WBS: 1.2.3.1
QA: QA

Civilian Radioactive Waste Management System
Management and Operating Contractor
Contract #: DE-AC01-91RW00134

Document Identifier Number: B00000000-01717-2200-00031, Rev. 00

Test Interference Evaluation for Fran Ridge Test Planning Support For The Engineered Barrier - Large Block Experiment - Test Planning Package T-93-3

To: Ronald D. Oliver, Project Engineer-Test Planning Package-93-3
Los Alamos National Laboratory
101 Convention Center Drive
Suite 820
Las Vegas, NV 89109

Date: July, 1993

PREPARED BY: _____ _____
Preparer Date

REVIEWED BY: _____ 8/11/93
Technical Reviewer Date

APPROVED BY: _____ 19 August 93
M&O Site Characterization Manager Date

This Test Interference Evaluation was developed in accordance with M&O Procedure QAP-3-5. Technical Review performed per QAP-3-5. R2, Section 5.3.3.A.

ENCLOSURE 4

WBS: 1.2.3.1
QA: QA

Interference Evaluation for The Fran Ridge Test Planning Support for the Engineered Barrier Large Block Experiment TPP-93-10

I. INTRODUCTION

A. Location

The area at the southeast end of Fran Ridge, north of the existing Test Pits #1 and #2, is planned to contain the large block coupled thermal-mechanical-hydrological-chemical tests and associated construction activity (Figures 1 and 3). This site is approximately 400 feet (122m) outside the Conceptual Controlled Area Boundary (CCAB), and approximately 17,400 feet (5307m) outside the Conceptual Perimeter Drift Boundary(CPDB).

B. Purpose

As a precursor activity to the Engineered Barrier System field tests in the Exploratory Studies Facility (ESF), the Large Block Experiment activities will be conducted at Fran Ridge by Lawrence Livermore National Laboratory (LLNL) as described in the Site Characterization Plan (SCP) Study 8.3.4.2.4.4, and the LLNL Scientific Investigation Plan SIP-NF-02, Rev. 0. The activities will pertain to preparation of a site with suitable volcanic tuff for subsequent test construction. Site preparation will include excavation of the existing outcrop. This entails leveling a defined area to within a prescribed tolerance. The work will also include some small block rock quarrying, sample collection, vertical drilling for instrumentation emplacement in the proposed large block, block geophysical logging,large block isolation (saw cuts), and instrument trailer setup. The test interference evaluation will consider 1) the existing pavement, pits, and boreholes, 2) the applicable functional requirements and appendix sections of YMP/CM-0019, "Exploratory Studies Facility Design Requirements," 3) the applicable functional requirement section of YMP/CM-0007, :Technical Requirements for the Yucca Mountain SCP Surface-based Testing," 4) the activity described by TPP 92-07, "Fran Ridge Pit Mapping," 5) any potential tracers, fluids, or materials to be used at the site[1], and 6)any proposed boreholes or other testing activities in the vicinity.

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[1] Draft Job Package JP-93-10, "Engineered Barrier-Large Block Experiment Site Preparation - Phase I", July, 1993

C. Physical Dimensions

Approximately 2.1 acres will be disturbed and affected by construction and operations. The general area is approximately 300 feet (91.5m) by 300 feet (91.5m) which will contain all construction and testing activities.

II. EVALUATION

A. Proximity

1. Boreholes

There are only two existing boreholes within 3000 feet (915m) of the proposed Large Block Test as shown on Figure 4. They are UE-25h#1 and UE-25 WT#3. UE25h#1 is a horizontal borehole drilled to a total depth of 400 feet (122m) bearing West, which is collared approximately 50 feet (15.25m) from Test Pit #1and was constructed to gain experience in horizontal drilling and attempt horizontal instrument emplacement. UE25h#1 is a Project resource which could be cleared and instrumented if needed.. UE-25 WT#3 is a water table test hole which was completed to a depth of 1142 feet (348.3m) approximately 2800 feet (854m) south of the study area. WT#3 is routinely monitored for water table fluctuations. No proposed testing boreholes, trenches, or other studies for the Surface-based Program are planned to be located within 3000 feet (915m) of the study area (see figure 3).

2. Repository

The Conceptual Perimeter Drift Boundary is approximately 17,400 feet (5304m) from this study area.

3. Underground Facilities and Experiments

This study provides both prototype and baseline information for the planned ESF Main Test Level Heater Tests. This study is located approximately 12,000 feet (3658m) from the planned South Ramp Portal which is the closest point of the ESF. No test interference is anticipated for planned ESF testing activities as a result of this study.

4. Significant Geologic Features

There are mapped faults on both sides of Fran Ridge, however, no geologic faults occur at the proposed site of the Large Block Test (see Figure 5). Fracturing of the bedrock which will be tested by the proposed testing activities has been mapped by the fracture mapping previously carried out on Fran

Ridge.

5. Water Table

The water table (per water table elevation from Drillhole WT-13/1988) lies approximately 915 feet (279m) below the proposed study site. It is not anticipated that construction will affect the water table levels and thereby affect monitoring results.

6. Surface-based Testing Studies

Test Pit #1 and Test Pit #2 are within 500 feet (152.5m) of the study area. Fracture and structure pavement mapping has been conducted in the area including Test Pit #1 and Test Pit #2. None of the construction or operations associated with this study will interfere with the ability to verify and expand mapping activities in the vicinity of Test Pits#1 and #2. No trenches, either existing or planned, are within 3000 feet (915m) of this study. A planned seismic reflection study line is proposed between Forty Mile Wash and Fran Ridge. The proposed seismic line No. 5 contains two shotholes #501 and #502 located approximately 2000 feet (610m) away to the southeast and northeast respectively. It is not anticipated that this proposed construction and testing will impact these shotholes or the proposed seismic testing.

B. Drilling Methods

An adaquate number of blastholes up to 20 feet (6.1m) deep and 2.5 inches (6.35cm) in diameter will be constructed to complete the clearing of a 27 foot (8.24m)by 36 foot (11m) level area after alluvial and colluvial material is excavated. This leveled area will be utilized for making the necessary saw cuts to isolate the large block. Blasthole drilling will use air and water in combination for drilling purposes. This drilling activity is not likely to cause test interference to the Large Block heater test or the infiltration rates study per the LLNL Principal Investigator[2]. Vertical drillholes up to 3 inches (7.62cm) diameter for instrument implacement will be drilled in the excavated surface of the Large Block before isolation by sawcuts is carried out. These drillholes will be constructed using compressed air and water. It is not anticipated that water used during this construction activity will impact test results on either nearby testing or the Large Block Test. This evaluation resulted from communications with the Project Engineer[3] and the reference information. All water quantities

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[2] Telephone communication between Lin (LLNL) and Distel (M&O), 5/93.

[3] Verbal communication between Oliver (LANL) and Distel (M&O) 5/93.

used shall be recorded in the DRC and reported to the TFM Manager.

C. Construction Methods

1. Surface Drainage

Given that Test Pits #1 and #2, plus the large-block test may retain surface runoff water if it is allowed to drain into these depressions, it is recommended that adequate ditches and berms be utilized to divert runoff water away from these excavations.

2. Seismic Vibrations Produced in Blasting

It is currently planned to use explosives during the construction for this study. Access for the rock saw will be developed by limited drilling and blasting. In addition, small block quarrying will utilize limited drill and blast techniques. Use of explosives for controlled blasting is not expected to generate disturbance of the proposed large block area, induce new or affect existing fractures in the large block area, or the existing Test Pits and horizontal borehole per the Principal Investigator for LLNL[2]. The quantities and types of explosives planned for such use and estimates of ground motions in peak particle velocity are to be pre-approved by the Principal Investigator and following use, quantities used are to be recorded in the Document Records Center (DRC), and submitted to the Tracers, Fluids and Materials (TFM) Manager.

3. Large Block Isolation (saw cuts)

Water is used to cool the large rock saw during sawing operations. Water quantities used will be limited to those quantities necessary to successfully complete the isolation of the proposed large block. It is not anticipated that this water will impact test results either of adjacent Project test resources (Test Pits and the horizontal borehole), or the large block heater tests and infiltration study. This evaluation resulted from communications with the Project Engineer[3] and the reference information. Tracers in the construction water are not needed because the site is outside the Conceptual Controlled Area Boundary. All water quantities used shall be recorded in the DRC and reported to the TFM Manager.

4. Sump for Drilling and Cutting Fluids

Water used for rock sawing and vertical drilling associated in developing and isolating the Large Block for the large block test will be collected in a sump area downslope from the construction site for the Large Block. Such water

will be recirculated back to the rock saw, or the rock drill during operations. Setup of the sump and recirculation system will utilize a metal tank for water retention and is not likely to cause any potential test interference if initially established per Principal Investigator's directions.

5. Pavement Cleaning

Additional rock pavement cleaning beyond that carried out for the Fran Ridge Pavement Study is being conducted per LANL as the Project Engineer for this activity, as part of the infiltration study. Compressed air with misted water for dust control is being utilized for this cleaning activity. In accordance with the previous Functional Requirements established for the Fran Ridge Test Pit #1 Pavement Mapping Test Interference Evaluation[4], no tracers are suggested for the air or water used for this pavement cleaning.

6. Tracers, Fluids and Materials

Refer to Reference Attachment I from the TFM Manager, TWS-EES-13-LV-06-93-13. Use of the fluids and materials identified to the TFM Manager by the Testing Organizations, are not anticipated to affect testing results. Clearance for unrestricted use of the identified fluids and materials must be obtained from the Principal Investigator of record for the Large Block Test, the TFM Manager and the designated representative for the Regulatory & Site Evaluation Division-DOE Yucca Mountain Project. Those quantities of food dyes used to visually identify fracture locations and penetrations are to be recorded with the DRC and reported to the TFM Manager. All materials to be left in the Large rock Block during and subsequent to the heater testing shall be recorded with the DRC and reported to the TFM Manager.

D. Handling of In Situ Water

No perched or other in situ water is likely to be encountered during this construction and testing activity.

E. Borehole Construction

Borehole construction will be only that needed for blasting purposes or for emplacement of instruments into the islolated large block (see Section II.B.).

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[4] Test Interference Evaluation, "Test and Construction Interference Evaluation results and Suggested Controls-Fran Ridge Fracture Mapping Upgrade on Test Pit #1", 8/11/92, LV.SC.BWD.8/92-066.

F. Surface Construction

See part C of Section II of this evaluation.

G. Expected Conditions

The surface geology is acceptable for the proposed experiment and testing. No known faults penetrate the site where testing is proposed as evaluated from fracture mapping resulting from Test Planning Package 92-07 activities (Fran Ridge Test Pit Mapping).

H. Access Roads

Current access roads will be maintained and extended to allow equipment access for construction and testing activities. In accordance with the Yucca Mountain Site Characterization Program Baseline[5], no tracer is recommended for any water used for construction or dust suppression. Outside the Controlled Area Boundary there is no specific limit on the volumes of water used for construction and dust suppression. However, volumes should be limited to those necessary for dust control, compaction and efficient operation of machinery. Volumes used should be recorded in the appropriate Document Records Center (DRC) job file.

I. Drill Pad Construction

This section is not applicable except as described in part II B..

J. Experiments and Operations

The Large Block Test has three objectives. First, to understand the coupled thermal-mechanical-hydrological-chemical processes in order to develop models that will predict the performance of a nuclear waste repository. The block and fracture properties can be well characterized at the proposed site, and, the block can be dismantled for post-testing examinations. The second is to provide preliminary data for developing of models that will predict the quality and quantity of water in the near-field environment of a repository over the cycle of thermal load, applied to the potential repository rock. The third objective is to develop and evaluate the various measurement systems and techniques that will later be employed in the Exploratory Studies Facility-Engineered Barrier System Field Tests (EBSFT) within the proposed repository horizon. Testing

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5 U.S. Department of Energy, Site Characterization Program Baseline, Rev. 9, 10/2/92, YMP/CM-0011.

and operations are scheduled and designed per the Project Engineer (LANL)[3] to minimize and avoid interference between tests.

III. Summary and suggested Controls

Fran Ridge Test Planning Support for the Engineered Barrier - Large Block Experiment Test Planning Package T-93-3

SUPPLEMENTAL FUNCTIONAL REQUIREMENTS

Reference to Supplemental Functional Requirements provided as Attachment 2, Los Alamos National Laboratory letter TWS-EES-13-LV-06-93-13

Test-to-Test and Test-to-Construction Controls and Constraints

1. Construction and Operations Control: All volumes of water used and other implaced materials shall be recorded in the appropriate Job Package according to pre-determined job activities with the Document and Record Center (DRC) and reported to the Tracers, Fluids and Materials (TFM) Manager.

2. Construction and Operations Control: All equipment and support vehicles shall be fueled and maintained so as to minimize possible accidental spills or releases of fuel, lubricants or coolants into the bedrock fracture systems. Any spills are to be reported to the Yucca Mountain Project Site Manager and reported to the TFM Manager (LANL)

3. Reference to Performance Criteria Ibi: Use of explosives for controlled blasting shall include ground motion estimates (in terms of peak particle velocity) and is to be pre-approved by the Principal Investigator. Please note Graph 1-Suggested relation between Safe Standoff Distance and Explosive Charge Size, use of this relation should help minimize affects on fractures.

4. It is assumed that electrical power needs will be provided by portable generators. Electrical grounding for these units shall utilize "GEM" Material as the approved grounding medium. Any "GEM" used shall be mixed off-site. Generators and/or associated fuel tanks should be situated within berms with impervious liners to contain any potential spills.

5. Construction and Operations Control: The water used in the rock sawing and drilling shall be collected into a sump of adaquate volume to handle the entire volume of water anticipated or planned for these operations, and recirculated for use in the sawing and drilling operations. The sump will consist of a metal tank or lined depression such that no water can be lost to the underlying rock surface to prevent

long term point source infiltration.

Constraint: Avoid enhancing run-off drainage into the Large Block test and Test Pits #1 and #2.

Constraint: Material must be prevented from falling into saw cut slashes and into instrument boreholes.

LIST OF REFERENCES

1. Memorandum, Weaver(LANL) to Oliver(LANL), "ADDITIONAL SUPPLEMENTAL INPUT FROM LAWRENCE LIVERMORE NATIONAL LABORATORY FOR TEST INTERFERENCE EVALUATIONS: FRAN RIDGE TEST PLANNING SUPPORT FOR THE ENGINEERED BARRIER - LARGE BLOCK EXPERIMENT - TEST PLANNING PACKAGE T-93-3," TWS-EES-13-LV-06-93-30, dated 6/21/93.

2. Memorandum, Oliver(LANL) to Foust(M&O), "ADDITIONAL SUPPLEMENTAL INPUT FOR WASTE ISOLATION AND TEST INTERFERENCE EVALUATIONS : FRAN RIDGE TEST PLANNING SUPPORT FOR THE ENGINEERED BARRIER - LARGE BLOCK EXPERIMENT - TEST PLANNING PACKAGE T-93-3," TWS-EES-13-LV-06-93-13, dated 6/15/93.

3. Memorandum, Oliver(LANL) to Dyer(YMPO), "SITE SELECTION ACTIVITY PRIOR T0 INITIATION OF A JOB PACKAGE FOR THE ENGINEERED BARRIER - LARGE BLOCK EXPERIMENT AT FRAN RIDGE," TWS-EES-13-LV-05-93-06, dated 5/17/93.

4. Site Investigation Plan by Lawrence Livermore National Laboratory(LLNL), "ENGINEERED BARRIER - LARGE BLOCK EXPERIMENT AT FRAN RIDGE", SIP-NF-02, Rev 0.

5. Letter, Blink(LLNL) to Kalia(LANL), "USE OF TFM DURING FY 1993(SCP: N/A)."LLYMP9303030, dated 1/13/93.

6. (Footnote 1) Draft Job Package JP-93-10, "Engineered Barrier-Large Block Experiment Site Preparation - Phase 1", July, 1993.

7. (Footnote 2) Telephone communication between Lin (LLNL) and Distel (M&O), 5/93

8. (Footnote 3) Verbal communication between Oliver (LANL) and Distel (M&O), 5/93

9. (Footnote 4) Test Interference Evaluation, "Test and Construction Interference Evaluation Results and Suggested Controls-Fran Ridge Fracture Mapping Upgrade on Test Pit #1", 8/11/92, LV.SC.BWD.8/92-066.

10. (Footnote 5) U.S. Department of Energy, Site Characterization Program Baseline, Rev. 9, 10/2/92, YMP/CM-0011.

11. Yucca Mountain Site Characterization Project Baseline Document, "Technical Requirements For The Yucca Mountain Site Characterization Project Surface-Based Testing, Section VI - Surface-Based Testing Facilities Requirements Document", YMP/CM-0007, Rev. 7.

12. Yucca Mountain Site Characterization Project Baseline Document, "Exploratory Studies Facility Design Requirements", YMP/CM-0019, Rev. 7/2/92.

LIST OF FIGURES, TABLES, GRAPHS AND ATTACHMENTS

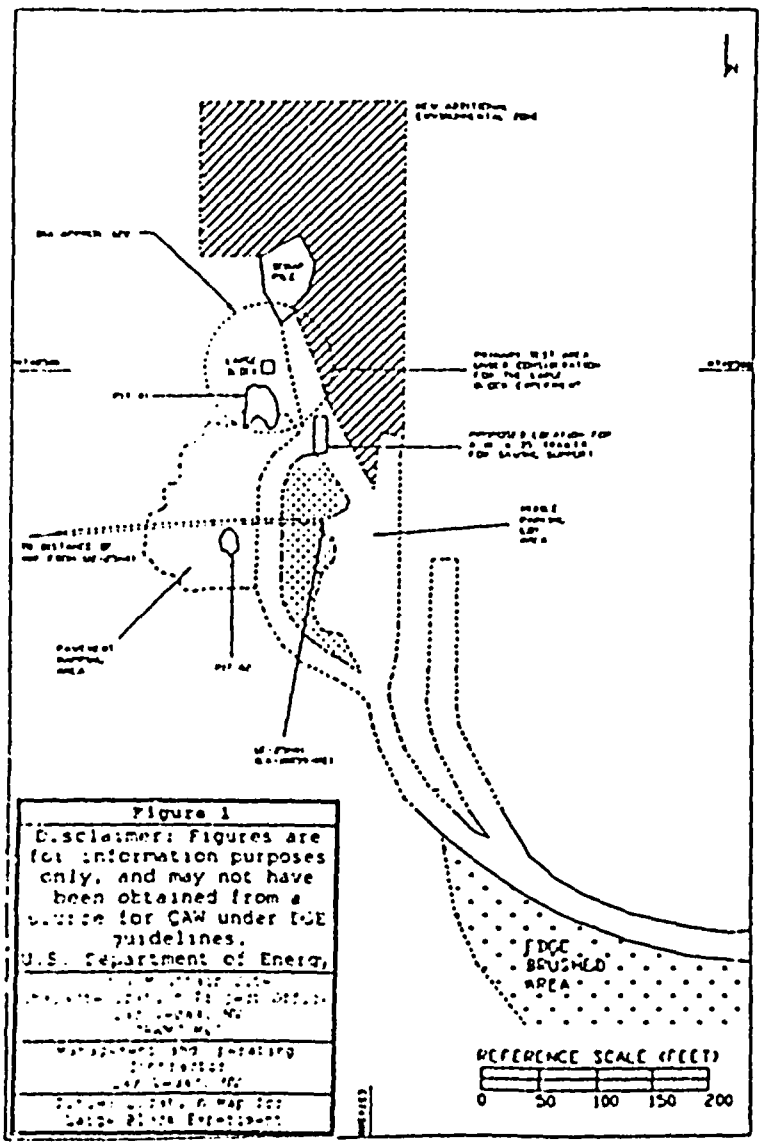
ENGINEERED BARRIER - LARGE BLOCK EXPERIMENT AT FRAN RIDGE

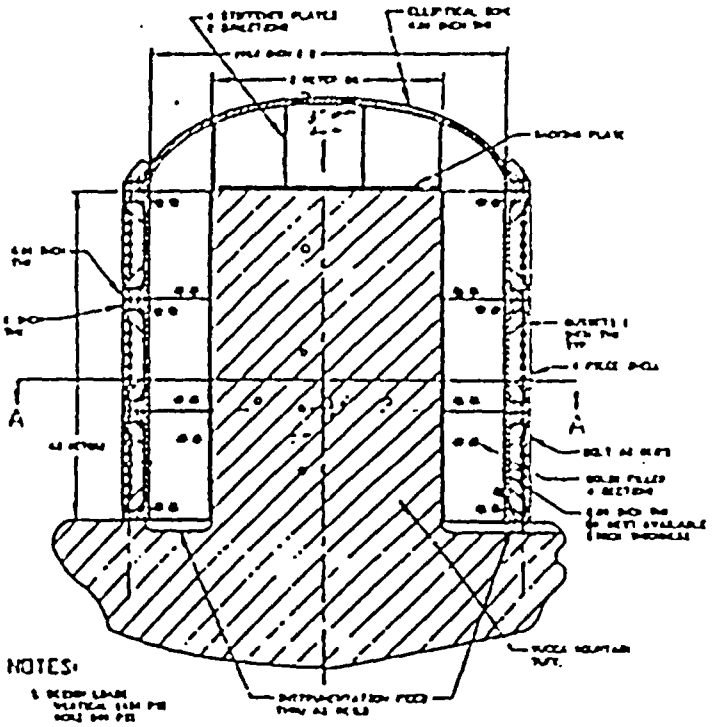
Definition of Test

The Large Block Testing (LBT) of Coupled Thermal-Mechanical-Hydrological-Chemical (TMHC) Processes is described in Section 8.3.4.2.4.4 of the Site Characterization Program Baseline (SCPB) and in the Scientific Investigation Plan for the Large Block Test, SIP-NF-2, Rev. 0.

A series of heater and infiltration tests are planned using the nonlithophysal, densely welded, fractured Topopah Spring tuff found at the Fran Ridge Test Site. Testing and validation of some model concepts on small blocks in the laboratory, and an integrated demonstration of the coupled TMHC processes in a larger block are planned at the site.

For the larger-block testing, a block will be chosen that contains appropriate fractures and that measures at least 3 m on each side and at least 4.5 m tall. Smaller blocks measuring a few tens of centimeters on each side and of the same material as the larger block will be tested at Lawrence Livermore National Laboratory. Both types of block will be used to investigate the thermal-mechanical properties of the rock and to validate model concepts of thermal-hydrological and geochemical processes.





PHASES OF THE ACTIVITY
1) Site Selection
2) Test Construction
3) Test Operation
4) Post Activity Excavation

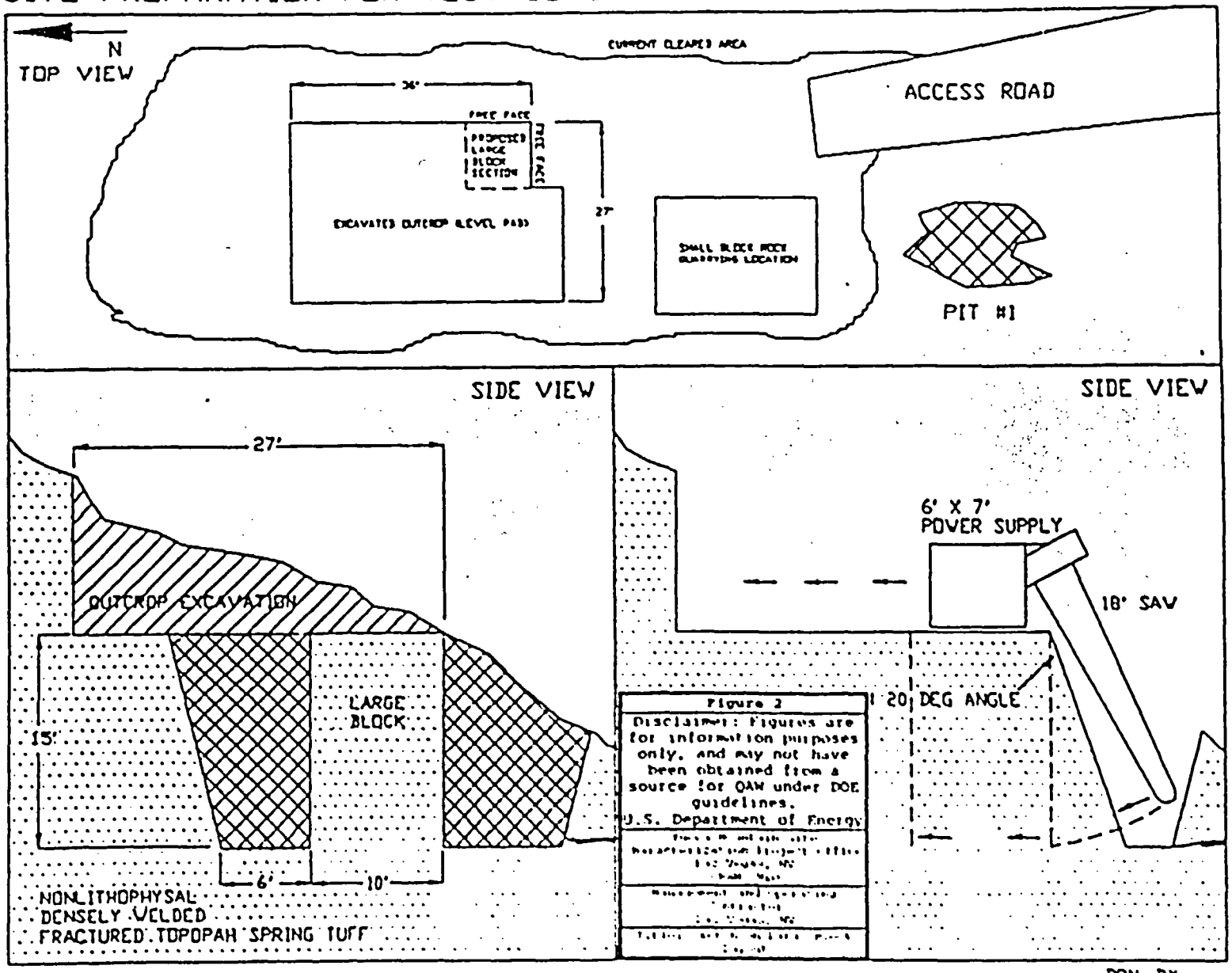
ADMINISTRATIVE USE ONLY

DRN BY DJ WEAVER

FRLBENV.DVG 5.13.93

WEAVER 5-14-93

ENGINEERED BARRIER - LARGE BLOCK EXPERIMENT
SITE PREPARATION FOR TEST CONSTRUCTION



NOT TO SCALE
ADMINISTRATIVE USE ONLY

DRN BY
D.J. WEAVER
06/03/93
FRBLOCK.DWG

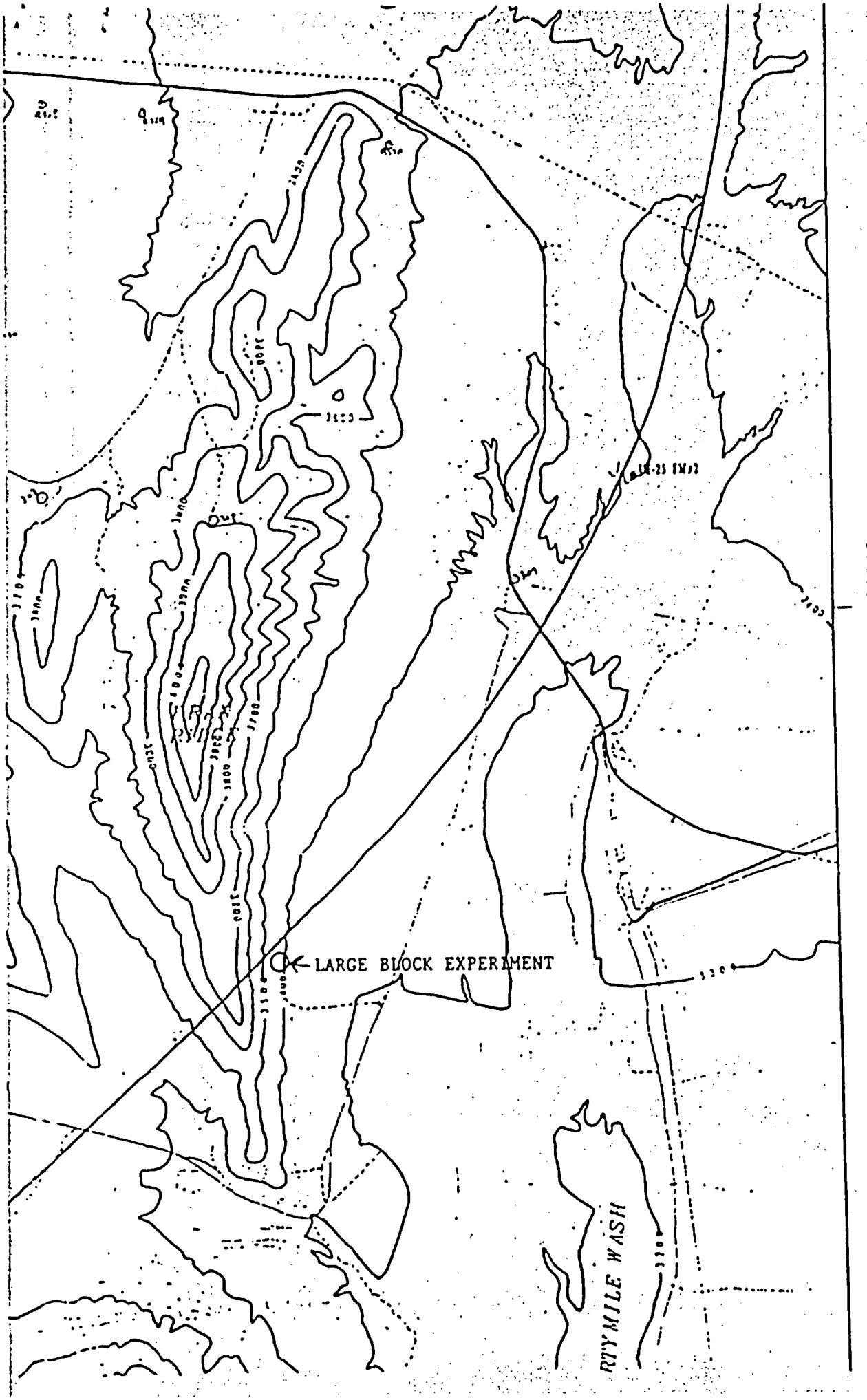
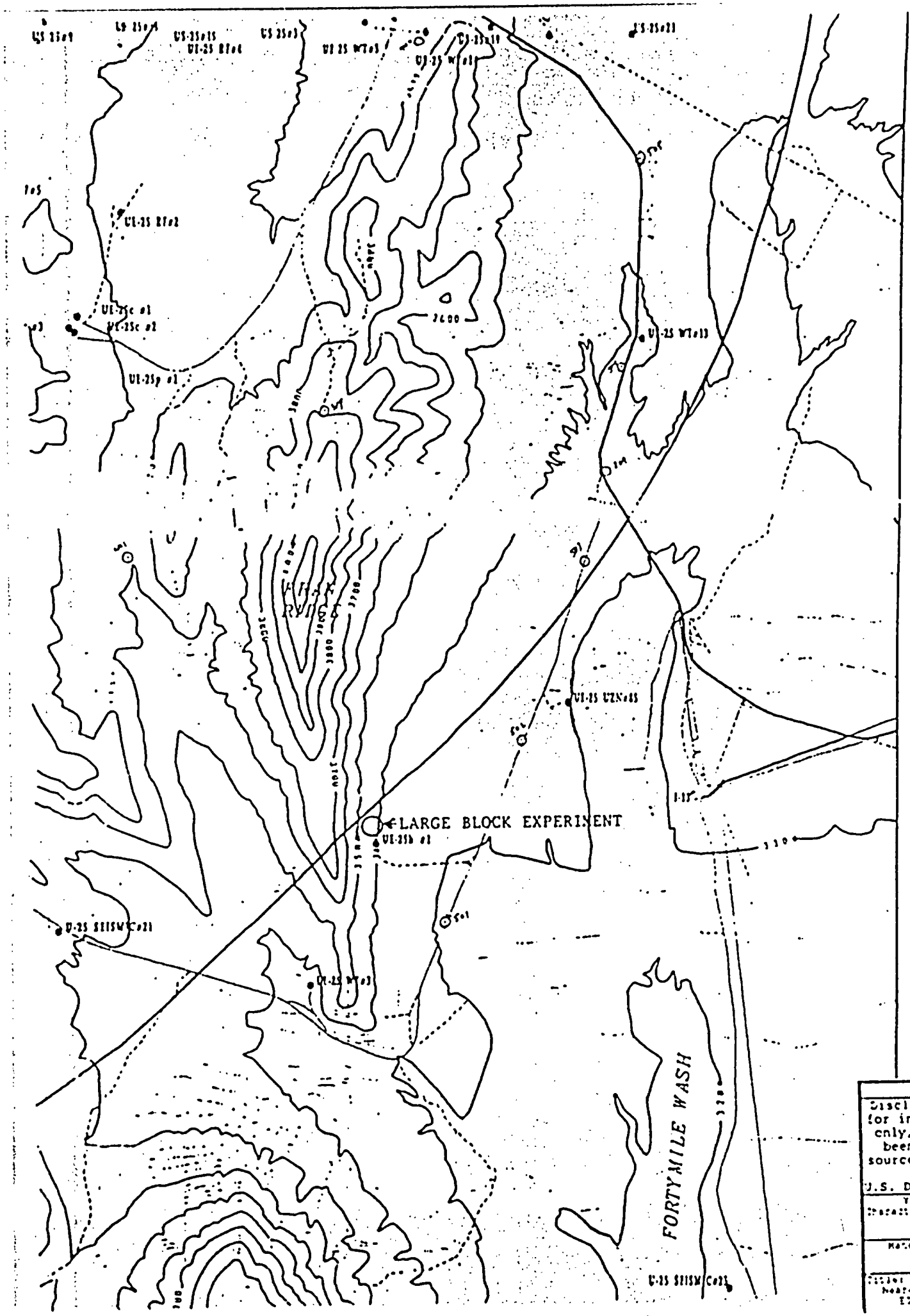


Figure 3

Disclaimer: Figures are for information purposes only, and may not have been obtained from a source for CAW under DOE guidelines.

U.S. Department of Energy


N7539501t
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LARGE BLOCK EXPERIMENT
FORTYMILE WASH
Figure 4
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only, and may not have
been obtained from a
source for OAW under DO
guidelines.
U.S. Department of Ener

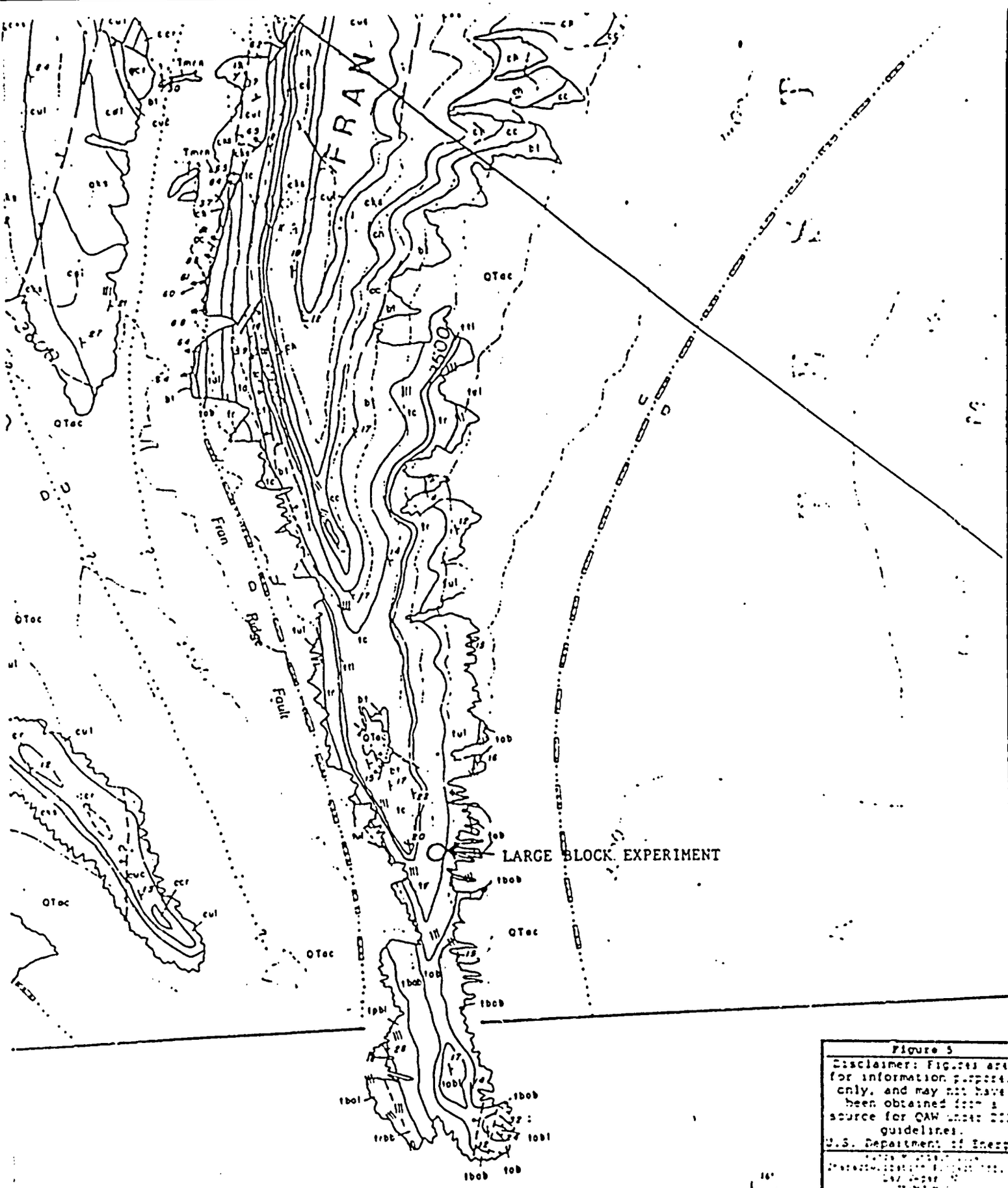
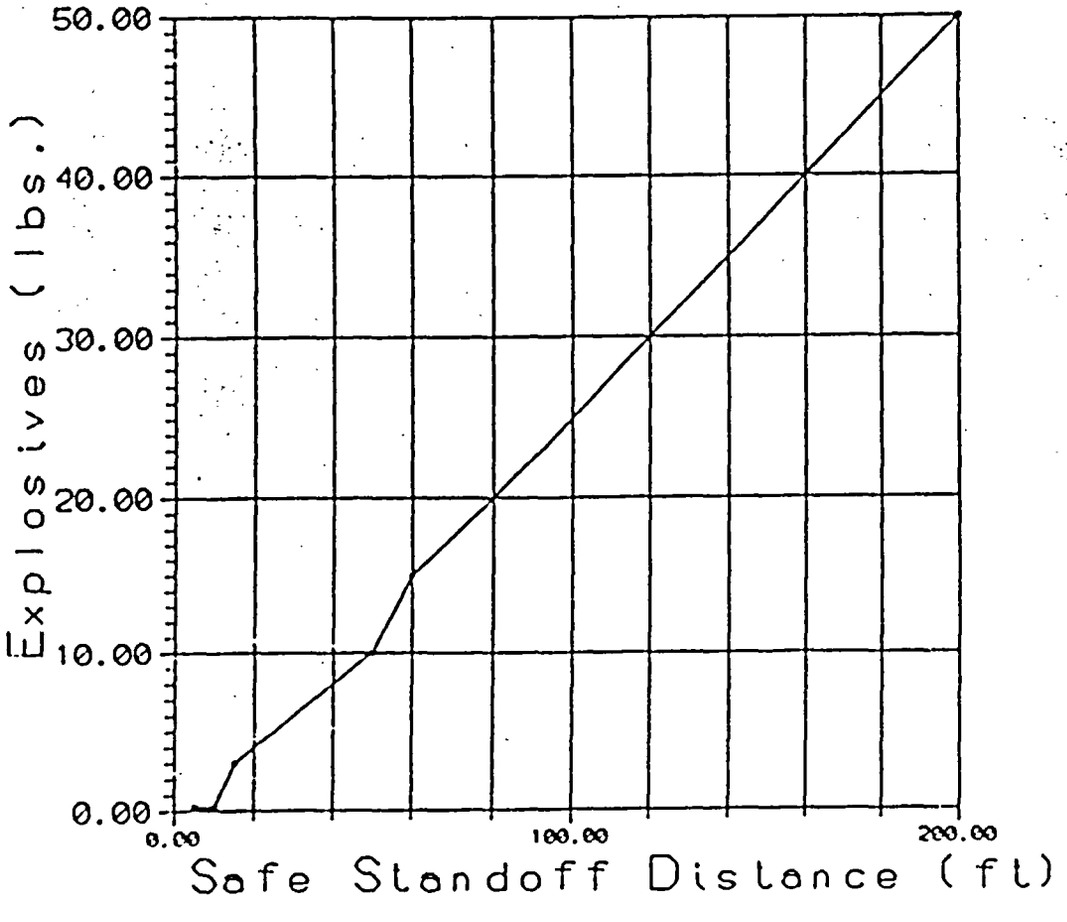


Figure 5

Disclaimer: Figures are for information purposes only, and may not have been obtained from a source for QAW under QAP guidelines.

U.S. Department of Energy

- Suggested relation between Safe Standoff Distance and Explosive charge size used in shallow shotholes. Based on data given in Table 28-2 of the E.I. duPont Blaster's Handbook, 15th edition (Shown as Table in this Test Interference Evaluation).



Graph 1
Disclaimer: Graphs are for information purposes only, and may not have been obtained from a source for QAW under DOE guidelines. U.S. Department of Energy

TABLE

Construction Blasting Quantity—Distance Table

Maximum quantity of explosives per shot for instantaneous firing or per delay, for delay firing in pounds.	Distance from blast area to nearest building or structure in feet (Trenching, Tunnels, Shafts, Side Hill or Through Cuts).
See Note 1	Less than 5
1/4 pound	6 to 10
1/5 pound per foot of distance	15 to 50
1/4 pound per foot of distance	60 to 200
Over 50—See Note 2	

1. Total quantity of explosives shall not exceed ¼ pound per shot up to five feet from nearest building or structure.
2. Seismic control, to determine the ground constant, shall be required for more than 50 pounds of explosives.

du Pont Blaster's Handbook, 1969, 15th ed.

Table 1
Disclaimer: Tables are for information purposes only, and may not have been obtained from a source for QAW under DOE guidelines. U.S. Department of Energy
[illegible]
[illegible]
[illegible]

ENGINEERED BARRIER - LARGE BLOCK EXPERIMENT AT FRAN RIDGE
SITE PREPARATION

TRACERS, FLUIDS, AND MATERIALS

CONSTRUCTION EQUIPMENT

Heavy and light duty vehicles and equipment. This includes field maintenance activities and fueling. A clearance for unlimited use is proposed. The following list of typical types of equipment to be used is provided: Sedans, Pickups, Dozers, Graders, Rollers, Scrapers, Dump Trucks, Water Trucks, Surface Drilling Equipment, Rock Sawing Equipment, and Cranes.

CONSTRUCTION SUPPLIES

Untraced water and air will be used as a drilling fluid, for pavement cleaning and dust control.

Commercial explosives will possibly be used during excavation. A clearance for unrestricted type and manufacturer is requested.

The following list of typical types of material to be used is provided:

Ground Support Rock Bolts
Drilling Supplies
2 ft Steel, 4 ft Steel, 6 ft Steel, and 8 ft Steel
Drill Bits
Fence

The following list of typical types of fluids to be used is provided:

- Cleaning Solvents
- Diesel Fuel
- Gasoline
- Ethylene Glycol
- Hydraulic Fluid
- Engine Lubricating Oil
- Automatic Transmission Fluid
- Gear Case Lubricant
- Air Compressor Lubricating Oil
- Portable Toilet Deodorant
- Brake Fluid
- Battery Acid
- Tire Ballast Materials
- Freon

Spray Paint
Grouts/Shotcrete/Epoxies
Food Dyes

- The asterisk items on this list will be used in quantities that are typically associated with normal operations. Spills will be mitigated using the appropriate YMP Administrative Procedures.

A clearance for unrestricted use of this type of materials is proposed.

ROCK SAWING SUPPLIES (Summarized from the following page)

The following list of typical types of fluids to be used is provided:

Mobile Hydraulic Oil - DTE 24	Maximum potential spill of 30 gal - depth of 0 ft
Chevron Ultra-Duty Grease-1	Depth of 16 ft
Rockbolts - steel	100 ea at 1 ft
Celtite epoxy resin for bolts	100 cart. at 1 ft
Cutting water	50 gpm at 16 ft

TRACERS, FLUIDS, AND MATERIALS
USER REQUEST

Request By: Ron Oliver Organization: LANL Date: 6-9-93

To Be Used For: TEST (Name): LLNL Engineered Barrier-Large Block Experiment at Fran Ridge

CONSTRUCTION: Sawing of Test Block

OTHER:

Name	Quantity Requested	Location	Depth	Conc. (1)	Comp.	Disposition (2)		Estimated Quantity Used	Actual Quantity Used	Approved By	Remarks
						Stays In	Removed				
Mobile Hydraulic Oil											
DTE 24*	maximum potential spill 30 gal		0 ft				16 hrs	30 gal			
Chevron Ultra-Duty Grease-1	20 lbs	Fran Ridge	16 ft					20 lbs			
Rockbolts—steel	100 ea	Fran Ridge	1 ft					100 ea			
Celtite epoxy resin for bolts	100 cart.	Fran Ridge	1 ft					100 cart.			
Cutting water	50 gpm	Fran Ridge	16 ft					50 gpm			

1. Provide material composition.
2. Will the TFM be removed from Yucca Mountain or permanently left in place. If removed, provide residence time.

MATERIAL SAFETY DATA SHEET

I PRODUCT IDENTIFICATION

Manufacturer's Name WARNER-JENKINSON CO.	Regular Telephone No. Emergency Telephone No. (314)658-7440
Address 2526 Baldwin Street, St. Louis, MO 63106	

TRADE NAME NO. 5601 FD&C BLUE #1

SYNONYMS

SHIPPING NAME* DOT: n/a

IATA: n/a

II HAZARDOUS INGREDIENTS*

MATERIAL OR COMPONENT	CAS NO.	%	HAZARD DATA
n/a			
FD&C Colors are not considered hazardous material.			
They do not fall under the jurisdiction of D.O.T.			

III PHYSICAL DATA

BOILING POINT, 760 MM HG	n/a	MELTING POINT	n/a
SPECIFIC GRAVITY (H_2O = 1)	n/a	VAPOR PRESSURE	n/a
VAPOR DENSITY (AIR = 1)	n/a	SOLUBILITY IN H_2O BY WT.	20%
% VOLATILES BY VOL.	n/a	EVAPORATION RATE (BUTYL ACETATE=1)	n/a
APPEARANCE AND ODOR	See Attached Spec.	Ph (AS IS) Ph (1% Soln.)	n/a

IV FIRE AND EXPLOSION DATA

FLASH POINT (TEST METHOD)	n/a	AUTOIGNITION TEMPERATURE	n/a		
FLAMMABLE LIMITS IN AIR, % BY VOL.		LOWER	n/a	UPPER	n/a

EXTINGUISHING MEDIA	WILL NOT BURN
SPECIAL FIRE FIGHTING PROCEDURES	n/a
UNUSUAL FIRE AND EXPLOSION HAZARD	n/a

MATERIAL SAFETY DATA SHEET

I PRODUCT IDENTIFICATION

Manufacturer's Name WARNER-JENKINSON CO.	Regular Telephone No. Emergency Telephone No. (314)652-2200
Address 2526 BALDWIN STREET, ST. LOUIS, MO 63106	
TRADE NAME NO. 7003 FD&C RED #3	
SYNONYMS	
SHIPPING NAME* DOT: n/a IATA: n/a	

II HAZARDOUS INGREDIENTS*

MATERIAL OR COMPONENT	CAS NO.	%	HAZARD DATA
n/a			
FD&C Colors are not considered hazardous material.			
They do not fall under the jurisdiction of D.O.T.			

III PHYSICAL DATA

BOILING POINT, 760 MM HG	n/a	MELTING POINT	n/a
SPECIFIC GRAVITY (H_2O = 1)	n/a	VAPOR PRESSURE	n/a
VAPOR DENSITY (AIR = 1)	n/a	SOLUBILITY IN H_2O BY WT.	%
% VOLATILES BY VOL.	n/a	EVAPORATION RATE (BUTYL ACETATE=1)	n/a
APPEARANCE AND ODOR	See Attached Spec.	Ph (AS IS) Ph (1% Soln.)	n/a

IV FIRE AND EXPLOSION DATA

FLASH POINT (TEST METHOD)	n/a	AUTOIGNITION TEMPERATURE	n/a		
FLAMMABLE LIMITS IN AIR, % BY VOL.		LOWER	n/a	UPPER	n/a
EXTINGUISHING MEDIA	WILL NOT BURN				
SPECIAL FIRE FIGHTING PROCEDURES	n/a				
UNUSUAL FIRE AND EXPLOSION HAZARD	n/a				

V HEALTH HAZARD INFORMATION

HEALTH HAZARD DATA	HAZARD CLASSIFICATION	BASIS FOR CLASSIFICATION
ROUTES OF EXPOSURE INHALATION	n/a	
SKIN CONTACT	n/a	
SKIN ABSORPTION	n/a	
EYE CONTACT	n/a	
INGESTION	n/a	

EFFECTS OF OVEREXPOSURE:

ACUTE OVEREXPOSURE: NO EFFECTS

EMERGENCY AND FIRST AID PROCEDURES:

EYES: n/a

SKIN: n/a

INHALATION: n/a

INGESTION: n/a

NOTES TO PHYSICIAN:

CONDITIONS CONTRIBUTING TO INSTABILITY:

INCOMPATIBILITY:

n/a

HAZARDOUS DECOMPOSITION PRODUCTS :

n/a

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION :

WILL NOT OCCUR

VII DISPOSAL, SPILL OR LEAK PROCEDURES

AQUATIC TOXICITY (E.G. 96HR. TLM):

n/a

WASTE DISPOSAL METHOD:

WILL NOT BURN - SUGGEST SANITARY LANDFILL IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:

CLEAN UP WITH WARM WATER AND HYPOCHLORITE BLEACH.

NEUTRALIZING CHEMICALS:

n/a

VIII SPECIAL PROTECTION INFORMATION

VENTILATION REQUIREMENTS:

THIS PRODUCT TENDS TO BE DUSTY. VENTILATION OR DUST COLLECTION WOULD BE HELPFUL, BUT NOT NECESSARY.

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT:

RESPIRATORY (SPECIFY IN DETAIL)

EYE:

n/a

GLOVES:

n/a

OTHER CLOTHING AND EQUIPMENT:

COLOR STAINS ARE AGGRAVATING BUT NOT HAZARDOUS. ANY PROTECTION FROM COLOR IS GENERALLY APPRECIATED BY EMPLOYEE.

PRECAUTIONARY STATEMENTS:

NOT NECESSARY

OTHER HANDLING AND STORAGE REQUIREMENTS:

STORE AT AMBIENT TEMPERATURE TIGHTLY SEALED.

ADDITIONAL REGULATORY CONCERNS:

FEDERAL: SEE ATTACHED SPECIFICATION.

FDA

USDA

CPSC

TSCA IS THIS PRODUCT, OR ALL ITS INGREDIENTS; BEING CERTIFIED FOR INCLUSION ON THE TOXIC SUBSTANCES CONTROL ACT INVENTORY OF CHEMICAL SUBSTANCES? YES

OTHER

STATE:

PREPARED BY: HARRY MEGOS

TITLE: MANAGER, COLOR SERVICE LABORATORY

COMPANY: WARNER-JENKINSON COMPANY

ADDRESS: 2526 BALDWIN STREET

CITY & STATE: ST. LOUIS, MO

ZIP CODE: 63106

FD:C

Post-it™ brand fax transmittal memo 7671	# of pages ▸ 11
To Ron Oliver	From Bob Glass
Co. LANL	Co. SNL/6115
Dept.	Phone # 4-4809
Fax # (702) 794-7099	Fax # 4-1221

Sandia National Laboratories

Albuquerque, New Mexico 87185

June 16, 1993

WBS: 1.2.1.5.6.
QA: N/A

Ron Oliver, LANL,
101 Convention Center Drive
Mail Stop 527, Suite 820
Las Vegas, Nevada 89109
(FAX: 702-794-7099, tele: 702-794-7095)

Dear Mr. Oliver:

Re: Flow path visualization test in support of LLNL Large Block Test

In support of the LLNL large block heater test, prior information on in situ fracture network connectivity is required for preliminary modeling and experimental interpretation. To develop information on the connection of fractures within the rock and the flow paths that result from infiltration events, a flow path visualization test will be conducted.

During preparation of the site at Fran Ridge, a large volume of rock will be removed in an annular region around the block (50 ft diameter by 10 ft deep). Before excavation of the rock around the in situ block, we will infiltrate a known volume of water containing USDA food coloring to a small aerial plot of from 9 to 100 sq ft. The volume of water will be chosen to correspond to that of a 50-200 year storm (1-12 inches of water, total of 6 to 748 gals) and will be applied either from a ponded condition or sprayed on the surface at a prescribed rate.

During excavation of the rock, the dyed fracture surfaces will be mapped to yield the wetted structure of the infiltration front. This information will show the fractures connected hydraulically to the infiltration surface during gravity driven infiltration. We will also be able to determine the fraction of the fracture network that is conducting fluid and, hopefully, the fraction of area contributing to flow in individual fractures.

For best results, the rock excavation techniques should use the least amount of water as possible. While the dyes chosen will absorb to the fracture surfaces, water may mobilize some of the dye and possibly obscure our interpretation of the data. Dyes proposed for use include Red and Blue USDA food colorings (MSD Sheets attached). A list and discussion of the various dyes considered is also attached. The food coloring has been chosen as it has been shown in preliminary tests to stain fracture surfaces we currently have in our laboratory and is presumed to be non problematic with respect to environmental, safety and health concerns. Concentrations of the food coloring will be from 2 to 4 grams per liter yielding a total mass of dye used in the test of from .05 to 12 kilograms.

Sincerely,

Mary Bachelor for

Robert J. Glass
Geoscience Assessment and
Validation Department 6115
(505-844-4809, FAX: 505-844-1321)

RJG:6115:mb

Copy to:
Wunon Lin, LLNL
Jim Blink, LLNL, Las Vegas
6115 Peter Davies
6115 R. J. Glass
6313 Larry Costin
6302 Les Shepherd
6302 Joe Shelling
6352 10/12156/1.2/NQ
6352 YMP CRF

MATERIAL SAFETY DATA SHEET

I PRODUCT IDENTIFICATION

Manufacturer's Name WARNER-JENKINSON COMPANY	Regular Telephone No. Emergency Telephone No. (314) 652-7440
Address 2526 BALDWIN STREET, ST. LOUIS, MISSOURI 63106	
TRADE NAME NO. 6503 FD&C GREEN #3	
SYNONYMS	
SHIPPING NAME DOT: n/a IATA: n/a	

II HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT	CAS NO.	%	HAZARD DATA
n/a			
FD&C Colors are not considered hazardous			
material. They do not fall under the jurisdiction			
of D.O.T.			

III PHYSICAL DATA

BOILING POINT, 760 MM HG	n/a	MELTING POINT	n/a
SPECIFIC GRAVITY (H_2O = 1)	n/a	VAPOR PRESSURE	n/a
VAPOR DENSITY (AIR = 1)	n/a	SOLUBILITY IN H_2O BY WT.	20%
% VOLATILES BY VOL.	n/a	EVAPORATION RATE (BUTYL ACETATE=1)	n/a
APPEARANCE AND ODOR	see specification :	Ph (AS IS) Ph (1% Soln.)	n/a

IV FIRE AND EXPLOSION DATA

FLASH POINT (TEST METHOD)	n/a	AUTOIGNITION TEMPERATURE	n/a		
FLAMMABLE LIMITS IN AIR, % BY VOL.		LOWER	n/a	UPPER	n/a
EXTINGUISHING MEDIA	Will not burn				
SPECIAL FIRE FIGHTING PROCEDURES	n/a				
UNUSUAL FIRE AND EXPLOSION HAZARD	n/a				

POTENTIAL DYES FOR USE IN TRACER TESTS

I. Food Colorings
II. Flouresent Dyes
III. Tests Conducted
IV. Costs
V. Summary

I. Food Colorings

FD&C Red #3
FD&C Blue #1
FD&C Green #3

FD&C colorings are not considered hazardous, and are not subject to DOT regulations. No hazards are associated with these dyes, and no special precautions must be taken. The use of these colorings is subject to the Federal Food, Drug, and Cosmetic Act. Disposal in a sanitary landfill is suggested, but is not required.

-non-toxic
-biodegradable
-not DOT regulated
-no hazards associated with use
-no special precautions required
-may be released to the environment
-visible in ordinary light
-none fluoresce under UV
-blue and green colorings may not provide sufficient contrast under certain conditions
-pulse testing should be conducted to determine extent of mixing at front interfaces
-sufficient staining in concentrations of 2.0 to 4.0 grams/liter

II. Fluorescent Dyes

Rhodamine WT (Red)
Uranine (Yellow)
Flavine FF (Yellow)
Disulfic Acid (Blue)
WD-802 (Green-Yellow)

-health effects are often not established or data is not available
-may require hazardous waste disposal
-may require environmental impact statement
-protective clothing (gloves, goggles, face-shield, respirator) often required
-use only if UV photography essential
-may be colorless in ordinary light
-may be combined (doped) in low concentrations with FD&C colorings

Cole-Parmer/Keystone fluorescent dye tracers

Intracid Rhodamine WT, Acid Red (Xanthene)
(Ref: Keystone Technical Data Bulletin "Intracid Rhodamine WT Liquid")

-Rhodamine dye developed for water tracing
-non-toxic
-biodegradable
-visible in normal light
-highly soluble
-low tendency to stain dirt, organics, suspended matter
-certified by the National Sanitation Foundation International for use in tracing drinking water:
  =concentrations in drinking water may not exceed 0.1 ppb and exposure must be infrequent
-US Army Corps of Engineers Environmental and Water Quality Operational Studies:
  =Rhodamine suitable for inflow studies.
  =No known environmental or health hazards in unpolluted waters.
-not pH sensitive (5.5 to 11.0)
-not hazardous as defined by hazardous communication standard.

III. Tests Conducted

A. Tuff Slabs

1. Tests conducted with tuff slabs treated with FD&C colorings (red, blue, green) at concentrations of 2.0 and 4.0 grams/liter, and with above concentrations doped with approximately 5.0 % Rhodamine (red) and Uranine (yellow) fluorescent dyes.

2. Both concentrations of pure FD&C colorings (Red, Blue, Green) stained the slabs, with the higher concentration providing a sharper contrast and more vivid stain.

3. FD&C colorings spiked with fluorescent dyes provided similar contrasts and staining, however the fluorescent dyes appeared to separate from the coloring, and no fluorescent dye remained on the slabs after rinsing and drying.

B. Fluvial Sediments

1. Tests conducted with unconsolidated fluvial sediments (Rio Bravo) treated with 4.0 gram/liter solutions of FD&C colorings (red, blue) doped with approximately 5.0 % fluorescent dyes (Rhodamine, Uranine).

2. Minimal fluorescence was displayed in vertical cross-section. Dyes did not separate from the colorings as with the tuff slabs, but some Uranine dye in the blue coloring appeared to separate and sink through the red coloring, forming a pocket which was not visible under normal light.

3. May not be suitable for UV photography, but may be used to indicate extent of the wetting front if it moves in advance of the first dye front.

IV. Costs

A. FD&C Colorings (Werner-Jenkensen)

Red #3	$30.20 / pound
Blue #1	$25.75 / pound
Green #3	$74.45 / pound

These prices are based on the purchase of 100 lb. drums. Additional costs for repacking:

50 pounds	$0.15 / pound
25 pounds	$0.20 / pound
5 pounds	$1.50 / pound

B. Fluorescent Dye Tracers (Cole-Parmer)

Rhodamine WT	$16.50 / pint
	$78.00 / gallon
Uranine	$13.50 / pint
	$65.25 / gallon

Minimum Detectable Concentration of 1 ppm obtained from above concentrates:

pint container	12,500 gallons
gallon container	100,000 gallons

V. Summary

A. FD&C colorings are suitable for most tracer applications. They are non-toxic and biodegradable, and no special precautions must be taken during use. Testing must be conducted to determine appropriate concentrations and the extent of mixing at front interfaces.

B. The fluorescent dyes Rhodamine and Uranine are also non-toxic and biodegradable, but will require some precautions to minimize eye and skin contact. These dyes are not considered hazardous, but contact may result in minor irritation. They were developed as water tracers, therefore staining of soils and organics is minimal. They appear to be unsuitable for staining, particularly in lithified materials, but low concentrations may be used to determine the extent of the advancing wetting front.

C. Other fluorescent dyes should be used only in the event that UV photography is required. Additional protective measures make these dyes unsuitable for use in a field environment, and release to the environment may be problematic. For the most part, the toxicity and health hazards of these dyes have not been established. Use of these dyes in proposed experiments, even in low concentrations, may require the preparation of additional environmental statements.

ENGINEERED BARRIER - LARGE BLOCK EXPERIMENT AT FRAN RIDGE SITE PREPARATION

SUPPLEMENTAL FUNCTIONAL REQUIREMENTS

Scope of Work

The Large Block Testing (LBT) of Coupled Thermal-Mechanical-Hydrological-Chemical (TMHC) Processes is described in Section 8.3.4.2.4.4 of the Site Characterization Program Baseline (SCPB), B-2.2.41 of the Exploratory Studies Facility Design Requirements (ESFDR) and in the Scientific Investigation Plan for the Large Block Test, SIP-NF-2, Rev. 0.

The work will pertain to preparing a site with suitable volcanic tuff for subsequent test construction. Site preparation will include excavation of the existing outcrop. This entails leveling a defined area to within a prescribed tolerance. The work will also include some small block rock quarrying, vertical drilling for instrumentation emplacement in the proposed large block, block geophysical logging, large block isolation (saw cuts), and trailer setup.

Supplemental Functional Requirements

1. Provide the test area, construction support, and operational flexibility to prepare the site for the Large Block Experiment at Fran Ridge.

Performance Criteria

1a. Necessary access area(s) are required for outcrop excavation, small block rock quarrying, vertical drilling, large block isolation (saw cuts) and trailer setup.

1b. When completed, a large block volume must be sufficiently excavated such that saw cutting and vertical drilling can be accomplished.

- i. Excavation methods must be such to minimize inducing new or affecting existing fractures in the large block volume to maintain block integrity.
- ii. An access road leading to the base of the large block volume is required.
- iii. A sump is required to recirculate drilling and cutting fluids.

iv. Excavation activities will be surveyed.

v. An area at least 27' (8.23m) back from the front face of the block and at least 36' (10.97m) from the farthest perpendicular face is required to be leveled to allow for emplacement of the rock saw.

1c. When complete, appropriate water, power and ability to transport and secure a rock saw to the surface of the outcrop must have been available to produce a number of small blocks, typically 1 ft cubed.

i. Packaging & transport of selected block samples is required.

ii. Sample Management Facility (SMF) Support is required.

1d. When complete, appropriate water, power, drilling apparatuses and core bits must have been available to accomplish vertical drilling activities.

i. Vertical drill holes will be surveyed.

ii. Vertical instrumentation borehole sizes to a maximum of 3" (7.62cm) in diameter will be drilled in the excavated surface of the block before isolation (saw cuts).

iii. An effort must be made to maintain parallelism between holes.

1e. When complete, appropriate water, power, lifting and assembly setup equipment must have been provided for suitable isolation of the large block volume.

i. A drill, rock bolts and a track is required for saw operation.

ii. Isolation procedures must be such as to minimize inducing new affecting existing fractures in the large block volume to maintain block integrity.

iii. A suitable portable water source, sump and irrigation pump is required.

iv. A generator, cables, compressors, mining and lifting equipment suitable to operate a 150kW/100hp/440V Rock Saw is required.

1f. All required permits and a borehole camera must be on hand to conduct geophysical logging of the vertical boreholes.

1g. When complete, a trailer must be provided at the surface of the test area. Parking space at the trailer pad and a generator is required.

i. Trenching under the trailer is required.

Interface Control Requirements

1. The engineering support contractor and constructor shall interface with the PI and Project Engineer to meet scientific needs.

2. The activity must be integrated with other scientific investigations to assure that the ability to characterize the site or isolate nuclear waste at Yucca Mountain is not compromised.

Constraints

A. All water and permanently implanted materials used during site preparation activities must be recorded.

B. Avoid enhancing run-off drainage into Test Pit #1 or #2.

C. Avoid any substance other than water from coming into contact with the large block volume.

D. Material must be prevented from falling into saw cut slashes or boreholes.

E. Excavation methods must minimize inducing new or affecting existing fractures in the block and must maintain block integrity.

Assumptions

1. Level II survey of as-built excavation, critical features, boreholes and saw cuts will be available.

2. There is no other activity in the vicinity such that the thermal load and/or mechanical load will affect the test, and vice versa. The mapping activity between Test Pits #1 and #2 will neither affect or be affected by the test or construction.