



Department of Energy

Washington, DC 20585

QA: L

FEB 24 1997

L. D. Foust, Technical Project Officer
for Yucca Mountain Site
Characterization Project
TRW Environmental Safety Systems, Inc.
1180 Town Center Drive, M/S 423
Las Vegas, NV 89134

VOIDING AND CLOSURE OF DEFICIENCY REPORT (DR) YM-96-D-072 FROM OFFICE OF QUALITY ASSURANCE (OQA) SURVEILLANCE YM-SR-96-019 OF THE CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM MANAGEMENT AND OPERATING CONTRACTOR (CRWMS M&O)

The OQA staff has reviewed documentation provided by the CRWMS M&O and has determined that an adverse condition does not exist. As a result the DR is considered voided.

If you have any questions, please contact either James Blaylock at (702) 794-1420 or Patout H. Cotter at (702) 794-1332.

Donald G. Horton, Director
Office of Quality Assurance

OQA:JB-1000

Enclosure:
DR YM-96-D-072

cc w/encl:
T. A. Wood, DOE/HQ (RW-55) FORS
J. O. Thoma, NRC, Washington, DC
S. W. Zimmerman, NWPO, Carson City, NV
B. R. Justice, M&O, Las Vegas, NV
R. A. Morgan, M&O, Las Vegas, NV
Records Processing Center

cc w/o encl:
W. L. Belke, NRC, Las Vegas, NV
P. H. Cotter, OQA/QATSS, Las Vegas, NV
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PDR WASTE PDR
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Recip: Naiss/HLUR

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PERFORMANCE/DEFICIENCY REPORT

1 Controlling Document:
Quality Assurance Requirements and Description (QARD) document, Revision 5

2 Related Report No.
YMP-SR-96-019

3 Responsible Organization:
CRWMS M&O

4 Discussed With:
R. Sandifer, S. Jones, R. Craun

5 Requirement/Measurement Criteria:

QARD, Section 2.0, Paragraph 2.2.3, "Controlling Activities," states, in part, "A. The QA program shall apply to site characterization data and samples." Study Plan for Study 8.3.1.15.1.8, "In-Situ Design Verification," Revision 0, effective February 3, 1993, Paragraph 4.1.1.1 states, in part, "Blast design would be performed by the constructor with monitoring in this experiment to include: . . . peak particle velocity."

6 Description of Condition:
"Determination of Importance for Subsurface Exploratory Studies Facility," BAB000000-01717-2200-00005, Revision 5, and specification, "Subsurface Drilling and Blasting," BAEBA0000-01717-6300-02313, Revision 1, do not identify the measurement of peak particle velocity (PPV) as a quality activity.

Discussion:
DIEs are performed to evaluate construction and testing processes and the potential affects those processes will have on waste isolation and test interference. During this evaluation, controls are to be identified for individual activities and stipulated within the DIE for incorporation into drawings and specifications.

The above cited DIE did not identify the measurement of PPV as an attribute important to waste isolation and test interference; therefore, no QA controls were imposed for this activity. However, Study Plan 8.3.1.15.1.8 identified this activity to be monitored. The results of the monitoring process are to be utilized as input to subsequent drill and blast design.

If the testing community is to monitor PPV and the A/E and construction utilizes the results for input into drill and blast design, then this activity would be considered "Q" and should have been identified as such.

7 Initiator
Patout H. Cotter *P.H. Cotter* Date 7/19/96

9 Is condition an isolated occurrence?
 Yes No Unknown; Must be Yes if PR

10 Recommended Actions: (Not required for PR)

- Evaluate the deficiency, perform remedial action, investigate the extent of deficiency, and perform root cause analysis to determine how the condition came about.
- Evaluate the process by which input is acquired by the DIE evaluators to determine if sufficient information is supplied by the PIs - to perform adequate waste isolation and test interference evaluations. In addition, determine whether corrective/investigative action performed for DR YMQAD-96-D014 was effective in identifying necessary corrective actions and like instances where the PI's input was not appropriately obtained.
- Reevaluate the waste isolation and test interference evaluations for drill and blast activities to determine the appropriateness of adding QA controls that identify maximum values that are not to be exceeded; i.e., PPV, overbreak, and drilling tolerances.

11 QA Review
QAR *P.H. Cotter* Date 7/19/96

12 Response Due Date
20 Working Days from Issuance

13 Affected Organization QA Manager Issuance Approval: (QAR for PR)

Printed Name Richard E. Spence Signature *R.E. Spence* Date 7/19/96

22 Corrective Actions Verified
QAR N/A Date

23 Closure Approved by: (N/A for PR)
AOQAM *[Signature]* Date 2/20/97

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PERFORMANCE/DEFICIENCY REPORT RESPONSE

14 Remedial Actions:

Review has determined that no deficiency exists; therefore, no remedial actions are required. See Continuation Pages (following) for supporting information.

15 Extent of Condition: (Not required for PR)

Review has determined that no deficiency exists; therefore, no "extent of condition" determination is required. See Continuation Pages (following) for supporting information.

16 Root Cause Determination: (Not required for PR)

Required Yes No

Review has determined that no deficiency exists; therefore, no root cause determination is required. See Continuation Pages (following) for supporting information.

17 Action to Preclude Recurrence: (Not required for PR)

Required Yes No

Review has determined that no deficiency exists; therefore, no actions to preclude recurrence are required. See Continuation Pages (following) for supporting information.

18 Corrective Action Completion Due Date:

N/A

19 Response by: *L. Dale Foust*

Initial

Amended

Date *8/21/96* *8/21/96* Phone (702)295-1804

20 Response Accepted

QAR

Date

N/A

21 Response Accepted (N/A for PR):

AOQAM

Date

N/A

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Supporting Information

The following information is provided to support the responses provided in Blocks 14 through 18 on page 2 of this DR. In summary, our investigation has resulted in the following conclusions:

- (1) the DIEs in question were prepared by qualified and trained personnel in accordance with an approved procedure;
- (2) the concerns expressed in this DR with regard to peak particle velocity being measured as "Q" data do not constitute a test interference issue (the collection of that data as "Q" site characterization is addressed in another DR); and
- (3) the provisions of the procedure adequately provide for establishment of controls to limit waste isolation and test interference impacts to the extent practical, and further that the QA controls found in the subject DIEs (that is, those QA controls associated with waste isolation and test interference) have been re-verified to be adequate.

The information below also discusses that part of the investigation that evaluated whether - irrespective of site characterization data collection requirements - peak particle velocity measurement should have been identified as a QA control in the DIE.

As a result of our investigation, and as indicated in Block 17, we have concluded that a deficient condition does not exist with regard to current DIE requirements. But, as a result of additional investigation into related documents, some additional actions are in progress, which are discussed at the end of this response, and should provide additional confidence that adequate controls are in place to limit adverse impacts.

(1) Investigation of DIE Preparation

The Determination of Importance Evaluation (DIE) cited in Block 6 of this DR (DIE for Subsurface Exploratory Studies Facility, BAB000000-01717-2200-00005 Rev 05) was prepared in accordance with Nevada Line Procedure NLP-2-0, *Determination of Importance Evaluations*, Revision 1. The "Impact on Site Characterization Testing" section of the DIE (Section 10) was prepared by a test interference evaluator from the Scientific Programs Operations (SPO) organization, and the "Impact to Waste Isolation Characteristics" section of the DIE (Section 11) was prepared by a waste isolation evaluator from the Performance Assessment (PA) organization. As part of our investigation, the qualifications of the contributors to this DIE were reviewed by inspection of their position descriptions and verifications of education and experience (produced in accordance with M&O QAP-2-2), and their training to NLP-2-0 was also verified by inspection of training records produced in accordance with QAP-2-1. We have therefore verified that the authors of the DIE were qualified under the M&O QA program to derive the conclusions and associated controls presented therein.

The DIE received the signed concurrence of the Exploratory Studies Facility (ESF) Test Coordination Office (TCO), the M&O's Quality Assurance (QA) organization, and the ESF Subsurface Design organization. The DIE was approved on July 14, 1995. (Procedure NLP-2-0 is currently in Revision 2, but was in Revision 1 at the time this DIE was prepared.)

Study Plan No. 8.3.1.15.1.8, *In Situ Design Verification* (Revision 0), describes four experiments to be conducted in the ESF: Evaluation of Mining Methods; Evaluation of Ground Support Systems; Monitoring Drift Stability; and Air Quality and Ventilation. The verbiage cited in Block 5 of this DR comes from Section 4.1.1.1 of the Study Plan and relates to the Evaluation of Mining Methods Experiment. The Study Plan is implemented through Yucca Mountain Site Characterization Project Test Planning Package (TPP) No. T-93-2, *Construction Monitoring in the Exploratory Studies Facility* (currently Revision 4). This TPP was in Revision 3 at the time the DIE for the Subsurface ESF (Revision 5) was prepared and approved, and is cited as Reference 14.40 in that DIE.

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(2) Investigation of PPV as "O" Data

The Description of Condition (Block 6) of this DR indicates that the associated DIE and specification section BABEA0000-01717-6300-02313, Revision 1, *Subsurface Drilling and Blasting*, "...do not identify the measurement of peak particle velocity (PPV) as a quality activity...[even though] Study Plan 8.3.1.15.1.8 identified this activity to be monitored [and] the results of the monitoring process are to be utilized as input to subsequent drill and blast design." This statement is misleading, however, as the subject study plan clearly indicates that data from the "Evaluation of Mining Methods" experiment is to be used as an input to *repository* design. The study plan's abstract states that its experiments are "intended to collect information related to construction of the experimental facility [i.e., the ESF] that will be useful in plans for design and construction of the proposed repository." Section 2.1.1 of the same study plan indicates that the experiment's data "will allow *repository* designers and constructors to make use of experience gained in ESF excavations." PPV is identified as one element to be monitored in the Evaluation of Mining Methods Experiment, but it is not identified as a parameter related to minimization impacts from ESF activities.

It is evident, therefore, that, inasmuch as the study plan provides for collection of PPV data, it provides for its collection as *site characterization* data. It is the nature of site characterization that data be gathered, and that this data be gathered in accordance with QARD requirements.

Note that DR YM-96-D-074 describes the lack of QA implementing documents or scientific notebooks for the conduct of the Sandia National Lab (SNL) blast monitoring program.

It is not the purpose of procedure NLP-2-0 to identify the measurement of data, or any other activity, as a quality activity. The purpose of a DIE is stated in Section 1 of NLP-2-0 (Rev 1): "This procedure establishes the responsibilities and process for evaluating the potential impacts of field activities at the Yucca Mountain site on Q-List items and site characterization data, and for identifying appropriate Quality Assurance (QA) controls for these activities." In other words, DIEs establish the applicability of the QA program to an activity only with regard to that activity's potential to impact Q-List items (including the natural barriers), or to impact test results through construction-to-test or test-to-test interference. In fact, procedure NLP-2-0 is necessarily unbiased concerning whether an activity under evaluation is a quality activity or not; either could present the potential to adversely impact Q-List items (including the natural barriers) or site characterization testing, and thus both receive equal scrutiny in accordance with procedure NLP-2-0.

Procedure NLP-2-0 further states that "the scope of DIEs does not extend to control of test data collection in terms of the adequacy or veracity of the data being collected under a test." The control of test data collection in terms of the adequacy or veracity of the data being collected is the responsibility of the responsible testing organization or Principal Investigator (PI). Specific to this investigation, Study Plan 8.3.1.15.1.8 reiterates this fact in its Section 2.4.6: "The investigator, A/E [Architect/Engineer], and constructors must cooperate to refine mining methods, share data collection tasks, and to collect data in a form that can be used by the investigator. However, the responsibility for the results of the study lie with the investigator who must take all steps necessary to insure success of the experiments, including data collection." This assignment of responsibility is repeated by TPP T-93-2 (Revision 3), which states in its Section 2.0 that: "The measurement...type, number, location, installation methods, data requirements, and sequencing related to construction activities for each activity...will be formally determined by the PI and the A/E based on requirements with concurrence from the ESF TCO, DOE YMPO Assistant Manager Engineering and Field Operations and the YMPO Assistant Manager for Scientific Programs. The field implementation of testing, based on the formal determinations, is the responsibility of the PI test organization under appropriate procedures."

By inspection of the related DR discussed above, and the additional discussion regarding the non-applicability of NLP-2-0 to the identification of QA controls for collecting site characterization data, it is apparent that YM-96-D-074 is actually the more appropriate mechanism for resolution of this concern.

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(3) Investigation of Procedural and DIE Adequacy

NLP-2-0 prescribes two criteria for determining whether a potential for test interference exists: whether the activity being evaluated could "impact or bias required site characterization tests in an undetected or unpredictable way"; or whether the activity being evaluated could "impact or bias required site characterization tests that cannot be repeated to the extent practical, with the expectation of collecting the required test results."

The latter consideration is only relevant in limited cases. One example would be activities that could have potentially adversely impacted monitoring that was conducted to develop the pneumatic model of the undisturbed Yucca Mountain interior. Evaluation concluded that data had to be collected prior to the TBM entering a particular thermomechanical contact, or the data would have been lost.

The former consideration is relevant in this case, and indeed is the basis for Requirement 5 in the DIE. Requirement 5 assures that blast information is retained and, therefore, that potentially affected PIs subsequently have access to the information and can use it as necessary to interpret their test results. As a result, site characterization testing to be fielded in test alcoves will not be impacted or biased "in an undetected or unpredictable way" as a result of drill-and-blast excavation.

The DIE process assures that PI coordination and input is achieved for each DIE. As indicated above, evidence of this coordination and input is provided by the signatures of the SPO test interference evaluator and the applicable TCO representative (i.e., either the ESF TCO or the Surface-Based Testing Coordination Office) on the DIE cover sheet.

As noted above, Study Plan 8.3.1.15.1.8 is implemented through TPP T-93-2, which was considered during the preparation of the DIE for the Subsurface ESF. That the DIE identified no particular potential for adverse impact from the Evaluation of Mining Methods Experiment on Q-List items (including the natural barriers) or site characterization testing is reasonable and justified based on the information contained in the Study Plan and the TPP. The Study Plan notes in its Section 2.4.1, "Potential Impacts on the Site," that "because the only additional excavation required specifically for this study consists of the drilling of short boreholes, this study is not expected to have any additional impacts to the site." In Section 2.4.7, "Test-to-Test Interference," the Study Plan states that "because the nature of the Design Verification experiments is primarily observational, no special constraints are required to incorporate these activities in the ESF testing, and no additional perturbation to natural conditions (stress, temperature, moisture, etc.) will result from these activities." Section 3.2, "Impacts to Waste Isolation," of the TPP (Revision 3) states that "no modifications to existing performance criteria or constraints are required." Test interference information and constraints are contained in Attachment 1 of the TPP. For the Evaluation of Mining Methods Experiment, Attachment 1 of the TPP (Revision 3) states that "this test can be scheduled independently of the scheduling of the other tests...[and that] no interference envelope exists; this test is observational only." Revision 4 of the TPP (the current revision) contains identical wording in its Section 3.2 and Attachment 1.

Although the identification of PPV as "Q" data for site characterization purposes is not within the scope of NLP-2-0 (as discussed above), a related concern might be that PPV monitoring, with some appropriate limit, should have been established as a QA control in the DIE for the Subsurface ESF based on legitimate waste isolation or test interference concerns. It is true that drill-and-blast excavation produces a thicker mechanically disturbed zone than mechanical excavation, but both excavation methods were evaluated in the DIE for the Subsurface ESF, with respect to both potential waste isolation and test interference impacts.

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With respect to potential adverse waste isolation impacts, the significant concern is that mechanical damage due to excavation will create aqueous pathways that will significantly enhance radionuclide transport. However, Section 11.4 ("Thermal/Mechanical Evaluations") of the Subsurface ESF DIE states that "there is a negligible impact on the overall waste isolation capability of the entire potential repository due to the generation of preferential aqueous pathways through the mechanically disturbed zone." This conclusion applies to both excavation methods. The DIE prescribes no QA controls on drill-and-blast activities based on waste isolation considerations.

Section 10.8.2 of the DIE addresses potential test interference impacts associated with both excavation methods as employed in test alcoves. Here the DIE also acknowledges that the effects of drill-and-blast excavation may extend farther from the excavated alcove opening than the effects due to mechanical excavation, and notes that these effects will be taken into consideration during the fielding of tests. To facilitate such consideration, the DIE establishes a QA Control (Requirement 5 in Section 13.2 of the DIE) that blast information, including blast plans, blast patterns, type and quantities of explosives used, location and time, be designated and retained as QA records.

As per review of design plans, blastings is presumed (in the DIE) to be controlled in accordance with standard industry methods. Controlled blasting is presumed both in the waste isolation impact evaluation, wherein no significant impact is concluded, and in the more general DIE conclusion that such excavation is not likely to preclude establishment of effective ground support. Partly on the basis of this presumption, Requirement 4 in the DIE provides for nominal control of these blasting methods, to provide reasonable assurance that the standard practice is consistently applied. This requirement also derives from the test interference considerations, and includes A/E approval of blasting plans and patterns, performance to required tolerances, and receipt inspection and verification of representative explosive samples.

As part of the response actions for this DR, the SPO and TCO signatories for the Subsurface ESF DIE were requested (1) to further document the specifics of the PI coordination and input that was accomplished with respect to the drill-and-blast related controls in the DIE, and (2) re-confirm and document that potentially affected PIs *still have no concerns* regarding the adequacy of these controls. The responses to this request - TRW Interoffice Correspondence (IOC) LV.SPO.JDA.7/96-445 and Los Alamos National Laboratory Memorandum LA-EES-13-LV-07-96-014 - are attached. In brief, these two documents affirm that potentially affected PIs did not and do not have any particular test interference concerns associated with drill-and-blast excavation in test alcoves, to the extent that additional controls were/are felt to be warranted.

Summary and Conclusions

This DR identifies as a deficiency that no QA controls were established in a DIE to ensure that certain site characterization data (PPV during drill-and-blast excavation) is collected as required in accordance with QARD requirements. However, it is not the purpose of DIEs to ensure that data be collected as "Q" data. DIEs establish QA controls based on the potential for an activity to adversely impact either Q-List items (including the natural barriers) or site characterization testing.

Our investigation has evaluated the contended deficiency, the process by which DIEs are performed, the qualifications of the personnel performing the evaluations, and the results of the DIEs in question. The governing procedure, NLP-2-0, was implemented correctly by qualified personnel, resulting in the appropriate identification of potential adverse impacts from these activities, and the application of sufficient QA controls, with regard to limiting impacts to waste isolation and test interference.

The DIE does not identify measurement of PPV as critical to limiting waste isolation or test interference impacts, as substantiated during this investigation. The act of data collection for any given test is the responsibility of the assigned PI; this responsibility is also stated in the Study Plan cited in this DR. Therefore, a related DR, YM-96-D-074, is a more appropriate vehicle for resolving concerns associated with collection of PPV as "Q" data. Because the condition identified in this DR in fact resulted from the correct implementation of a satisfactory procedure, the identified condition is not deficient.

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Additional documentation produced during the course of this investigation includes SNL's *Blast Monitoring During Northern Ghost Dance Fault Alcove Construction* (Brady to Elkins, 8 Aug 96). This document indicates that an objective of blast vibration monitoring is to help design controlled and smooth blasting to preserve the integrity of rock in the alcove. The letter clarifies later, however, that the intent of this test is to determine if a predictive tool can be developed, based on PPV measurement, for the purposes of repository construction. SNL personnel have substantiated that it is not their intention to indicate that PPV constitutes a critical measurement for the purposes of limiting test interference.

The implementation of this monitoring has resulted in the collection of additional seismic data which is being controlled as "Q" data, not for its potential use in modifying subsequent ESF blasting, but because of its potential use in the establishment of a predictive tool for repository design. Nevertheless, this additional monitoring has provided and will continue to provide additional management confidence in the adequacy of the existing controls.

Additional discussion with the A/E has further substantiated that measured PPV does not constitute a necessary parameter for the purposes of correcting subsequent blast plans. Rather, PPV measurements are taken into account as secondary information, only because they are being collected as site characterization data for other reasons (i.e., as part of the study plan discussed above). The primary mechanism for iterating on blast plans, based on the results of previous blasting, is the overbreak that is evaluated after each round.

As part of resolution of related DR YM-96-D-075, the A/E is evaluating the existing blasting specification controls for possible clarification. This review should provide additional assurance that adequate limits or acceptance criteria exist to limit adverse impacts, and that no additional deficient condition exists.

Interoffice Correspondence
Civilian Radioactive Waste Management System
Management & Operating Contractor



TRW Environmental
Safety Systems Inc.

WBS: 1.2.3
QA: N/A

Subject
Documentation of
Coordination Between Test
Interference and Principal
Investigators for Blasting of the
Thermal Test Alcove
(SCPB: N/A)

Date
July 18 1996
LV.SPO.JDA.7/96-445

From
J. D. Agnew

To
L. R. Hayes

cc
P. S. Hastings
R. P. Ruth
R. M. Sandifer
C. T. Statton
LVRPC

Location/Phone
TES3/BOA227
702-295-9696

Test Interference Evaluations (TIEs) are performed for the purpose of determining whether unforeseen impacts may occur to ongoing or planned scientific tests as a result of construction activities or other nearby scientific test activities. It is not the intention of the TIE to prevent or eliminate all possibility of adverse impacts, but only to determine whether tests may be impacted in "an unpredictable or undetectable way" (per NLP-2-0). Determination of Importance Evaluation (DIE) Controls are recommended when it appears that tests may be altered in unknown ways. However, no DIE control will absolutely prevent testing impacts.

In some cases, new construction or scientific testing will interfere in a known way with an ongoing or planned test. These known interferences are noted in the associated DIE and can be accounted for within the scientific testing community, either by avoiding the area in question, or by adjusting the data to account for a known change to the natural environment. For example, one DIE control mandates that blasting times and poundages be recorded so that blasts are not misidentified as earthquakes by the seismic monitoring subcontractor (UNR/SL). By mandating that records be kept of each blast, we ensure that test impacts are neither unpredictable nor undetectable (per NLP-2-0).

Whenever a Test Interference is performed, the Principal Investigators (PIs) most likely to be affected by a construction or testing activity are notified of the impending activity, and asked whether they have any concerns regarding adverse impacts to their tests. These communications typically consist of a telephone call or an e-mail message (or both) from the Test Interference Evaluator to the PI, or from the TIE to the SPO Technical Leads (or both). For the above alcove blasting, the PIs contacted include, but may not be limited to, June Fabryka-Martin (LANL) for evaluation of adverse impacts to Chlorine-36 studies underground, Jim Brune (UNR/SL) for evaluation of impact to the seismic monitoring of the Yucca Mountain area, and to all the SPO technical leads, who in turn may contact their respective PIs if

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they feel that it may be warranted. All PIs contacted indicated that either 1) there were no test interference concerns, 2) they could account for any adverse impacts by avoiding sampling in the immediate area, or 3) they could account for spurious events by checking the blast records.

If a PI is concerned about an impending test or construction activity, this information is related to the DIE Group, which incorporate controls, if deemed necessary, to minimize adverse impact to a test. We do not generally file documentation of non-impacts.

It appears that the draft CAR is saying that the test interference evaluation and subsequent DIE should account for and prevent impacts which are easily observed in the field, such as wall-rock damage. This is not the purpose of TIE/DIEs, and in fact, the PIs can (and do) account for and correct for this type of obvious testing impact. For example, if wall rock is damaged, testing boreholes can be drilled slightly deeper into pristine wall rock, or the damaged rock can be removed by mechanical means, if necessary.

The potentially affected PIs (including those involved in thermal and permeability studies) and the SPO Technical Leads were recontacted on 7/16/96 to determine whether, in their opinion, any test interference had occurred as a result of the blasting in the thermal test alcove. No PI expressed the opinion that the above alcove blasting irreparably damaged his/her ability to conduct a scientific test, or even that test interference occurred (known or unknown).

The SPO Technical Leads for Permeability Studies (Roger Henning) and for Thermal Studies (Robin Datta) were asked to contact their respective PIs to determine whether test interference had occurred, with the following results:

Permeability Studies (Roger Henning, SPO Technical Lead for Hydrology)

Roger Henning related that no USGS permeability studies are planned for the Thermal Test Alcove.

However, other testing alcoves were constructed by drill & blast, so the USGS Permeability Studies PIs were questioned as to whether test interference could have occurred in these other alcoves. Gary LeCain, USGS PI for UZ Hydraulics Studies, never expressed any concerns about the excavation methods, even though he was aware of the planned excavation method and was supplied with the field work program plans in advance. Dr. LeCain said that he had thought about it, but concluded that blasting was not a concern. By either method, drill & blast or mechanical mining, the nature of the natural fractures requires that plans provide a "setoff" from the alcove wall of about 30 meters by drilling test holes into pristine rock, so the type of excavation method was not of concern to him.

Dr. Gary Patterson, USGS PI for UZ Geochemistry, also never expressed any concerns with the excavation method, even though he was aware of the plans to drill & blast and was provided with the field work program plans in advance. Some of the earlier testing by Charlie Peters were inconclusive as to whether test interference had occurred, but showed that there was no discernable adverse impact from

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the drill & blast excavation method. The results of current testing in Alcove #2 (mined by drill & blast) show no discernable impact. Dr. Patterson stressed that they had never seen any definite adverse effects from blasting in any of the alcoves. Although it has not been proven that there was no effect, they had not seen any effects to date. He related that it would take a rather expensive testing program to determine whether test interference had occurred as a result of blasting, but they did not have the money or workscope to perform them, and they were not in a position to perform those tests anyway, due to other commitments in completing the FY96 Summary Reports and Ghost Dance fault testing in late FY96 and FY97.

Dr. Larry Anna, USGS PI for Fracture Mapping and Modeling, does not have any workscope or funding to perform fracture mapping in the alcoves - he is restricted to the main ESF tunnel for his studies, and as such, had no test interference concerns with the drill & blast method in the alcoves.

Thermal Testing (Robin Datta, SPO Technical Lead for Thermal Testing)

Refer to enclosure 1 for the Thermal Testing discussion.

We therefore must conclude that the original list of DIE controls was sufficient to prevent test interference impacts from blasting in the thermal test alcove (and in the other alcoves), and that additional QA controls are not warranted at this time. If, in the future, a PI expresses concern about the drill & blast method, we would be happy to reexamine our test interference evaluation.

If a more formal response is needed from the PIs, please have Ken Skipper formally request our response from the PIs, because they are all very busy working on deliverables that are due by September 30, 1996. If the PIs are pulled off working on their deliverables, some of these deliverables may be delayed.

JDA/kb

Enclosure:

IOC: LV.SPO.RND.7/96-446, R. N. Datta to File, dtd 7/18/96, Drill and Blast Excavation of the Thermal Test Facility

WBS: 1.2.3.14.2
QA: L

Subject
Drill and Blast Excavation of
the Thermal Testing Facility
(SCPB: N/A)

Date
July 18, 1996
LV.SPO.RND.7/96-446

From
R. N. Datta

To
File

cc
See Below

Location/Phone
TES3/BOA230
702-794-7565

In this note the "immediate vicinity" of an opening is defined as the zone around it whose thickness perpendicular to the wall of the opening is approximately one-half its diameter.

The thermal testing facility and the test blocks for both the single heater test and the drift scale test will be located entirely in the crystal poor middle non-lithophysal lithologic unit (tptpmn) of the Topopah Spring member. This is the uppermost of the three lithologic units of which the thermomechanical unit, TSw2 - the proposed repository horizon - is comprised.

The proposed repository horizon, TSw2 is moderately to densely welded volcanic tuff and is highly fractured. Analyses of data from pre-SCP surface mapping and core logging estimate the volumetric fracture frequency in TSw2 to be 19.6 fractures per cubic meter (Reference 1). Mapping in the ESF main drift which is in the middle non-lithophysal (tptpmn) lithologic unit, also indicate that this subunit of TSw2 is highly fractured. The average number of fractures as measured by line survey in the ESF is 3.3 fractures per meter in tptpmn (Reference 2). Visual observation as well as mapping in the thermal testing facility also bear this out.

Examination of the video logs of the 27 or so holes drilled in the 650 cubic meter single heater test block (which was created by mechanically excavated openings) and pneumatic measurements of bulk permeability in these holes show that not only is the rock in the thermal test facility fractured but the fractures and fracture permeability are randomly distributed.

The extent of the zone, around an opening in rock described as above, in which the rock mass thermal, mechanical and hydrological properties are appreciably altered by drill and blast excavation of the opening, is conservatively estimated to be limited to the "immediate vicinity". The degree of alteration will rapidly diminish as the distance into the rib from the wall of the opening increases. The reduction in rock mass deformability as measured by the "petite seismique" technique in fractured rock was less than 20% (Reference 3).

Incidentally, the volume of rock in the drift scale test in which the observable effects of the heat-driven processes take place will extend over at least four diameters around the drift.

In the context of the above and the nature and role of the ESF thermal tests as well as the manner in which their results will be utilized as outlined in Attachment 1, excavation of the heated drift for the drift scale test by mechanical method is considered desirable but not required. Excavation of this drift by drill & blast method is not thought to adversely impact the thermal test results so as to jeopardize their ultimate utility. Drill & blast excavation of the access/observation drift started at station 0+85.9 is not considered to adversely affect the single heater test which is located at approximately station 0+40.

Reference 1: Lin, M., M. P. Hardy, S. J. Bauer; "Fracture Analysis and Rock Quality Designation Estimation for Yucca Mountain Site Characterization Project"; SAND92-0449, February 1993.

Reference 2: Stroud, S. W., D. S. Sweetkind, J. Coe; "Characteristics of Fractures at Yucca Mountain", U.S. Geological Survey FY96 Level 3 Deliverable # 3GGF205M.

Reference 3: Bieniawski, Z.T; "The 'Petite Seismique' Technique - A Review of Current Developments in the proceedings of the Second Conference on Acoustic Emission/Microseismic Activity in Geologic Structures and Materials" - The Pennsylvania State University, November 13-15, 1978. Publisher: Trans Tech Publications, Clausthal, Germany.

RND/kb

Attachment:

Nature and Role of ESF Thermal Tests

cc:

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ATTACHMENT I

Nature and Role of ESF Thermal Tests

In the broadest sense the objective of the ESF thermal tests is to generate a base of "site-specific" observed data which can be utilized to build confidence in the various conceptual models representing heat-driven nearfield processes. The processes of concern are thermal, mechanical, hydrological and chemical. In the rock surrounding the emplacement drifts, these processes are intensified by the heat from the emplaced waste. The utility of the conceptual models of the nearfield processes and hence, that of the ESF thermal tests are in confirming/refining the nearfield transport models which in turn provide the source term for the TSPA calculations.

In the repository, the nearfield processes occur in various scales, both spatial and temporal, in an open system. By definition, the ESF thermal tests can not replicate all the nearfield processes nor can they replicate any one process in all aspects of scale. These are not "closed system" tests conducted in a man-made facility under fully controlled conditions so that the use of the results in resolving one or two issues can not be questioned. These are large scale "open system" tests in which observable effects of heat on a natural system are measured over extended periods of time. The measurements are made before heating starts and the relative changes in the observable effects are measured frequently as heat is applied and withdrawn.

Also, the results of the ESF thermal tests will be utilized in an existing knowledge base in conjunction with the results of many other tests and studies. There is virtually no heat-driven process related issue which will be or is planned to be resolved exclusively on the basis of any aspect or aspects of the ESF thermal test results by themselves.

The heating and cooling phases of the drift scale test will span over five or six years or more. From time to time (every six months or so) the results of the test will be analyzed and evaluated against results predicted *a priori*. Such evaluations will enable corrections or adjustments or refinements to be made to the conceptual models on the basis of which the *a priori* predictions were made. The adjusted/refined models will then be exercised to predict the results at the next point of time when another analysis of the results is planned. The next analyses of results and evaluation against the relevant predictions will lead to another round of refinement to the conceptual models. This predictive-corrective process is expected to eventually lead to convergence of the conceptual models and a high degree of confidence in them.

In the above iterative process, the interpretive data analyses are performed synergistically with then current body of knowledge in its totality derived from a variety of sources such as laboratory testing, analog studies, previous in situ thermal tests, modeling analyses and knowledge of established physical phenomena. One of the many challenges of the interpretive analyses is to appropriately take into account the multitude of conditions prevailing in the ESF test.

memorandum

LA-EES-13-LV-07-96-014
Page 1 of 1

July 16, 1996
702/794-7828
MS 527

TO: EES-13/LV File

FROM: T. Brake, EES-13/LV *TJ Brake*

SUBJECT: REAFFIRMATION OF AFFECTED PRINCIPAL INVESTIGATORS
UNCONCERN ABOUT THE EFFECTS OF DRILLING AND BLASTING
ACTIVITIES WITHIN THE THERMAL TESTING FACILITY

- REFERENCE: 1. LETTER, ELKINS TO DISTRIBUTION, "STRATEGY FOR
CONTROLLED BLASTING AND BLAST MONITORING IN THE
THERMAL TEST ALCOVE - TRW-1996-1362", LA-EES-13-LV-
02-96-005, DATED FEBRUARY 21, 1996
2. YMP RECORD OF VERBAL COMMUNICATION, WEAVER TO OLIVER,
DISCUSSIONS WITH SITE PROGRAM MANAGERS AND PRINCIPAL
INVESTIGATORS ABOUT DRILL AND BLAST OPERATIONS IN
THERMAL TEST FACILITY, DATED FEBRUARY 22, 1996

Principal Investigators (PIs) involved with testing activities and studies to be carried out within the Thermal Testing Facility (TTF) have responded verbally to the drill and blast (D&B) strategies (Reference 1) and queries (Reference 2) early in the development of TTF construction planning. In addition, a recurring dialogue has been maintained with the Test Lead (Robin Datta) and PIs over the intermediate time period and no further concerns about planned or ongoing D&B have been forthcoming.

The PIs know that blast records, including blast plans, blast patterns, type and quantity of explosives, time and locations, are retained as Quality Assurance records and acknowledge that this data, if necessary, may be utilized in preparing their respective test procedures and prorated in the interpretation of data from test results.

TLB:bm05

Cy: J. Skov, CRWMS M&O, MS 423
R. Oliver, EES-13/LV, MS 527
EES-13/LV, MS 527 (1)
RPC/LV, MS 527 (2)

OFFICE OF CIVILIAN
RADIOACTIVE WASTE MANAGEMENT
U.S. DEPARTMENT OF ENERGY
WASHINGTON, D.C.

8 Performance Report
 Deficiency Report

NO. YM-96-D-072

PAGE _____ OF _____

QA: L

PR/DR CONTINUATION PAGE

JUSTIFICATION FOR VOIDING FOR DR YM-96-D-072

At the time this deficiency was issued, it was not clear (indeterminate) that measurement of PPV associated with blasting was a quality activity and that blasting could cause interference of proposed testing.

The following documents were reviewed:

- 1) response, TRW letter, LV.SED.JMS.08/96-072
- 2) Interoffice Correspondence LV.SPO.DDP.01/97-009 and LV.SPO.PP.DDP.01/97-010

These documents clarified that:

- 1) PPV is only used as a tool to monitoring performance of blasting from a cost and schedule point of view and not from an acceptance criteria for test interference or waste isolation ie; creation of potential preferential aqueous pathways.
- 2) Testing would be conducted well beyond the area affected by blasting.

Based on the results of the above review it has been determined that an adverse condition does not exist and this DR is void.



P. H. Cotter, QAR

2/12/97
Date