



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

Reply to:  
301 E. Stewart Ave., #203  
Las Vegas, NV 89101  
Tel: (702) 388-6125

DATE: October 21, 1993

TO: Joseph Holonich, Director  
Repository Licensing and Quality Assurance Project  
Directorate

FROM: Philip S. Justus, Sr. On-Site Licensing Representative,  
HLPD

SUBJECT: ON-SITE LICENSING REPRESENTATIVE'S REPORT ON YUCCA  
MOUNTAIN PROJECT FOR SEPTEMBER 1993

INTRODUCTION

During the thirteenth month as On-Site Licensing Representative (OR), I participated in three site visits, a workshop in Las Vegas on Waste Package considerations, and interacted with various DOE staff and contractors to ascertain details of Exploratory Studies Facility (ESF) and Surface-Based Testing (SBT) activities. This report summarizes those activities that I consider particularly relevant to staff work.

A principal purpose of these OR reports is to alert NRC staff, managers and contractors to information from DOE's programs for site characterization, repository design, performance assessment and environmental studies that may be of use in fulfilling NRC's role during prelicensing consultation. Relevant information includes such things as new technical data, DOE's plans and schedules and the status of activities to pursue site suitability and Exploratory Studies Facility (ESF) development. In addition to communication of information, any potential licensing concerns identified are reported, as appropriate. The principal focus of this and future ORs reports will be on DOE's programs for ESF, surface-based testing (SBT), performance assessment, data management systems and environmental studies (at this time, mainly water resources).

EXPLORATORY STUDIES FACILITY (ESF)

1) STARTER TUNNEL COMPLETED AT 200 FEET. A first phase (package 2A) activity of the ESF, the North Ramp starter tunnel heading at 200 ft.(61m), was completed on 9/9. I observed the geologic mapping and stereophotography of the last fifty feet on 9/10. A DOE QA project manager simultaneously observed that the U.S. Bureau

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of Reclamation geologists appeared to be adequately following the approved mapping procedures. The tunnel was completely shotcreted by the end of September, except for the outline of Test Alcove #1, centered on station 0 + 140. Pattern rockbolts were installed and pull-tests of them were conducted into October. Results of testing of bolts and drill and blasting of the Test Alcove will be summarized in the October report.

2) NOTES ON GEOLOGIC MAPPING OF THE ESF AND TEST ALCOVE. Geologic mapping of the Starter Tunnel was completed on 9/10. Mapping will continue in Test Alcove #1 and YMPD considers the results essential input to the decision on where to terminate the Alcove's heading. In particular, a shear zone is projected to intersect the Alcove at about 60 ft. from the tunnel. The hydrologic radial borehole tests are to be conducted beyond the zone of shear. The geologists are responsible for identifying that shear zone.

According to the geologist Principal Investigator (PI), certain observable details of rock discontinuities (such as joints, fractures, faults and shear zones) and lithologic features (such as aspects of matrix texture and shape of small clasts) in tunnel walls are expected to appear differently on jagged drilled and blasted surfaces like those in the Starter Tunnel and Test Alcove than on smoother machine-bored surfaces. The PI plans to compare and to contrast various kinds and amounts of geologic data that emanate from mapping (by both ground truth and stereophotogrammetric methods) similar rocks exposed by the different excavation methods. The PI indicated that such a study would suggest what rock characteristics (e.g., discontinuities of particular size or orientation with respect to the tunnel wall, and lithologic features such as pumice clasts) may be determined reliably and which ones not as reliably, on smooth or jagged tunnel walls.

3) NOTES ON TEST ALCOVE #1. Significant underground activities in FY94 are associated with Test Alcove #1. The Alcove entrance, centerline, centered on 0+140, will be constructed non-perpendicular to the main tunnel alignment. Documentation of the decision to "angle" the Alcove will be compiled and sent to HQ. The Alcove will be constructed by drilling and blasting. As discussed in Item 2, above, its length will be determined in the field as geologic conditions are identified. Radial borehole tests are to be conducted in the rear and hydrochemical tests nearer the Starter Tunnel. (See Job Package 92-20E).

4) GEOLOGIC INPUT TO THE DECISION TO CHANGE NORTH RAMP GRADIENT. This is a brief followup to the previous reports on the subject. The proposed repository level was defined by thermo-mechanical rock properties (Ortiz and others, 1985). It is variously referred to as the middle non-lithophysal zone of Topopah Spring Member of Paintbrush Tuff, the TS level, the main test level, Tsw2, among others. The Tsw2 layer is of both variable thickness and depth

below the surface. The top of Tsw2 layer is known as the Tsw1/Tsw2 contact and is the principal reference for communicating to designers the location of the top of the repository level at a specific spot. The design criterion for the entry point of the North Ramp invert (bottom of ramp) into the TS level apparently is 10m or 33 ft. below Tsw1/Tsw2 contact. The 10m was apparently arrived at by adding 5m standoff below the contact and 5m uncertainty.

Several analytical tools were used to estimate Tsw1/Tsw2 from the few data points (picks from core and borehole logs) available. For Title II Design, Tsw1/Tsw2 (3298 ft., elevation above sea level) was based largely on Interactive Graphics Information System (IGIS) Product SAN0022 (see RIB, Ch.1, Sect.1, item 5, p.1 of 11. It is admitted there that the IGIS model has certain limitations and QA of IGIS-derived elevations has not been demonstrated).

The Tsw1/Tsw2 contact at the junction of North Ramp and TS level has been variably estimated by at least three organizations using several methods. For example, USGS has used the classical three-point method and calculated contact at 3368 ft. elevation. USGS also used the Lynx 3-D computer code and projected contact at 3404 ft. (uncorrected) and 3356 ft. (adjusted to NRG-6 data) (Hayes to Sandifer, 3/28/93). SNL, using IGIS, projected contact at 3389 ft. Also, the M&O calculated an elevation from four closest boreholes at 3349 ft., and, averaged with results of others, proposed that 3366 ft. be used to determine the entry point. It is not clear that the picks of Tsw1/Tsw2 from boreholes G-4, UE25a-6 and NRG-6, among others used, were based on qualified data. The ORs have requested additional information on this subject from DOE.

5) CONSTRUCTION MONITORING ACTIVITIES (CMA) IN ESF. This brief report hits highlights of CMA. CMA started only three months ago. Previous report on this subject is in OR Report for May-June 93. This report is based largely on interviews of LANL CM coordinator, field observations and limited review of documents (documents reviewed were sent to HQ on 9/28). Four types of CMA were active: 1) total load-cell monitoring in high-wall boreholes, 2) convergence monitoring of fixed points in starter tunnel, near portal, 3) resurveying benchmarks, 4) seismometer recording of peak particle velocities from blasts (this topic will be covered in a future report). These CMA currently are not quality affecting, but will be.

The YMPO assessments of data described briefly below indicated that through September no instability had been detected except for convergence which was considered normal relaxation in the course of rock adjustments due to excavation of boxcut and Starter Tunnel. There were no additional concerns about safety which resulted from these measurements. The OR was told that the M&O's periodic (at least weekly) reinterpretation of all the accumulating data, in consultation with SNL data collectors, led to the current position

that the openings monitored are relatively stable. That is to say, for the Starter Tunnel, only routine ground support measures were deemed to be needed to protect workers, such as the use of wiremesh held by split set rockbolts, lattice girders, shotcrete with steel fibers, in addition to the pattern rock bolt system (see OR Report for July-August 93).

Outline of CMA history.

- \* Nov-Dec92 - SNL proposed CMA and budget to partially implement SCP 8.3.1.15.1.5.1-access convergence test, 8.3.1.15.1.8.2-evaluation of mining methods and monitoring of ground support systems;
- \* Jan93 - start boxcut;
- \* Apr93 - start Starter Tunnel;
- \* Jun93 - install load cells on highwall of boxcut; install extensometers in Starter Tunnel;
- \* Aug93 - install load cells in Starter Tunnel;
- \* Sep93 - complete Starter Tunnel. CMA continue to evolve; supplemental reports will be forthcoming.

Observations of data collected by SNL and REECO by OR. Graphs of data from measuring highwall rock mass movement from three load cells from 6/1 to about 9/15 (SNL) indicate a relaxation of stress of up to about 1400 lbs in first few days and, thereafter, up to about 600 lbs change in a few weeks. Graphs of data from two tape-extensometers in Starter Tunnel from 6/10 to about 9/15 (SNL) indicate positive and negative changes in length and rate of change for each tie line. Changes in length generally ranged up to about 0.26 in. Rate changes were generally less than 0.02 in./day. There were disruptions of some pins and measurements by construction activity and installation of the crown ventilation duct. Graphs of data from three load cells in Starter Tunnel at 0+55 for about 30 days beginning 8/17 (SNL) indicate a relaxation of stress of up to about 900 lbs. I'm told that REECO periodic surveying of fifteen fixed monitoring points since 1/93, at an accuracy of 0.015 ft., indicates no change in fracture frequency or in coordinates within tolerance of the method. Reports on CMA will continue.

6) WATER USE IN STARTER TUNNEL. About 361,000 gallons were used by 9/14. About 120,000 gal of the 361,000 were used to mix grout and are considered to be 'fixed' or immobilized water, as is the water used to mix shotcrete. Water used for drilling, dust control and to clean surfaces to be mapped is 'free' water. Apparently much of the free water is removed through the ventilation system or with the muck. About 377,293 gallons were used by (9/30 (LANL). Water use was first discussed in the July-August93 OR Report. Reports on fluids introduced into the ESF system will continue.

7) ROCKBOLTS, GROUT AND FIBERCRETE USED IN STARTER TUNNEL. REECO reports the following amounts of materials used in August: a) 131 permanent rockbolts installed; b) 183 split set rockbolts

installed; c) 2084 cubic feet of cementitious grout pumped; d) 168 bags of fibercrete applied; e) 18 highwall rockbolts with 184 cubic feet of cementitious grout installed. Total amount of various materials introduced into the ESF Starter Tunnel will be reported as they are compiled.

8) TUNNEL BORING MACHINE (TBM) PLANS AND SCHEDULE. At the Technical Project Officer (TPO) meeting on 9/17 that I attended, Mr. C.Gertz described the proposed plans and schedule for TBM deployment. The TBM will operate on two shifts in FY94 and three in FY95. Step 1, April94- start assembling front end of TBM train at North Portal pad. Step 2, tbd- 'walk' front end of train into Starter Tunnel; set it up; test it; start assembling rest of train. Step 3, July94 (Aug94, as reported at NWTRB meeting 10/19)- start boring, mucking, mapping from platform; complete assembling TBM train elements on pad (at NWTRB meeting 10/20, YMPO indicated slip to August94 due to budget shortfall). Step 4, tbd- hookup entire train in tunnel. Step 5, September94- continue boring, mucking, mapping to Bow Ridge Fault, about 650 ft. underground by end of FY94. Step 6, tbd- hookup conveyor system; continue boring, mucking, mapping. Step 7, FY95- three shifts; about 2000 ft. excavated by end of 1st quarter, including the 200 ft. Starter Tunnel. The TBM constructor, Peter Keywit, Corp., apparently does not intend to routinely probe ahead of the TBM with "pilot" boreholes. The basis for this decision is intended to be documented. I will transmit the document when it becomes available.

9) SAWING LARGE BLOCK AT FRAN RIDGE IS FEASIBLE. At the TPO meeting on 9/17, W.L.Clarke showed a video of the walls of 2 in.-wide test-cuts at the Fran Ridge site made by a saw. This test affirmed both the feasibility of the saw method for excavating a smooth-walled block and the conductivity of existing fractures. The Large Block Experiment will proceed in FY 94.

10) THERMAL LOADING SYSTEM STUDY STATUS. At the TPO meeting on 9/17, S.Satterly indicated that the report on thermal loading options is expected to be available in 12/93.

11) NOTES ON WASTE PACKAGE (WP) WORKSHOP. I attended part of the "Yucca Mountain Site Characterization Project Waste Package Workshop" on 9/21 (see Enclosure 1 for Agenda). The following items of interest were selected from various presenters. A more detailed report will be filed by D.Dancer, DHLWM. \* The M&O proposed to start a non-metallic materials program. \* The French have proposed to incorporate a retrievability option in their repository design. \* MPUs may not hold as much spent fuel as MPCs because, even though MPU is larger, MPU would be too weighty. \* A major problem with copper is welding. The gas tungsten arc welding technique requires messy pre-heating of the copper. \* The anticipated near-field environment was described: no liquid water in contact with WP; fracture flow is possible, but not likely to

be continuous; water chemistry is benign. \* If water in fractures is in equilibrium with pore water, the former would be like J-13 well water. \* Some rock fractures above WPs act like heat pipes. Without fractures a repository gets hotter than one with. Not likely to get liquid water in contact with WP in hot repository; however, vapor phase transport would become relatively more significant. Nevertheless, a designer might prefer emplacement areas without fractures that act like heat pipes.

In OR's opinion, this last point, if it should become a design consideration, would likely require geologists to map (or, to have mapped) fractures with certain properties that could foster heat-pipe behavior in emplacement areas. Specifications of fractures that might be of concern as potential heat pipes apparently have not been established. This topic, one of several dealing with characterization of fractures (for example, identifying fractures important to far-field liquid and gas transport, requiring communication between flow and transport modelers & geologists; and fractures important to stability of openings, requiring communication between geotechnical engineers & geologists), emphasizes the continuing need for interdisciplinary communication of design concepts, in this case, between waste package system engineers & geologists.

#### SURFACE-BASED TESTING (SBT)

1) BOREHOLE UZ-14 STATUS. Water was encountered in this borehole (BH) on 7/30/93 at 1256.6 to 1258.5 ft. This is a dry-drilling operation using the LM-300 rig (see July-August OR Report). The water has a component (apparently a polymer drilling fluid mixed with J-13 water) that was introduced in BH G-1, 1000 ft. southeast of UZ-14 in March-August 1980 when 2.4 million gallons were lost in G-1. The source of the polymer-containing water has not been resolved. The USGS, at the TPO meeting on 9/17, suggested three working hypotheses to explain the origin of the water encountered: 1) it's drilling fluid that migrated from G-1; 2) it's perched water contaminated by G-1 drilling fluid; 3) it's the water table contaminated by G-1 drilling fluid. The leaky interval was grouted and drilling and coring continued. However, more water was encountered at about 1266 to 1271 feet. This interval is to be grouted. The October report will summarize continuing developments.

2) CORE LOGGING PROCEDURE ESTABLISHED. Procedure for "field logging, handling, and documenting borehole samples" was issued on 8/20 (YLP-SII.2Q-SMF). It will enable YMPD staff to issue qualified lithologic and structural logs at the wellhead. Previously, only USGS staff could issue qualified logs. The 33-page procedure is on file in the OR office. Sample Management Facility staff (SAIC) will be trained in the logging procedures in

order to implement the YLP. I have requested a copy of the course information, when it becomes available.

3) 'PICKING' STRATIGRAPHIC UNITS. The USGS was requested by DOE to develop written criteria to distinguish visually and quickly (in about five minutes per core run) one rock unit from another in drill core. Such criteria are needed to fully implement the core logging procedures noted in Item 2, above. I understand that the USGS has developed a descriptive classification of YM volcanic rocks using traditional petrographic terminology suitable for relatively non-weathered specimens encountered in underground excavations and in boreholes. Certain descriptive terms now in use that were based upon characteristics found in weathered surface exposures, e.g.: caprock, clinkstone, cannot be readily applied to core. Additional stratigraphic nomenclature for YM rocks is expected to be published in October or November.

4) YMPD TO DEVELOP A STRATIGRAPHIC COMPENDIUM. The M&O was directed by YMPD to develop a YM stratigraphic compendium (Dyer to Foust, June 8, 1993). This document apparently will be based upon a search and compilation of existing literature on stratigraphic nomenclature and descriptions of rock units. Its purpose is to a) serve as a standard reference for all core logging and field mapping exercises; b) serve as a basis for license application support providing criteria for definition, recognition and correlation of rock units in YM area. It is expected to be completed in FY94. Such a compendium will include charts of rock units described from the viewpoints of geology, hydrology and hydrochemistry and thermo-mechanics. Such a compendium would be helpful in mitigating the confusion of stratigraphic terms applied to the same rock units in the repository block and vicinity by the various participants.

5) GHOST DANCE FAULT EXPOSURE AT ANTLER RIDGE. Attempts to excavate the Ghost Dance Fault along the southern slope of Antler Ridge by using a ripper on a bulldozer were not successful. The outcrop is being cleared manually and by water hose. Detailed mapping is to start in FY94.

6) BOREHOLE NRG-2B COMPLETED. On 9/14, drilling and coring North Ramp geologic BH NRG-2B was completed to total depth of 329.46 ft., with 5 in. odex casing to 263.60 ft. Refer to Job Package 93-09 for detailed specifications.

#### GENERAL

1) N-TUNNEL TO BE SEALED. The ORs were notified that N-tunnel, NTS-Ranier Mesa, will be sealed in spring, 1994. Heads up. Plans to observe the tuffs, mainly non-welded, with some weeping fractures and machine-bored drifts, should be made soon. A

NRC/CNWRA Appendix 7 visit to N-tunnel, among other places of hydrologic interest, is planned for 11/16-17.

#### ON-SITE REP (OR) ACTIVITIES

1) ATTENDED TPO MEETING. I attended the 9/17 TPO meeting in Las Vegas and reported highlights to you on 9/20 (Enclosure 2 is the Agenda).

2) TRANSMITTED C. CONNOR'S TRIP REPORT TO STATE AND AFFECTED UNITS OF LOCAL GOVERNMENT (AULG). On 9/22 I transmitted C. Connor's trip report, "NRC-DOE Technical Exchange (TE) on Volcanism" to the State and AULG, after providing YMPD with a copy.

3) NRC STAFF VISITORS. The following NRC staff visited the site and/or attended meetings in Las Vegas in September: Wm. Belke, D. Dancer, K. McConnell, S. McDuffie and E. O'Donnell.

#### Enclosures:

- |  |      |
|--|------|
| 1. Yucca Mountain Site Characterization Project<br>Workshop Agenda | 9/21 |
| 2. TPO Meeting Agenda  | 9/17 |

cc w/encl: R. Dyer, DOE  
D. Shelor, DOE  
L. Smith, DOE  
T. Hickey, State Senator  
W. Patrick, CNWRA  
R. Loux, State Nuclear Waste Project Office

cc w/o encl: C. Abrams, M/S 4 H 3  
R. Bernero, M/S 6 E 6  
J. Fouchard, M/S 2 G 5  
S. Gagner, M/S 2 G 5  
J. Linehan, M/S 4 H 3  
E. O'Donnell, M/S NLS 260  
H. Thompson, M/S 17 G 21  
B. Youngblood, M/S 4 H 3  
G. Cook, Region V  
D. Kunihiro, Region V  
J. Martin V  
S. Jones, DOE  
D. Foust, M&O  
S. LeRoy, M&O  
J. Russell, CNWRA  
L. Reiter, NWTRB  
D. Bechtel, Clark Co.  
L. Bradshaw, Nye Co.

**YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT  
WASTE PACKAGE WORKSHOP**

**AGENDA**

September 20-23, 1993  
Howard Johnson - Plaza Suites  
Las Vegas, Nevada

**Monday, September 20, 1993**

8:00 am-5:00 pm Tour of Yucca Mountain site - Meet in hotel lobby

**Tuesday, September 21, 1993**

8:00 - 10:15 am

Welcome	Linda Smith - YMPO
Workshop Overview	Bill Simecka - YMPO
Introduction of facilitator and experts	Dean Stucker - YMPO
Review of agenda/procedures	Holmes Brown - Facilitator
Summary of 1991 workshop	Holmes Brown
✓ Status of Waste Package Development	Hugh Benton - M&O/BWFC
✓ Pre- and post-closure design/performance reqmts.	David Stahl - M&O/BWFC
Near-Field Environment	Dale Wilder - LLNL
10:30 am - 1:00 pm	
SESSION I - GENERAL CONTAINER CONCEPTS	
✓ Technical Lead - General Container Concepts	Thomas Doering - M&O/BWFC
✓ "Multi-Barrier Copper-Base Containers for HLW Disposal"	Dale Peters - CDA, Inc.
✓ "Conceptual Repository Overpack - Design Guidelines"	Bob Lehnert - Pacific Nuclear

**LUNCH**

Waste Package Development Workshop Agenda  
Page 2 (Con't)

2:00 - 4:45 pm

SESSION II - MATERIALS BEHAVIOR/DEGRADATION PROCESSES

Technical Lead - Materials Behavior Issues/Concern      Dan McCright - LLNL

"Toughness Properties of Forged Shells SA350 LF5  
Grade of Cask Bodies for Irradiated Fuel Elements"      Roger M. Squire - Creusot-Marrel, Inc.

"Use of Radioactive Scrap Metal for the Fabrication  
of Spent Fuel Containers"      David Atteridge - Oregon Graduate Institute

✓ "Electrochemical Sensor for Monitoring Atmospheric  
Corrosion under Anticipated Yucca Mountain  
Environment"      Denny Jones - University of Nevada, Reno

4:45 - 5:15 pm

OPEN DISCUSSION

**Wednesday, September 22, 1993**

8:00am - 8:45 am

SESSION II - MATERIALS BEHAVIOR/DEGRADATION PROCESSES (Con't)

✓ "Selection of Alloys for the Nuclear Waste Repository:  
Corrosion Resistance and the Influence of Long-Term  
Low Temperature Aging"      Galen Hodge - Haynes International

8:45 - 12:00 noon

SESSION III - FABRICATION, WELDING, AND NDE

✓ Technical Lead - Fabrication/Closure Concerns      Thomas Doering - M&O/BWFC

✓ "Concept for Hazardous Materials Management  
and Container Closure using Copper Based Alloys"      Holt Murray, Jr - Princeton University

✓ "Fabrication and Closure Issues for a  
Multi-Barrier Waste Package"      Edward Robitz - Babcock & Wilcox

"The use of Spirally Welded Pipe for the  
Fabrication of Spent Fuel Containers"      David Atteridge - Oregon Graduate Institute

LUNCH

Waste Package Development Workshop Agenda  
Page 3 (Con't)

1:00 - 4:15 pm

SESSION IV - PERFORMANCE ASSESSMENT

Technical Lead - Waste Package PA Issues/Concerns

Bill Halsey - LLNL

✓ "Fundamental Consideration in Predicting the  
Performance of Containers for Radioactive Waste"

Roger Staehle - University of Minnesota

✓ "Use of Surrogates to Estimate Waste  
Package Licensability"

Hollister Hartman - M&O/TRW

"Near-Field Environment Considerations for  
Alternative Waste Package Concepts"

Martin Altenhofen - Waste Management  
Consultant

4:15 - 5:00 pm

OPEN DISCUSSION

**Thursday, September 23, 1993**

8:00 am - 12:00 Noon

Open Discussion

Experts Discussion/Opinions

**12:00 Noon Workshop Adjourns**

**Note :** Breaks (15 minutes) will be provided each morning and afternoon

(Rev. 2, 9/14/93)

## AGENDA

## YUCCA MOUNTAIN PROJECT - PROJECT MANAGER'S/TPO MEETING

SEPTEMBER 17, 1993, FRIDAY

SAIC CONFERENCE ROOM 450

TIME	WHAT	WHO	EXPECTED OUTCOME
9:00-9:15	Welcome & Introductions o Review Agenda	C. Gertz	
9:15-10:00	Status of Yucca Mountain Site Characterization Project	C. Gertz	Understand Current Status of Program and Project
10:00-10:15	Status of Design and Construction Effort Supporting the Exploratory Studies Facility (ESF)	W. Simecka	Understand Current Status of ESF Design and Construction Effort
10:15-10:30	Status of Site Characterization Testing Program and Preparation and Approval of Study Plans(SPs)	R. Dyer	Understand Current Status of Testing Program and SPs
10:30-10:45	<b>BREAK</b>		
10:45-11:00	Status of Mined Geological Disposal System (MGDS) Thermal Loading Study	W. Simecka	Focus the Range of MGDS Thermal Loading Options
11:00-11:15	Status of Interactions With the National Academy of Sciences (NAS) on the Energy Policy Act of 1992, Section 801, Nuclear Waste Disposal	R. Dyer	Understand Current Status of Interactions With the NAS
11:15-11:30	Current Understanding of Water Encountered During Drilling of the UZ-14 Drillhole	R. Luckey	Updated Information on Water Found in the UZ-14 Drillhole
11:30	<b>ADJOURN FOR LUNCH</b>		

*all: W.L. Clarke LLNL on LBE*