ECR 021	C/SCR No: 89/013

Summary of Recommended Actions:

	Project Office				T&MSS			
	R&SE	E&D	P&CC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☒	☒	☒	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☐	☐	☐	☐
Non Concurrence	☐	☐	☐	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation:

Impact Analyses:

CCB Secretary P. C. Merkley [signature] Date 12/12/88

Page 1 of 1

OSCR ____'89 013

Department of Energy
Nevada Operations Office
P. O. Box 98518
Las Vegas, NV 89193-8518

JUL 20 1988

RECEIVED
M. E. SPAETH
JUL 21 1988
Route Merkley - XTRA
Copies ______

Michael E. Spaeth
Technical Project Officer
for NNWSI
ATTN: Phil Merkley
Science Applications
International Corporation
Suite 407
101 Convention Center Drive
Las Vegas, NV 89109

PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

Received In Configuration Management Division
JUL 22 1988

SAIC/T&MSS
JUL 21 1988
CCF RECEIVED

OSCR ——'89 013

JUL 20 1988

cc w/o encl:
V. J. Cassella, HQ (RW-123) FORS
Dean Stucker, HQ (RW-223) FORS
G. K. Beall, SAIC, Las Vegas, NV
M. C. Brake, SAIC, Las Vegas, NV
R. R. Reust, SAIC, Las Vegas, NV
John Nimmo, SAIC, Las Vegas, NV
S. H. Klein, SAIC, Las Vegas, NV
W. E. Narrows, SAIC, Las Vegas, NV
James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

CSCR ____ '89 013

ESF ENGINEERING CHANGE REQUEST

ESF11.FMB-12/28

ECR NO. 021 PAGE 1 OF 1

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL: N/A
SOURCE: ESF SDRD
WBS DESIGNATION: 1.2.6
TITLE: 1.2.6.4 First Shaft
DESCRIPTION OF CHANGE

PARTICIPANT: SAIC
DATE: 6/10/88
ORIGINATOR: SAIC
REV. NO. 1 DATE 12/18/87

In the ESF SDRD, 1.2.6.4 First Shaft Functional Requirements (page 4-1) change 1 to read, "Provide safe access between the ESF surface and the underground portion of the ESF to meet the needs of underground site characterization testing (at two levels). The flexibility to sink shafts in the Calico Hills will be maintained."

SEE CONTINUATION PAGE

BASIS FOR CHANGE

Agreement from DOE ESF Issues Meeting 4/21/88. "Project will initiate the appropriate changes to the SDRD removing any requirements to penetrate the Calico Hills. However, the requirement for flexibility to sink shafts and drift in the Calico Hills will be maintained."

SEE CONTINUATION PAGE

PARTICIPANT QA REP [signature] DATE 6/23/88
ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 6/30/88

SECTION 2. ICWG CHAIRMAN ACTION ____ NOT APPLICABLE

1. PROCEED WITH ECR EVALUATION ____ YES ____ NO SCOPE CHANGE ____ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO CONSTRUCTION IMPACT ____ YES ____ NO

3. TOTAL COSTS (increase/decrease) ____ NOT APPLICABLE

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT ____ NOT APPLICABLE
   ENGINEERING ____ WEEKS
   CONSTRUCTION ____ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
   PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

6. FUNDING:
   ____ NOT APPLICABLE ____ NOT FUNDED, PROJECTED ONLY
   ____ CHANGE ORDER ____ SPECIAL STUDIES

   ICWG CHAIRMAN/DATE

7. APPROVED

   [signature] 7/8/88
   ICWG CHAIRMAN/DATE

1.2.6.4 FIRST SHAFT

Subparts are:

1.2.6.4.1 Collar
1.2.6.4.2 Lining
1.2.6.4.3 Stations
1.2.6.4.4 Furnishings
1.2.6.4.5 Hoist System
1.2.6.4.6 Sump

Definition of Subsystem Elements

The first shaft system is defined by the vertical engineered openings, within an 11-foot radius of the shaft centerline, that connect the surface with the targeted horizons, provide safe and controlled access to the targeted horizons for personnel, equipment, underground service systems, and includes the materials required for development of the underground drifts and excavations, as well as underground testing operations.

Applicable Regulations, Codes, and Specifications

See Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

Functional Requirements

1. Provide safe access between the ESF surface and the underground portion of the ESF to meet the needs of underground site characterization testing (at two levels). The flexibility to sink shafts in Calico Hills will be maintained.

2. Provide for testing in the shaft as required.

3. Provide for water drainage and/or control in the shaft.

4. Provide means for emergency egress.

Performance Criteria

1. The shaft shall be designed and constructed such that it meets the requirements of personnel, equipment, materials, utilities, excavated rock, and ventilation.

2. Permanent shaft structures, systems, and components shall be designed and constructed for a maintainable 100-year design life.

3. Structures, systems, and components shall be provided for effective water and ground control.

4. Muck handling systems shall be sized and designed for operation and in-situ site characterization needs and shall minimize the spillage of rock during rock handling. This system shall provide capabilities for gathering and cleaning out rock spillage from the shaft bottom.

5. The location of openings for rock handling shall be selected to minimize effects on the integrity of any other openings.

6. Appropriate gravity drainage and/or pumping systems shall be incorporated into the shaft for draining water away from testing and other working areas to suitable collection point(s) for further treatment and/or disposal.

7. The shaft and its drainage systems shall control standing water and air water contact surfaces where ventilation air will be flowing through in order to control the humidity in the air and to maintain the quality of the ventilation air being supplied.

8. The size and shape of the shaft shall be adequate to supply and exhaust the required volumes of air for underground construction, operation, and in situ site characterization.

9. The size and depth of the shaft shall be sufficient for in situ site characterization needs in terms of testing, personnel, materials, equipment, utilities, and schedule.

10. The size and layout of the shaft shall be adequate for in-situ site characterization needs and capable of supporting the excavation allowances determined under General Exploratory Shaft Facility requirements, Section 1.2.6.0, Performance Criteria item #2.

11. Shaft design and construction shall provide for ESF design and construction testing, performance confirmation, and in situ site characterization testing to the extent necessary.

12. Necessary shaft facilities and equipment required for handling excavated rock, materials, equipment, and supplies shall support construction, operations, and in situ site characterization testing.

13. Water handling and control in the shaft shall be sized for credible water inflows.

14. Support facilities, utilities, and equipment shall be designed and constructed to accommodate conventional shaft sinking techniques (i.e., drill and blast).

15. Shaft instrumentation will be protected from physical damage.

16. The shaft shall be excavated and structurally lined using methods and materials based upon conventional shaft construction technology for the shaft diameter and depth under consideration.

17. Functional requirements of the shafts may be assigned to either of the shafts.

Interface Control Requirements

See Section 1.2.6.0, Interface Control Requirements.

Constraints

1. The shaft and its furnishings shall be designed to minimize air resistance to the extent practicable.
2. Techniques used for shaft excavation shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass.
3. The shaft will be designed to provide stability and to minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration.
4. The use of blasting agents, explosives, and water shall be controlled so that in situ site characterization is not adversely affected.
5. Rock support and other structural anchoring materials shall be compatible with waste isolation and shall neither interfere with radionuclide containment nor enhance radionuclide migration.
6. Ventilation air velocities in the shaft shall not exceed 2,000 feet per minute.
7. Ventilation capacity, shaft design, and air velocities in the shaft shall be optimized with respect to the NNWSI Project objectives.
8. The predicted thermal and thermomechanical response of the host rock and surrounding strata and groundwater system shall be designed to withstand the anticipated effects.
9. The centerline coordinate location of ES-1 (science shaft) shall be N766,255, E563,630 as defined by the Nevada Coordinate System.
10. The shaft shall be connected with ES-2 (second shaft) prior to full-scale in situ testing on the Main Test Level (1020 level).
11. Utility lines, shaft steel, etc., shall be designed such that the underground electrical grounding system is electrically bonded to the surface electrical "safety" grounding system.
12. The shaft shall be designed and constructed such that its nominal finished inside diameter is 12 feet.
13. Shaft permanent structures shall be designed and constructed to withstand the effects of the seismic events as defined in the RIB.

Assumptions

None.

1.2.6.4 FIRST SHAFT

Subparts are:

Definition of Subsystem Elements

The first shaft system is defined by the vertical engineered openings, within an 11-foot radius of the shaft centerline, that connect the surface with the targeted horizons, provide safe and controlled access to the targeted horizons for personnel, equipment, underground service systems, and includes the materials required for development of the underground drifts and excavations, as well as underground testing operations.

Applicable Regulations, Codes, and Specifications

See Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

Functional Requirements

1. Provide safe access between the ESF surface and the underground portion of the ESF to meet the needs of underground site characterization testing (at three levels).
2. Provide for testing in the shaft as required.
3. Provide for water drainage and/or control in the shaft.
4. Provide means for emergency egress.

Performance Criteria

1. The shaft shall be designed and constructed such that it meets the requirements of personnel, equipment, materials, utilities, excavated rock, and ventilation.
2. Permanent shaft structures, systems, and components shall be designed and constructed for a maintainable 100-year design life.

3. Structures, systems, and components shall be provided for effective water and ground control.

4. Muck handling systems shall be sized and designed for operation and in-situ site characterization needs and shall minimize the spillage of rock during rock handling. This system shall provide capabilities for gathering and cleaning out rock spillage from the shaft bottom.

5. The location of openings for rock handling shall be selected to minimize effects on the integrity of any other openings.

6. Appropriate gravity drainage and/or pumping systems shall be incorporated into the shaft for draining water away from testing and other working areas to suitable collection point(s) for further treatment and/or disposal.

7. The shaft and its drainage systems shall control standing water and air/water contact surfaces where ventilation air will be flowing through in order to control the humidity in the air and to maintain the quality of the ventilation air being supplied.

8. The size and shape of the shaft shall be adequate to supply and exhaust the required volumes of air for underground construction, operation, and in situ site characterization.

9. The size and depth of the shaft shall be sufficient for in situ site characterization needs in terms of testing, personnel, materials, equipment, utilities, and schedule.

10. The size and layout of the shaft shall be adequate for in-situ site characterization needs and capable of supporting the excavation allowances determined under General Exploratory Shaft Facility requirements, Section 1.2.6.0, Performance Criteria item #2.

11. Shaft design and construction shall provide for ESF design and construction testing, performance confirmation, and in situ site characterization testing to the extent necessary.

12. Necessary shaft facilities and equipment required for handling excavated rock, materials, equipment, and supplies shall support construction, operations, and in situ site characterization testing.

13. Water handling and control in the shaft shall be sized for credible water inflows.

14. Support facilities, utilities, and equipment shall be designed and constructed to accommodate conventional shaft sinking techniques (i.e., drill and blast).

15. Shaft instrumentation will be protected from physical damage.

16. The shaft shall be excavated and structurally lined using methods and materials based upon conventional shaft construction technology for the shaft diameter and depth under consideration.

17. Functional requirements of the shafts may be assigned to either of the shafts.

Interface Control Requirements

See Section 1.2.6.0, Interface Control Requirements.

Constraints

1. The shaft and its furnishings shall be designed to minimize air resistance to the extent practicable.
2. Techniques used for shaft excavation shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass.
3. The shaft will be designed to provide stability and to minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration.
4. The use of blasting agents, explosives, and water shall be controlled so that in situ site characterization is not adversely affected.
5. Rock support and other structural anchoring materials shall be compatible with waste isolation and shall neither interfere with radionuclide containment nor enhance radionuclide migration.
6. Ventilation air velocities in the shaft shall not exceed 2,000 feet per minute.
7. Ventilation capacity, shaft design, and air velocities in the shaft shall be optimized with respect to the NNWSI Project objectives.
8. The predicted thermal and thermomechanical response of the host rock and surrounding strata and groundwater system shall be designed to withstand the anticipated effects.
9. The centerline coordinate location of ES-1 (science shaft) shall be N766,255, E563,630 as defined by the Nevada Coordinate System.
10. The shaft shall be connected with ES-2 (second shaft) prior to full-scale in situ testing on the Main Test Level (1020 level).
11. Utility lines, shaft steel, etc., shall be designed such that the integrity of the underground electrical grounding system is electrically isolated from the surface electrical grounding system.
12. The shaft shall be designed and constructed such that its nominal finished inside diameter is 12 feet.
13. Shaft permanent structures shall be designed and constructed to withstand the effects of the seismic events as defined in the RIB.

Assumptions

None.

NNWSI PROJECT
COST/SCHEDULE CHANGE REQUEST (C/SCR)

N-AD-036
9/87

Change No.:	Organization:	Originator:	Origination Date:
89/014	SAIC	M. E. Spaeth	11/15/88

Title:

Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Request (ECR) 022

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 022.

REASON: See the "Basis for Change" on ESF ECR 022.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS: 1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010 through 027.

2. ESF ECR 022.

Responsible Organization M. E. Spaeth [signature] Date 11/22/88

CCB Secretary P. C. Merkley [signature] Date 12/13/88

Approval: Project Manager, WMPO C. P. Gertz [signature] Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF-ECR 022	C/SCR No: 89/014

Summary of Recommended Actions:

	Project Office				TSMSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☒	☒	☒	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☐	☐	☐	☐
Non Concurrence	☐	☐	☐	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation:

Impact Analyses:

CCB Secretary P. C. Merklev [signature] Date 12/12/88

Page 1 of 1

CSCR '89 014

Department of Energy
Nevada Operations Office
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PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

Received In Configuration Management Division
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JUL 20 1988

cc w/o encl:
V. J. Cassella, HQ (RW-123) FORS
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G. K. Beall, SAIC, Las Vegas, NV
M. C. Brake, SAIC, Las Vegas, NV
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W. E. Narrows, SAIC, Las Vegas, NV
James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

CSCR ____'89 014

ESF ENGINEERING CHANGE REQUEST

ESF11 FMB-12/2

ECR NO. 022 | PAGE 1 OF 1

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL N/A
SOURCE ESF SDRD
WBS DESIGNATION 1.2.6
TITLE 1.2.6.6 Underground
DESCRIPTION OF CHANGE Excavations

PARTICIPANT SAIC
DATE 6/10/88
ORIGINATOR SAIC
REV. NO. 1 DATE 12/18/87

In the ESF SDRD 1.2.6.6 Underground Excavations Performance Criteria, (pages 6-1 and 6-2) make the following changes: 1) In 2, change "Underground openings within the Topopah Spring and Calico Hills welded" to "Underground openings within the Topopah Spring welded." 2) In 3, change "Underground openings within the Topopah Spring and Calico Hills units" to "Underground openings within the Topopah Spring unit." 3) In 7, change "(DBR), and the Main Test Level. The flexibility to drift in the Calico Hills will be maintained."

SEE CONTINUATION PAGE

BASIS FOR CHANGE

Agreement from DOE ESF Issues Meeting 4/21/88. "Project will initiate the appropriat changes to the SDRD removing any requirements to penetrate the Calico Hills. Howeve the requirement for flexibility to sink shafts and drift in the Calico Hills will be maintained."

SEE CONTINUATION PAGE

PARTICIPANT QA REP [signature] DATE 7/7/88
ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 7/8/88

SECTION 2. ICWG CHAIRMAN ACTION ____ NOT APPLICABLE

1. PROCEED WITH ECR EVALUATION ____ YES ____ NO SCOPE CHANGE ____ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO CONSTRUCTION IMPACT ____ YES ____ N

3. TOTAL COSTS (increase/decrease) ____ NOT APPLICABLE

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT ____ NOT APPLICABLE

ENGINEERING ____ WEEKS
CONSTRUCTION ____ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

6. FUNDING:
____ NOT APPLICABLE ____ NOT FUNDED, PROJECTED ONLY
____ CHANGE ORDER ____ SPECIAL STUDIES

ICWG CHAIRMAN/DATE

7. APPROVED

[signature] 7/8/88
ICWG CHAIRMAN/DATE

1.2.6.6 UNDERGROUND EXCAVATIONS

Subparts are: 1.2.6.6.1 Operations Support Areas
1.2.6.6.2 Test Areas

Definition of Subsystem Elements

The underground excavations are defined as those underground openings 5 feet beyond the shaft liner that extend away from the shaft stations and which comprise the excavations at the proposed test levels and the preferred repository horizon, based on the needs for underground site characterization.

Functional Requirements

1. Provide underground openings in welded and nonwelded tuff for in situ site characterization construction, operations, and maintenance.

2. Provide compatibility with the repository conceptual design so that the test level development does not adversely impact future repository development.

3. Provide the specific excavation required for shaft stations, muck storage, refuge chambers, power centers, shop and storage areas, fueling, sanitation, ventilation, utilities, drifts, test levels, test rooms and alcoves, communications, IDS, service, special function, and other areas as determined by the in situ site characterization program.

4. Provide a system for removing excavated rock to the shaft.

Performance Criteria

1. Underground openings shall be designed and constructed to minimize impacts on underground site characterization.

2. Underground openings within the Topopah Spring welded and non-welded tuff shall be designed and constructed to meet testing, personnel, equipment, utility, and ventilation requirements.

3. Underground openings within the Topopah Spring unit shall be designed to provide stability and to minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration.

4. Rock support and other structural anchoring materials used in rock support systems shall be compatible with waste isolation operations and shall neither interfere with radionuclide containment nor enhance radionuclide migration.

5. The design of underground openings and their supports shall utilize pillar and opening geometries that limit stress concentration to acceptable levels.

6. The size, shape, excavation and support of underground openings shall be adequate to meet transfer requirements for excavated rock, personnel, equipment, ventilation, utilities and the underground test plan.

7. A station landing and test drifts will be constructed as part of the ES-1 shaft at the Upper Demonstration Breakout Room. The flexibility to drift in the Calico Hills will be maintained.

8. Underground openings shall be designed to minimize air resistance to the extent practicable.

9. Underground excavated areas shall be designed for safe and maintainable ground support and control where required.

10. The test level development will be accomplished by conventional mining (drill, blast, muck).

11. Full face, blast hole drilling will be accomplished by using a multi-boom drill jumbo.

12. The testing requirements outlined in Appendix B will serve as the basis for the test level development.

13. Dry air coring will be required for some tests.

14. Permanent (as defined in Section 1.2.6.0, Functional Requirements item #2.) ESF structures, systems, and components shall be designed and constructed with a 100-year maintainable life.

15. Nonpermanent underground facilities shall be designed and constructed with a maintainable 5-year life.

16. Instrument cables shall be separated from power cables in drifts to minimize electrical interference. Instrument and IDS cables shall be contained in overhead runs to protect them from damage.

17. The size and layout of the openings excavated on the test levels shall be adequate for in situ site characterization needs and capable of supporting additional excavation beyond the initially planned test areas (see Section 1.2.6.0, Performance Criteria item #2.).

18. Appropriate gravity drainage and/or pumping systems shall be incorporated in underground openings for draining water away from testing and other working areas to suitable collection point(s) for further treatment and/or disposal.

19. During in situ site characterization testing, facilities shall be provided for at least 10 visitors underground at any one time.

20. The maintenance, refueling, and equipment storage areas shall be designed and located to minimize the fire and safety risks.

21. A refuge chamber(s) shall be provided with sufficient capacity and facilities to accommodate personnel underground.

22. The equipment and facilities required for excavating and handling rock shall meet the needs of construction and testing activities and shall be capable of supporting the uncertainty allowance (see Section 1.2.6.0. Performance Criteria item =2.).

23. Excavation techniques shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass.

24. The chemical content of the blasting agents and explosives shall be controlled to preclude adverse effects on in situ site characterization.

Constraints

1. The underground test and operations support areas shall be parallel to the dip of the tuff stratigraphy to the extent practicable and safe.
2. The proposed Main Test Level floor within the Topopah Spring Member at the first shaft will be defined as the 1020 level.
3. The ventilation system shall be designed to provide an air cooling power greater than or equal to 400 watts per square meter.
4. Targets to be utilized in the design and construction of the underground drifts can be found on Sketch Number 5, Appendix A.

Assumptions

1. Mucking will be accomplished by using rubber-tired, diesel-powered equipment.
2. Groundwater inflow will not be an adverse factor during mining operations.
3. The use of water in the development of underground openings shall be minimized to the extent practicable.

1.2.6.6 UNDERGROUND EXCAVATIONS

Subparts are: 1.2.6.6.1 Operations Support Areas
1.2.6.6.2 Test Areas

Definition of Subsystem Elements

The underground excavations are defined as those underground openings 5 feet beyond the shaft liner that extend away from the shaft stations and which comprise the excavations at the proposed test levels and the preferred repository horizon, based on the needs for underground site characterization.

Functional Requirements

1. Provide underground openings in welded and nonwelded tuff for in situ site characterization construction, operations, and maintenance.
2. Provide compatibility with the repository conceptual design so that the test level development does not adversely impact future repository development.
3. Provide the specific excavation required for shaft stations, muck storage, refuge chambers, power centers, shop and storage areas, fueling, sanitation, ventilation, utilities, drifts, test levels, test rooms and alcoves, communications, IDS, service, special function, and other areas as determined by the in situ site characterization program.
4. Provide a system for removing excavated rock to the shaft.

Performance Criteria

1. Underground openings shall be designed and constructed to minimize impacts on underground site characterization.
2. Underground openings within the Topopah Spring and Calico Hills welded and nonwelded tuff shall be designed and constructed to meet testing, personnel, equipment, utility, and ventilation requirements.
3. Underground openings within the Topopah Spring and Calico Hills units shall be designed to provide stability and to minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration.
4. Rock support and other structural anchoring materials used in rock support systems shall be compatible with waste isolation operations and shall neither interfere with radionuclide containment nor enhance radionuclide migration.

5. The design of underground openings and their supports shall utilize pillar and opening geometries that limit stress concentration to acceptable levels.

6. The size, shape, excavation and support of underground openings shall be adequate to meet transfer requirements for excavated rock, personnel, equipment, ventilation, utilities and the underground test plan.

7. A station landing and test drifts will be constructed as part of the ES-1 shaft at the Upper Demonstration Breakout Room (DBR), the Main Test Level, and the Calico Hills drill room.

8. Underground openings shall be designed to minimize air resistance to the extent practicable.

9. Underground excavated areas shall be designed for safe and maintainable ground support and control where required.

10. The test level development will be accomplished by conventional mining (drill, blast, muck).

11. Full face, blast hole drilling will be accomplished by using a multi-boom drill jumbo.

12. The testing requirements outlined in Appendix B will serve as the basis for the test level development.

13. Dry air coring will be required for some tests.

14. Permanent (as defined in Section 1.2.6.0, Functional Requirements item #2.) ESF structures, systems, and components shall be designed and constructed with a 100-year maintainable life.

15. Nonpermanent underground facilities shall be designed and constructed with a maintainable 5-year life.

16. Instrument cables shall be separated from power cables in drifts to minimize electrical interference. Instrument and IDS cables shall be contained in overhead runs to protect them from damage.

17. The size and layout of the openings excavated on the test levels shall be adequate for in situ site characterization needs and capable of supporting additional excavation beyond the initially planned test areas (see Section 1.2.6.0, Performance Criteria item #2.).

18. Appropriate gravity drainage and/or pumping systems shall be incorporated in underground openings for draining water away from testing and other working areas to suitable collection point(s) for further treatment and/or disposal.

19. During in situ site characterization testing, facilities shall be provided for at least 10 visitors underground at any one time.

20. The maintenance, refueling, and equipment storage areas shall be designed and located to minimize the fire and safety risks.

21. A refuge chamber(s) shall be provided with sufficient capacity and facilities to accommodate personnel underground.

22. The equipment and facilities required for excavating and handling rock shall meet the needs of construction and testing activities and shall be capable of supporting the uncertainty allowance (see Section 1.2.6.0, Performance Criteria item #2.).

23. Excavation techniques shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass.

24. The chemical content of the blasting agents and explosives shall be controlled to preclude adverse effects on in situ site characterization.

Constraints

1. The underground test and operations support areas shall be parallel to the dip of the tuff stratigraphy to the extent practicable and safe.

2. The proposed Main Test Level floor within the Topopah Spring Member at the first shaft will be defined as the 1020 level.

3. The ventilation system shall be designed to provide an air cooling power greater than or equal to 400 watts per square meter.

4. Targets to be utilized in the design and construction of the underground drifts can be found on Sketch Number 5, Appendix A.

Assumptions

1. Mucking will be accomplished by using rubber-tired, diesel-powered equipment.

2. Groundwater inflow will not be an adverse factor during mining operations.

3. The use of water in the development of underground openings shall be minimized to the extent practicable.

NNWSI PROJECT
COST/SCHEDULE CHANGE REQUEST (C/SCR)

N-AD-036
9/87

Change No.:	Organization:	Originator:	Origination Date:
89-015	SAIC	M. E. Spaeth	11/15/88

Title:
Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Request (ECR) 023

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 023.

REASON: See the "Basis for Change" on ESF ECR 023.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:
1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010 through 027.
2. ESF ECR 023.

Responsible Organization M. E. Spaeth [signature] Date 11/22/88

CCB Secretary P. C. Merkley [signature] Date 12/13/88

Approval: Project Manager, WMPO C. P. Gertz [signature] Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF-ECR 023

C/SCR No: 89/015

Summary of Recommended Actions:

	Project Office				T&MSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☒	☒	☒	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☐	☐	☐	☐
Non Concurrence	☐	☐	☐	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation:

Impact Analyses:

CCB Secretary P. C. Merkley [signature] Date 12/12/88

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CSCR ____'89 015

Department of Energy
Nevada Operations Office
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Las Vegas, NV 89109

PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

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R. R. Reust, SAIC, Las Vegas, NV
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W. E. Narrows, SAIC, Las Vegas, NV
James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

CSCR ____'89 015

ESF ENGINEERING CHANGE REQUEST

ESF11.FMB-12/

ECR NO. 023

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL N/A
SOURCE ESF SDRD
WBS DESIGNATION 1.2.6
TITLE 1.2.6.6.2 Test Areas
DESCRIPTION OF CHANGE

PARTICIPANT SAIC
DATE 6/10/88
ORIGINATOR SAIC
REV. NO. 1 DATE 12/18/87

In the ESF SDRD 1.2.6.6.2 Test Areas Definition of Subsystem Elements, change to read "The test areas are defined as those openings excavated in ES-1 (science shaft) at the Upper Demonstration Breakout Room and the Main Test Level for conducting undergro site characterization tests at the potential repository horizon and the other geologi horizons."

SEE CONTINUATION PAGE

BASIS FOR CHANGE

Agreement for DOE ESF Issues Meeting 4/21/88. "Project will initiate the appropriate changes to the SDRD removing any requirements to penetrate the Calico Hills. However, the requirement for flexibility to sink shafts and drift in the Calico Hills will be maintained."

SEE CONTINUATION PAGE

PARTICIPANT QA REP [signature] DATE 7/7/88

ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 7/8/88

SECTION 2. ICWG CHAIRMAN ACTION ____ NOT APPLICABLE

1. PROCEED WITH ECR EVALUATION ____YES ____NO SCOPE CHANGE ____YES ____NO
2. PROCEED WITH WORK ____YES ____NO CONSTRUCTION IMPACT ____YES ____N

3. TOTAL COSTS (increase/decrease) ____ NOT APPLICABLE

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT ____ NOT APPLICABLE

ENGINEERING ________ WEEKS
CONSTRUCTION ________ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ____YES ____NO
PROCEED WITH DETAIL ESTIMATE ____YES ____NO

6. FUNDING:

____ NOT APPLICABLE ____ NOT FUNDED, PROJECTED ONLY

____ CHANGE ORDER ____ SPECIAL STUDIES

ICWG CHAIRMAN/DATE

7. APPROVED

[signature] 7/8/88
ICWG CHAIRMAN/DATE

1.2.6.6.2 TEST AREAS

Definition of Subsystem Elements

The test areas are defined as those openings excavated in ES-1 (science shaft) at the Upper Demonstration Breakout Room and the Main Test Level for conducting underground site characterization tests at the potential repository horizon and other geologic horizons.

Functional Requirements

The test areas shall provide excavated space of adequate size and appropriate opening geometry to conduct the necessary underground site characterization test activities.

Performance Criteria

1. The number and the size of openings shall satisfy underground testing needs in terms of personnel, materials, equipment, and utilities as found in the Underground Test Requirements in Appendix B.
2. ESF structures, systems, components, and operations must accommodate additional tests and monitoring if required (see Section 1.2.6.0, Performance Criteria item #2.)
3. Underground test areas shall have a minimum excavation width of 14 feet and a minimum height of 12 feet.

Constraints

1. Test areas shall be separated so they are not affected by the excavation disturbed zone, geotechnical edge effects, thermal, mechanical, chemical, and hydrological interactions.

Assumptions

None.

1.2.6.6.2 TEST AREAS

Definition of Subsystem Elements

The test areas are defined as those openings excavated in ES-1 (science shaft) at the Upper DBR (520 level), the Main Test Level (1020 level), and the Calico Hills drill room (1400 level) for conducting underground site characterization tests at the potential repository horizon and two other geologic horizons.

Functional Requirements

The test areas shall provide excavated space of adequate size and appropriate opening geometry to conduct the necessary underground site characterization test activities.

Performance Criteria

1. The number and the size of openings shall satisfy underground testing needs in terms of personnel, materials, equipment, and utilities as found in the Underground Test Requirements in Appendix B.
2. ESF structures, systems, components, and operations must accommodate additional tests and monitoring if required (see Section 1.2.6.0, Performance Criteria item #2.).
3. Underground test areas shall have a minimum excavation width of 14 feet and a minimum height of 12 feet.

Constraints

1. Test areas shall be separated so they are not affected by the excavation disturbed zone, geotechnical edge effects, thermal, mechanical, chemical, and hydrological interactions.

Assumptions

None.

NNWSI PROJECT
COST/SCHEDULE CHANGE REQUEST (C/SCR)

N-AD-036
9/87

Change No:	Organization:	Originator:	Origination Date:
89/016	SAIC	M. E. Spaeth	11/15/88

Title:

Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Request (ECR) 024

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 024.

REASON: See the "Basis for Change" on ESF ECR 024.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:
1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010 through 027.
2. ESF ECR 024.

Responsible Organization: M. E. Spaeth — Date: 11/22/88

CCB Secretary: P. C. Merkley — Date: 12/13/88

Approval: Project Manager, WMPO: C. P. Gertz — Date: 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF-ECR 024	C/SCR No: 89/016

Summary of Recommended Actions:

	Project Office				T&MSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☒	☒	☒	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☐	☐	☐	☐
Non Concurrence	☐	☐	☐	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation:

Impact Analyses:

CCB Secretary P. C. Merkley [signature] Date 12/12/88

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CSCR '89 016

Department of Energy
Nevada Operations Office
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PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

Received In Configuration
Management Division
JUL 22 1988

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CSCR ____'89 016

JUL 20 1988

cc w/o encl:
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E. L. Wilmot, WMPO, NV

CSCR ____'89 016

ESF ENGINEERING CHANGE REQUEST

ESF11 FMB-12/28

ECR NO. 023 PAGE 1 OF 1

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL N/A
SOURCE ESF SDRD
WBS DESIGNATION 1.2.6
TITLE 1.2.6.8 Undergroun. Tests
DESCRIPTION OF CHANGE

PARTICIPANT SAIC
DATE 6/10/88
ORIGINATOR SAIC
REV. NO. 1 DATE 12/18/87

In the ESF SDRD, 1.2.6.8 Underground Tests Assumptions (page 8-3) rewrite 1 as follows: "Planned testing and monitoring will be conducted in the ES-1 (science) shaft, the Upper Demonstration Breakout Room and the Main Test Level. The flexibility to drift in the Calico Hills will be maintained."

SEE CONTINUATION PAGE

BASIS FOR CHANGE

Agreement from DOE ESF Issues Meeting 4/21/88. "Project will initiate the appropriate changes to the SDRD removing any requirements to penetrate the Calico Hills. However, the requirement for flexibility to sink shafts and drift in the Calico Hills will be maintained."

SEE CONTINUATION PAGE

PARTICIPANT QA REP [signature] DATE 7/7/88 ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 7/8/88

SECTION 2. ICWG CHAIRMAN ACTION ____ NOT APPLICABLE

1. PROCEED WITH ECR EVALUATION ____ YES ____ NO SCOPE CHANGE ____ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO CONSTRUCTION IMPACT ____ YES ____ NO

3. TOTAL COSTS (increase/decrease) ____ NOT APPLICABLE

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT ____ NOT APPLICABLE

ENGINEERING ________ WEEKS
CONSTRUCTION ________ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

6. FUNDING:

____ NOT APPLICABLE ____ NOT FUNDED, PROJECTED ONLY

____ CHANGE ORDER ____ SPECIAL STUDIES

ICWG CHAIRMAN/DATE

7. APPROVED

[signature] 7/9/88
ICWG CHAIRMAN/DATE

PROPOSED MODIFICATION CSCR ____'89 016
Rev. ?

1.2.6.8 UNDERGROUND TESTS

Subparts are:

1.2.6.8.1 Integrated Data Acquisition System (IDS)
1.2.6.8.2 Geological Tests
1.2.6.8.3 Geomechanics Tests
1.2.6.8.4 Near-Field and Thermally Perturbed Tests
1.2.6.8.5 Hydrologic and Transport Phenomena Tests
1.2.6.8.6 Prototype Tests

Definition of Subsystem Elements

The underground test systems are defined by those activities associated with test equipment installation. test execution. test data recording, and test analysis for in situ site characterization to be performed within the Yucca Mountain ESF.

Applicable Regulations, Codes, and Specifications

The design requirements and criteria for the Integrated Data System (IDS) can be found in the Technical Requirements for the Integrated Data System of the NNWSI Project Exploratory Shaft Facility. See SDRD Volume II, Appendix D, Reference Project Documentation.

See Section 1 2.6.0. for additional Applicable Regulations. Codes. and Specifications.

Functional Requirements

The underground tests shall provide the means for the implementation of site characterization testing plans and provide data to support performance confirmation testing.

Performance Criteria

1. In situ site characterization shall meet applicable requirements of 10 CFR part 60 and 10 CFR part 960.

2. In situ site characterization shall meet the applicable requirements of the Site Characterization Plan (SCP).

3. Testing plans must provide for feedback and modification as a result of initial and ongoing tests and monitored results.

4. Testing instrumentation hardware, cables computer equipment, and data acquisition and monitoring systems, shall be designed to withstand the expected underground environment.

5. Reports shall contain adequate visual and diagrammatic information to make the conduct, setup, and objectives of all the tests clear to readers outside the NNWSI Project.

6. In situ site characterization shall provide reliable information with specified accuracy and uncertainty as determined by the NNWSI Project.

7. Measurements, tests, and analyses shall be sufficient to determine the performance of the ESF and the effects of ESF construction on in situ site characterization.

8. An uninterruptable power supply system shall be available to ensure continuous operation of equipment and instrumentation related to critical testing as determined by the NNWSI Project through analysis.

9. Written procedures shall be developed for the procurement, construction, installation, maintenance, and operation of testing instruments, and data collection facilities.

10. Performance confirmation testing shall be carried out to meet the requirements of 10 CFR 60, Subpart F.

Constraints

1. Tests shall be designed and located within the facility to ensure that thermal, mechanical, chemical, and hydrological interactions will not endanger the structural stability of the ESF or adversely affect tests conducted in adjacent areas.

2. Testing shall not affect overall site integrity of the Mined Geologic Disposal System as required by 10 CFR 60.112.

3. Testing equipment requirements, including design life, shall be based on the performance goals of the tests.

4. Tests shall be classified according to primary information needs (i.e., site characterization, ESF site characterization, ESF design confirmation, repository design, or performance confirmation) and defined with respect to duration, scale, and space requirements. This classification and definition shall be the basis for equipment design, underground layout, ventilation, personnel, and utility requirements.

5. The ESF shafts shall be connected prior to initiation of full-scale in situ testing.

Interface Control Requirements

See Section 1 2 6 0 Interface Control Requirements.

PROPOSED MODIFICATION

Assumptions

1. Planned testing and monitoring will be conducted in the ES-1 (science) shaft, the Upper Demonstration Breakout Room and the Main Test Level. The flexibility to drift in the Calico Hills will be maintained.

2. The development of the underground testing program at the ESF has been based upon the qualitative derivation of information needs to satisfactorily address key issues in the Issues Hierarchy The number of tests may change as site characterization proceeds and more variable or unexpected conditions are encountered. See Section 1 2.6.0, Performance Criteria item =2.

3. The underground utility system at the Main Test Level shall be sufficient to accommodate drifting and testing at any point surrounding the immediate operations area See Section 1.2.6.7, Underground Utility Systems.

1.2.6.8 UNDERGROUND TESTS

Subparts are:

- 1.2.6.8.1 Integrated Data Acquisition System (IDS)
- 1.2.6.8.2 Geological Tests
- 1.2.6.8.3 Geomechanics Tests
- 1.2.6.8.4 Near-Field and Thermally Perturbed Tests
- 1.2.6.8.5 Hydrologic and Transport Phenomena Tests
- 1.2.6.8.6 Prototype Tests

Definition of Subsystem Elements

The underground test systems are defined by those activities associated with test equipment installation, test execution, test data recording, and test analysis for in situ site characterization to be performed within the Yucca Mountain ESF.

Applicable Regulations, Codes, and Specifications

The design requirements and criteria for the Integrated Data System (IDS) can be found in the Technical Requirements for the Integrated Data System of the NNWSI Project Exploratory Shaft Facility. See SDRD Volume II, Appendix D, Reference Project Documentation

See Section 1.2.6.0, for additional Applicable Regulations, Codes, and Specifications.

Functional Requirements

The underground tests shall provide the means for the implementation of site characterization testing plans and provide data to support performance confirmation testing.

Performance Criteria

1. In situ site characterization shall meet applicable requirements of 10 CFR part 60 and 10 CFR part 960.

2. In situ site characterization shall meet the applicable requirements of the Site Characterization Plan (SCP).

3. Testing plans must provide for feedback and modification as a result of initial and ongoing tests and monitored results.

4. Testing instrumentation/hardware, cables, computer equipment, and data acquisition and monitoring systems, shall be designed to withstand the expected underground environment.

5. Reports shall contain adequate visual and diagrammatic information to make the conduct, setup, and objectives of all the tests clear to readers outside the NNWSI Project.

6. In situ site characterization shall provide reliable information with specified accuracy and uncertainty as determined by the NNWSI Project.

7. Measurements, tests, and analyses shall be sufficient to determine the performance of the ESF and the effects of ESF construction on in situ site characterization.

8. An uninterruptable power supply system shall be available to ensure continuous operation of equipment and instrumentation related to critical testing as determined by the NNWSI Project through analysis.

9. Written procedures shall be developed for the procurement, construction, installation, maintenance, and operation of testing instruments, and data collection facilities.

10. Performance confirmation testing shall be carried out to meet the requirements of 10 CFR 60, Subpart F.

Constraints

1. Tests shall be designed and located within the facility to ensure that thermal, mechanical, chemical, and hydrological interactions will not endanger the structural stability of the ESF or adversely affect tests conducted in adjacent areas.

2. Testing shall not affect overall site integrity of the Mined Geologic Disposal System as required by 10 CFR 60.112.

3. Testing equipment requirements, including design life, shall be based on the performance goals of the tests.

4. Tests shall be classified according to primary information needs (i.e., site characterization, ESF site characterization, ESF design confirmation, repository design, or performance confirmation) and defined with respect to duration, scale, and space requirements. This classification and definition shall be the basis for equipment design, underground layout, ventilation, personnel, and utility requirements.

5. The ESF shafts shall be connected prior to initiation of full-scale in situ testing.

Interface Control Requirements

See Section 1.2.6.0, Interface Control Requirements.

Assumptions

1. Planned testing and monitoring will be conducted in the ES-1 (science) shaft, the Upper Demonstration Breakout Room (520 level), the Main Test Level (1020 level), and the Calico Hills drill room (1400 level) breakout levels.

2. The development of the underground testing program at the ESF has been based upon the qualitative derivation of information needs to satisfactorily address key issues in the Issues Hierarchy. The number of tests may change as site characterization proceeds and more variable or unexpected conditions are encountered. See Section 1.2.6.0, Performance Criteria item #2.

3. The underground utility system at the Main Test Level shall be sufficient to accommodate drifting and testing at any point surrounding the immediate operations area. See Section 1.2.6.7, Underground Utility Systems.

NNWSI PROJECT Page 1 of 1 N-AD-036 9/87

COST/SCHEDULE CHANGE REQUEST (C/SCR)

Change No.:	Organization:	Originator:	Origination Date:
89/017	SAIC	M. E. Spaeth	11/15/88

Title:

Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Request (ECR) 025

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ECR ESF 025.

REASON: See the "Basis for Change" on ESF ECR 025.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:
1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010 through 027.
2. ESF ECR 025.

Responsible Organization M. E. Spaeth [signature] Date 11/22/88

CCB Secretary P. C. Merkley [signature] Date 12/13/88

Approval: Project Manager, WMPO C. P. Gertz [signature] Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF-ECR 025

C/SCR No: 89/017

Summary of Recommended Actions:

	Project Office				T&MSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☒	☒	☒	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☐	☐	☐	☐
Non Concurrence	☐	☐	☐	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation:

Impact Analyses:

CCB Secretary P. C. Merkley (signature) Date 12/12/88

Page 1 of 1

CSCR ——'89 017

Department of Energy

Nevada Operations Office
P. O. Box 98518
Las Vegas, NV 89193-8518

JUL 20 1988

RECEIVED
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JUL 21 1988
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Copies ______

Michael E. Spaeth
Technical Project Officer
for NNWSI
ATTN: Phil Merkley
Science Applications
International Corporation
Suite 407
101 Convention Center Drive
Las Vegas, NV 89109

PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

Received In Configuration
Management Division

JUN 22 1988

SAIC/T&MSS
JUL 21 1988
CCF RECEIVED

Multiple Addressees JUL 20 1989

cc w/o encl:
V. J. Cassella, HQ (RW-123) FORS
Dean Stucker, HQ (RW-223) FORS
G. K. Beall, SAIC, Las Vegas, NV
M. C. Brake, SAIC, Las Vegas, NV
R. R. Reust, SAIC, Las Vegas, NV
John Nimmo, SAIC, Las Vegas, NV
S. H. Klein, SAIC, Las Vegas, NV
W. E. Narrows, SAIC, Las Vegas, NV
James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

CSCR ——'89 017

ESF ENGINEERING CHANGE REQUEST

ESF11.FMB-12/28

ECR NO. 025 PAGE 1 OF 1

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL	N/A	PARTICIPANT	SAIC
SOURCE	ESF SDRD	DATE	6/10/88
WBS DESIGNATION	1.2.6	ORIGINATOR	SAIC
TITLE	1.2.6.8.5 Hydrologic and Transport Phenomena	REV. NO.	DATE

DESCRIPTION OF CHANGE

In the ESF SDRD 1.2.6.8.5 Hydrologic and Transport Phenomena Test Performance Criteria, make the following changes: 1) Delete 7 in its entirety. 2) In 11, rewrite the first sentence to "In situ diffusion test measurements shall be made on nonsorbing tracers in the Topopah Spring welded unit."

SEE CONTINUATION PAGE

BASIS FOR CHANGE

Agreement from DOE ESF Issues Meeting 4/21/88. "Project will initiate the appropriate changes to the SDRD removing any requirements to penetrate the Calico Hills. However, the requirement for flexibility to sink shafts and drift in the Calico Hills will be maintained."

SEE CONTINUATION PAGE

PARTICIPANT QA REP [signature] DATE 7/7/88 ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 7/8/88

SECTION 2. ICWG CHAIRMAN ACTION ____ NOT APPLICABLE

1. PROCEED WITH ECR EVALUATION ____YES ____NO SCOPE CHANGE ____YES ____NO
2. PROCEED WITH WORK ____YES ____NO CONSTRUCTION IMPACT ____YES ____NO

3. TOTAL COSTS (increase/decrease) ____ NOT APPLICABLE

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT ____ NOT APPLICABLE

ENGINEERING ____ WEEKS
CONSTRUCTION ____ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ____YES ____NO
PROCEED WITH DETAIL ESTIMATE ____YES ____NO

6. FUNDING:

____ NOT APPLICABLE ____ NOT FUNDED, PROJECTED ONLY

____ CHANGE ORDER ____ SPECIAL STUDIES

ICWG CHAIRMAN/DATE

7. APPROVED

[signature] 7/8/88

ICWG CHAIRMAN/DATE

1.2.6.8.5 HYDROLOGIC AND TRANSPORT PHENOMENA TESTS

Definition of Subsystem Elements

The hydrologic and transport phenomena tests are defined as those tests that are required to characterize the hydrologic and transport phenomena of the welded and nonwelded tuff These properties are an integral part of the information needed to:

1 supplement and complement the surface-based hydrologic information needed to characterize the Yucca Mountain site; and

2 provide information for analyzing fluid flow and the potential for radionuclide transport through unsaturated tuff.

Functional Requirements

Provide the test plans, test data, equipment, and instrumentation to access and record the detailed hydrologic and transport phenomena characteristics of the potential repository site

Performance Criteria

1 Field and laboratory methods shall be used to measure the rock-matrix hydrologic properties on large-rock samples collected from selected horizons during excavation of the Exploratory Shaft (ES-1).

2 Fluid flow and chemical transport measurements shall be conducted in the laboratory on variably saturated single fractures. Samples will be obtained from the main test level and the breakout levels by bolting perpendicular to a fracture and then overcoring.

3 In situ fluid flow and chemical transport measurements shall be made through fracture networks in variably saturated welded tuff. This test will be an infiltration test performed by trickling tracer-tagged water onto the floor of a specially designed drift

4 In situ bulk (rockmass) permeability measurements shall be made within bounded rock mass blocks of the Topopah Spring welded unit at the main test level This test will utilize a test chamber and parallel boreholes.

5 In situ rockmass hydrologic properties measurements shall be made at 12 depth locations in ES-1 using two radial boreholes at each depth drilled perpendicular to the shaft and perpendicular to each other.

6 Measurements shall be made to determine the effect excavating and lining ES-1 will have on the hydrologic properties of the unsaturated welded tuff. The tests will be conducted in vertical boreholes drilled in radial arrangements in the floors of the two breakout rooms and will consist of air-permeability, deformation, and moisture content measurements.

7. DELETED

8. If perched-water zones are encountered during construction of ES-1, then borehole hydrological measurements and geologic characterization shall be conducted to detect the occurrence and estimate the properties of the perched-water zones.

9 Hydrochemistry analysis of the unsaturated zone water shall be made on pore-water samples obtained from bulk rock samples taken from the walls of ES-1 at various horizons and from fracture water samples taken directly from the shaft where inflow is observed.

10 The rate of water movement downward through the unsaturated zone to the water table beneath Yucca Mountain shall be determined by conducting Chlorine-36 tracer measurements of pore or fracture water from blast rubble rock obtained at various depths within ES-1.

11. In situ diffusion test measurements shall be made on nonsorbing tracers in the Topopah Spring welded unit. Tracers will be introduced into boreholes and later overcoring will be conducted to obtain tracer concentrations as a function of distance from the borehole.

Constraints

See Section 1.2.6.8, Constraints.

Assumptions

None.

1.2.6.8.5 HYDROLOGIC AND TRANSPORT PHENOMENA TESTS

Definition of Subsystem Elements

The hydrologic and transport phenomena tests are defined as those tests that are required to characterize the hydrologic and transport phenomena of the welded and nonwelded tuff. These properties are an integral part of the information needed to:

1. supplement and complement the surface-based hydrologic information needed to characterize the Yucca Mountain site; and

2. provide information for analyzing fluid flow and the potential for radionuclide transport through unsaturated tuff.

Functional Requirements

Provide the test plans, test data, equipment, and instrumentation to access and record the detailed hydrologic and transport phenomena characteristics of the potential repository site.

Performance Criteria

1. Field and laboratory methods shall be used to measure the rock-matrix hydrologic properties on large-rock samples collected from selected horizons during excavation of the Exploratory Shaft (ES-1).

2. Fluid flow and chemical transport measurements shall be conducted in the laboratory on variably saturated single fractures. Samples will be obtained from the main test level and the breakout levels by bolting perpendicular to a fracture and then overcoring.

3. In situ fluid flow and chemical transport measurements shall be made through fracture networks in variably saturated welded tuff. This test will be an infiltration test performed by trickling tracer-tagged water onto the floor of a specially designed drift.

4. In situ bulk (rockmass) permeability measurements shall be made within bounded rock mass blocks of the Topopah Spring welded unit at the main test level. This test will utilize a test chamber and parallel boreholes.

5. In situ rockmass hydrologic properties measurements shall be made at 12 depth locations in ES-1 using two radial boreholes at each depth drilled perpendicular to the shaft and perpendicular to each other.

6. Measurements shall be made to determine the effect excavating and lining ES-1 will have on the hydrologic properties of the unsaturated welded tuff. The tests will be conducted in vertical boreholes drilled in radial arrangements in the floors of the

two breakout rooms and will consist of air-permeability, deformation, and moisture content measurements.

7. Borehole hydrological measurements and geologic characterization shall be made to determine the hydrogeologic characteristics of the Calico Hills nonwelded unit.

8. If perched-water zones are encountered during construction of ES-1, then borehole hydrological measurements and geologic characterization shall be conducted to detect the occurrence and estimate the properties of the perched-water zones.

9. Hydrochemistry analysis of the unsaturated zone water shall be made on pore-water samples obtained from bulk rock samples taken from the walls of ES-1 at various horizons and from fracture water samples taken directly from the shaft where inflow is observed.

10. The rate of water movement downward through the unsaturated zone to the water table beneath Yucca Mountain shall be determined by conducting Chlorine-36 tracer measurements of pore or fracture water from blast rubble rock obtained at various depths within ES-1.

11. In situ diffusion test measurements shall be made on nonsorbing tracers in the Topopah Spring welded unit and the Calico Hills nonwelded unit. Tracers will be introduced into boreholes and later overcoring will be conducted to obtain tracer concentrations as a function of distance from the borehole.

Constraints

See Section 1.2.6.8, Constraints.

Assumptions

None.

NNWSI PROJECT
COST/SCHEDULE CHANGE REQUEST (C/SCR)

Page 1 of 1

N-AD-036
9/87

Change No.:	Organization:	Originator:	Origination Date:
89/018	SAIC	M. E. Spaeth	11/15/88

Title:
Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Request (ECR) 026

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 026.

REASON: See the "Basis for Change" on ESF ECR 026.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:
1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010 through 027.
2. ESF ECR 026.

Responsible Organization M. E. Spaeth [signature] Date 11/22/88

CCB Secretary P. C. Merkley [signature] Date 12/13/88

Approval: Project Manager, WMPO C. P. Gertz [signature] Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF-ECR 026	C/SCR No: 89/018

Summary of Recommended Actions:

	Project Office				T&MSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☐	☒	☐	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☒ (1)	☐	☐	☐
Non Concurrence	☐	☐	☒ (2)	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation: (1) "This change will have a Cost and Schedule Impact".
(2) "This request for relocating the warehouse site to the auxilary pad to allow space on the main pad for a larger shop needs further data input to be provided. A cost and schedule analysis, if requested for both, needs to be provided to ascertain the viability of this proposal".

Impact Analyses: Data was not provided to indicate impacts relating to cost and schedule.

CCB Secretary P. C. Merkley Date 12/12/88

Page 1 of 1

CSCR ——'89 018

Department of Energy

Nevada Operations Office
P. O. Box 98518
Las Vegas, NV 89193-8518

JUL 20 1988

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M. E. SPAETH

JUL 21 1988
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Michael E. Spaeth
Technical Project Officer
for NNWSI
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PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

for Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

Received In Configuration Management Division

JUL 22 1988

SAIC/T&MSS

JUL 21 1988

CCF RECEIVED

cc w/o encl:
V. J. Cassella, HQ (RW-123) FORS
Dean Stucker, HQ (RW-223) FORS
G. K. Beall, SAIC, Las Vegas, NV
M. C. Brake, SAIC, Las Vegas, NV
R. R. Reust, SAIC, Las Vegas, NV
John Nimmo, SAIC, Las Vegas, NV
S. H. Klein, SAIC, Las Vegas, NV
W. E. Narrows, SAIC, Las Vegas, NV
James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

CSCR ____ '89 018

ESF ENGINEERING CHANGE REQUEST

ESF 11 FMB-12/2?

ECR NO. 026 PAGE 1 OF 2

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL III
SOURCE REECo
WBS DESIGNATION 1.2.6.2.1.03
TITLE Main Pad
DESCRIPTION OF CHANGE Warehouse

PARTICIPANT REECo
DATE 6/24/88
ORIGINATOR W. H. Grams
REV. NO. ____ DATE ____

Reynolds Electrical & Engineering Co. (REECo) recommends the Subsystem Design Requirements Document (SDRD), specifically Section 1.2.6.1.1., Main Pad, be changed by deleting Functional Requirement No. 9, Warehouse (plus Storage Area), and further changing Section 1.2.6.1.2, Auxiliary Pads, by adding the warehouse (plus storage area to the Functional Requirements.

SEE CONTINUATION PAGE

BASIS FOR CHANGE From the SDRD, Performance Criteria No. 2 of Section 1.2.6.0 along with Functional Requirement No. 2 of Section 1.2.6.1 require that the surface site be capable of handling a 100 percent increase in the underground testing. As currently specified, the shop, warehouse, and subcontractor areas are located on the same area o the pad and, due to their close proximity and space requirements, have very limited expansion capability. Moving the warehouse to the auxiliary pad makes space available for a larger shop on the main pad and places the warehouse on a location which allows ease of expansion. In addition to enhancing the flexibility and ease of expansion, a number of other serendipitous attributes present themselves.

SEE CONTINUATION PAGE

PARTICIPANT QA REP [signature] DATE 6/24/88 ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 6-24-88

SECTION 2. ICWG CHAIRMAN ACTION ____ NOT APPLICABLE

1. PROCEED WITH ECR EVALUATION ✓ YES ____ NO SCOPE CHANGE ____ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO CONSTRUCTION IMPACT ____ YES ____ NO

3. TOTAL COSTS (increase/decrease) ____ NOT APPLICABLE

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT ____ NOT APPLICABLE

ENGINEERING ____ WEEKS
CONSTRUCTION ____ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

6. FUNDING:

____ NOT APPLICABLE ✓ NOT FUNDED, PROJECTED ONLY
____ CHANGE ORDER ____ SPECIAL STUDIES

[signature] 7/8/88
ICWG CHAIRMAN/DATE

7. APPROVED

[signature] 7/8/88
ICWG CHAIRMAN/DATE

ESF ENGINEERING CHANGE REQUEST

ECR NO. 026

Continuation Page

TITLE Main Pad

CONTINUATION DATA For the warehouse:

1. Future expansion of the warehouse facilities would have minimal impact on the construction and operation of the ESF.
2. The warehouse could be located contiguous to the controlled (fenced with locked gates) outdoor storage area for efficient control and documentation of all materia especially Quality Levels I and II.
3. The warehouse location could include enough space for 18-wheel truck semi-trailer turn around, plus the ramps and loading docks necessary for a safe and efficient operation.
4. Truck traffic to and from the warehouse facility would not interfere with the construction and operation of the ESF.
5. By keeping delivery trucks off the main pad, safety and security are enhanced.

As a result of relocating the warehouse to the auxiliary pad, the following features in regard to the shop would enhance the design:

1. Additional area is available for parking of dedlined vehicles and laydown of items in preparation of assembly such as the hoists, or for disassembly for lowering into the underground facility.
2. Area is now available for a wash down and steam clean pad.
3. Outdoor storage of full and empty compressed gas bottles in racks in addition to paints and other flammable liquids.
4. Area is now unencumbered for maintenance of any large machinery which would not fit inside, including dump trucks, loaders, graders, etc.

OTHER INFORMATION

1.2.6.1.1 MAIN PAD

Definition of Subsystem Elements

The main pad consists of the structures, systems, and components defined by the area prepared to accommodate shaft collars, headframes, hoist systems, substations, offices, laboratories, warehouse, contractor's temporary facilities, as well as other normal facilities such as parking space.

Functional Requirements

The main pad shall provide an area of adequate size and shape to support all anticipated structures, systems, and components that will be located near the shafts. This includes the following items:

1. Roads (muck haulage and access)
2. ES-1 (plus standoff distances)
3. ES-2 (plus standoff distances)
4. Permanent hoist house(s) (plus standoff distances)
5. Headframes and back legs
6. Muck handling facilities
7. First aid
8. Shop (plus equipment storage)
9. ~~Warehouse (plus materials storage area)~~ Delete
10. Substation (69 kV)
11. Compressor(s)
12. Ventilation fans (plus standoff distances)
13. Standby generator(s) (plus fuel tanks)
14. Utilities (power, water, sewage, communications)
15. Change house(s)
16. Subcontractor facilities (offices, change house, shop)
17. Trailers and parking
18. Integrated data acquisition system/communications building

Performance Criteria

1. The main pad shall be designed to handle potential runoff in the existing natural drainage channels from a probable maximum flood.

2. Site preparation for the shaft collars shall be designed and constructed for a maintainable 100-year life.

1.2.6.1.2 AUXILIARY PADS

Definition of Subsystem Elements

The auxiliary pads consist of the areas prepared to support the ESF construction and operation. These pads include the G-4 laydown pad, explosives magazine pad, muck storage pad, topsoil storage pad, batch plant pad, water tank pad, lower storage pads, and other areas defined as the design progresses.

Functional Requirements

The auxiliary pads shall provide areas of adequate size and shape to support all anticipated functions. This includes the following:

1. Parking
2. Utilities (power, water, sewage, communications)
3. Materials storage
4. Storage and equipment (subcontractor and REECo)
5. Fuel and lubricants storage/tank
6. Explosive storage plus access roads
7. Batch plant
8. Borrow pit
9. Water tank and access
10. Muck storage
11. Stock pile of topsoil
12. Sewage disposal
13. Mine wastewater disposal
14. Booster pump station
15. Warehouse (plus storage area)

Performance Criteria

1. All auxiliary pads shall be designed to handle potential runoff of a 100 year storm unless otherwise specified. The following pads shall be designed to the runoff potential shown.

Batch Plant Pad	10 year storm
Lower Storage Pads	10 year storm
G-4 Pad	25 year storm
Booster Pump Bldg. Pad	50 year storm

2. Drainage ponds and muck storage pile liners shall be designed and constructed for a maintainable 25-year life. All other civil improvements for auxiliary pads shall be designed and constructed for a maintainable 5-year life.

Constraints

1. The auxiliary pads shall facilitate the safe and efficient flow of material and personnel within and around their respective areas.

2. The muck storage pad design shall ensure that the capacity includes allowances for excavation overbreak and swell of broken rock.

3. The location and size of the explosives storage area shall be determined by the current California and Mine Health and Safety Administration (MSHA) regulations and the MSHA table of distances.

4. The auxiliary pad design and construction shall ensure considerations for expansion (uncertainty allowance).

Assumptions

1. The graded areas for the auxiliary pad(s) do not need to be contiguous or even on a single level if such an arrangement is cost effective (considering construction, operation, and maintenance) or provides for efficient operations.

1.2.6.1.1 MAIN PAD

Definition of Subsystem Elements

The main pad consists of the structures, systems, and components defined by the area prepared to accommodate shaft collars, headframes, hoist systems, substations, offices, laboratories, warehouse, contractor's temporary facilities, as well as other normal facilities such as parking space.

Functional Requirements

The main pad shall provide an area of adequate size and shape to support all anticipated structures, systems, and components that will be located near the shafts. This includes the following items:

1. Roads (muck haulage and access)
2. ES-1 (plus standoff distances)
3. ES-2 (plus standoff distances)
4. Permanent hoist house(s) (plus standoff distances)
5. Headframes and back legs
6. Muck handling facilities
7. First aid
8. Shop (plus equipment storage)
9. Substation (69 kV)
10. Compressor(s)
11. Ventilation fans (plus standoff distances)
12. Standby generator(s) (plus fuel tanks)
13. Utilities (power, water, sewage, communications)
14. Change house(s)
15. Subcontractor facilities (offices, change house, shop)
16. Trailers and parking
17. Integrated data acquisition system/communications building

Performance Criteria

1. The main pad shall be designed to handle potential runoff in the existing natural drainage channels from a probable maximum flood.

2. Site preparation for the shaft collars shall be designed and constructed for a maintainable 100-year life.

Constraints

1. The main pad shall facilitate the safe and efficient flow of material and personnel within the ESF site.
2. Buildings shall be so spaced as to allow sufficient room for construction and maintenance of the facilities.

Assumptions

1. The graded area for the ESF site does not need to be contiguous or even on a single level if such an arrangement is cost effective (considering construction, operation, and maintenance) or provides for efficient operations.

1.2.6.1.2 AUXILIARY PADS

Definition of Subsystem Elements

The auxiliary pads consist of the areas prepared to support the ESF construction and operation. These pads include the G-4 laydown pad, explosives magazine pad, muck storage pad, topsoil storage pad, batch plant pad, water tank pad, lower storage pads, and other areas defined as the design progresses.

Functional Requirements

The auxiliary pads shall provide areas of adequate size and shape to support all anticipated functions. This includes the following:

1. Parking
2. Utilities (power, water, sewage, communications)
3. Materials storage
4. Storage and equipment (subcontractor and REECo)
5. Fuel and lubricants storage/tank
6. Explosive storage plus access roads
7. Batch plant
8. Borrow pit
9. Water tank and access
10. Muck storage
11. Stock pile of topsoil
12. Sewage disposal
13. Mine wastewater disposal
14. Booster pump station

add ⇒ 15. Warehouse (plus Storage Area)

Performance Criteria

1. The pads shall be designed to handle potential runoff in the existing natural drainage channels from a probable maximum flood.

2. Drainage ponds and muck storage pile liners shall be designed and constructed for a maintainable 25-year life. All other civil improvements for auxiliary pads shall be designed and constructed for a maintainable 5-year life.

Constraints

1. The auxiliary pads shall facilitate the safe and efficient flow of material and personnel within and around their respective areas.

N-AD-036
9/87

NNWSI PROJECT
COST/SCHEDULE CHANGE REQUEST (C/SCR)

Change No.:	Organization:	Originator:	Origination Date:
89/019	SAIC	M. E. Spaeth	11/15/88

Title:
Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with the Approved ESF Engineering Change Request (ECR) 027

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 027.

REASON: See the "Basis for Change" on ESF ECR 027.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:
1. Letter, L. P. Skousen to M. E. Spaeth, July 20, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Requests (ECRs) 010 through 027.
2. ESF ECR 027.

Responsible Organization M. E. Spaeth Date 11/22/88
CCB Secretary P. C. Merkley Date 12/13/88
Approval: Project Manager, WMPO C. P. Gertz Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF-ECR 027

C/SCR No: 89/019

Summary of Recommended Actions:

	Project Office				T&MSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☐	☒	☐	☒	☒	☒
Concurrence with Conditions	☐	☐	☐	☐	☒ (1)	☐	☐	☐
Non Concurrence	☐	☐	☒ (2)	☐	☐	☐	☐	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation: (1) "A cost and schedule impact will be realized with this change".
(2) "With the reconfiguring of the main warehouse at the ESF site, a detailed analysis of the conceptual size of facility, Engineering/Construction Cost and Schedule impact, if any, needs to be provided. Cannot make fair evaluation of this request unless data as stated above is provided.

Impact Analyses: Data was not provided to indicate impact relating to either cost or schedule.

CCB Secretary P. C. Merkley [signature] Date 12/12/88

Page 1 of 1

CSCR ——'89 019

Department of Energy
Nevada Operations Office
P. O. Box 98518
Las Vegas, NV 89193-8518

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Michael E. Spaeth
Technical Project Officer
for NNWSI
ATTN: Phil Merkley
Science Applications
International Corporation
Suite 407
101 Convention Center Drive
Las Vegas, NV 89109

PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

Received in Configuration
Management Division

JUL 22 1988

SAIC/T&MSS

JUL 21 1988

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cc w/o encl:
V. J. Cassella, HQ (RW-123) FORS
Dean Stucker, HQ (RW-223) FORS
G. K. Beall, SAIC, Las Vegas, NV
H. C. Brake, SAIC, Las Vegas, NV
R. R. Reust, SAIC, Las Vegas, NV
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S. H. Klein, SAIC, Las Vegas, NV
W. E. Narrows, SAIC, Las Vegas, NV
James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

CSCR '89 019

ESF ENGINEERING CHANGE REQUEST

ESF11.FMB-12/28

ECR NO. 021

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL: III
PARTICIPANT: REECo
SOURCE: REECo
DATE: 6/24/88
WBS DESIGNATION: 1.2.6.3.1.05
ORIGINATOR: W. H. Grams
TITLE: Warehouse
REV. NO. ____ DATE ____

DESCRIPTION OF CHANGE

Reynolds Electrical & Engineering Co. (REECo) recommends that the Subsystem Design Requirements Document, specifically Section 1.2.6.3.7 Warehouse, be modified such that Assumption 1 which states, "The existing government-owned building will satisfy the requirements for the ESF warehouse", be deleted.

SEE CONTINUATION PAGE

BASIS FOR CHANGE The warehouse located at the ESF site will be the main facility for receipt, documentation, staging, storing, and issuing of construction materials, equipment, maintenance items, and quality assurance documentation and control records. In order to assure that warehousing does not become problematical and cause critical delays in ESF operations, both construction and testing, facilities must be sized to handle the expected requirements and also have the ability to be expanded. The warehouse will support construction, operations (testing), and maintenance throughout the life of the Project. Figure 1, Warehouse Support Requirements, presents an

SEE CONTINUATION PAGE

PARTICIPANT QA REP [signature] DATE 6/24/88
ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 6-24-88

SECTION 2. ICWG CHAIRMAN ACTION ____ NOT APPLICABLE

1. PROCEED WITH ECR EVALUATION ✓ YES ____ NO SCOPE CHANGE ____ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO CONSTRUCTION IMPACT ____ YES ____ NO

3. TOTAL COSTS (increase/decrease) ____ NOT APPLICABLE

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT ____ NOT APPLICABLE
ENGINEERING ____ WEEKS
CONSTRUCTION ____ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

6. FUNDING:
____ NOT APPLICABLE ✓ NOT FUNDED, PROJECTED ONLY
____ CHANGE ORDER ____ SPECIAL STUDIES

[signature] 7/8/88
ICWG CHAIRMAN/DATE

7. APPROVED

[signature] 7/8/88
ICWG CHAIRMAN/DATE

ESF ENGINEERING CHANGE REQUEST

ESF12-FMB-11/2

ECR NO. 027
Continuation Page

TITLE Warehouse

CONTINUATION DATA abbreviated construction schedule through 1991 which delineates the overall warehouse requirements by quarters. No attempt was made to determine actual line items, but to identify major systems or pieces of equipment which would impact on warehousing. Figure 1 is divided into three general areas which are; construction support, maintenance support and testing (operations) support. Initially the warehous will mainly support the construction effort with requirements to house components and parts for:

- o ES-1 and ES-2 hoists installation and hoist house.
- o ES-1 and ES-2 headframes and sinking equipment.
- o ESF mine plant including generators, compressors and fans.

From the time it is fully operational, the warehouse will house equipment and supplies to support the testing program. In addition to the tests which would begin quickly; such as, the rock matrix, radial borehole, shaft convergences, and UBOL DBR tests, the warehouse would be responsible for storage and control of the IDS/DAS equipment. Spare parts for critical equipment, mobile, portable, and fixed, will also be stored in the warehouse. These spares, if Quality Level III, may be issued to the shop for storage there as a part of their normal maintenance program. Quality Levels I and II spares will only be kept in the main warehouse and issued as needed. Upon completion of the ES-2 shaft, the warehouse would then support the construction of the main test level plus MTL testing, including the IDS system and DAS stations. Figure 1 lists, at the bottom, may of the systems, equipment, and construction components that will be in the warehouse facility.

The warehouse facility must be sized to support the following activities:

1. Receiving//Inspection; each item delivered to the ESF will be received and documented. For those items to be stored inside, a storage/receiving area is necessary. As items arrive, they will be inspected. Critical Quality Levels I and II items may have extensive inspection procedures prior to placing them into temporary or permanent locations.
2. Overage, Shortage, and Damaged Storage; any item or shipment that does not pass inspection--wrong item, too may or few or damaged--will be tagged and placed in a locked area. These items will be held until the problem is rectified.

OTHER INFORMATION

CSCR '89 019

ESF ENGINEERING CHANGE REQUEST

ESF 12 FMB-11/7

ECR NO. 027

Continuation Page

TITLE Warehouse

CONTINUATION DATA

3. Hazardous material storage; any item considered hazardous would be stored in a special area such as solvents, cleaners, chemicals.
4. Lock and Key Storage; any items requiring special custodial procedures will be stored in a locked storage area. Such items could be IDS/DAS computer spare parts hoist electrical components, communications equipment, special tools, calibrated instruments, etc.
5. Restroom Facilities
6. Offices; the office space would house the files, record keeping micro computers and desks and tables for processing, receiving, inspection, storage, and issuing documentation.

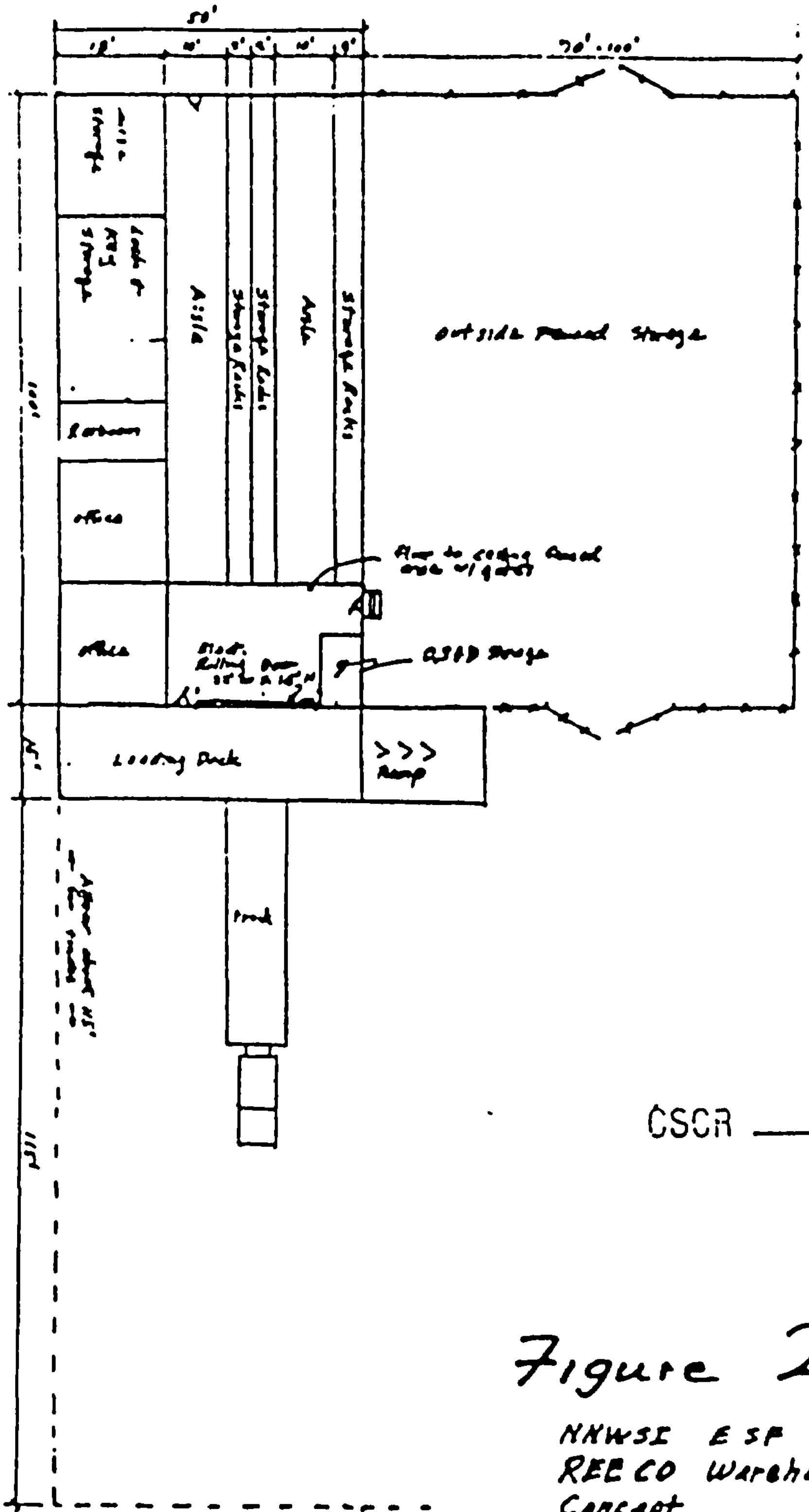
Additional features which would be a part of the warehouse facility to assure safe and efficient operation are a contiguous loading dock and ramp.

The numbers of line items which will be stored are estimated to be between 2,000 and 3,000 items. In addition, the warehouse staff will control all of the items stored in the controlled yard(s). Figure 2, Conceptual Warehouse, which contains all of the above listed features is presented with this ECR.

Information developed herein on warehouse requirements is based upon the tasks derived from the work breakdown structure and further defined by the work order outline at the sixth level.

OTHER INFORMATION

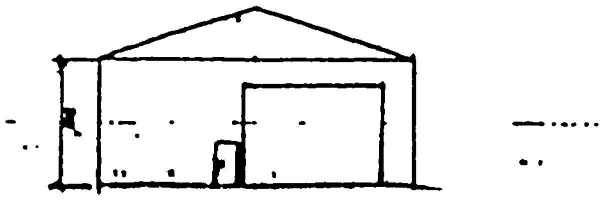
Exhibit-D



CSCR ____'89 019

Figure 2

NNWSI ESF
REECO Warehouse
Concept



1" = 30'
5/6/88

1.2.6.3.7 WAREHOUSE

Definition of Subsystem Elements

The warehouse shall include all the facilities, systems, and services for the safe storage and dispensing of materials within the ESF.

Functional Requirements

Provide facilities for general warehousing in support of the ESF construction and operations

Performance Criteria

1. The warehouse shall meet the operational requirements of the users.
2. Space and equipment shall support the functions of purchasing, storing, and dispensing equipment and materials, and shall be sized to accommodate the inventory needed for ESF operations and in situ site characterization.
3. Storage of critical components shall be under controlled access.
4. The warehouse shall provide a chemical storage area.

Constraints

1. The warehouse will be designed and constructed as a prefabricated metal building
2. The warehouse shall contain a rest room and offices.
3. The warehouse shall be insulated and heated. In addition, the office areas and rest rooms shall be air conditioned.

Assumptions

(deleted)

NNWSI PROJECT
COST/SCHEDULE CHANGE REQUEST (C/SCR)

N-AD 036
9/87

Change No.	Organization:	Originator:	Origination Date.
89 020	SAIC	M. E. Spaeth	11/15/88

Title.

Revise the Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) NVO-309 in Accordance with Approved ESF Engineering Change Request (ECR) 028

Explanation & Reason for Change:

WBS: 1.2.6.1.1.T

CHANGE: See the attached ESF ECR 028.

REASON: See "Basis for Change" on ESF ECR 028.

COST IMPACT: None

SCHEDULE IMPACT: None

ATTACHMENTS:
1. Letter, L. P. Skousen to M. E. Spaeth, July 21, 1988, Proposed Changes to the Exploratory Shaft Facility Subsystem Design Requirements Document (SDRD) Engineering Change Request 028.
2. ESF ECR 028.

Responsible Organization M. E. Spaeth *[signature]* Date 11/22/88

CCB Secretary P. C. Merkley *[signature]* Date 12/13/88

Approval. Project Manager, WMPO C. P. Gertz *[signature]* Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Revise ESF SDRD in accordance with approved ESF-ECR 028	C/SCR No: 89/020

Summary of Recommended Actions:

	Project Office				TSMSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	☐	☒	☒	☒	☒	☒	☐	☒
Concurrence with Conditions	☐	☐	☐	☐	☐	☐	☐	☐
Non Concurrence	☐	☐	☐	☐	☐	☐	☒ (1)	☐
No Recommendation	☒	☐	☐	☐	☐	☐	☐	☐

Comment Summary Evaluation: (1) "Assessment for batch plant pad, lower storage pads and booster pump building is probably okay, but I'm concerned about the G-4 pad. G-4 borehole represents a possible pathway to repository horizon until is sealed. Because of potential impacts on repository performance and testing, it is more appropriate to design to p.m.f. This can also be used as an argument that we've take a conservative "alternate" to 60.21 requirements".

Impact Analyses: (1) Recommendation - "Design G-4 pad for probable maximum flood (p.m.f.)".

CCB Secretary P. C. Merkley Date 12/12/88

Page 1 of 1

CSCR ____'89 020

Department of Energy
Nevada Operations Office
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Las Vegas, NV 89193-8518

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Michael E. Spaeth
Technical Project Officer
for NNWSI
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International Corporation
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101 Convention Center Drive
Las Vegas, NV 89109

PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUESTS (ECRs) 010 through 027

The Chairman of the Interface Control Working Group approved the subject ECRs on July 8, 1988. The contents of these ECRs change the information contained in various sections of the SDRD under the formal Project Baseline Process. Send all holders of the SDRD controlled copies of this information. If you have any questions, please feel free to contact Dennis R. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development and
Engineering Branch
Waste Management Project Office

WMPO:DHI-2970

Enclosure:
Approved ECRs 010 through 027

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Management Division
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cc w/o encl:
V. J. Cassella, HQ (RW-123) FORS
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G. K. Beall, SAIC, Las Vegas, NV
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R. R. Reust, SAIC, Las Vegas, NV
John Nimmo, SAIC, Las Vegas, NV
S. H. Klein, SAIC, Las Vegas, NV
W. E. Narrows, SAIC, Las Vegas, NV
James Blaylock, WMPO, NV
E. L. Wilmot, WMPO, NV

CSCR ——'89 020

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PROPOSED CHANGES TO THE EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD) ENGINEERING CHANGE REQUEST (ECR) 028

The Chairman of the Interface Control Working Group has approved the subject ECR on July 11, 1988. The content of this ECR changes the information contained in section 1.2.6.1.2 of the SDRD under the formal Project baseline process. All holders of the SDRD are to receive this information. If you have any questions, please feel free to contact Dennis H. Irby at 794-7932.

Lester P. Skousen, Chief
Technology Development &
Engineering Branch
Waste Management Project Office

WMPO:DHI-2967

Enclosure:
Approved ECR 028

cc w/encl:
V. J. Cassella, HQ (RW-123) FORS
Dean Stucker, HQ (RW-223) FORS
G. K. Beall, SAIC, Las Vegas, NV
M. C. Brake, SAIC, Las Vegas, NV
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H&N-ECR-001

CSCB '89 020

ESF ENGINEERING CHANGE REQUEST

ESTP11 FMB-12/28

ECR NO. 028

PAGE 1 OF 2

SECTION 1. TO BE COMPLETED BY PARTICIPANT REQUESTING CHANGE

QA LEVEL: III
SOURCE: SDRD-NVO-309 Rev. 1
WBS DESIGNATION: 1.2.6.2.1.H
TITLE: 1.2.6.1.2 AUXILIARY PADS
DESCRIPTION

PARTICIPANT: H&N
DATE: 04/11/88
ORIGINATOR: J. C. Calovini
REV. NO. 1 DATE 07/08/88
REV. NO. ____ DATE ____

SDRD 1.2.6.1.2, Pg. 1.2-1, Performance Criteria, 1: Currently reads: "The pads shall be designed to handle potential runoff in the existing natural drainage channels from a probable maximum flood."

Suggest changing to: All auxiliary pads shall be designed to handle potential runoff of a 100 year storm unless otherwise specified. The following pads shall be designed to the runoff potential shown.

Batch Plant Pad 10 year storm

SEE CONTINUATION PAGE ✓

BASIS FOR CHANGE

The costs to design and construct these pads is considerably higher for probable maximum flood protection 10, 25, 50 or 100 year storm runoff protection. We suggest these changes based on replacement costs of the pads and equipment damage from runoff, taking into consideration the life of the ESF.

SEE CONTINUATION PAGE

SCOPE CHANGE x YES ____ NO   CONSTRUCTION IMPACT x YES ____ NO

PARTICIPANT QA REP [signature] DATE 7/8/88   ESF ICWG REPRESENTATIVE OR PARTICIPANT TPO [signature] DATE 7/7/88

SECTION 2. ACTION

1. PROCEED WITH ECR EVALUATION ✓ YES ____ NO
2. PROCEED WITH WORK ____ YES ____ NO

[signature]
ESF ICWG CHAIRMAN

3. TOTAL COSTS (increase/decrease)

	ROM	BUDGET	PROJECTED
ENGINEERING			
CONSTRUCTION			
TOTALS			

4. SCHEDULING IMPACT

ENGINEERING ____ WEEKS
CONSTRUCTION ____ WEEKS

5. PROCEED WITH DETAIL ENGINEERING ____ YES ____ NO
PROCEED WITH DETAIL ESTIMATE ____ YES ____ NO

ESF CHAIRMAN ICWG

6. FUNDING:

____ CHANGE ORDER ____ SPECIAL STUDIES
✓ NOT FUNDED, PROJECTED ONLY

[signature]
ESF CHAIRMAN ICWG

7. APPROVED FOR BASELINING

[signature]
ESF CHAIRMAN ICWG

ENCLOSURE

ESF ENGINEERING CHANGE REQUEST

ESTP12 FMB-1'2

ECR NO. 028

Continuation Page

PAGE 2 OF 2

TITLE 1.2.6.1.2 AUXILIARY PADS

CONTINUATION DATA

Lower Storage Pads	10 year storm
G-4 Pad	25 year storm
Booster Pump Bldg. Pad	50 year storm

OTHER INFORMATION

1.2.6.1.2 AUXILIARY PADS

Definition of Subsystem Elements

The auxiliary pads consist of the areas prepared to support the ESF construction and operation. These pads include the G-4 laydown pad, explosives magazine pad, muck storage pad, topsoil storage pad, batch plant pad, water tank pad, lower storage pads, and other areas defined as the design progresses.

Functional Requirements

The auxiliary pads shall provide areas of adequate size and shape to support all anticipated functions. This includes the following:

1. Parking
2. Utilities (power, water, sewage, communications)
3. Materials storage
4. Storage and equipment (subcontractor and REECo)
5. Fuel and lubricants storage/tank
6. Explosive storage plus access roads
7. Batch plant
8. Borrow pit
9. Water tank and access
10. Muck storage
11. Stock pile of topsoil
12. Sewage disposal
13. Mine wastewater disposal
14. Booster pump station
15. Warehouse (plus storage area)

Performance Criteria

1. All auxiliary pads shall be designed to handle potential runoff of a 100 year storm unless otherwise specified. The following pads shall be designed to the runoff potential shown.

Batch Plant Pad	10 year storm
Lower Storage Pads	10 year storm
G-4 Pad	25 year storm
Booster Pump Bldg. Pad	50 year storm

2. Drainage ponds and muck storage pile liners shall be designed and constructed for a maintainable 25-year life. All other civil improvements for auxiliary pads shall be designed and constructed for a maintainable 5-year life.

Constraints

1. The auxiliary pads shall facilitate the safe and efficient flow of material and personnel within and around their respective areas.

2. The muck storage pad design shall ensure that the capacity includes allowances for excavation overbreak and swell of broken rock.

3. The location and size of the explosives storage area shall be determined by the current California and Mine Health and Safety Administration (MSHA) regulations and the MSHA table of distances.

4. The auxiliary pad design and construction shall ensure considerations for expansion (uncertainty allowance).

Assumptions

1. The graded areas for the auxiliary pad(s) do not need to be contiguous or even on a single level if such an arrangement is cost effective (considering construction, operation, and maintenance) or provides for efficient operations.

1.2.6.1.2 AUXILIARY PADS

Definition of Subsystem Elements

The auxiliary pads consist of the areas prepared to support the ESF construction and operation. These pads include the G-4 laydown pad, explosives magazine pad, muck storage pad, topsoil storage pad, batch plant pad, water tank pad, lower storage pads, and other areas defined as the design progresses.

Functional Requirements

The auxiliary pads shall provide areas of adequate size and shape to support all anticipated functions. This includes the following:

1. Parking
2. Utilities (power, water, sewage, communications)
3. Materials storage
4. Storage and equipment (subcontractor and REECo)
5. Fuel and lubricants storage/tank
6. Explosive storage plus access roads
7. Batch plant
8. Borrow pit
9. Water tank and access
10. Muck storage
11. Stock pile of topsoil
12. Sewage disposal
13. Mine wastewater disposal
14. Booster pump station

Performance Criteria

1. The pads shall be designed to handle potential runoff in the existing natural drainage channels from a probable maximum flood.

2. Drainage ponds and muck storage pile liners shall be designed and constructed for a maintainable 25-year life. All other civil improvements for auxiliary pads shall be designed and constructed for a maintainable 5-year life.

Constraints

1. The auxiliary pads shall facilitate the safe and efficient flow of material and personnel within and around their respective areas.

2. The muck storage pad design shall ensure that the capacity includes allowances for excavation overbreak and swell of broken rock.

3. The location and size of the explosives storage area shall be determined by the current California and Mine Health and Safety Administration (MSHA) regulations and the MSHA table of distances.

4. The auxiliary pad design and construction shall ensure considerations for expansion (uncertainty allowance).

Assumptions

1. The graded areas for the auxiliary pad(s) do not need to be contiguous or even on a single level if such an arrangement is cost effective (considering construction, operation, and maintenance) or provides for efficient operations.

NNWSI PROJECT
COST/SCHEDULE CHANGE REQUEST (C/SCR)

N-AD-036
9/87

Change No.:	Organization:	Originator:	Origination Date:
89/021	Project Office	W. R. Dixon	11/17/88

Title:

Remove from the Project Baseline the following documents:
(1) NNWSI/88-8, NNWSI Baselined Documents-Project Work Breakdown Structure and
(2) NNWSI/88-7, NNWSI Project Work Breakdown Structure Dictionary

Explanation & Reason for Change:

The Yucca Mountain Project has been directed to report to a Work Breakdown Structure (WBS) which differs from the current Program and Project Baseline WBS. (Enclosure No. 1).

The Programmatic procedure, OGR/B-1, requires modifications to the Program WBS, OGR/B-4, by the OCRWM Change Control Board (CCB). An OGR Baseline Change Proposal (BCP-154)(Enclosure 2), was submitted by OGR to align the Program WBS with the guidance provided in enclosure 1. Inaction by the OCRWM CCB to approve BCP-154 inhibits effective planning and timely implementation of the Project Management Control System and associated reporting requirements.
It is therefore recommended to remove the WBS from the Project Baseline to allow the Project flexibility to fulfill it's reporting obligation to DOE/HQ.

Removing the WBS from the Project Baseline will not remove it from Project control. It is recognized that the Project WBS must be controlled to reflect changes in the technical baseline.

Responsible Organization W. R. Dixon [signature] Date 11/27/88

CCB Secretary P. C. Merkley [signature] Date 12/13/88

Approval: Project Manager, WMPO E. L. Wilmot [signature] Date 12/13/88

YUCCA MOUNTAIN PROJECT
BASELINE CHANGE EVALUATION SUMMARY

Baseline Change: Remove from the Project Baseline The following documents: (1) NNWSI/88-8, NNWSI Baselined Documents - Project Work Breakdown Structure and (2) NNWSI/88-7, NNWSI Project Work Breakdown Structure Dictionary	C/SCR No: 89/021

Summary of Recommended Actions:

	Project Office				T&MSS			
	R&SE	E&D	P&OC	QA	MI&S	S&EI	SE&C	ADMIN
Concurrence	[X]	[ ]	[X]	[ ]	[ ]	[X]	[X]	[X]
Concurrence with Conditions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Non Concurrence	[ ]	[ ]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]
No Recommendation	[ ]	[X]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]

Comment Summary Evaluation: "The YM Project Procedures AP-3.1 and AP-3.3 are implemented to provide a management control mechanism to assure planning and scheduling documents are revised in accordance with a standard set of review and approval steps. They provide for maintenance of a change log to ensure an auditable record of cost and schedule changes. Also included is the control and maintenance of the WBS and WBS Dictionary. The YM Project Change Control Board is specifically charged with maintenance of cost and schedule matters in AP-3.3. This change request states that the WBS will continue to be controlled, but the implication is that some undefined set of procedures will be implemented for this purpose. The cost and time associated with new or modified procedures should be weighed against the facility of whatever new process is anticipated".

Recommendation: "Do not approve this change. Request the modification of the Project WBS and WBS Dictionary to reflect the Project direction provided in reference 1 of the change. This will ensure a Project baseline element which is consistent with the OCRWM guidance and a uniform reporting structure which participants can utilize to develop lower tier structures".

CCB Secretary P. C. Merkley (signature) Date 12/12/88

Page 1 of 1

C/SCR 89/021

Enclosure No. 1

DOE Memorandum
Dated: October 15, 1987
Subject: SCP Consultative Draft
Schedule Guidance and
Baseline Change Proposal for
the OGR WBS (OBR/B-4)

Re: HQO.871015.0070

United States Government | Department of Energy

Received In Configuration Management Division

memorandum

OCT 20 1987 HQO.871015.0070

DATE: OCT 15 1987

REPLY TO ATTN OF: RW-222

SUBJECT: SCP Consultative Draft Schedule Guidance and Baseline Change Proposal for the OGR WBS (OGR/B-4)

TO: John Anttonen, BWIP
Carl Gertz, NNWSI
Jeff Neff, SRPO
Sally Mann, RTTD

On October 6, 1987, OGR met with the first repository Project Office representatives to help develop guidance on the schedule information that is to be included in the consultative draft of the SCP's. Prior to the meeting, OGR proposed an approach that would make the Work Breakdown Structure (WBS) and the structure of investigations in the SCP Annotated Outline consistent. The intent of this proposed approach was to permit the Project Offices to plan their activities one way and one way only, according to an OGR WBS, without losing the current structure of investigations in the SCP Annotated Outline. With the cooperation of the Project Office representatives, the meeting enabled OGR to prepare the two attachments that, when taken together and implemented, will achieve the objective of the meeting. The cooperation that was received at the meeting is appreciated.

Attachment 1 is a copy of schedule guidance to be implemented by each Project Office for the consultative draft SCP. Revisions to SCP Section 8.3 and 8.5 (and any other SCP sections containing schedule information) should be completed prior to submittal to Headquarters of the concurrence draft. Although dates and durations for site characterization activities will not be specified in the consultative draft, the Project Offices should continue with bottoms-up development of an integrated Project Master Schedule that incorporates the scope of work described in the consultative draft SCP.

Attachment 2 is the Baseline Change Proposal to modify the OGR WBS (OGR/B-4) so that it is better aligned with the structure of the site characterization program. The WBS structure changes are the same as those discussed by the participants at the October 6 meeting. Expeditious review of this change proposal is requested. Please return your evaluation within two (2) weeks. It is intended that the WBS changes will be reflected in the FY 1990 budget submittal, which is due in March 1988, and implemented in monthly progress reports submitted by the Project Offices in FY 1989. A primary objective for the Baseline Change Proposal is to allow SCP investigations to better map to the OGR

WBS so that the Level 1 and Level 2 networks maintained by the projects for project management purposes can also be used for presentation of schedule information in the SCP and in SCP progress reports.

Your support in implementing the attachments is requested and appreciated. If there are any questions on these matters, please call Don Alexander or Dick Blaney.

Stephen H. Kale
Associate Director
for Geologic Repositories

Attachments (2)

cc: JBresee, RW-22
RStein, RW-23
JKnight, RW-24
DAlexander, RW-232
GAppel, SRPO
MBlanchard, NNWSI
JMecca, BWIP
FVan Loan, SRPO
GHiggins, BWIP
WDixon, NNWSI
JMorris, RW-222
VCassella, RW-222
JDaly, RW-222
DSiefken, Weston
JNelson, Weston

C/SCR 89/021

Enclosure No. 2

Office of Geologic Repositories
Program
Baseline Change Proposal
Number B-154

Re: HQO.871015.0072

C/SCR 89/021 (Enclosure No. 2) ATTACHMENT 2

OMB CONTROL NO: 1910-0900

OFFICE OF GEOLOGIC REPOSITORIES PROGRAM BASELINE CHANGE PROPOSAL

HQO.871015.0072

DATE: October 18, 1987

SHEET 1 OF 1

BCP NUMBER B- 154

BCP TITLE Alignment of WBS with SCP work structure in Section 8.3

DOCUMENT NUMBER OGR/B-4 REVISION 0

DOCUMENT TITLE OGR Work Breakdown Structure and Dictionary

ADDITION OF DOCUMENT ☐ CHANGE BASELINED DOCUMENT ☒ BASELINED DOCUMENT EXEMPTION ☐

DESCRIPTION AND JUSTIFICATION FOR PROPOSED CHANGE:

Description - See attachment

Justification - See page 2

OCT 20 1987

OTHER BASELINE DOCUMENTS AND INTERFACES AFFECTED:

Project Management System (PMS) Manual (DOE/RW-0043), Project Office and contractor WBS

INDICATE LEVEL OF INTERFACE

LEVEL 0 ☐ LEVEL 1 ☒ LEVEL 2 ☐ LEVEL 3 ☒

DETAILS OF IMPACT ACTIVITY/ITEM AFFECTED	COST IMPACT	SCHEDULE IMPACT
When the WBS is modified, all documents based on the WBS will require modification, e.g., MSA reports, project management plans, project networks, etc.	There will be a cost impact (To be determined). Positive - Reduction in effort to produce summary schedules for the SCP and progress reports, since a special SCP summary will not be required. Negative - Data structures will require modification.	Negligible.

ORIGINATOR

NAME R. Blaney

ORGANIZATION OGR

PHONE 586-9896

SUBMITTED BY

SIGNATURE S. Kale

PROJECT OGR

DATE 01/16/87

DISTRIBUTE FOR REVIEW TO:

CCB MEMBERS

ASSOCIATE DIRECTOR, OGR
PROJECT MANAGER, SRPO
PROJECT MANAGER, BWIPO
DIRECTOR, WMPO
PROJECT MANAGER, CPO

CCB AD HOC MEMBERS

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DISTRIBUTE FOR INFORMATION TO:

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DIRECTOR, OPO
ASSOCIATE DIRECTOR, ORM

JUSTIFICATION FOR PROPOSED CHANGES

BCP PAGE	CHANGE/REVISION	JUSTIFICATION
3, 4, 5 6, 8, 9	1. For selected waste package, and repository elements; added references in dictionary to planning and conduct of tests, studies, and investigations.	1. Will allow investigations and studies visibility (where appropriate) on project WBS-based Level 1 and 2 summary networks so that networks can be used for both project management and SCP reporting.
3, 4, 5,	2. For selected waste package, site and repository elements; added references in dictionary to laboratory, surface-based, and exploratory shaft testing.	2. The ES testing element is deleted and ESF testing will be included in appropriate waste, package, site, and repository elements.
7	3. Added new climatology and meteorology, and resource potential Level 4 elements to site. See also change 5.	3. These two new elements are specific programs in the site characterization program. SCP investigations in these programs can be described in the two new WBS elements.
9, 11, 12	4. Sealing is elevated from a level 5 to a level 4 element. Other repository level 4 elements are renumbered.	4. Sealing systems is a generic SCP program (at the same level as site, waste package, and repository). Greater visibility is required to properly show sealing investigations and studies on project networks and in project management systems.
13, 4	5. Environment and socioeconomic elements are moved from site to regulatory and institutional. References to meteorology are removed from the environment element and included in the new climatology and meteorology elements. Other regulatory and institutional Level 4 elements are renumbered.	5. Environmental and socioeconomic activities are not part of site characterization and the work scope better fits in the regulatory and institutional element.

BCP PAGE	CHANGE/REVISION	JUSTIFICATION
14	6. Changed name of ES to ESF.	6. Appropriate since testing is removed.
16	7. Added reference to design validation testing to first shaft, second shaft, and subsurface excavation elements.	7. To provide elements for non-site characterization ESF testing.
16	8. Included common data acquisition system elements under operations.	8. Shared testing support systems would be difficult to allocate across user end functions. (See 9)
16	9. Eliminated ES testing as Level 4 element. ES insitu-testing will be included in appropriate waste package, site, and repository elements.	9. Eliminates ambiguity in original structure. Projects can still maintain internal ESF testing logistics networks to assure integration.

Geologic Repository Work Breakdown Structure Dictionary
Development and Evaluation Phase

Systems HQO.871015.0075

1. Management and Integration

- Provide overall management of the systems activities, including planning, scheduling, budgeting, controlling, and reporting.
- Provide for interaction with other OCRWM participants in the systems area (e.g., participation in the Performance Assessment Coordinating Group).
- Prepare and implement QA program procedures for systems activities.

2. Systems Engineering

- Perform special studies of technical issues that affect the overall waste isolation system, including transportation interface considerations.
- Perform risk assessments, system optimization studies and analyses of cost/schedule consequences of alternative approaches.
- Develop estimates of total system life-cycle costs. [Note: Cost estimates related solely to the waste package, exploratory shaft, and repository are included in their respective end functions.]
- Baseline the major requirements for the overall waste isolation system, e.g., development of the Generic Requirements document.
- Develop, operate, and maintain a configuration management system that identifies, controls, and records all changes to the technical baseline documents. The technical baseline documents will include a description of the waste isolation system configuration indicating the interrelationships among the system components, their functions, and their performance requirements.

3. Technical data Base Management

- Establish and maintain a base of significant technical data that will be used in evaluating the performance of the waste isolation system. Includes activities to ensure that data can be documented, traced, and controlled.
- To support licensing activities, establish and maintain an administrative record that documents the development of the data base.
- Provide access to the technical data base and historical records to outside agencies.

4. Total System Performance Assessment

- Develop, verify validate, benchmark, and document codes for assessing the performance of the overall waste isolation system.
- Allocate the total system performance objectives among the waste package, repository, and site subsystems.
- Identify and prioritize data requirements for the total system performance assessment.
- Analyze the performance of the overall waste isolation system, utilizing input from waste package, site, and repository performance assessment activities.
- Manage preclosure safety analyses c' overall waste isolation system. [Note: Safety analyses related solely to the waste package, exploratory shaft, and repository are included in their respective end functions.]
- Provide for peer review of the systems performance assessment activity.

Waste Package

1. Management and Integration

- Provide overall management of waste package activities including planning, scheduling, budgeting, controlling, and reporting.
- Provide for interaction with other OCRWM program participants on waste package activities (e.g., participation in the Waste Package Coordinating Group).
- Prepare and implement QA program procedures for waste package activities.

2. Waste Package Environment

- Characterize the near-field environment in which the waste packages would reside, including the physical, hydrologic, geochemical, and geomechanical conditions in the vicinity of the waste package. This characterization is based on data obtained from the site and repository test programs and through additional tests required to characterize the near-field environment. The waste package end function includes the development and confirmation of testing methods for the required additional tests; planning and conduct of the laboratory and exploratory shaft tests, studies and investigations; and performance of mathematical modeling and analyses.
- Determine how the near-field environment might change in response to repository construction and closure as well as waste emplacement.

- Based on experimental and modeling activities to characterize the waste package environment, provide input to the waste package and repository design and performance assessment tasks.

3. Waste Form and Materials Testing

A. Waste Form

- Characterize the behavior and determine radionuclide release rates and mechanisms for spent fuel, commercial high-level waste, and other waste forms under both expected and unexpected repository conditions. Includes the development and confirmation of testing methods, and the planning and conduct of tests, studies, and investigations. Includes interaction tests between the waste form and the barrier material.

- Develop conceptual models to describe radionuclide release rates from the waste forms for use in evaluating waste package performance.

- Develop waste form acceptance requirements and specifications.

- Provide input to waste package and repository design and performance assessment tasks.

B. Metal Barriers

- Characterize the behavior and determine corrosion rates and corrosion mechanisms, including the interaction between the metal barrier and its surrounding environment. Plan and conduct metal degradation tests to determine corrosion modes of candidate materials for the waste package canister and overpack under both expected and unexpected repository conditions. Includes the development and confirmation of testing methods, and the planning and conduct of tests, studies, and investigations.

- Develop conceptual models of corrosion for use in evaluating waste package performance.

- Provide input to canister and overpack design, and to waste package and repository design and performance assessment tasks.

C. Other Materials

- Characterize the behavior of candidate packing materials under both expected and unexpected repository conditions. Includes the development and confirmation of testing methods, and the planning and conduct of tests, studies, and investigations.

- Develop conceptual models to describe the behavior of packing materials.

- Provide input to packing material design, and waste package and repository design and performance assessment tasks.

D. Integrated Testing

- Plan and conduct waste package laboratory and exploratory shaft tests, studies, and investigations to characterize the integrated behavior of the waste form, barrier materials, and surrounding environment.
- Develop conceptual models to describe the integrated behavior of the waste form, barrier materials, and surrounding environment.
- Provide input to the waste package and repository design and performance assessment tasks.

4. Design, Fabrication, and Prototype Testing

- Establish waste package design requirements.
- Provide engineering design and analysis to develop and evaluate alternative waste package concepts, including thermal, structural, criticality, economic, and other analyses.
- Develop waste package design, including drawings and specifications.
- Plan and conduct tests to qualify the waste package design. Includes the fabrication of test components as well as the development and confirmation of testing methods.
- Provide input to waste package performance assessment task and to repository design and performance assessment tasks.

5. Waste Package Performance Assessment

- Develop, verify, validate, benchmark, and document codes for assessing the performance of the waste package.
- Identify data requirements for the waste package performance assessment.
- Utilize codes in assessing waste package performance.
- Conduct preclosure safety analyses of the waste package under both expected and unexpected conditions.
- Provide for peer review of the waste package performance assessment activity.

Site

1. Management and Integration

- Provide for the overall management of site characterization activities, including planning, scheduling, budgeting, controlling, and reporting.

- Provide for interaction with other OCRWM program participants on site activities (e.g., participation in the Site Characterization Coordinating Group).

- Prepare and implement QA program procedures for site activities.

2. Geology

- Plan and conduct laboratory, surface-based, and exploratory shaft tests, studies, and investigations needed to evaluate the geological characteristics of the site under both expected and unexpected conditions. Includes stratigraphy, geomorphology, structural geology, geomechanics, geophysics, and tectonics. [Note: The development of rock mechanics data required for repository design is included in the repository end function.]

- Analyze geologic data and develop conceptual models to describe the geologic characteristics of the site.

3. Hydrology

- Plan and conduct laboratory, surface-based, and exploratory shaft tests, studies, and investigations needed to evaluate the hydrologic characteristics of the site under both expected and unexpected conditions. Includes water level, water flowpath and travel times, hydraulics, recharge rates, and water age and origin.

- Analyze hydrologic data and develop conceptual models to describe the hydrologic characteristics of the site.

4. Geochemistry

- Plan and conduct laboratory, surface-based, and exploratory shaft tests, studies, and investigations needed to evaluate the geochemical characteristics of the site under both expected and unexpected conditions. Includes the composition and chemistry of the groundwater, the composition and chemistry of the host rock, and the sorption, precipitation, and diffusion of radionuclides. Includes salt dissolution studies.

- Analyze geochemistry data and develop conceptual models to describe the geochemical characteristics of the site.

5. Drilling

- Provide the drilling expertise to support the planning of site characterization.
- Perform surface drilling activities, including engineering design boreholes, and related construction work in support of site characterization. [Note: Drilling of the exploratory shaft is included in the exploratory shaft end function.]
- Establish and maintain a library of core samples.

6. Climatology and Meteorology

- Plan and conduct tests, studies, and investigations needed to evaluate the past, present, and future climate of the site and region.
- Analyze climatology data and predict future climate variations at the site.
- Plan and conduct tests, studies, and investigations needed to evaluate the meteorology of the site and the region, including extreme weather phenomena. Meteorology data for repository design as well as for environmental compliance will be obtained under this element.
- Analyze meteorology data for use in repository design and environmental analysis.

7. Resource Potential

- Plan and conduct laboratory, surface-based, and exploratory shaft tests, studies, and investigations needed to evaluate the existence of energy, mineral, land, and ground-water resources at and near the site.
- Analyze resource data and evaluate the present and future values of resources at and near the site.

8. Performance Assessment

- Develop, verify, validate, benchmark, and document codes for assessing the performance of the site.
- Identify data requirements for the site performance assessment.
- Utilize codes in assessing the site performance.
- Provide for peer review of the site performance assessment activity.

9. Deferred Site Close-Out

- Perform those activities required to return the site to satisfactory condition if the site is eliminated from further consideration.

Repository

1. Management and Integration

- Provide for the overall management of repository design and testing and development activities,m including planning, scheduling, budgeting, controlling, and reporting. Includes project management and support activities of the architect-engineer and the construction-manager, such as development of cost estimates and preparation of schedules. Includes the preparation of the integrated repository design report.

- Prepare and implement QA program procedures for repository activities.

- Develop and baseline the functional criteria, standards, analytical methods, assumptions, and interface requirements required to design the repository surface facilities, shafts, subsurface excavations and underground service systems.

- Assemble thermal, mechanical, hydrologic, and other data to support the design of the repository.

- Evaluate repository subsystem design options, including the cost and schedule consequences of alternative approaches.

- Provide for interaction with other OCRWM program participants on repository activities (e.g., participation in the Repository Coordinating Group).

2. Development and Testing

A. Rock Mechanics

- Plan and conduct laboratory, surface-based, and exploratory shaft tests, studies, and investigations, including subsurface drilling to determine the properties of host rock required for repository design. Includes the development and confirmation of testing methods and the valtdation and optimization of mathematical models and codes.

- Perform thermomechanical anayses of the host rock, using the results of field and laboratory tests.

- Provide input to repository design and performance assessment tasks.

3. Equipment and Instrumentation Development

- Evaluate equipment needs and develop equipment as required, including the design, fabrication, and testing of prototypes. Includes excavation/transport equipment, waste handling equipment and backfill equipment.

- Evaluate monitoring and instrumentation needs. Adapt existing and develop new instruments as required.

3. Sealing

- Establish sealing requirements, including requirements due to both expected and unexpected conditions, and develop concepts for the repository.
- Evaluate preclosure and postclosure concepts and designs for sealing shafts, underground excavations, and boreholes. [Note: Development of backfill equipment is under equipment development.]
- Evaluation potential materials for sealing shafts, underground excavations, and boreholes.
- Plan and conduct laboratory and exploratory shaft tests, studies and investigations to evaluate the performance of selected sealing materials and design. Includes the development and confirmation of testing methods.
- Develop designs for sealing shafts, underground excavations, and boreholes.
- Provide input to repository design and performance assessment tasks.

4. Facilities

A. Site Preparation

- Perform all surface general arrangement activity.
- Define and design off-site improvements required for the repository, including roads, rails, utilities, communications, etc., to the boundary of the site.
- Identify and plan for removal of existing on-site structures not required for the repository.
- Define and design on-site improvements (inside fenced boundaries, excluding areas with 5 feet of all buildings, structures, and components) including:
  - clearing, grading, excavation, and filling;
  - landscaping'
  - roads, rails, walks, bridges, culverts, curbing, guard rails and traffic barriers;
  - utilities
  - sewers, drains and catch basins outside building lines; and
  - surface installations for on-site haulage, storage and disposal of surplus mined material.

- Perform engineering studies and evaluate design options.

B. Surface Facilities

- Design the waste handling facility for the receipt and handling of waste packages.

- Design the exhaust shaft filtration facility, including structure, utilities, and equipment and structures related to the shafts/ramps.) Included are the following facilities:

  - Health/Medical
  - Fire Protection
  - Security, including fences, gates, guardhouse and tower.
  - Maintenance
  - Administrative and Personnel
  - Laboratory and Testing
  - Warehousing and Receiving
  - Visitors Center
  - Backup Power Generation
  - Change Room
  - Compressed Air and Steam
  - Cooling Tower and Chilled Water
  - Excavated Material/Storage/Backfill
  - Fuel Storage
  - Chemical Storage
  - Control
  - Potable Water/Sewage
  - Others

- Perform engineering studies and evaluate design options.

C. Shafts/Ramps

- Design repository shafts, including hoist, headframes, shaft collars, and other shaft-connected but surface-located equipment and structures, and shaft liners.
- Design all shaft stations (out to only 5' beyond liner for repository horizon stations).
- Perform engineering studies and evaluate design options.

D. Subsurface Excavations

- Design repository subsurface excavations.
- Perform engineering studies and evaluate design options.

E. Underground Service Systems

- Design repository underground service systems. Included are the following:
  - Material handling system
  - Support systems, e.g. fire protection, dewatering, ventilation, medical, and maintenance
  - Utilities
  - Monitoring and control systems, including facilities and equipment required for confirmation testing.
- Perform engineering studies and evaluate design options

5. Operations/Maintenance

- Develop repository operating concepts and perform tradeoff and. optimization studies.
- Determing operating modes for all systems and equipment. Included are the following:
  - Waste receipt, interim storage, packaging and handling.
  - Waste package fabrication, preparation, repair, handling, emplacement and retrieval.
  - Seal and backfill emplacement.
  - Hauling, storage and disposal of mined material.
  - Waste control and safeguards.
  - Site security.

- Acceptance testing and readiness reviews.
- Maintenance and logistics support.
- Personnel staffing.

• Provide input to the design and safety analyses of the, repository Through definition of (1) modes of operation of all systems and Equipment; (2) procedures for assembly, emplacement, monitoring, and retrieval of taste package; and (3) maintenance requirements of the operational facility.

6. Decommissioning

• Analyze repository decommissioning concepts and requirement, and provide input to respository design and safety analyses as required. Include es analysis of closure concepts and requirements. Includes site restoration, decontamination, dismantlement, operation of postclosure monitoring instruments. and site security.

7. Repository Performance Assessment

• Develop, verify, validate, benchmark, and document codes for assessing the performance of the repository, including perclosure (e.g., impacts of facility construction and operation, radiological releases from both expected and unexpected conditions) and postclosure phases.

• Utilize codes in assessing the preclosure and postclosure performance of the repository.

• Conduct preclosure safety analyses of repository under both expected and unexpected conditions.

• Provide for peer review of the repository performance assessment activity.

Regulatory and Institutional

1. Management and Integration

• Provide for the overall management of regulatory and institutional activities, including planning, scheduling, budgeting, controlling, and reporting.

• Provide for interaction with other OCRWM program participants on regulatory and institutional activities (e.g., participation in Licensing and Institutional Coordinating Groups).

• Prepare and implement QA program procedures fur regulatory and institutional activities.

2. Licensing

- Review, analyze, and interpret regulatory are requirements to provide licensing guidance to project activities that integrate licensing concerns and the needs of the project.
- Participate in defining licensing strategies.
- Prepare licensing documents, including site characterization plans, safety analysis reports, and construction authorization application.
- Provide for peer review of licensing activities.

3. Environmental Compliance

- Review, analyze and interpret NEPA requirements to provide guidance to project activities that integrate NEPA concerns and the needs of the project.
- Review, analyze, and interpret State and local environmental regulations.
- Identify all permitting requirements, including those required for the exploratory shaft and the repository.
- Prepare documents required to comply with NWPA and NEPA, including environmental assessments and environmental impact statements.
- Provide for peer review of environmental compliance activities.

4. Environment

- Identify data requirements, plan and conduct tests to obtain site environmental data. Includes ecological, noise, archaeological, and soil data. Also includes development of data on human health and safety and the physical environment.
- Analyze environmental data and develop conceptual models to describe the environmental characteristics of the site.
- Develop strategies to mitigate significant environmental impacts.

5. Socioeconomic

- Identify data requirements, obtain the data needed to establish the social and economic conditions in the area likely to be affected by the construction and operation of a repository. Includes field activities required to obtain data.
- Develop or adapt models to determine the socioeconomic impact that might result from the construction and operation of a repository.
- Develop strategies to mitigate significant socioeconomic impacts.

6. Communication and Liaison

- Collect and disseminate relevant information and coordinate activities with affected States, local governments, affected Indian tribes and the general public.
- Coordinate information meetings, public presentations, exhibits, films and other public information activities. Includes support of such activities with preparation, reproduction, and collection of audio-visual materials.
- Conduct workshops to enhance communications with the public that may be affected by the program.
- Prepare and negotiate consultation and cooperation agreements with affected States and Indian tribes.
- Consult and cooperate with, and provide support to, affected States and Indian tribes.
- Provide media skills training to project participants.
- Conduct public hearings.
- Select and operate public information offices.

7. Financial/Technical Assistance

- Provide grants in accordance with NWPA for document review/monitoring, information transfer, and commenting on statutory documents.
- Provide grants-in-lieu-of-taxes of in accordance with NWPA.
- Provide impact mitigation grants in accordance with NWPA.

Exploratory Shaft Facility

1. Management and Integration

- Provide for the overall management of exploratory shaft activities including planning, scheduling, budgeting, controlling, and reporting. Includes project management and support activities performed by the architect-engineer and the construction manager; the preparation of the integrated exploratory shaft facility design; and the conduct of safety analyses associated with the exploratory shaft facility. Also includes obtaining the permits for exploratory shaft construction.
- Provide for interaction with other OCRWM program participants on exploratory shaft activities (e.g., participation in the Underground Testing Coordinating Group).
- Prepare and implement QA program procedures for exploratory shaft activities.

2. <u>Site Preparation</u>

   - Provide for surveys and maps, and the demolition and removal of structures that are unusable.

   - Provide general civil improvements, including clearing, grading, excavating, filling, parking, installation of drainage systems, and muck storage pads as required.

   - Construct new and relocate or refurbish existing roads, power systems, water supply, communications, and sewage treatment for the site. Includes provision for road and rail access to the site, as required.

3. <u>Surface Facilities</u>

   - Provide all storage buildings or fenced storage areas as required.

   - Provide all shop facilities, both fabrication and maintenance.

   - Provide buildings designed to house engineering and administrative services, training and qualification services, personal health and hygiene services, plant safety, emergency equipment and personnel, environmental monitoring systems, etc.

   - Provide all security buildings, guard houses, etc.

   - Provide drilling pads, mud ponds, and starter holes.

4. <u>First Shaft</u>

   - Design shaft, including hoist, headframe, and supports required for service systems.

   - Perform engineering studies in support of design.

   - Excavate the shaft.

   - Line the shaft, including installation of supports for service systems.

   - Seal the shaft liner.

   - Plan and conduct tests required for design validation.

5. <u>Second Shaft</u>

   - Design shaft, including hoist, headframe, and supports required for service systems.

   - Perform engineering studies in support of design.

   - Excavate the shaft.

- Line the shaft, including installation of supports for service systems.
- Seal the shaft liner.
- Plan and conduct tests required for design validation.

6. Subsurface Excavations

- Design subsurface excavations, including required rock bolting and grading.
- Excavate the subsurface working areas, including grading and installation of rock bolting, wire mesh, shotcrete, and fire wall as required.
- Plan and conduct tests required for design validation.

7. Underground service Systems

- Design, procure, and install underground service systems, including material and personnel transport systems (other than hoist and headframe), ventilation system, communications and instrumentation networks, utilities, emergency systems, etc.

8. Operations

- Operate, maintain, and inspect (1) the systems necessary to transport personnel and material onto the site, into the shaft, and into the underground workings; and (2) the systems necessary to remove excavated material from the underground workings to its storage pad. Includes the hoist, headframe, cage and other related equipment. Also includes the preparation of operating and maintenance manuals.
- Operate, maintain, and inspect system components for shaft and subsurface ventilation, communications, instrumentation, plant utilities, and emergency systems. Includes the preparation of operating and maintenance manuals. Includes design, procurement, and installation of common data acquisition system elements. Test operations are contained in the waste package, site, and repository end functions.
- Provide for security, health and safety, environmental protection, and related safeguards.

9. Decommissioning

- Prepare plans to decommission the exploratory shafts.
- Decommission and seal exploratory shafts after a determination is made that the shafts are no longer needed.