

*rec'd user letter
Dtd. 9/21/93*

**TRW Environmental
Safety Systems Inc.**

101 Convention Center Drive, Suite 540
Las Vegas, NV 89109
702.794.1800

Civilian Radioactive Waste Management System
Management and Operating Contractor

**Contract #: DE-AC01-91RW00134
LV.SC.BWD.8/92-103**

Erosion Rates at Yucca Mountain

**Technical Assessment
Qualification of Data**

August 31, 1992

102.8

9303110103 930224
PDR WASTE
WM-11 PDR



**RW Environmental
Safety Systems Inc.**

101 Convention Center Drive, Suite P 110
Las Vegas, NV 89109
702.794.1800

**WBS: 1.2.5.2.4
QA: QA**

October 8, 1992

**Contract #: DE-AC01-91RW00134
LV.SC.BWD.10/92-099**

**Carl P. Gertz, Project Manager
U. S. Department of Energy
Yucca Mountain Site Characterization Project Office
P. O. Box 98608
Las Vegas, NV 89193-8608**

Attention: J. Russell Dyer

**Subject: Technical Assessment Report for the Qualification
of Data for the Erosion Rates at Yucca Mountain**

A Technical Assessment Report has been completed qualifying data under DOE's QARD, Rev. 3 requirements for data developed prior to NRC's acceptance of DOE's Quality Assurance Program. This data is the basis for the determination of erosion rates on Yucca Mountain.

This Technical Assessment, performed in accordance with QMP-02-08, Rev. 1, has provided YMPO with the recommendation that this data should be accepted as qualified under the DOE's QARD, Rev. 3 requirements.

Please address any questions to Tom Statton at (702) 794-1830, or Bill Distel at (702) 794-1827.

Sincerely,

**L. Dale Foust, Manager, Nevada Site
Technical Project Officer
Management and Operating Contractor**

Enclosure: Technical Assessment Report

October 8, 1992
LV.SC.BWD.10/92-099
Page Two

cc:

M. B. Blanchard, DOE/YMP, Las Vegas, NV
S. B. Jones, DOE/YMP, Las Vegas, NV
T. W. Bjerstedt, DOE/YMP, Las Vegas, NV
J. A. Canepa, LANL, Los Alamos, NM
L. R. Hayes, USGS, Denver, CO
M. A. Lugo, M&O/TRW, Las Vegas, NV
E. M. Weaver, M&O/Duke, Las Vegas, NV
M. A. Haghi, M&O/Duke, Vienna, VA

BWD/CTS/kcb

TRW Environmental
Safety Systems Inc.

101 Convention Center Drive, Suite 540
Las Vegas, NV 89109
702.794.1800

TRW

WBS: 1.2.5.2.4
QA: N/A

February 22, 1993

Contract #: DE-AC01-91RW00134
LV.SC.BWD.2/93-053

J. Russell Dyer, Director
Regulatory & Site Evaluation Division
U. S. Department of Energy
Yucca Mountain Site Characterization Project Office
P. O. Box 98608
Las Vegas, NV 89193-8608

Subject: Correction to Letter {LV.SC.BWD.10/92-099}, Foust to Gertz,
October 8, 1992, Technical Assessment Report for the
Qualification of Data for the Erosion Rates at Yucca Mountain

The above referenced letter contained an error as to the correct
QARD revision in effect at that time. QARD Rev. 3 was
identified as the revision the Technical Assessment was performed
under. That is incorrect, the Technical Assessment Report was
performed under QARD Rev. 4.

Please address any questions to me at (702) 794-1830 or Bill
Distel at (702) 794-1827.

Sincerely,



C. Thomas Statton, Manager
Site Characterization
Management and Operating Contractor

cc: M. B. Blanchard, DOE/YMP, Las Vegas, NV
T. W. Bjerstedt, DOE/YMP, Las Vegas, NV
J. A. Canepa, LANL, Los Alamos, NM
L. D. Foust, M&O/TRW, Las Vegas, NV
C. P. Gertz, DOE/YMP, Las Vegas, NV
M. A. Haghi, M&O/Duke, Vienna, VA
L. R. Hayes, USGS, Denver, CO
S. B. Jones, DOE/YMP, Las Vegas, NV
M. A. Lugo, M&O/TRW, Las Vegas, NV
H. C. Stafford, M&O/TRW, Las Vegas, NV
E. M. Weaver, M&O/Duke, Las Vegas, NV

BWD/kcb

**CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM
MANAGEMENT AND OPERATING CONTRACTOR**

To: J. Russell Dyer, Director
Regulatory & Site Evaluation Division
Yucca Mountain Site Characterization Project Office
U. S. Department of Energy

Date: August 31, 1992

M&O Program: Technical Assessment
Qualification of Technical Data Collected and Evaluated Prior
to NRC Acceptance of YMPO Quality Assurance Program.

Submitted by: B. William Distel B. William Distel 8/31/92
Technical Assessment Chairperson date
(702) 794-1827

M&O Review

Martie W. Pendleton 9/7/92
Technical Reviewer Date

W. J. Leonard 9/8/92
Technical Reviewer Date

Approved:

C. Thomas Statton 14 Sept '92
C. Thomas Statton, M&O Site Characterization Manager Date

This Technical Assessment has been done in accordance with YMPO
QMP-02-08, and M&O Procedure QAP-3-5.

TABLE OF CONTENTS

Section	Page
Executive Summary	ii-iv
Technical Assessment Summary and Conclusions for Qualification of Data - Extreme Erosion	1-15
Technical Assessment Notices, Rev. 0 and Rev. 1	Attachment I
Technical Assessment Team Members and their Qualifications	Attachment II
Technical Assessment Communications	Attachment III
Technical Assessment Team Member Comments - Phase I	Attachment IV
Technical Assessment Team Member Review of Scientific Notebooks - Phase II	Attachment V
LANL 1989 VCR Peer Review Report	Attachment VI

EXECUTIVE SUMMARY

Data Qualification of Existing Data for Erosion

The Erosion Data has been subjected to technical assessment to establish that: Equivalent QA existed during data gathering and evaluation, that corroborative data exists to substantiate the Erosion Data, and that an independent Peer Review of leading geomorphologists has examined the varnish cation-ratio age dating process used by the Principal Investigators on erosion at Yucca Mountain and find it the best technique currently available.

The Nuclear Regulatory Commission (NRC) published NUREG-1298 (Generic Technical Position on Qualification of Existing Data for High-Level Waste Repositories) to provide guidance to the DOE regarding the process by which existing data should be qualified to meet the requirements of 10 CFR 60, Subpart G. DOE has implemented Administrative Procedure 5.9Q (Qualification of Data or Data Analyses Not Developed Under the Yucca Mountain Project Quality Assurance Plan) to allow a qualification process for Project data gathered prior to the NRC's acceptance of Yucca Mountain Project Office's (YMPO) Quality Assurance Requirements Document (QARD) guidelines.

A Technical Exchange was held on May 27, 1992 between DOE, and the NRC to present the technical basis for a DOE Topical Report (TR) on Erosion. In line with DOE issuing a TR, this Technical Assessment has been conducted to demonstrate the QA acceptability of Erosion Data.

This Technical Assessment was completed in accordance with Yucca Mountain Project Office (YMPO) Quality Management Procedure (QMP) 02-08, Rev. 1 and with YMPO Administrative Procedure (AP) 5.9Q, Rev. 1, Sections 4.5, 5.3.2.1, and 5.3.2.5. Just prior to summarization of this Technical Assessment, AP 5.9Q, Rev. 2 has been implemented. AP 5.9Q, Rev. 2 was being developed during the Assessment period, and was actually a result of working with Rev. 1 and NUREG-1298 in the Assessment effort. The Technical Assessment method is consistent with Rev. 2 requirements, as well as the requirements of Rev. 1.

This Technical Assessment, and all directly related Technical and QA Procedures, TATM qualifications, correspondence, Assessment results, the LANL Independent Peer Panel Review, and the Technical Assessment Notice, Rev. 0 and Rev. 1 have been entered in the YMPO Records Information System.

TECHNICAL ASSESSMENT RESULTS

This Technical Assessment was conducted in two (2) phases. Phase one consisted of having the Technical Assessment Team Members (TATM) review Technical and QA Procedures in-place for the U. S. Geological Survey (USGS), and Los Alamos National Laboratory (LANL) guiding sample collecting and analysis, and field measurements against current Technical and QA Procedures for the USGS and LANL which control field and laboratory processes today. The second Phase of this Technical Assessment verified that the Scientific Notebooks showing field work and laboratory work conformed to, and followed those relevant Procedures in-place during the time the Notebooks were developed.

The Technical Assessment Team consisted of:

Dr. John C. Dohrenwend
U. S. Geological Survey
Menlo Park, California

Dr. Peter W. Birkeland
University of Colorado
Boulder, Colorado

August C. Matthusen
SAIC
Las Vegas, Nevada

Jeff McCleary
Woodward-Clyde Federal Services
Moab, Utah

B. Robert Justice
Duke Engineering & Services, Inc.
CRWMS/Management and Operating Contractor
Las Vegas, Nevada

These Team Members were chosen based on their professional standing in the geomorphological field and/or their expertise in High Level Waste Site Characterization work. None of these people have worked within the Erosion Study Program on Yucca Mountain except as independent reviewers of specific portions of the Study.

Conclusions and Recommendations

The Technical Assessment Team has compared current and previous QA and Technical Procedures that control erosion samples collection and analyses, and field measurements for erosion. In addition, field and laboratory notebooks of the Principal Investigators (Dr.'s Whitney and Harrington) were examined and compared to these Procedures.

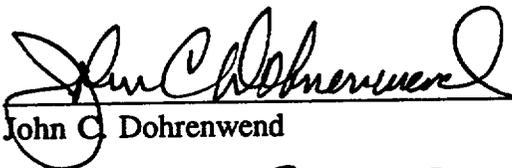
Conclusion

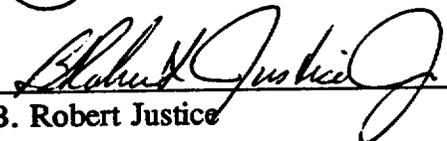
It is unanimously agreed by all five Technical Assessment Team Members that data collection and evaluation completed prior to NRC acceptance of the YMPO Quality Assurance Program can be qualified under current YMPO QARD requirements.

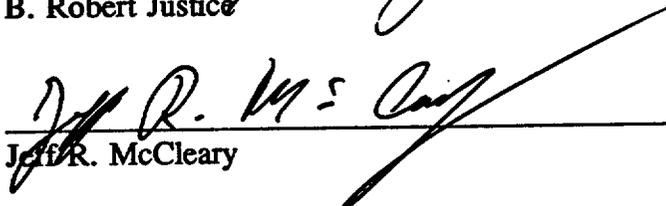
Recommendation

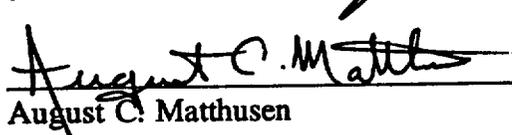
The Technical Assessment Team does recommend to DOE YMPO that the technical data on Erosion be formally accepted as qualified under current YMPO QARD, Rev. 4 guidelines.


Peter W. Birkeland 11/19/92
Date


John C. Dohrenwend 11/19/92
Date


B. Robert Justice 10/2/92
Date


Jeff R. McCleary 9/17/92
Date


August C. Matthusen 9/11/92
Date

TECHNICAL ASSESSMENT

Qualification of Technical Data - Extreme Erosion

INTRODUCTION

On May 1, 1992, the Regulatory & Site Evaluation Division (RSED) of the Department of Energy (DOE) Yucca Mountain Project Office (YMPO) initiated a Technical Assessment to evaluate the ability of DOE to accept as "Qualified" the technical data on extreme erosion. This data was collected and evaluated prior to NRC acceptance of the YMPO Quality Assurance Program. The scope of the Technical Assessment has been to evaluate the Quality Assurance (QA) and Technical Procedures guiding sample collecting and analysis, and field measurements against current procedures in-place for the U. S. Geological Survey (USGS) and Los Alamos National Laboratory (LANL), under the DOE Quality Assurance Requirements Document (QARD) acceptable to the Nuclear Regulatory Commission (NRC).

In accordance with YMPO Administrative Procedure (AP) 5.9Q, Rev. 1, Section 4.5, this Technical Assessment has been carried out to provide review and evaluation of the data and data analyses in line with AP-5.9Q, Rev. 1, Sections, 5.3.2.1 and 5.3.2.5. AP-5.9Q, Rev. 2 has been implemented soon after this Technical Assessment was completed. AP-5.9Q, Rev. 2 was in development during the Assessment period, and was a result of working with AP-5.9Q, Rev. 1 and NUREG 1298 in the Assessment effort. The Assessment method is consistent with AP-5.9Q, Rev. 2 requirements. This Technical Assessment has been done in accordance with YMPO Quality Management Procedure (QMP) 02-08, Rev. 1, to establish technical merit.

The Technical Assessment Notices, Revision 0 and Revision 1, are included as Attachment I. The Technical Assessment Team (TAT) initially consisted of four (4) members, then was expanded on June 12, 1992, to include one additional member. These TAT members are identified in Attachment II, as are their qualifications to perform this Technical Assessment.

Communications between the Technical Assessment Chairperson (TAC) and the Technical Assessment Team Members, (TATM) are included in Attachment III, as are the initial comments by TAT Members.

This Technical Assessment has been conducted in two (2) phases. Phase I consisted of having the TATM review the Procedures described above in the first Paragraph. As a result of the Phase I evaluation, a second Phase was initiated during which two members of the TAT visited the Principal Investigators for the Erosion studies on the Yucca Mountain Site, Dr. Whitney (USGS), and Dr. Harrington (LANL) at their respective offices. These visits were for the purpose of examining field and laboratory scientific notebooks, and interviewing Dr. Whitney and Dr. Harrington.

SUMMARY - PHASE I

The Technical Assessment Notices of May 1, 1992, and June 22, 1992 asked the TATM to evaluate the QA and Technical Procedures in-place in the U. S. Geological Survey (USGS), and Los Alamos National Laboratory (LANL), during the time that sample collection, analysis, and field measurements were performed. These were compared against procedures currently in place at the USGS and LANL under the DOE QARD guidelines. The purpose was to examine any differences between these procedures in order to answer the following questions:

- Would data collection and evaluation under current Participant technical procedures differ from those procedures actually followed?
- Are any differences significant enough to affect technical results?
- Can a recommendation be made to DOE YMPO that the procedures used to gather and evaluate samples, and guide field measurements are acceptable to allow the technical data to be qualified under current QARD guidelines?

This Assessment has been conducted in line with the Instructions for Assessment included in Attachment I.

ASSESSMENTS

Dr. John C. Dohrenwend
U. S. Geological Survey
Menlo Park, California

I have examined the differences between those procedures that were in place during collection and evaluation of samples for rock varnish analysis (for the purpose of assessing extreme erosion as an issue at Yucca Mountain) and current procedures under the DOE QARD that are applicable to such collection and evaluation activities. As a result of this examination, I have reached the following conclusions:

- *Current sample collection and evaluation procedures are nearly the same as the procedures actually followed during sample collection and evaluation.*
- *None of the procedural differences that do exist are significant enough to affect the technical results of the extreme erosion study.*
- *Therefore, a recommendation can be made to DOE YMPO that the procedures used to collect and evaluate samples are acceptable and that the technical data pertaining to the extreme erosion study should be qualified under current QARD guidelines.*

Dr. Peter W. Birkeland
University of Colorado
Boulder, Colorado

In summary, in answer to the three questions posed:

- *I think the sample collection and evaluation was not significantly different under both procedures.*
- *The differences are not significant enough to effect technical results.*
- *I recommend that the procedures used to gather and evaluate samples are acceptable to allow the technical data to be qualified under current QARD guidelines.*

I should add, however, that it is very difficult to make these judgements without knowing the kind of data that were collected. It would help to see the report that resulted from the field work, or lab work.

The rest of Dr. Birkeland's assessment is contained in Attachment IV.

August C. Matthusen
SAIC
Las Vegas, Nevada

- *From the procedures reviewed, it is not possible to determine if the technical results would differ from the results that were determined. The procedures reviewed govern mainly the documentation of results and not the gathering and analysis processes.*
- *(Requires verification of technical data to reviewed procedures).*
- *There do not appear to be any valid reasons why any of these data can not be qualified under current QARD guidelines.*

The rest of Mr. Matthusen's assessment on equivalent QA is contained in Attachment IV. Resolution of Mr. Matthusen's comments are addressed further into this Summary Report on pages 6-7.

Jeff McCleary
Woodward-Clyde Federal Services
Moab, Utah

- *In summary, based on the information provided, because of the unknown criteria for sample collection prior to 5/1/87 it is possible that technical results could differ if current procedures were followed. Similarly, potential shipping damage should be considered in accepting the technical results. I feel that if recommendations 1 and 2 are followed these issues can be resolved.*

Recommendations

1. *The LANL notebooks developed under the R and D procedures should be reviewed in order to determine how samples were selected in the field prior to 5/1/87. If it can be shown that the same criteria for site and sample selection were followed*

prior to 5/1/89, as after the sample collection procedure for rock varnish studies was issued, then all samples can be considered valid.

2. *All samples shipped should be examined for abrasion or other shipping damage to the varnish surface. If all samples show an intact varnish surface they can be considered valid.*

The rest of Mr. McCleary's assessment on equivalent QA is contained in Attachment IV. Resolution of Mr. McCleary's comments are addressed further into this Summary Report on pages 7-10.

B. Robert Justice
CRWMS Management & Operating Contractor
Las Vegas, Nevada

- *Would sample collection and evaluation under current participant technical procedures differ from those procedures actually followed?*

Response - Inconclusive in that procedures for collection did not exist until 5/1/87 and until 5/3/88 did not adequately address the handling of samples. The guidelines for determining collection areas were less restrictive than current requirements and could have led to samples being collected from areas which may be unsuitable under current procedures. Additionally, there is no evidence of procedural guidelines for conducting the rock varnish for erosion analysis.

- *Are there any differences significant enough to affect technical results?*

Response - Yes, in the area of handling the samples once they were collected. There was not any specific guidelines provided for the handling of samples until 5/3/88 when change Request #29 to procedure TWS-ESS-DP-114, Rev. 0 became effective. Also, the lack of procedural processes for the collection and analysis of samples raises questions with respect to what processes were actually used and the consistency with which those processes were repeated.

- *A recommendation to accept the data based on the procedures provided for this assessment cannot be made. The obvious lack of procedural guidance in the early stages of this activity supports this conclusion. Other evidence may be available to support the processes used to accomplish the collection and analysis of samples. The notebooks, which have been used throughout this activity to document the work that was performed, may contain enough information to identify the processes used and the consistency with which they were repeated.*

The rest of Mr. Justice's assessment on equivalent QA is contained in Attachment IV. Resolution of Mr. Justice's comments are addressed further into this Summary Report on pages 10-14.

After evaluating the TATM Phase I comments (excerpted above and provided in full in Attachment IV), it was apparent that:

- a. All of the TAT Members recognized that the two sets of procedures (those prior to DOE QARD guidelines, and those after) provided to them for evaluation are very similar.
- b. Mr.'s McCleary and Justice recognized that samples were collected prior to 5/1/87 before the initial sample collection procedure became effective. Handling and shipping controls were not well addressed before 5/3/88.
- c. Mr.'s Matthusen, McCleary, Justice, and Dr. Birkeland, all commented that it would be desirable to see data and results (i.e. field and laboratory notebooks) in order to compare data entries to the reviewed procedures.

SUMMARY - PHASE II

In order to resolve the concerns and questions identified in the Phase I procedures review, the following assignments were given to Mr. McCleary and Mr. Matthusen of the TATM:

Mr. McCleary went to interview Dr. Whitney at the USGS offices in Denver on July 14, 1992, and examine his field notebooks relating to the erosion studies, particularly those sections on sampling for cation ratio dating of desert varnish.

Mr. Matthusen went to interview Dr. Harrington at the LANL offices in Albuquerque on July 14, 1992, and examine his field and laboratory notebooks.

The results of these examinations were quite positive. Mr. McCleary concluded "... it is my opinion that cation-ratio dating of desert varnish can be used to support the Project position on erosion rates at Yucca Mountain."

Mr. Matthusen has stated "The procedures (which includes the methodology reflected in field and laboratory notebooks) for gathering and evaluating samples, and the documentation of the gathering and evaluation of samples, allow the data to be qualified."

The full text of Mr.'s McCleary's and Matthusen's observations and evaluations are in Attachment V.

In the following Section, point by point resolutions are provided for each TATM comment.

RESOLUTION OF ASSESSMENT COMMENTS

Dr. John C. Dohrenwend

Dr. Dohrenwend has answered the three questions posed by the Technical Assessment in recommending "to DOE YMPO that the procedures used to collect and evaluate samples are acceptable and that the technical data pertaining to the extreme erosion study should be qualified . . .".

Dr. Peter W. Birkeland

Dr. Birkeland has also recommended that the technical data pertaining to the extreme erosion study should be qualified. Dr. Birkeland's one concern was the kind of data (samples) that were collected, and the results (documentation) of field work, or lab work. Mr. McCleary and Mr. Matthusen have resolved Dr. Birkeland's concern by inspecting the scientific field and laboratory notebooks.

August C. Matthusen

First Comment:

- *From the procedures reviewed, it is not possible to determine if the technical results would differ from the results that were determined. The procedures reviewed govern mainly the documentation of results and not the gathering and analysis process.*

Resolution of Mr. Matthusen's comment is addressed in the verification of data to procedures which was carried out by Mr. Matthusen, at LANL and Mr. McCleary, at the USGS, subsequent to the Procedures Assessment.

Proposed Resolution - Mr. Matthusen:

Additionally, the purpose of the Technical Assessment Notice requested that I assess three questions. These are assessed as follows:

Would sample collection and evaluation under current participant technical procedures differ from those procedures actually followed?

No, they would not differ.

Are any differences significant enough to affect technical results?

No, there are not significant differences.

Can a recommendation be made to DOE YMPO that the procedures used to gather and evaluate samples are acceptable to allow the technical data to be qualified under current QARD guidelines?

Yes. The procedures for gathering and evaluating samples and the documentation of the gathering and evaluation of samples allow the data to be qualified. The documentation of sample and data collection would allow a knowledgeable person to retrace the investigation and confirm the results. The same documentation would allow a peer of Dr. Harrington to repeat the investigation and achieve comparable results without recourse to Dr. Harrington. From my review of the documentation I recommend that the data be accepted.

The rest of Mr. Matthusen's verification report is contained in Attachment V.

Proposed Resolution - Mr McCleary:

Based on the above observations of the procedures and notebooks and my discussions with John Whitney, it is my opinion that if the early sampling were repeated under current procedures, the results would not be significantly different.

It is also worth noting that the early samples collected by the USGS alone have, in general, yielded age estimates that are younger than average. Therefore, eliminating the use of these samples would only support older deposits and slower erosion rates, a less conservative position relative to the regulations. In addition the overall argument on erosion rates does not hinge on the cation-ratio dating technique. U-series, U-trend, Cl-36, and tephrochronology studies were also carried out on early samples collected by the USGS and are in general agreement with the cation-ratio data.

In summary, I have made the following observations:

- *USGS field notebooks document to a reasonable extent that the samples collected early in the study would also have been selected under the 5/1/87 procedure.*
- *Inclusion of the early data produces a slightly more conservative erosion rate relative to the regulations.*
- *Other dating studies carried out to address the erosion issue generally support the results of the desert varnish studies.*

Therefore, it is my opinion that the cation-ratio dating of desert varnish can be used to support the project position on erosion rates at Yucca Mountain. If other assessment team members, or the project, still have concerns, other evaluations can be made with existing information and examination of the samples at LANL.

Resolved: Based on the documentation in the scientific notebooks of the Principal Investigators it is apparent that sample collection and evaluation procedures followed during the investigation were not different from those currently in place. Therefore, technical results would not be significantly different.

Second comment:

- *Requires verification of technical data to reviewed procedures.*

Resolved - This comment has been resolved by the verification of data to procedures by Mr. Matthusen and Mr. McCleary.

Jeff McCleary

First Comment:

- *In summary, based on the information provided, because of the unknown criteria for sample collection prior to 5/1/87 it is possible that technical results could differ if current procedures were followed.*

Proposed Resolution by comparison of field notebooks to procedures provided the following:

Proposed Resolution - Mr. Matthusen:

The documentation materials reviewed include the following:

- *Field Notebooks. Two of Dr. Harrington's field notebooks document samples, sample collection, field sample identification numbers assigned, dates of collection, field personnel, collection rationale, hypotheses, and descriptions of sample collection localities for rock varnish samples for the Yucca Mountain Project. The first notebook (NB1) covered the period from 10/2/85 to 5/13/87. This notebook also included information on rock varnish projects not related to Yucca Mountain. The second field notebook (NB2) covers the period from 1/10/87 to 1990 and includes only Yucca Mountain related information. NB1 contains copies of pages from the field notebook of J. Whitney (USGS) documenting rock varnish sample collection activities in 6/84, 10/85, 11/85, and 7/86. NB1 also contains notes by Dr. Harrington regarding sample collection done in conjunction with J. Whitney for the previously mentioned dates after 10/85. NB2 is more detailed than NB1 and contains more detailed descriptions of samples, sample locations, collection rationales, and hypotheses. Samples and locations recorded in NB1 and NB2 are further documented in a Sample Tracking Notebook and on topographic maps.*
- *Sample Tracking Notebook for rock varnish samples. Samples are recorded with field sample identification number, lab disk identification number (two disks of rock are cut from the field samples and cemented onto a glass slide for use in the scanning electron microscope (SEM) and a new lab disk identification number is assigned to the slide as the field sample identification is often too long to fit on the slide), geologic deposit name, description of sample, and samples are keyed to collection locations documented on topographic maps.*
- *NNWSI Log Book. This notebook documents sample transfers and handlings for the ESS-1 group of Los Alamos National Laboratory from the time period 5/14/86 to 10/2/91. The first entry by Dr. Harrington was 6/3/87. The notebook has been technically reviewed five times between 1/15/88 to 10/2/91.*

Proposed Resolution - Mr McCleary:

The following observations were made:

- *The current procedure requires that samples be collected:*
 - *from stabilized deposits or outcrops*
 - *that exhibit mature varnish development (darker)*

- that avoids cracks, lichens, etc.
- that are not wind abraded or spalled.
- Samples were collected by the USGS (John Whitney) alone in 1984 and by the USGS and LANL jointly in 1985 and later. I therefore concentrated my examination on the 1984 notebooks.
 - The stabilized deposits are well described (slope angle, thickness, etc.) in each case.
 - Varnish maturity is not always described but it is noted often and it is apparent from the notebook as a whole that the intent was to sample darker (more mature) varnish.
 - The physical condition of the sample relative to cracks, lichens, abrasion, etc. was not well described. However, if necessary, the rock samples actually collected could be examined at LANL to determine their physical condition.

Resolved: Documentation available in the field and laboratory notebooks of the Principal Investigators at the USGS and LANL demonstrates that the same sample collection procedures were followed prior to 5/1/87 as after. Therefore, technical results would not be significantly different.

Second Comment:

- *The LANL notebooks developed under the R and D procedures should be reviewed in order to determine how samples were selected in the field prior to 5/1/87. If it can be shown that the same criteria for site and sample collection were followed prior to 5/1/87 as after the "sample collection procedure for rock varnish studies" was issued, then all samples can be considered valid.*

Proposed Resolution has been done by Mr. Matthusen in verifying that samples collected prior to 5/1/87 were selected using the same guidelines as were established in the subsequent sampling procedure.

Proposed Resolution - Mr. Matthusen:

What techniques were used for sample collection?

Discussions with Dr. Harrington elicited that the technique used for sample collection was as described in Harrington and Whitney (1987) and in the Sample Collection Procedure for Rock Varnish Samples (TWS-ESS-DP-114).

Was a procedure followed?

The Sample Collection Procedure for Rock Varnish Samples was implemented in 5/87. Prior to that time the work was being done under the Quality Assurance Procedure for One-time Research and Development Work (TWS-MSTQA-QP-14, R0) implemented in 5/85, and the Research and Development (Experimental) Procedure (TWS-MSTQA-QP-14, R1) implemented in 2/86. These procedures allow development work to be done and documented in notebooks.

Resolved: As noted previously, documentation is available to demonstrate that the same procedures were followed pre and post the 5/1/87 issue date of the sample collection procedure.

Third Comment:

- *All samples shipped should be examined for abrasion or other shipping damage to the varnish surface. If all samples show an intact varnish surface they can be considered valid.*

Proposed Resolution has been done by Mr. Matthusen.

Proposed Resolution - Mr. Matthusen:

- *The SEM samples (the rock disks on slides). These are retained in a locked cabinet in Dr. Harrington's office. The cabinet was opened and I observed the samples. One sample was checked for ID number and the ID number could be tracked to corresponding numbers in notebooks, maps, etc. In discussion, Dr. Harrington indicated that the rock samples from which the disks had been cut are also maintained in storage. Dr. Harrington stated that all rock varnish samples have been hand carried to Los Alamos, so use of the procedure for shipping samples has not been needed.*

Resolved: Observation of the samples and the careful handling of the samples (i.e. all hand carried) demonstrates that the varnish surface is intact and the samples can be considered valid.

B. Robert Justice

First Comment:

1. *Would sample collection and evaluation under current Participant technical procedures differ from those procedures actually followed?*

Response - Inconclusive in that procedures for collection did not exist until 5/1/87. The procedure used for collection (TWS-ESS-DP-114, Rev. 0) from 5/1/87 until 5/3/88 did not adequately address the handling of samples. The guidelines for determining collection areas were less restrictive than current requirements and could have led to samples being collected from areas which may be unsuitable under current procedures. Additionally, there is no evidence of procedural guidelines for conducting the rock varnish for erosion analysis.

Proposed Resolution - August Matthusen

Prior to 1987 LANL and the USGS were evolving defined (specific locations) sample sites, and the analysis process.

The Sample Collection Procedure for Rock Varnish Samples was implemented in 4/87. Prior to that time the work was being done under the Quality Assurance Procedure for One-time Research and Development Work (TWS-MSTQA-QA-14, R0) implemented in 5/85, and the Research and Development (Experimental) Procedure (TWS-MSTQA-QP-14, R1)

implemented in 2/86. These procedures allow development work to be done and documented in notebooks.

1. **Field Notebooks.** Two of Dr. Harrington's field notebooks document samples, sample collection, field sample identification numbers assigned, dates of collection, field personnel, collection rationale, hypotheses, and descriptions of sample collection localities for rock varnish samples for the Yucca Mountain Project. The first notebook (NB1) covered the period from 10/2/85 to 5/13/87. This notebook also included information on rock varnish projects not related to Yucca Mountain. The second field notebook (NB2) covers the period from 1/10/87 to 1990 and includes only Yucca Mountain related information. NB1 contains copies of pages from the field notebook of J. Whitney (USGS) documenting rock varnish sample collection activities in 6/84, 10/85, 11/85, and 7/86. NB1 also contains notes by Dr. Harrington regarding sample collection done in conjunction with J. Whitney for the previously mentioned dates after 10/85. NB2 is more detailed than NB1 and contains more detailed descriptions of samples, sample locations, collection rationales, and hypotheses. Samples and locations are recorded in NB1 and NB2 and further documented in a Sample Tracking Notebook and on topographic maps.
2. **Sample Tracking Notebook for rock varnish samples.** Samples are recorded with field sample identification number, lab disk identification number (two disks of rock are cut from the field samples and cemented onto a glass slide for use in the scanning electron microscope [SEM] and a new lab disk identification number is assigned to the slide as the field sample identification is often too long to fit on the slide), geologic deposit name, description of sample, and samples are keyed to collection locations documented on topographic maps.
3. **NNWSI Log Book.** This notebook documents sample transfers and handlings for the ESS-1 group of Los Alamos National Laboratory from the time period 5/14/86 to 10/2/91. The first entry by Dr. Harrington was 6/3/87. The notebook has been technically reviewed five times between 1/15/88 to 10/2/91.
4. **SEM Notebook Rock Varnish.** Begun in 6/86 to document the SEM and energy dispersive X-ray analyzer (EDAX) work performed on the rock varnish samples. It begins referencing the initial analytic procedure (Harrington and Whitney, in review; later published as Harrington and Whitney, 1987, "Scanning electron microscope method for rock-varnish dating", *Geology*, Vol.15, pp. 967-970) and briefly describing the initial analytic procedure in the notebook. It described specifics of analyses and analytic results. The notebook also documents much additional pertinent information (e.g., on 9/22/86 the SEM machine was moved to a new location, a new run was done with a previously analyzed sample to verify/compare new results to previous analytic results). Therefore, for a new series of runs, an old sample would be re-run to ensure similarity of results. Over the course of the experiment, the experimental methodology was refined. All changes in SEM settings in response to methodological refinements are documented (e.g., on 9/22/86 - the procedure was modified to ascertain penetration for the varnish coating without inclusion of the rock substrate, that is, to ensure that only the varnish is being sampled) and previous samples retested. The notebook has undergone frequent technical review by technical staff from Los Alamos (Carlos, Vaniman, Broxton, Maassen). Thirteen reviews are documented between 7/1/86 to 1/18/91. The last technical entry in this notebook is 1/14/90, it was reviewed

1/18/91, and was closed out 2/10/92. Additionally, the notebook documents changes in the SEM program used to deconvolute the data, hypotheses, changes in hypotheses, problems encountered, investigations pursued to resolve problems, data, and assumptions in methods.

Proposed Resolution - Jeff McCleary

The current procedure requires that samples be collected:

- from stabilized deposits or outcrops
- that exhibit mature varnish development (darker)
- that avoid cracks, lichens, etc.
- That are not wind abraded or spalled.

Samples were collected by the USGS (John Whitney) alone in 1984 and by the USGS and LANL jointly in 1985 and later. I therefore concentrated my examination on the 1984 notebooks.

- The stabilized deposits are well described (slope, angle, thickness, etc.) in each case.
- Varnish maturity is not always described but it is noted often and it is apparent from the notebook as a whole that the intent was to sample darker (more mature) varnish.
- The physical condition of the sample relative to cracks, lichens, abrasion, etc. was not well described. However, if necessary the samples (at LANL) could be examined to determine their physical condition.

Based on the above observations of the procedures and notebooks and my discussions with John Whitney, it is my opinion that if the early sampling were repeated under current procedures, the results would not be significantly different.

It is also worth noting that the early samples collected by the USGS alone have, in general, yielded age estimates that are younger than average. Therefore, eliminating the use of these samples would only support older deposits and slower erosion rates, a less conservative position relative to the regulations. In addition the overall argument on erosion rates does not hinge on the cation-ratio dating technique. U-series, U-trend, Cl-36, and tephrochronology studies were also carried out and are in general agreement with cation-ratio data.

Resolved: That the sampling process, and sample analysis process (via the documentation in the Notebooks) is the same as would be done under current procedures (which were developed from the processes demonstrated in the Notebooks).

Therefore, there would be only minimal differences, if any, for sample collection and evaluation under current LANL and USGS procedures.

Second Comment:

2. Are there any differences significant enough to affect technical results?

Response - Yes, in the area of handling the samples once they were collected. There were not any specific guidelines provided for the handling of samples until 5/3/88 when Change Request #29 to procedure TWS-ESS-DP-114, Rev. 0 became

effective. Also, the lack of procedural processes for the collection and analysis of samples raises questions with respect to what processes were actually used and the consistency with which those processes were repeated.

Proposed Resolution - August Matthusen

The field notebooks, the sample tracking notebook, the NNWSI Log Book, the maps, and the samples themselves (all discussed prior) exist to document the sample collection and handling. Dr. Harrington stated that all rock varnish samples have been hand carried to Los Alamos, so use of the procedure for shipping samples has not been needed.

Sample handling used a "best practices" approach to protect samples being "hand carried" by Dr. Harrington.

The data, documentation, and work comply to procedures governing scientific notebooks (Quality Assurance Procedure for One-time Research and Development Work [TWS-MSTQA-QA-14, R0] implemented in 5/85; Research and Development Work [Experimental] Procedure [TWS-MSTQA-QP-14, R1] implemented in 2/86; and Procedure for Documenting Scientific Investigations [TWS-QAS-AP-03.5, R0] implemented 3/10/89). These procedures allow development work to be done and documented in notebooks.

Proposed Resolution - Jeff McCleary

In summary, I have made the following observations:

- *USGS field notebooks document to a reasonable extent that the samples collected early in the study would also have been selected under the 5/1/87 procedure.*
- *Inclusion of the early data produces a slightly more conservative erosion rate relative to the regulations.*
- *Other dating studies carried out to address the erosion issue generally support the results of the desert varnish studies.*

Therefore, it is my opinion that the cation-ratio dating of desert varnish can be used to support the project position on erosion rates at Yucca Mountain. If other assessment team members, or the project, still have concerns, other evaluations can be made with existing information and examination of the samples at LANL.

The question of what processes were actually used (to collect samples and evaluate samples), and the consistency with which these processes were repeated, is answered in resolution of Comment #1.

Resolved: That the sampling and evaluation processes actually used, and the consistency of repeating these processes is documented, and demonstrated in the Scientific Notebooks available from Dr. Harrington. Therefore, in that current procedures have been developed from the processes demonstrated within these Scientific Notebooks, there would not be significantly different data obtained if tests were performed today.

Third Comment:

3. *Can a recommendation be made to DOE YMPO that the procedures used to gather and evaluate samples are acceptable to allow the technical data to be qualified under current QARD guidelines?*

Response - A recommendation to accept the data based on the procedures provided for this assessment cannot be made. The obvious lack of procedural guidance in the early stage of this activity supports this conclusion. Other evidence may be available to support the processes used to accomplish the collection and analysis of samples. The notebooks, which have been used throughout this activity to document the work that was performed, may contain enough information to identify the processes used and the consistency with which they were repeated. These notebooks were not provided as part of the review package.

Resolved: That the Scientific Notebooks verify that the processes used would conform to current procedures. Therefore, a recommendations can be made to DOE YMPO to accept the erosion technical data as qualified under current DOE QARD guidelines.

Conclusions and Recommendations

The Technical Assessment Team has evaluated current and previous QA and Technical Procedures that relate to sample collection and analysis, and field measurements for cation ratio dating. In addition, field and laboratory notebooks of the Principal Investigators were examined and compared to the procedures. Three questions have been answered:

1. Would data collection and evaluation under current Participant technical procedures differ from those procedures actually followed?
2. Are any differences significant enough to affect technical results?
3. Can a recommendation be made to DOE YMPO that the procedures used to gather and evaluate samples, and guide field measurements are acceptable to allow the technical data to be qualified under current QARD guidelines?

First question

It has been unanimously agreed by all five Technical Assessment Team Members (TATM) that data collection and evaluation would not differ under current QA and Technical Procedures for LANL and the USGS.

Second question

The TATM unanimously agrees that no significant differences would result from data collection and evaluation under current QA and Technical Procedures.

Third Question

The Technical Assessment Team Members do recommend to DOE YMPO to allow the technical data on Extreme Erosion be formally accepted as qualified under current YMPO QARD guidelines.

In June 1989 LANL organized a peer review group of leading geomorphologists to examine the VCR (varnish cation-ratio) age dating technique and "critically reviewed rock-varnish studies within the LANL Yucca Mountain Project". This Peer Review Panel concluded "... that the VCR age determinations by Dr. Harrington and collaborators are the best presently being done." This Panel also stated: "We are impressed with the excellent work being done on VCR age determination by the LANL research and technical staff and their associates at the USGS and the University of New Mexico. The members of this high-quality team, primarily in the ESS-1 Group (LANL), are extremely careful in all phases of the work, from the initial field sampling, through the laboratory work, to the final age estimation." This peer review supports the results of this Technical Assessment. The report by this Panel is included as Attachment VI.

**YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
TECHNICAL ASSESSMENT NOTICE**

Revision 0

To: DISTRIBUTION (SEE ATTACHMENT 2) Date: MAY 1, 1992

Technical Area to be Reviewed: QUALIFICATION OF TECHNICAL DATA UNDER CURRENT QARD
GUIDELINES COLLECTED AND EVALUATED PRIOR TO NRC ACCEPTANCE OF YMPO QUALITY ASSURANCE

PROGRAM. 5/1/92
WBS No.: 1.2.5.2.4

Review Date: 5/4/92-5/22/92 Location: AT RESPECTIVE TAR
TEAM MEMBER SITES Time: N/A

Technical Assessment Chairperson: B. WILLIAM DISTEL (M&O) 702/794-1827

Scope of Technical Assessment:

SEE ATTACHMENT 1.

Purpose of Technical Assessment:

SEE ATTACHMENT 1.

The signatures below constitute procedural compliance. I have read, understood, and complied with Procedure QMP-02-08, Rev. 1, ICN # 0 in accomplishing my responsibilities in this procedure.

Signed: *William Distel*

Attachments: ATTACHMENT 1
ATTACHMENT 2

Attachment 1

TECHNICAL ASSESSMENT NOTICE

Scope and Purpose

SCOPE: The Department of Energy, Yucca Mountain Project (DOE, YMP) is preparing a topical report for the Nuclear Regulatory Commission (NRC) staff that provides the basis for concluding that extreme erosion did not exist at the Yucca Mountain site during the Quaternary Period. DOE's position is that adequate technical data exists from Yucca Mountain site studies to currently demonstrate that Federal Regulation 10 CFR 60.122(c) (16)* is not relevant to the Yucca Mountain site.

Collection of samples and age dating of these samples to develop the technical data for this DOE position occurred prior to acceptance by the NRC of DOE's Quality Assurance Requirements Document (QARD) RW 0214/Rev. 4, for Site Characterization of the Yucca Mountain Site. This means that the technical data developed for extreme erosion needs to become qualified for YMP use under current QARD guidelines. The basis for qualifying this data is proposed for resolution by comparing procedures guiding sample collecting and analysis against current procedures in place under the DOE QARD guidelines acceptable to the NRC.

PURPOSE: This Technical Assessment Review shall examine the difference between the procedures in place during sample collection and evaluation and current procedures under the DOE QARD applicable to such sample collection and evaluation. Assessment of this difference shall answer the following questions:

1. Would sample collection and evaluation under current participant technical procedures differ from those procedures actually followed?
2. Are any differences significant enough to affect technical results?
3. Can a recommendation be made to DOE YMPO that the procedures used to gather and evaluate samples are acceptable to allow the technical data to be qualified under current QARD guidelines?

* attached herein as Attachment A

Attachment A

10 CFR 60.122 (c) (16)

Nuclear Regulatory Commission

Siting Criteria

60.122 Siting criteria.

- (c) *Potentially adverse conditions.* The following conditions are potentially adverse conditions if they are characteristic of the controlled area or may affect isolation within the controlled area.
- (16) Evidence of extreme erosion during the Quaternary Period.

Attachment 2

TECHNICAL ASSESSMENT TEAM MEMBERS

Peter Birkeland, Geomorphologist
University of Colorado
Boulder, Colorado
(303) 492-6985
(303) 492-2606 - Fax

John Dohrenwend, Geomorphologist
U. S. Geological Survey
Menlo Park, California
(415) 329-5432
FTS 459-5432

August C. Matthusen, Geologist
SAIC
Las Vegas, Nevada
(702) 794-7413

Jeff McCleary, Geologist
Woodward-Clyde Federal Services
Moab, Utah
(801) 259-6164
Fax number is same as above, arrange beforehand

4/14/92

YMP-049-R0

**YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
TECHNICAL ASSESSMENT NOTICE**

Revision 1

To: DISTRIBUTION (SEE ATTACHMENT 2)

Date: JUNE 12, 1992

Technical Area to be Reviewed: QUALIFICATION OF TECHNICAL DATA UNDER CURRENT OARD GUIDELINES COLLECTED & EVALUATED PRIOR TO NRC ACCEPTANCE OF YMPO QUALITY ASSURANCE PROGRAM

WBS No.: 1.2.5.2.4

Review Date: 5/4/92-7/31/92 Location: AT RESPECTIVE TA TEAM MEMBER SITES Time: N/A

Technical Assessment Chairperson: B. WILLIAM DISTEL, (M&O), (702) 794-1827

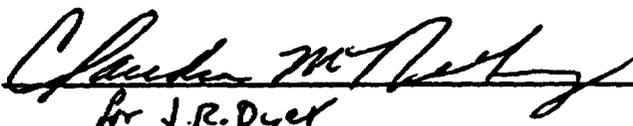
Scope of Technical Assessment:

SEE ATTACHMENT 1.

Purpose of Technical Assessment:

SEE ATTACHMENT 1.

The signatures below constitute procedural compliance. I have read, understood, and complied with Procedure QMP-02-08, Rev. 1, ICN # 0 in accomplishing my responsibilities in this procedure.

Signed: 
for J.R. Dyer

Attachments:

- ATTACHMENT 1
- ATTACHMENT 2

Attachment 1

TECHNICAL ASSESSMENT NOTICE

Scope and Purpose

SCOPE: The Department of Energy, Yucca Mountain Project (DOE, YMP) is preparing a topical report for the Nuclear Regulatory Commission (NRC) staff that provides the basis for concluding that extreme erosion did not exist at the Yucca Mountain site during the Quaternary Period. DOE's position is that adequate technical data exists from Yucca Mountain site studies to currently demonstrate that Federal Regulation 10 CFR 60.122(c) (16)* is not relevant to the Yucca Mountain site.

Collection of samples and age dating of these samples to develop the technical data for this DOE position occurred prior to acceptance by the NRC of DOE's Quality Assurance Requirements Document (QARD) RW 0214/Rev. 4, for Site Characterization of the Yucca Mountain Site. This means that the technical data developed for extreme erosion needs to become qualified for YMP use under current QARD guidelines. The basis for qualifying this data is proposed for resolution by comparing procedures guiding sample collecting and analysis against current procedures in place under the DOE QARD guidelines acceptable to the NRC.

PURPOSE: This Technical Assessment Review shall examine the difference between the procedures in place during sample collection and evaluation and current procedures under the DOE QARD applicable to such sample collection and evaluation. Assessment of this difference shall answer the following questions:

1. Does the technical data sample collection and evaluation process conform to the procedures in-place during the period of collection and evaluation? (no more than two Technical Assessment Members shall verify this.)
2. Would sample collection and evaluation under current participant technical procedures differ from those procedures actually followed?
3. Are any differences significant enough to affect technical results?
4. Can a recommendation be made to DOE YMPO that the procedures used to gather and evaluate samples are acceptable to allow the technical data to be qualified under current QARD guidelines?

* attached herein as Attachment A

Attachment 2

TECHNICAL ASSESSMENT TEAM MEMBERS

Peter Birkeland, Geomorphologist
University of Colorado
Boulder, Colorado
(303) 492-6985
(303) 492-2606 - Fax

John Dohrenwend, Geomorphologist
U. S. Geological Survey
Menlo Park, California
(415) 329-5432
FTS 459-5432

August C. Matthusen, Geologist
SAIC
Las Vegas, Nevada
(702) 794-7413

Jeff McCleary, Geologist
Woodward-Clyde Federal Services
Moab, Utah
(801) 259-6164
Fax number is same as above, arrange beforehand

B. Robert Justice, Jr.
Duke Engineering & Services, Inc.
CRWMS/M&O
Las Vegas, Nevada
(702) 794-1882

Attachment A

10 CFR 60.122 (c) (16)

Nuclear Regulatory Commission

Siting Criteria

60.122 Siting criteria.

- (c) *Potentially adverse conditions.* The following conditions are potentially adverse conditions if they are characteristic of the controlled area or may affect isolation within the controlled area.
- (16) Evidence of extreme erosion during the Quaternary Period.

TECHNICAL ASSESSMENT QUALIFICATION OF DATA - EXTREME EROSION

Instructions for Assessment

PURPOSE:

This Technical Assessment shall examine the difference between the procedures in place during sample collection, evaluation and field measurements, and current procedures under the DOE QARD applicable to such sample collection and evaluation. Assessment of this difference shall answer the following questions:

- Would sample collection and evaluation under current participant technical procedures differ from those procedures actually followed?
- Are any differences significant enough to affect technical results?
- Can a recommendation be made to DOE YMPO that the procedures used to gather and evaluate samples are acceptable to allow the technical data to be qualified under current QARD guidelines?

INFORMATION:

Organizational procedures being assessed:

Los Alamos National Laboratory
Yucca Mountain Project
Julie A. Canepa
Technical Project Officer
P. O. Box 1633 EES-13
Mail Stop J521
Los Alamos, NM 87545
Commercial: 505-667-9286
FTS Phone: 843-9286, 843-4109

LANL Principal Investigator: Charles D. Harrington

U. S. Geological Survey
Yucca Mountain Project
Larry R. Hayes
Technical Project Officer
P. O. Box 25046
Denver Federal Center
Denver, CO 80225
Commercial: 303-236-0516
FTS Phone: 776-0516

USGS Principal Investigator: John W. Whitney

TECHNICAL ASSESSMENT INSTRUCTIONS:

Rock varnish samples were collected between 1985 and 1988 by C. D. Harrington, LANL, in coordination with J. W. Whitney, USGS. Samples were collected, handled, shipped and stored in accordance with LANL Procedures applicable during this time frame. The USGS was under a Stop Work Order from DOE during this period which kept Whitney from collecting samples directly.

Applicable Procedures - LANL NNWSI QA Procedures

<u>Title</u>	<u>Identifier</u>	<u>Date effective</u>	<u>Date Superseded</u>
Handling, Storage and Shipping Procedure	TWS-MSTQA-QP-04, R2	4/2/85	4/5/88
Handling, Storage and Shipping Procedure	TWS-QAS-QP-13.1, R0	4/5/88	11/3/89
Records Control Procedure	TWS-MSTQA-QA-09, R0	1/3/84	
Quality Assurance for One-Time Research and Development Work	TWS-MSTQA-QP-14, R0	5/22/85	5/19/86
Research and Development (Experimental) Procedure	TWS-MSTQA-QP-14, R1	5/19/86	
Sample Collection Procedure for Rock Varnish Studies	TWS-ESS-DP-114, R0	5/1/87	6/5/90

Rock Varnish Analysis was conducted between 1986 and 1988 by C. D. Harrington, LANL. All dating analyses were carried out under LANL procedures applicable during this time frame.

Applicable Procedures - LANL NNWSI QA Procedures

<u>Title</u>	<u>Identifier</u>	<u>Date Effective</u>	<u>Date Superseded</u>
Document Control	TWS-MSTQA-QP-03, R5	3/19/85	10/27/87
Document Control	TWS-MSTQA-QP-03, R7	10/27/87	4/21/92
Records Control Procedure	TWS-MSTQA-QP-09, R0	1/3/84	
Quality Assurance for One-Time Research and Development Work	TWS-MSTQA-QP-14, R0	5/22/85	5/19/86
Research and Development (Experimental) Procedure	TWS-MSTQA-QP-14, R1	5/19/86	

The LANL QA program, in response to YMP QARD requirements, is described in the LANL-YMP-QAPP and includes a program description addressing each of the NQA-1 criteria.

Applicable LANL-YMP-QAPP Quality Procedures

Rock Varnish Samples:

<u>Title</u>	<u>Identifier</u>	<u>Date Effective</u>
Handling, Storage and Shipping	TWS-QAS-QP-13.1, R2	11/3/89
Document Control	TWS-QAS-QP-06.1, R4	4/21/92
Control of Data Measuring and Test Equipment	TWS-QAS-QP-08.2, R0 TWS-QAS-QP-12.1, R4	8/23/89 2/20/90
Sample Collection for Rock Varnish Studies	TWS-ESS-DP-114, R1	6/5/90
Identification and Control of Samples	TWS-QAS-QP-08.1, R2	2/28/92

Rock Varnish Analysis:

<u>Title</u>	<u>Identifier</u>	<u>Date Effective</u>
Document Control	TWS-QAS-QP-06.1, R4	4/21/92
Control of Data	TWS-QAS-QP-08.2, R0	8/23/89
Measuring and Test Equipment	TWS-QAS-QP-12.1, R4	2/20/90
Group Resident File	TWS-QAS-QP-17.1, R0	9/20/88
Records Preparation	TWS-QAS-QP-17.4, R0	2/28/92
Records Processing	TWS-QAS-QP-17.5, R0	2/28/92

Field Measurements were made between 1985 and 1986 by J. W. Whitney, USGS, on erosion surfaces. Such measurements were entered in a Scientific Notebook in accordance with USGS Quality Assurance Procedures applicable during this time frame. The Stop Work Order allowed this type of work to be conducted by the USGS during this period.

Applicable Procedures - USGS QA Procedures - Then

<u>Title</u>	<u>Identifier</u>	<u>Date Effective</u>
	NNWSI-USGS-QMP-11.01, R0	8/24/85
	UGSG-SIP-3231G-10, R0	8/28/87
	NNWSI-USGS-QMP-5.01, R1	10/27/86
	NWM-USGS-HP-174, R0	6/7/88

Current Applicable USGS QA Procedures

<u>Title</u>	<u>Identifier</u>	<u>Date Effective</u>
	YMP-USGS-QMP-5.05, R2	11/5/90
	YMP-USGS-QMP-5.01, R4	9/4/90

TECHNICAL ASSESSMENT INSTRUCTIONS:

INSTRUCTIONS:

1. Please review the procedures contained in the Technical Assessment Packet to determine those differences between the procedures in place during sample collection, sample evaluation, and field measurements, and current procedures under the DOE QARD applicable to such sample collection, evaluation, and field measurements.
2. Please comment on any differences you deem significant enough to affect technical results.
3. Please return your comments and your summary recommendation as to the acceptability of the technical data to be qualified under current DOE QARD guidelines. Please address these areas in your summary:
 - a. Could technical results differ significantly were sample collection, analysis, and field measurements to be done under current DOE QARD procedures?
 - b. Any differences between current applicable procedures and past applicable procedures which should be considered in accepting the technical results as qualified under current DOE QARD guidelines?

WBS 1.2.5.2.4

EROSION RATES AT YUCCA MOUNTAIN

TECHNICAL ASSESSMENT

QUALIFICATION OF DATA

PETER W. BIRKELAND

Background and Resume

ACCESSION NUMBER NNA.921006.0026

WBS 1.2.5.2.4

EROSION RATES AT YUCCA MOUNTAIN

TECHNICAL ASSESSMENT

QUALIFICATION OF DATA

JOHN C. DOHRENWEND

Background and Resume

ACCESSION NUMBER NNA.921006.0026

WBS 1.2.5.2.4

EROSION RATES AT YUCCA MOUNTAIN

TECHNICAL ASSESSMENT

QUALIFICATION OF DATA

JEFF R. McCLEARY

Background and Resume

ACCESSION NUMBER NNA.921006.0026

WBS 1.2.5.2.4

EROSION RATES AT YUCCA MOUNTAIN

TECHNICAL ASSESSMENT

QUALIFICATION OF DATA

AUGUST C. MATTHUSEN

Background and Resume

ACCESSION NUMBER NNA.921006.0026

WBS 1.2.5.2.4

EROSION RATES AT YUCCA MOUNTAIN

TECHNICAL ASSESSMENT

QUALIFICATION OF DATA

B. ROBERT JUSTICE, JR.

Background and Resume

ACCESSION NUMBER NNA.921006.0026

WBS 1.2.5.2.4

EROSION RATES AT YUCCA MOUNTAIN

TECHNICAL ASSESSMENT

QUALIFICATION OF DATA

QUALIFICATIONS TO CONDUCT TECHNICAL ASSESSMENTS
YMP-QMP-02-08

B. WILLIAM DISTEL
PETER W. BIRKELAND
JOHN C. DOHRENWEND
JEFF R. McCLEARY
AUGUST C. MATTHUSEN
B. ROBERT JUSTICE, JR.

ACCESSION NUMBER NNA.921006.0026

TRW Environmental
Safety Systems Inc.

161 Convention Center Drive, Suite 2110
Las Vegas, NV 89109
(702) 794-1827

TRW

WBS: 1.2.5.2.4
QA: QA

May 4, 1992

Contract #: DE-AC01-91RW00134
LV.MGSC.5/92.BWD-011

Peter Birkeland
University of Colorado at Boulder
Department of Geological Sciences
Campus Box 250
Boulder, CO 80309-0250

Dear Mr. Birkeland:

Subject: Technical Assessment for the Qualification of Data evaluating
Extreme Erosion as an Issue for Possible Licensing to Construct
an Underground Repository at the Yucca Mountain Site

Please initiate this Assessment immediately upon receiving this Packet.
Should arrangements to complete contracting be pending resolution please
initiate this Assessment upon signing the contract.

It is requested that your response and recommendations be received by me
no later than May 15, 1992. I shall remain in communication with you to
facilitate this process as possible. Any questions need to be directed to me
immediately to allow fast resolution.

Your interest and participation are appreciated and of significant value to the
Yucca Mountain Project. I can be reached at (702) 794-1827 or by fax at
(702) 794-1844.

Sincerely,



B. William Distel, Technical Assessment Chairperson
Site Characterization
Management and Operating Contractor

BWD:kcb



Science Applications International Corporation
An Employee-Owned Company

May 14, 1992

Garth Phillips
Contracting Officer
U. S. Department of Energy
Yucca Mountain Site Characterization
Project Office
P. O. Box 98608
Las Vegas, NV 89193-8608

OCI REPRESENTATION/DISCLOSURE STATEMENT, CONTACT #DE-AC08-87NV10576

Pursuant to Clause H.7, Services of Consultants, enclosed are an OCI Representation Statement and resume for Dr. Peter W. Birkeland, whose expertise in Geomorphology is required under the subject contract. His costs are not anticipated to exceed \$10,000.

Based upon SAIC's review of Dr. Birkeland's resume, we feel that there is little likelihood that a possible conflict of interest would exist if his services are utilized under the T&MSS contract. Please provide written consent to the undersigned at:

Science Applications International Corporation
101 Convention Center Drive, Suite 407
Mail Stop 517/T-31
Las Vegas, NV 89109

Should you have any questions, please call me at 794-7822.

Kathleen L. Fehr
Associate Contract Representative

L93-2846

Enclosures:

1. OCI Representation Statement
2. Resume

cc:

- B. W. Distel, M&O/TRW, Las Vegas, NV, MS 423
- S. P. Fogdall, SAIC, Las Vegas, NV, 517/T-21
- J. R. Gonzales, SAIC, Las Vegas, NV, 517/T-28
- C. G. Pflum, SAIC, Las Vegas, NV, 517/T-27
- J. D. Weaver, SAIC, Las Vegas, NV, 517/T-03



TRW Environmental
Safety Systems Inc.

101 Convention Center Drive, Suite P110
Las Vegas, NV 89109
702 794 1800

WBS: 1.2.5.2.4
QA: QA

May 5, 1992

Contract #: DE-AC01-91RW00134
LV.MGSC.5/92.BWD-014

Larry R. Hayes, Technical Project Officer
U. S. Geological Survey/Denver
Yucca Mountain Project
P. O. Box 25046
Denver Federal Center
Denver, CO 80225

Dear Mr. Hayes

Subject: Assistance in Supporting the Issue Resolution Initiative -
Technical Assessment for Data Qualification Concerning
Extreme Erosion

In accordance with DOE/YMPO Technical Direction Letter dated March 31, 1992 to Project TPO's to support the Issues Resolution Initiative, it is requested you provide funds adequate to cover the cost and expenses for use of John Dohrenwend, USGS-Menlo Park, to provide Technical Assessment on data qualification concerning Extreme Erosion.

Mr. Dohrenwend's cost and expenses should not exceed \$4,000.00 during this Technical Assessment which has no more than an eight day duration. This work shall be initiated by May 5, 1992, with comments due back to myself by May 15, 1992.

YMP Quality Management Procedure QMP-02-08, R1, requests that each Technical Assessment Team Member (TATM) have a Participant Manager who can certify that the TATM meets the minimum technical qualifications. It is requested that you assume this responsibility for this Technical Assessment unless you wish to appoint someone else within the USGS to this capacity.

Should you have questions, please contact me at (702) 794-1827.

Sincerely,

B. William Distel, Technical Assessment Chairperson
Site Characterization
Management and Operating Contractor

BWD:kcb



TRW Environmental
Safety Systems Inc.

101 Convention Center Drive, Suite 400
Las Vegas, NV 89109
702 794 1800

WBS: 1.2.5.2.4
QA: QA

May 4, 1992

Contract #: DE-AC01-91RW00134
LV.MGSC.5/92.BWD-013

John Dohrenwend
U. S. Geological Survey
Mail Stop 901
345 Middlefield
Menlo Park, CA 94025

Dear Mr. Dohrenwend:

Subject: Technical Assessment for the Qualification of Data evaluating
Extreme Erosion as an Issue for Possible Licensing to Construct
an Underground Repository at the Yucca Mountain Site

Please initiate this Assessment immediately upon receiving this Packet.

It is requested that your response and recommendations be received by me
no later than May 15, 1992. I shall remain in communication with you to
facilitate this process as possible. Any questions need to be directed to me
immediately to allow fast resolution.

Your interest and participation are appreciated and of significant value to the
Yucca Mountain Project. I can be reached at (702) 794-1827 or by fax at
(702) 794-1844.

Sincerely,

B. William Distel, Technical Assessment Chairperson
Site Characterization
Management and Operating Contractor

BWD:kcb



WBS: 1.2.5.2.4
QA: QA

TRW Environmental
Safety Systems Inc.

1111 Convention Center Drive, Suite P 1111
Las Vegas, NV 89103
(702) 794-1800

May 4, 1992

Contract #: DE-AC01-91RW00134
LV.MGSC.5/92.BWD-012

Jeff McCleary
367 E. Center
Moab, UT 84532

Dear Mr. McCleary:

Subject: Technical Assessment for the Qualification of Data evaluating
Extreme Erosion as an Issue for Possible Licensing to Construct
an Underground Repository at the Yucca Mountain Site

Please initiate this Assessment immediately upon receiving this Packet.

It is requested that your response and recommendations be received by me
no later than May 15, 1992. I shall remain in communication with you to
facilitate this process as possible. Any questions need to be directed to me
immediately to allow fast resolution.

Your interest and participation are appreciated and of significant value to the
Yucca Mountain Project. I can be reached at (702) 794-1827 or by fax at
(702) 794-1844.

Sincerely,

B. William Distel, Technical Assessment Chairperson
Site Characterization
Management and Operating Contractor

BWD:kcb

TRW Environmental
Safety Systems Inc.

101 Convention Center Drive, Suite P110
Las Vegas, NV 89109
702 794 1800

TRW

WBS: 1.2.5.2.4
QA: QA

May 5, 1992

Contract #: DE-AC01-91RW00134
LV.MGSC.5/92.BWD-015

August C. Matthusen
SAIC
Mail Stop 517
101 Convention Center Drive
Las Vegas, NV 89109

Dear Mr. Matthusen:

Subject: Technical Assessment for the Qualification of Data evaluating
Extreme Erosion as an Issue for Possible Licensing to Construct
an Underground Repository at the Yucca Mountain Site

Please initiate this Assessment immediately upon receiving this Packet.

It is requested that your response and recommendations be received by me
no later than May 15, 1992. I shall remain in communication with you to
facilitate this process as possible. Any questions need to be directed to me
immediately to allow fast resolution.

Your interest and participation are appreciated and of significant value to the
Yucca Mountain Project. I can be reached at (702) 794-1827 or by fax at
(702) 794-1844.

Sincerely,



B. William Distel, Technical Assessment Chairperson
Site Characterization
Management and Operating Contractor

BWD:kcb

cc:
Paul Cloke, SAIC, Las Vegas

TRW Environmental
Safety Systems Inc.161 Convention Center Drive, Suite 2111
Las Vegas, NV 89102
Tel: 794 1800

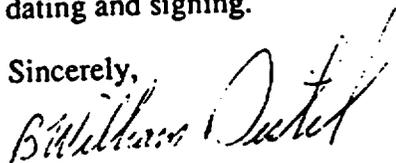
May 6, 1992

Contract #: DE-AC01-91RW00134
LV.MGSC.5/92.BWD-020Jeff McCleary
367 E. Center
Moab, UT 84532

Dear Mr. McCleary:

Subject: Revision to Technical Assessment Packet. Additional USGS
Procedures for consideration.Please include the enclosed procedures in your Assessment of the USGS
Procedures. They clarify documentation for field notebooks.Included for your signature (after reading the Technical Assessment
Procedure QMP-02-08) is a Compliance Form. Please return to me after
dating and signing.

Sincerely,

B. William Distel, Technical Assessment Chairperson
Site Characterization
Management and Operating Contractor

BWD:kcb

TRW Environmental
Safety Systems Inc.

101 Convention Center Drive, Suite P 110
Las Vegas, NV 89109
702 794 1800

TRW

WBS: 1.2.5.2.4
QA: QA

May 6, 1992

Contract #: DE-AC01-91RW00134
LV.MGSC.5/92.BWD-019

John Dohrenwend
U. S. Geological Survey
Mail Stop 901
345 Middlefield
Menlo Park, CA 94025

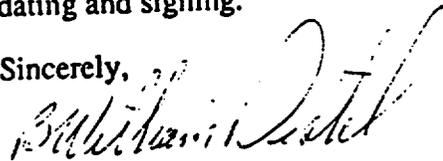
Dear Mr. Dohrenwend:

Subject: Revision to Technical Assessment Packet. Additional USGS
Procedures for consideration.

Please include the enclosed procedures in your Assessment of the USGS
Procedures. They clarify documentation for field notebooks.

Included for your signature (after reading the Technical Assessment
Procedure QMP-02-08) is a Compliance Form. Please return to me after
dating and signing.

Sincerely,



B. William Distel, Technical Assessment Chairperson
Site Characterization
Management and Operating Contractor

BWD:kcb

TRW Environmental
Safety Systems Inc.101 Convention Center Drive, Suite 1010
Las Vegas, NV 89101
702/794-1800

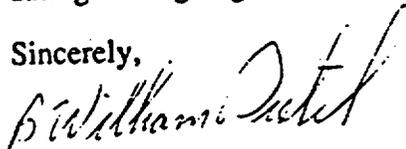
May 6, 1992

Contract #: DE-AC01-91RW00134
LV.MGSC.5/92.BWD-021Peter Birkeland
University of Colorado at Boulder
Department of Geological Sciences
Campus Box 250
Boulder, CO 80309-0250

Dear Mr. Birkeland:

Subject: Revision to Technical Assessment Packet. Additional USGS
Procedures for consideration.Please include the enclosed procedures in your Assessment of the USGS
Procedures. They clarify documentation for field notebooks.Included for your signature (after reading the Technical Assessment
Procedure QMP-02-08) is a Compliance Form. Please return to me after
dating and signing.

Sincerely,

B. William Distel, Technical Assessment Chairperson
Site Characterization
Management and Operating Contractor

BWD:kcb

MAY 6 1992

Contract #: DE-AC01-91RWO0134
LV.MGSC.5/92.BWD

August C. Matthusen
SAIC
Mail stop 517
101 Convention Center Drive
Las Vegas, NV 89109

Subject: Revision to Technical Assessment Packet. Additional USGS
Procedures for Consideration.

(This Revision was hand delivered to Mr. Matthusen by Mr. Distel on the above date)



B. William Distel, Technical Assessment Chairperson
Site Characterization
Management and Operating Contractor

TRW Environmental
Safety Systems Inc.

101 Convention Center Drive, Suite P-110
Las Vegas, NV 89109
702 794 1827

TRW

WBS: 1.2.5.2.4
QA: QA

June 17, 1992

Contract #: DE-AC01-91RW00134
LV.SC.6/92.BWD-046

B. Robert Justice
TESS/CRWMS M&O
101 Convention Center Drive, Suite P-110
Las Vegas, NV 89109

Subject: Technical Assessment for the Qualification of Data evaluating
Extreme Erosion as an Issue for Possible NRC Licensing of the
Yucca Mountain Site

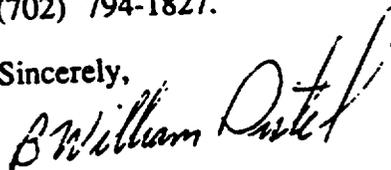
Enclosed is a copy of the Technical Assessment Notice, Revision 1, which
identifies your addition to the Technical Assessment Team. Also enclosed
are Instructions for Assessment, and a packet of the pertinent procedures.

Please initiate this Assessment immediately upon receiving this packet.

It is requested that your response and recommendations be received by me
no later than July 10, 1992. I shall remain in communication with you to
facilitate this process as possible. Any questions need to be directed to me.

Your interest and participation are of significant value to this Technical
Assessment due to your Quality Assurance expertise. I can be reached at
(702) 794-1827.

Sincerely,



B. William Distel, Technical Assessment Chairperson
Site Characterization
Management and Operating Contractor

BWD/kcb

TRW Environmental
Safety Systems Inc.171 Convention Center Drive, Suite 2111
Las Vegas, NV 89179
(702) 794-1827

June 29, 1992

Contract #: DE-AC01-91RW00134
LV.SC.6/92.BWD-047Larry R. Hayes, Technical Project Officer
U. S. Geological Survey
Yucca Mountain Project
P. O. Box 25046
Denver Federal Center
Denver, CO 80225Subject: Supporting the Technical Assessment for Data Qualification
Concerning Extreme Erosion - Verification of Data to
Applicable Procedures

In accordance with DOE/YMPO Technical Direction Letter dated March 31, 1992 to Project TPO's to support the Issues Resolution Initiative, it is requested you allow John Whitney to be available in his office for verification of his field notebooks on Extreme Erosion in conforming to applicable procedures (which are attached).

This is a part of the Technical Assessment for Qualification of Data on Extreme Erosion. Mr. Jeff McCleary, a Technical Assessment Team Member, will meet with Mr. Whitney in Denver to carry out the verification.

The best date and time for this meeting is the morning of July 14, 1992.

Should you have further questions, or needed changes in arrangements please call Bill Distel at (702) 794-1827.

Sincerely,

C. Thomas Statton, Manager
Site Characterization
Management and Operating Contractor

Enclosure:

cc:

B. W. Distel, M&O/WCFS, Las Vegas, NV
L. D. Foust, M&O/TRW, Las Vegas, NV
J. R. McCleary, M&O/WCFS, Moab, UT
E. M. Weaver, M&O/Duke, Las Vegas, NV
J. W. Whitney, USGS, Denver, CO

BWD/CTS/kcb

RW Environmental
Safety Systems Inc.

101 Convent Road, Suite 500
Basking Ridge, NJ 07005

WBS: 1.2.5.2.4
QA: N/A

July 31, 1992

Contract #: DE-AC01-91RW00134
LV.SC.7/92.BWD-061

Julie A. Canepa, Technical Project Officer
Yucca Mountain Site Characterization Project Office
Los Alamos National Laboratory
P. O. Box 1633, EES-13
N-5 Mail Stop J521
Los Alamos, NM 87545

Subject: Support of the Technical Assessment for Data
Qualification Concerning Extreme Erosion -
Verification of Data to Applicable Procedures

As part of the Technical Assessment for Qualification of Data on Extreme Erosion, Mr. August (Augie) Matthusen, a Technical Assessment Team Member, met with Mr. Chuck Harrington on July 14, 1992. This was done in accordance with DOE/YMPO Technical Direction Letter dated March 31, 1992 to Project TPO's to support the Issues Resolution Initiative. Chuck Harrington made himself available for verification of his field and analysis notebooks. The review for conformance with applicable LANL QA and technical procedures went well and it appears that this will provide sufficient evidence that these data are indeed qualified for use in the issue resolution effort.

We appreciate Mr. Harrington's assistance and support in this matter.

Should you have further questions, please call Bill Distel at (702) 794-1827.

Sincerely,



C. Thomas Statton
Site Characterization Manager
Management and Operating Contractor

Page 2

LV.SC.7-92.BWD-061

July 30, 1992

cc:

B. W. Distel, WCFS/M&O, Las Vegas, NV
L. D. Foust, TRW/M&O, Las Vegas, NV
E. M. Weaver, Duke/M&O, Las Vegas, NV
A. C. Matthusen, SAIC, Las Vegas, NV
C. D. Harrington, LANL, Los Alamos, NM

 BWD/CTS/kcb



Science Applications International Corporation

WBS 1.2.5.2.4
QA: QA

July 28, 1992

L. Dale Foust
Technical Project Officer
TRW Environmental Safety Systems, Inc.
ATTN: B. W. Distel
101 Convention Center Drive
Phase II, Suite P110
Las Vegas, NV 89109

TRANSMITTAL OF TECHNICAL ASSESSMENT REVIEW FOR QUALIFICATION OF TECHNICAL DATA
FOR THE EROSION PROGRAM (SCP 8.3.1.6)

August C. Matthusen of my staff participated in a Technical Assessment Review (QMP-02-08) of data gathered in support of the erosion program. His initial participation was to review the procedures governing sampling and data collection. These findings are documented in the enclosed memo (Enclosure 1). Further verification of documentation required that he travel to Los Alamos and review scientific notebooks and other documentation. The second enclosed memo (Enclosure 2) contains his findings regarding the qualification of the data.

If there are any questions regarding these reviews, please contact Mr. Matthusen at (702) 794-7413.

Jeffrey D. Weaver
Assistant Project Manager
Site Characterization Support
Technical and Management
Support Services

JDW:ACM:eem:L92-025

Enclosures:
As stated

cc w/encl:
D. K. Chandler, SAIC, Las Vegas, NV, 517/T-44
P. L. Cloke, SAIC, Las Vegas, NV, 517/T-03
M. D. Voegele, SAIC, Las Vegas, NV, 517/T-44

U.S. Geological Survey

MS 901

345 Middlefield Road
Menlo Park, CA 94025

11 May 1992

B. William Distel, Technical Assessment Chairperson
TRW Environmental Safety Systems Inc.
101 Convention Center Drive, Suite P-110
Las Vegas, NV 89109

Dear Mr. Distel:

Subject: Technical Assessment for the Qualification of Data evaluating Extreme Erosion as an Issue for Possible Licensing to Construct an Underground Repository at the Yucca Mountain Site

I have examined the differences between those procedures that were in place during collection and evaluation of samples for rock varnish analysis (for the purpose of assessing extreme erosion as an issue at Yucca Mountain) and current procedures under the DOE QARD that are applicable to such collection and evaluation activities. As a result of this examination, I have reached the following conclusions:

1. Current sample collection and evaluation procedures are nearly the same as the procedures actually followed during sample collection and evaluation.
2. None of the procedural differences that do exist are significant enough to affect the technical results of the extreme erosion study.
3. Therefore, a recommendation can be made to DOE YMPO that the procedures used to collect and evaluate samples are acceptable and that the technical data pertaining to the extreme erosion study should be qualified under current QARD guidelines.

Sincerely,



Dr. John C. Dohrenwend
Technical Assessment Team Member
U.S. Geological Survey

Department of Geological Sciences

Campus Box 250
Boulder, Colorado 80309-0250
(303) 492-8141
FAX: (303) 492-2606

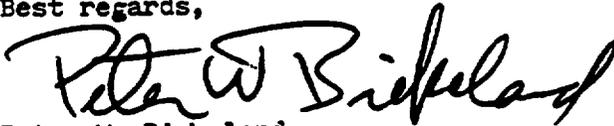
May 14, 1992

Mr. B. William Distal
TRW
101 Convention Center Drive, Suite F-110
Las Vegas, NV 89109

Dear Bill:

I have gone through the document you sent me, and attached is my assessment. I hope they address the issues in the manner in which you wanted them. It was very hard to do this without concrete examples before me, but this is the best I can do. If you need me to assess the scientific parts of their work, I probably could also do that—and I suspect it could be more enjoyable reading.

Best regards,



Peter W. Birkeland

P.S. We are up in the boondocks. I will bike to the nearest village and seek out a FAX ~~BOOK~~. If it goes FAX I also will mail the original.

PPS I signed the form that said I had read a document & sent it to you yesterday C/O SAIC. Later I realized you are with TRC. Hopefully they'll pass it on to you.

Comparison of MNWSI-USGS-QMP-11.01,R1 (hereafter called MNWSI) with YMP-USGS-QMP-5.05, R2 (hereafter called YMP).

I will address what I think are the major differences and address whether or not they would significantly alter technical results. Page number refers to page in YMP.

Major differences

Alter results?

p. 2. Responsibilities are well laid out, it all seems rather obvious, and I am sure the USGS operates that way.

NO

p.2. Scientific Notebook system is well defined and much better than in MNWSI. I shall hit the highlights and see if the contrasts are significant.

p.3. It is obvious to any scientist doing that kind of work in that area that the notebook is of utmost importance. I would be very surprised if contents could not be read and understood by a colleague. Somebody should be able to take the the notebook into the field and duplicate the effort. Not easily done, as I address later.

NO

p.3. Notebook ID number is a good idea, but each scientist has own way of so identifying a notebook used for a particular task.

NO

p.4. Hard to discuss calibration requirements, potential sources of uncertainty and error, suspect input data, and required levels of precision and accuracy. In field work, which I assume much of this is addressing, it is a problem that could be addressed by the group doing the work. Quantification of field data (rock weathering features, rock varnish, soils) involves subjective calls. One way to determine consistency in the eyes of the operator is to occupy the same field site periodically (once a year) and see if the same data set can be obtained—are the data repeatable? Or can 2 individuals occupy the same site at different times and come up with the same data set? Obviously, all of this with lab equipment is much easier.

NO. Hard to be sure on the field data. It really comes down to a case-by-case call with the actual field data.

p.4. Highlighting the questionable results probably is very important. I think it is addressed in both documents, however—as 'questionable results' in MNWSI, and 'potential sources of uncertainty and error' in YMP.

NO

p. 6. Final results and having a colleague go over the Scientific Notebook (p. 7) are good ideas. In my opinion, however, the USGS has an adequate review system, although not spelled out.

NO

Attachment 1 of both NNWSI and YMP is quite similar. YMP has some attractive line items, however:

--6.0: Potential limitations. However, 6.3 and 6.4 of the NNWSI probably address the same thing.

--7.0: Quantitative/Qualitative Criteria. However, 6.3 of NNWSI could address that.

In summary, in answer to the 3 questions posed:

1. I think sample collection and evaluation was not significantly different under both procedures.
2. The differences are not significant enough to effect technical results.
3. I recommend that the procedures used to gather and evaluate samples are acceptable to allow the technical data to be qualified under current QARD guidelines.

I should add, however, that it is very difficult to make these judgements without knowing the kind of data that were collected. It would help to see the report that resulted from the field work, or lab work.

The GREEN book you sent me is a bit difficult to go through as there are so many alterations as time went on. And, much of it kept being repeated, because of new revisions, etc. As I understand it the first about 1/2 of the book (to the first blue divider) is the new procedures, and the second 1/2 of the book (that between the first and second divider) is the procedures used by LANL for the period in question (before the new procedures were in force).

So, back to the 3 questions posed:

1. Were sample collection and evaluation under either procedure different? My reading of the documents would say they were basically the same.
2. Are there any differences significant enough to affect technical results?
This is hard to say without actually going through the notebooks. But, from the procedures as written down, I again would have to say no.

The main difference is that the new procedures are much more detailed in the calibration aspects of the research, but these also are addressed in the LANL document. I am not convinced that these slight differences would effect the technical results.

I could add a minor point here. Documentation in a notebook and on maps are fine, but for a project of this importance photographs of the key sites in the field should be mandatory. The only way to be sure that the sites can be reoccupied by either another person, or even the PI several years after the original work. In short, no matter how many maps or ~~photos~~ air photos one has, it is extremely difficult to relocate sites. Anyone who does not believe this has not tried to duplicate others work, or even tried to find their localities.

3. So, yes, I recommend to DOE YNPO that the procedures used to gather and evaluate samples are acceptable to allow the technical data to be qualified under current QARD guidelines.

Submitted by Peter W. Birkeland, May 14, 1992


signed



May 21, 1992

B. William Distel
Technical Assessment Chairperson
TESS/CRWMS/M&O/WCFS
101 Convention Center Drive, Suite P-110
Las Vegas, NV 89109

Subject: Technical Assessment for the qualification of data evaluating extreme erosion as an issue related to the licensing of an underground nuclear waste repository at the Yucca Mountain site.

Dear Bill:

I have read and evaluated the procedures provided with your letter of May 4, 1992. I received additional procedures from you with your letter of May 6, 1992. I have also read and evaluated these procedures. In a subsequent phone conversation on May 11, 1992 you stated that the USGS procedures included in the May 6, transmittal should be viewed as a replacement for the USGS procedures in the May 4, transmittal. My review and evaluation has taken this verbal instruction into account. Based on my review of the material provided I have developed the following observations and recommendations:

Observations

1. The issue being evaluated (erosion rates) requires field measurements of the depths of channel incision below dated geomorphic surfaces. A dating technique used at Yucca Mountain was cation-ratation dating of rock varnish on undisturbed geomorphic surfaces. Therefore the most critical procedures to evaluate are those related directly to field measurements, collecting rock varnish samples and analyzing the rock varnish samples. These will be discussed further in observation 3.
2. While the above named proccdures are most critical they must be supported by other procedures such as handling and shipping, calibration of measuring and test equipment, and control of data in order for the whole process to be well documented and the data considered valid. My review of the supporting procedures in place at the time of sample collection and analysis versus the supporting procedures currently approved indicates that there is not a significant difference that would have a major effect on technical results. While the new procedures are an improvement over the ones previously in use in terms of clarity; all of the procedures do in fact state their purpose and scope, assign responsibilities to individuals and define or describe requirements. Based on the material provided it appears that the controls for calibration, data generation and storage etc. were adequate during the study.
3. Based on the information provided it appears that field measurements were made in 1985 and 86 by the USGS, samples were collected between 1985 and 1988 by LANL in coordination with the USGS, and the samples were analyzed between 1986 and 1988 by LANL.

- a. Field measurements in the 1985-86 time frame would have been covered by "Preparation and issuance of tentative technical procedures" USGS - QMP-11.01 revisions 0 and 1. These appear to be the predecessor documents to the current QMP-5.05 Scientific notebook system and include most of the same elements (Purpose, objective, plan, personnel, calibration, approval, etc.).
- b. Sample collection in the 1986 time frame would be under LANL procedure TWS-MSTQA-QP-14 revisions 0 and 1 for R and D work. Sample collection in 1987 and 1988 would be under TWS-ESS-DP-114 revision 0. The major difference between revision 0 of DP-114 and the current revision 1 effective 6/5/90 is more specificity in the shipping requirements to avoid abrading the varnish surface during transport.
- c. Sample analysis at LANL in the 1986 through 1988 time frame would be under the same R and D procedures noted above in (b). If work were ongoing it would apparently be done under Data Control and Measuring and Test Equipment Control procedures, based on the information available.

If the above observations are correct then it appears that controls on field measurements and varnish analysis are probably adequate. However, samples collected prior to 5/1/87 may be in question because there were no procedural guidelines for their collection (ie. sampling sites, degree of varnish development etc.). In addition, the shipping of all samples shipped may be in question since abrasion protection was not included in the procedure until 1990.

Recommendations

1. The LANL notebooks developed under the R and D procedures should be audited in order to determine how samples were selected in the field prior to 5/1/87. If it can be shown that the same criteria for site and sample selection were followed prior to 5/1/87 as after the "sample collection procedure for rock varnish studies" was issued, then all samples can be considered valid.
2. All samples shipped should be examined for abrasion or other shipping damage to the varnish surface. If all samples show an intact varnish surface they can be considered valid.

In summary, based on the information provided, because of the unknown criteria for sample collection prior to 5/1/87 it is possible that technical results could differ if current procedures were followed. Similarly, potential shipping damage should be considered in accepting the technical results. I feel that if recommendations 1 and 2 are followed these issues can be resolved.

Sincerely,



Jeff McCleary
Technical Reviewer

JM:kcb

ENCLOSURE 1

DATE: May 18, 1992
TO: B. W. Distel
FROM: A. C. Matthusen 
SUBJECT: Technical Assessment Review for Erosion

The procedures received with the Technical Assessment Package were reviewed to assess the differences between the procedures in place at the time that the rock varnish and stream incision evaluation work were done and the procedures currently in place.

From the procedures reviewed, it is not possible to determine if the technical results would differ from the results that were determined. The procedures reviewed govern mainly the documentation of results and not the gathering and analysis of results.

For example, with regard to the USGS work, the documentation successively was governed by NNWSI-USGS-QMP-11.01, R0 (Preparation and Issuance of Tentative Technical Procedures); NNWSI-USGS-QMP-11.01, R1 (Preparation and Issuance of Tentative Technical Procedures); and currently by YMP-USGS-QMP-5.05, R2 (Scientific Notebook System). QMP-11.01 allows for the use of scientific notebooks to document investigations, but calls for the completion of a form for "Documentation of Tentative Procedure". This appears similar to the "Scientific Notebook Plan" currently required by QMP-5.05. However, the Documentation of Tentative Procedure, Scientific Notebook Plan, and the scientific notebooks that would govern the collection and evaluation of data were not included with this package to be evaluated. These materials are what need to be evaluated to determine if the procedures would differ. Additionally, the relevant scientific work should be captured in the scientific notebooks and the technical results could be evaluated against the current procedure for Scientific Notebooks to evaluate if the technical results would differ.

With regard to the work done by LANL, documentation successively was governed by TWS-MSTQA-QP-14, R0 (Quality Assurance for One Time Research and Development Work); TWS-MSTQA-QP-14, R1 (Research and Development (Experimental) Procedure; and currently by TWS-QAS-QP-03.5, R0 (Procedure for Documenting Scientific Investigations). Sample collection was governed by TWS-ESS-DP-114, R0 (Sample Collection Procedure for Rock Varnish Studies) after 5/1/87. It appears that prior to this time sample collection was governed QP-14, R0 and then QP-14, R1 and was documented in scientific notebooks. The analyses were apparently governed by scientific notebooks under QP-14 (and the LANL technical procedures for Scanning Electron Microscope, TWS-ESS-DP-112 and procedure for Rock Varnish Mounts, TWS-ESS-DP-120). The scientific notebooks apparently document the initial controlling data collection and analysis procedures. They need to be evaluated to determine if the procedures would differ. These scientific notebooks and the relevant scientific work and technical results captured in them should be evaluated against QP-03.5 to evaluate if the technical results would differ.

It should be noted that TWS-MSTQA-QP-14, R0 (Quality Assurance for One Time Research and Development Work) specifies that "Work accomplished in accordance

with this procedure cannot be used to support NNWSI licensing requirements without further upgrading. Upgrading must meet the criteria given in NVO-196-17." The superseding procedures do not have a similar stipulation. It would appear that if work done under QP-14, R0 meets the requirements of the later superseding procedures, then the requirement for upgrading would be satisfied.

There do not appear to be any valid reasons why any of these data can not be qualified under current QARD guidelines.



TRW Environmental
Safety Systems Inc.

101 Convention Center Drive, Suite P-110
Las Vegas, NV 89109
702/394-1511

WBS: 1.2.9.3

QA: QA

July 24, 1992

Contract #: DE-AC01-91RW00134
LV.NSQA.7/92.BRJ-036

B. William Distel
TESS/CRWMS M&O
101 Convention Center Drive, Suite P-110
Las Vegas, NV 89109

Subject: Technical Assessment for the Qualification of Data Evaluating
Extreme Erosion as an Issue for Possible NRC Licensing of the
Yucca Mountain Site

Enclosed is my report of subject Technical Assessment.

If you have any questions, please contact me at 794-1882.

Yours very truly,

B. Robert Justice, Jr.
Quality Engineering Manager
Management & Operating Contractor

Enclosure: Technical Assessment Report

Technical Assessment for the Qualification of Data Evaluating Extreme Erosion as an Issue
for Possible NRC Licensing of the Yucca Mountain Site

PURPOSE

This assessment was to determine if any differences between current applicable procedures and past applicable procedures which should be considered in accepting the technical results as qualified under current DOE QARD guidelines. The assessment will address the following questions as identified in the June 17, 1992 letter from B. William Distel to B. Robert Justice Jr.:

- "Would sample collection and evaluation under current participant technical procedures differ from those procedures actually followed?"
- "Are there any differences significant enough to affect technical results?"
- "Can a recommendation be made to DOE YMPO that the procedures used to gather and evaluate samples are acceptable to allow the technical data to be qualified under current QARD guidelines?"

This assessment addresses the procedures which were in place between 1985 and 1988 for the collection and analysis of rock varnish for erosion samples.

PROCESS

Performance of this task was accomplished by detailed review of the procedures in place during sample collection, evaluation and field measurements against current procedures in place for these same activities. The actual notebooks used to document activities referenced in this report were not available for review. This assessment does not intend to verify whether or not the procedures were followed in the execution of work, only whether procedural requirements were addressed.

ASSESSMENT

1. Would sample collection and evaluation under current participant technical procedures differ from those procedures actually followed?

Response - Inconclusive in that procedures for collection did not exist until 5/1/87. The procedure used for collection (TWS-ESS-DP-114, Rev.0) from 5/1/87 until 5/3/88 did not adequately address the handling of samples. The guidelines for determining collection areas were less restrictive than current requirements and

could have led to samples being collected from areas which may be unsuitable under current procedures. Additionally, there is no evidence of procedural guidelines for conducting the rock varnish for erosion analysis.

2. Are there any differences significant enough to affect technical results?

Response - Yes, in the area of handling the samples once they were collected. There was not any specific guidelines provided for the handling of samples until 5/3/88 when Change Request #29 to procedure TWS-ESS-DP-114, Rev. 0 became effective. Also, the lack of procedural processes for the collection and analysis of samples raises questions with respect to what processes were actually used and the consistency with which those processes were repeated.

3. Can a recommendation be made to DOE YMPO that the procedures used to gather and evaluate samples are acceptable to allow the technical data to be qualified under current QARD guidelines?

Response - A recommendation to accept the data based on the procedures provided for this assessment cannot be made. The obvious lack of procedural guidance in the early stages of this activity supports this conclusion. Other evidence may be available to support the processes used to accomplish the collection and analysis of samples. The notebooks, which have been used throughout this activity to document the work that was performed, may contain enough information to identify the processes used and the consistency with which they were repeated. These notebooks were not provided as part of the review package.

EVALUATION

I. Collection of Rock Varnish for Erosion Samples

A. Overview

During the time from 1985 to 5/1/87 there was not any procedural guidance in place for the collection of rock varnish for erosion samples. Procedure TWS-ESS-DP-114, Rev. 0 "Sample Collection Procedure for Rock Varnish Studies" was implemented 5/1/87. This is the only procedure which directly discusses sample collection. This procedure requires that a qualified geologist select the samples. The procedure as initially written is very general and addresses tools to be used in conduct of research but is devoid of direction on how to accomplish specific tasks. It leaves the methodology of the collection of samples up to the judgement of the person performing the activity. The information in the notebooks may provide some insight as to how these activities were performed. (The

reference to "notebook" throughout this report includes scientific notebooks, field notebooks, or laboratory notebooks. The work activity specifies the type of notebook to be used for documentation.)

B. Assessment Results

The major concerns in collection of rock varnish for erosion samples are (1) the lack of procedures prior to 5/1/87, (2) guidance for determining the locations to obtain samples, and (3) the marking of samples.

(1) Procedures did not exist for the collection of rock varnish samples prior to 5/1/87. Procedures were in place for records, field notebooks, handling and shipping, and document control. These procedures were generic for the applications covered and specific areas of concern are identified elsewhere in this report.

Conclusion - The lack of procedural guidance for collection of rock varnish samples generates concerns with respect to what activities were actually accomplished, the consistency with which the samples were obtained, and the controls utilized to ensure that the integrity of the samples was not compromised.

(2) The lack of procedural guidance until 5/1/87 allowed the individual(s) to apply sample collection techniques based on his/her experience. Procedure TWS-ESS-DP-114, Rev. 0 (5/1/87) provides some general guidelines to consider for the selection of sites for collection of samples as follows: "Sample sites are located on rock outcrops, on desert pavements formed on geomorphic surfaces, or on other stabilized geomorphic deposits." This procedure created some documented guidance for the collection of samples, but the directions were very general and left the person collecting samples to rely on their experience for this activity. Thus collection techniques would have differed from one person to another, creating inconsistency in obtaining samples.

Revision 1 of procedure TWS-ESS-DP-114 (effective 2/27/90) provides significant controls on the collection of samples as follows: " Samples of rock varnish are either collected as whole varnish coated surface clasts or as chips of varnished rock broken from surface clasts or outcrops of rock. The number of samples acquired for a surface depends on the degree of complexity of the surface but generally equals or exceeds eight. Samples are not collected in close proximity to lichens and other vegetation; to varnish formed along cracks; or rock surfaces in contact with soil. Wind-abraded and spalled rock surfaces are also avoided. Photographs may be taken to show the character of the surface from which the samples are taken and that portion of the surface from which the samples are collected. Rationale for sample collection is recorded in the investigator's

notebook." This revision provided clearer guidelines for the collection of samples and is in my opinion sufficient instruction for qualified persons to achieve consistency in the collection process.

Conclusion - Samples collected prior to 5/1/87 were not collected in accordance with any documented procedures. The samples collected between 5/1/87 and 1988 used procedure TWS-ESS-DP-114, Rev. 0 for this activity. This procedure provided very general guidelines for the collection of samples which could lead to inconsistency in collection techniques.

(3) Procedure TWS-ESS-DP-114, Rev. 0 and Rev. 1 require marking of samples as follows: "The sample will be marked by a permanent marking pen either on the sample itself, or on tape wrapping the sample, or on the sample bag."

Conclusion - Using this guidance, the validity of the analysis could be in question if the surface tested was the surface marked or the one that came in contact with the adhesive on the tape. The introduction of such impurities on the testing surface could produce unreliable results used for analysis. Good field practice is to only mark samples on the surface not being tested, but the procedure does not consider this as a condition of marking.

II. Handling Rock Varnish for Erosion Samples

Procedures existed for the handling, storage and shipping of items. Procedure TWS-MSTQA-QP-04, Rev. 2, "Handling, Storage and Shipping Procedure" was used from 4/2/85 until 4/5/88 when it was superseded by the issuance of TWS-QAS-QP-13.1, Rev. 0, "Handling, Storage and Shipping Procedure". These procedures are very general with a requirement that additional procedures be written to delineate the methods of control (TWS-MSTQA-QP-04) or require instructions be detailed in the technical procedures (TWS-QAS-QP-13.1). Evidence of procedural requirements for the handling, storage and shipping of samples other than "accomplished with appropriate care" were not identified in procedures until TWS-ESS-DP-114, Rev 0. Change Request #29 was implemented 5/3/88.

Procedure TWS-ESS-DP-114, Rev. 0 describes minimal controls on handling, storage and shipping of samples. These controls are targeted at tracking the sample rather than protection of the sample during the handling and shipping process. Change Request #29 (interim change) was processed and became effective 5/3/88 which provided more detail on the handling and shipping of rock varnish samples as follows: "Rock varnish samples shall be packed for shipment in a manner to preclude destruction of the varnished rock surface during transport. Each varnished clast will be individually wrapped in paper or other protective material and placed in a cloth sample bag on which sample identification

numbers will be marked by a permanent marking pen. Sample bags containing rock varnish samples will be hand carried to Los Alamos whenever possible. If sample bags containing rock varnish samples are shipped to Los Alamos, they shall be packed in heavy cardboard shipping containers sturdy enough to preclude crushing of samples during transport". This change was initiated as a result of Audit LANL- NNWSI-88-03. The audit did not indicate any problems associated with the handling and shipping, only that the criteria were not addressed. Even though the audit did not indicate that problems existed with the handling of the samples, there is a concern with respect to the processes actually used in handling and shipping of samples prior to specific procedural guidance being provided.

Conclusion - The proper handling of samples prior to 5/3/88 is questionable due to lack of procedural guidance. Samples not properly protected could encounter abrasions or be introduced to impurities which could have contaminated the surface conditions to an extent to cause unreliable results to be obtained.

III. Rock Varnish for Erosion Analysis

None of the procedures provided describe the methods or processes for this analysis. Procedure TWS-ESS-DP-114, Revision 0 and Revision 1, only makes reference to the principles behind this analysis.

Conclusion - Evidence of procedural guidance was not available for rock varnish analysis. The notebooks may be the only place where this is documented.

IV. Documentation

Procedure TWS-MSTQA-QP-14, Rev. 0, "Quality Assurance for One-Time Research and Development Work" initiated 5/22/85 and Revision 1 issued 5/19/86 discussed the laboratory notebook as the primary method of documentation. Revision 0 of this procedure did not identify any guidelines for specific information to be included in the notebook. Revision 1 (5/19/86) required a list of information to be included with notebook entries.

Conclusion - Even though procedural guidance or formal notebook format and content did not exist prior to 5/19/86, a comparison of notebook entries made prior to and subsequent to this date could determine if the required data was captured.

V. Field Measurements

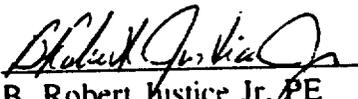
Field measurements are documented in Scientific Notebooks in accordance with USGS Quality Assurance Procedures. The procedure NNWSI-USGS-QMP-5.01, Rev. 1 (10/27/86) "Preparation of Technical Procedures" was identified as the applicable procedure for this activity.

Conclusion - This procedure addresses the preparation of other procedures to perform the activity, but does not provide any guidance on field measurements or the information which has to be captured in the notebook.

VI. Records

Although later procedures (TWS-QAS-QP-17.4, Rev. 0, "Records Preparation" and TWS-QAS-QP-17.5, Rev.0, "Records Processing", both initiated 2/28/92) provide for the preparation and retention of records, the procedure in place from 1985 to 1988 (TWS-MSTQA-QP-09, Rev. 0, "Records Control Procedure", initiated 1/3/84) provide controls for the maintenance of records. The notebooks were considered records and were required to be handled in accordance with quality assurance procedures.

Conclusion - The records control process is clearly defined and is not considered to be a problem.


B. Robert Justice Jr., PE

7/24/92
Date

101 Convention Center Drive
Suite P110
Las Vegas, Nevada 89109
(702) 794-1828
FAX (702) 794-1844

**Woodward-Clyde
Federal Services**



July 24, 1992

B. William Distel
Technical Assessment Chairperson
TRW Environmental Safety Systems, Inc.
CRWMS/M&O - Site Characterization
101 Convention Center Drive, Suite P-110
Las Vegas, NV 89109

Subject: Technical Assessment for Qualification of Data Evaluating Erosion Rates at Yucca Mountain. Examination of USGS field notebooks and interviews with USGS personnel in Denver, CO.

Dear Bill:

In May of 1992, at your request I evaluated procedures by LANL and the USGS relative to the collection and analysis of samples of desert varnish for cation-ratio dating. I observed during that evaluation that samples were collected prior to there being a formal procedure in place to guide the collection process. I recommended that field notebooks be examined in order to determine how samples were collected in the field prior to 5/1/87 when the procedure on sample collection became effective. As part of implementing that recommendation I, at your request, met in Denver with USGS personnel on July 14, 1992 to examine field notebooks and interview the principal investigator for the erosion studies. Present at the meeting were:

- Jeff McCleary, Woodward-Clyde Federal Services
- John Whitney, USGS, Principal Investigator
- Ardell Whiteside, USGS Quality Assurance
- Tom Chaney, USGS Quality Assurance.

The following observations were made:

- The current procedure requires that samples be collected:
 - from stabilized deposits or outcrops
 - that exhibit mature varnish development (darker)
 - that avoid cracks, lichens, etc.
 - that are not wind abraded or spalled.
- Samples were collected by the USGS (John Whitney) alone in 1984 and by the USGS and LANL jointly in 1985 and later. I therefore concentrated my examination on the 1984 notebooks.
 - The stabilized deposits are well described (slope angle, thickness, etc.) in each case.
 - Varnish maturity is not always described but it is noted often and it is apparent from the notebook as a whole that the intent was to sample darker (more mature) varnish.
 - The physical condition of the sample relative to cracks, lichens, abrasion, etc. was not well described. However, if

necessary the samples (at LANL) could be examined to determine their physical condition.

Based on the above observations of the procedures and notebooks and my discussions with John Whitney, it is my opinion that if the early sampling were repeated under current procedures, the results would not be significantly different.

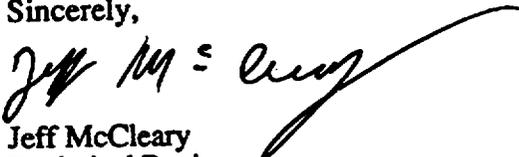
It is also worth noting that the early samples collected by the USGS alone have, in general, yielded age estimates that are younger than average. Therefore, eliminating the use of these samples would only support older deposits and slower erosion rates, a less conservative position relative to the regulations. In addition the overall argument on erosion rates does not hinge on the cation-ratio dating technique. U-series, U-trend, CI-36, and tephrochronology studies were also carried out and are in general agreement with the cation-ratio data.

In summary, I have made the following observations:

- USGS field notebooks document to a reasonable extent that the samples collected early in the study would also have been selected under the 5/1/87 procedure.
- Inclusion of the early data produces a slightly more conservative erosion rate relative to the regulations.
- Other dating studies carried out to address the erosion issue generally support the results of the desert varnish studies.

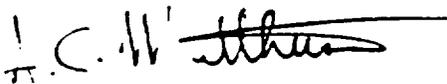
Therefore, it is my opinion that the cation-ratio dating of desert varnish can be used to support the project position on erosion rates at Yucca Mountain. If other assessment team members, or the project, still have concerns, other evaluations can be made with existing information and examination of the samples at LANL.

Sincerely,


Jeff McCleary
Technical Reviewer

JM/kcb

ENCLOSURE 2

DATE: July 24, 1992
TO: B. W. Distel
FROM: A. C. Matthusen 
SUBJECT: Technical Assessment Review for Erosion

To evaluate the technical data being used in support of the the issue resolution paper on erosion; I traveled to Los Alamos New Mexico, reviewed the available rock varnish dating documentation, and discussed the data documentation with Dr. Charles Harrington, the principal investigator at Los Alamos for rock varnish dating. The documentation materials reviewed include the following:

- 1) Field Notebooks. Two of Dr. Harrington's field notebooks document samples, sample collection, field sample identification numbers assigned, dates of collection, field personnel, collection rationale, hypotheses, and descriptions of sample collection localities for rock varnish samples for the Yucca Mountain Project. The first notebook (NB1) covered the period from 10/2/85 to 5/13/87. This notebook also included information on rock varnish projects not related to Yucca Mountain. The second field notebook (NB2) covers the period from 1/10/87 to 1990 and includes only Yucca Mountain related information. NB1 contains copies of pages from the field notebook of J. Whitney (USGS) documenting rock varnish sample collection activities in 6/84, 10/85, 11/85, and 7/86. NB1 also contains notes by Dr. Harrington regarding sample collection done in conjunction with J. Whitney for the previously mentioned dates after 10/85. NB2 is more detailed than NB1 and contains more detailed descriptions of samples, sample locations, collection rationales, and hypotheses. Samples and locations recorded in NB1 and NB2 are further documented in a Sample Tracking Notebook and maps.
- 2) Sample Tracking Notebook for rock varnish samples. Samples are recorded with field sample identification number, lab disk identification number (two disks of rock are cut from the field samples and cemented onto a glass slide for use in the scanning electron microscope [SEM] and a new lab disk identification number is assigned to the slide as the field sample identification is often too long to fit on the slide), geologic deposit name, description of sample, and samples are keyed to collection locations documented on topographic maps.
- 3) NNWSI Log Book. This notebook documents sample transfers and handlings for the ESS-1 group of Los Alamos National Laboratory from the time period 5/14/86 to 10/2/91. The first entry by Dr. Harrington was 6/3/87. The notebook has been technically reviewed five times between 1/15/88 to 10/2/91.
- 4) SEM Notebook Rock Varnish. Begun in 6/86 to document the SEM and energy dispersive X-ray analyzer (EDAX) work performed on the rock varnish samples. It begins by referencing the initial analytic procedure (Harrington and Whitney, in review; later published as Harrington and Whitney, 1987, "Scanning electron microscope method for rock-varnish dating," Geology, Vol. 15, pp. 967-970) and briefly describing the initial analytic procedure in the notebook. It describes specifics of the analyses and analytic results. The notebook also documents much additional pertinent information (e.g., on 9/22/86 the SEM machine was moved to a new location, a new run was done with a previously analyzed sample to

verify/compare new results to previous analytic results). Before a new series of runs, an old sample would be re-run to ensure similarity of results. Over the course of the experiment, the experimental methodology was refined. All changes in SEM settings in response to methodological refinements are documented (e.g., 9/22/86--the procedure was modified to ascertain penetration of the varnish coating without inclusion of the rock substrate, that is, to ensure that only the varnish is being sampled) and previous samples retested. The notebook has undergone frequent technical review by technical staff from Los Alamos (Carlos, Vaniman, Broxton, Maassen). Thirteen reviews are documented between 7/1/86 to 1/18/91. The last technical entry in this notebook was 11/14/90, it was reviewed 1/18/91, and was closed out 2/10/92. Additionally, the notebook documents changes in SEM programs used to deconvolute the data, hypotheses, changes in hypotheses, problems encountered, investigations pursued to resolve problems, data, and assumptions in methods.

5) The SEM samples (the rock disks on slides). These are retained in a locked cabinet in Dr. Harrington's office. The cabinet was opened and I observed the samples. One sample was checked for ID number and the ID number could be tracked to corresponding numbers in notebooks, maps, etc. In discussion, Dr. Harrington indicated that the rock samples from which the disks had been cut are also maintained in storage.

6) Computer generated printouts documenting output of the SEM analytic program from the rock varnish SEM runs. These are retained in binders in Dr. Harrington's office.

7) A computer file exists which details the links among Field ID sample number, disk ID sample number, and ID number used in the draft report on Colluvial Boulder Flows by Whitney and Harrington. A paper copy of this information was reviewed. This information is also included in the Sample Tracking Notebook.

8) U.S.G.S topographic maps marked to indicate the areas from which samples were collected and these areas on the maps labeled with corresponding sample ID numbers. These maps are retained on file in Dr. Harrington's office.

Prior to leaving for Los Alamos, I was asked to evaluate several questions regarding the rock varnish dating. The questions and the evaluations are as follows:

What techniques were used for sample collection?

Discussions with Dr. Harrington elicited that the technique used for sample collection was as described in Harrington and Whitney (1987) and in the Sample Collection Procedure for Rock Varnish Samples (TWS-ESS-DP-114).

Was a procedure followed?

The Sample Collection Procedure for Rock Varnish Samples was implemented in 4/87. Prior to that time the work was being done under the Quality Assurance Procedure for One-time Research and Development Work (TWS-MSTQA-QP-14, R0) implemented in 5/85 and Research and Development (Experimental) Procedure (TWS-MSTQA-QP-14, R1) implemented in 2/86. These procedures allow development work to be done and documented in notebooks.

What documentation exists?

The field notebooks, the sample tracking notebook, the NNWSI Log Book, the maps, and the samples themselves (all discussed prior) exist to document the sample collection and handling. Dr. Harrington stated that all rock varnish samples have been hand carried to Los Alamos, so use of the procedure for shipping samples has not been needed.

Were notebooks used?

As discussed prior.

Verify that notebooks have been reviewed.

The field notebooks and the Sample Tracking Notebook discussed above have not undergone a technical review to date. Dr. Harrington stated that they were viewed as work in progress and the activity is not yet terminated. The notebooks would be reviewed when they are closed out. The current procedure (TWS-QAS-QP-03.5, R0 Procedure for Documenting Scientific Investigations) indicates that "At a minimum, all notebooks and logbooks must be independently reviewed when they are completed or when the activity is terminated." It should be noted that in a Quality Assurance audit done at Los Alamos in 1990 (Audit 90-01) the field notebooks and the Sample Tracking Notebook were reviewed and found satisfactory by a technical auditor (technical checklist queries T-116 and T-118). The other notebooks have been reviewed as noted in the prior discussion.

Does the study conform to the "study plan?"

The "study plan" (document with accession number NNA.891003.0015) is not actually a study plan. At the time that the "study plan" document was written, it was unclear how the rock varnish work fit into the Yucca Mountain characterization program. Rock varnish dating is used in many different investigations, studies, and activities (e.g., erosion, climate, volcanic, etc.). When this document was prepared it was thought that rock varnish dating may be set up as a separate study. This document was later slightly revised to become a method and was attached to Study Plan 8.3.1.8.5.1, Characterization of Volcanic Features, as Appendix A. The rock varnish work done conforms to the "study plan" and goes farther. The SEM Notebook documents the work that has been done and changes in methodology, rationale, and hypotheses related to methodology.

Do the data comply to existing procedures? Previous procedures?

The data, documentation, and work comply to procedures governing scientific notebooks (Quality Assurance Procedure for One-time Research and Development Work {TWS-MSTQA-QP-14, R0} implemented in 5/85; Research and Development [Experimental] Procedure {TWS-MSTQA-QP-14, R1} implemented in 2/86; and Procedure for Documenting Scientific Investigations {TWS-QAS-QP-03.5, R0} implemented 3/10/89). These procedures allow development work to be done and documented in notebooks.

Additionally, the purpose of the Technical Assessment Notice requested that I

assess three questions. These are assessed as follows:

Would sample collection and evaluation under current participant technical procedures differ from those procedures actually followed?

No, they would not differ.

Are any differences significant enough to affect technical results?

No, there are not significant differences.

Can a recommendation be made to DOE YMPO that the procedures used to gather and evaluate samples are acceptable to allow the technical data to be qualified under current QARD guidelines?

Yes. The procedures for gathering and evaluating samples and the documentation of the gathering and evaluation of samples allow the data to be qualified. The documentation of sample and data collection would allow a knowledgeable person to retrace the investigation and confirm the results. The same documentation would allow a peer of Dr. Harrington to repeat the investigation and achieve comparable results without recourse to Dr. Harrington. From my review of the documentation I recommend that the data be accepted.

PEER REVIEW REPORT ON ROCK-VARNISH STUDIES WITHIN THE
YUCCA MOUNTAIN PROJECT--LOS ALAMOS NATIONAL LABORATORY,
EARTH AND SPACE SCIENCES DIVISION,
GEOLOGY AND GEOCHEMISTRY GROUP (ESS-1)

August 1989

Peer Review Group

Peter W. Birkeland, Ph.D., Professor of Geology, Department of
Geosciences, University of Colorado, Boulder, CO 80309-0205
Ted M. Oberlander, Ph.D., Professor of Geography, Department of
Geography, Earth Science Building, Berkeley, CA 94720
John W. Hawley, Ph.D., Senior Environmental Geologist, New Mexico
Bureau of Mines and Mineral Resources, New Mexico Institute
of Mining and Technology, Socorro, NM 87801; Group Chairman
and Report Compiler

INTRODUCTION

At the invitation of Wayne A. Morris, Leader of the LANL Earth and Space Sciences Division, Geology and Geochemistry Group (letter of June 9, 1989--Appendix A), the above-named peer review group met at Los Alamos National Laboratory on June 26 and 27, 1989 to critically review rock-varnish studies within the LANL Yucca Mountain Project. We were asked to "address, where appropriate, the validity of assumptions, alternate interpretations, uncertainty of results, appropriateness of methodology, adequacy of application, and validity of conclusions within the rock varnish work. A peer review report documenting the results of the peer review, including comments, suggestions, and conclusions is required . . ."

Scheduled activities on the morning of June 26 started with an orientation session on LANL rock varnish studies with P.I. Charles Harrington and ESS-1 Group Leader, Wayne Morris, and concluded with a tour of laboratory facilities. An "Organizational Diagram" (Appendix B--Item A) shows major components of, and key personnel in the LANL rock-varnish dating program. Also included in Appendix B is an annotated list of supporting documents given to us prior to or during the 2-day review session. Item B in Appendix B is a "progress report on rock varnish work" by Chuck Harrington that covers much of the material presented in the orientation session. The tour of office and laboratory facilities that followed emphasized sample preparation, physical and chemical analysis, and Quality Assurance record procedures (including very thorough sample archival operations). David Mann (head of the rock-sample-preparation and thin-section laboratory), Robert Raymond (with overall responsibility for rock-varnish geochemistry investigations), and Roland Hagan (SEM-XRF-Microprobe specialist) explained their respective roles in rock varnish studies during the course of the tour. They were also available throughout our

visit for in-depth discussions and demonstrations of the very impressive LANL/ESS-1 laboratory capabilities.

On the afternoon of June 26, Chuck Harrington presented detailed overviews (illustrated with numerous slides of field research areas) of his draft "study plan for rock-varnish dating of geomorphic surfaces" (Appendix B--Item C) and his "sample collection procedure for rock varnish studies" (Appendix B--Item D). The latter, formally set forth in a standard operating procedure document, has been used successfully for the past two years. Robert Raymond then joined us for an expanded discussion of analytical work being done to help resolve the "barium problem," and he described recent work he has initiated (with Chuck Harrington and Steve Reneau) on manganese-enriched stromatolitic structures within rock-varnish micro-basins (Appendix B--Item I).

We spent most of the morning of June 27 in the ESS-1 SEM Laboratory participating in an in-depth review of analytic techniques and demonstration of SEM analyses of representative rock varnish samples by Chuck Harrington. We were also able to track several rock-varnish test specimens from Dave Mann's sample preparation laboratory through various stages of SEM analysis. Our review included an extended discussion with Roland Hagan on the exciting potential for greater use of the microprobe in rock-varnish analysis.

The final meeting of the peer review group on the afternoon of June 27 included closing discussions with P.I. Chuck Harrington, co-workers Robert Raymond and Roland Hagan, and ESS-1 Group Leader Wayne Morris. We then met privately to discuss preparation and organization of the final peer review report, following the broad guidelines set forth in Wayne Morris' June 9, 1989 request for assistance (Appendix A), and the division of responsibility in this critique of the LANL rock varnish studies within the Yucca Mountain Project.

The bulk of the following text is by Ted Oberlander and Pete Birkeland, with comments by John Hawley on "Sample Collection Procedures" in the section on "Methodology and Suggestions for Additional Work." Expanded comments on basic VCR assumptions and competing analytic methods are mainly by Oberlander; and Birkeland contributed most of the comments on calibration. Hawley wrote the introductory section and was responsible for report organization and compilation. The "Conclusions" section is a joint effort; and the entire report represents a consensus statement by our group.

VALIDITY OF ASSUMPTIONS

The fundamental assumption of this project is that derivation of the maximum age of a 10- to 300-micrometer-thick film of microbially-produced rock varnish establishes the minimum age for the rock surface underlying the varnish, whether this

surface is a human artifact, an erosional feature, the clasts exposed on an alluvial or colluvial deposit, or a tectonically-generated surface such as a fault scarp. The principal question for this panel is whether the procedures employed in the research at Los Alamos do correctly establish the approximate age of rock varnish films.

VCR Computation

Varnish films are accretionary products, older at the base and younger at the surface, with the different levels having experienced varying numbers of climatic oscillations and associated leaching regimes.

The use of the "cation ratio" (CR) as an index of the approximate age of rock varnish is predicated on the tendency of rock varnish to incorporate the range of elements composing the local dust flux, and that the proportion of less mobile elements increases over time as more mobile cations are partially leached. The cation ratio $[(Ca+K)/Ti]$ is based on the well-established immobility of TiO_2 , which is sufficiently abundant to be represented in all varnish films, and the mobility of the leachable cations, K and Ca. Na and Mg are not measured because elements lighter than Al are not recorded accurately by the micro-analytical techniques used to characterize rock varnish chemistry. The CR determination obviously requires extremely accurate measurement of the key varnish constituents Ca, K, and Ti.

The hypothesis that varnish leaching actually occurs (expressed as a cation ratio) seems to have been validated by comparison of CRs on volcanic rocks having K/Ar ages ranging from 40 ka to more than 1,000 ka (Dorn, 1983; Harrington and Whitney, 1987). Three such studies have indicated linear relationships between varnish CRs and the logarithms of the K/Ar ages of the rocks in discrete volcanic fields. The specific leaching mechanisms and kinematics affecting varnish films are not known, and the accumulation of other stable residues (in addition to TiO_2) has not been investigated.

We can suggest two major areas for future research:

1. In studies of soil and rock weathering profiles, Ti also is used as an immobile element (see review in Birkeland, 1984). However, in work with weathering profiles it has to be proven that Ti content is constant with depth in the profile, or between profiles being compared. This can be demonstrated only by immobile element: immobile element ratios. In future VCR studies one could use Ti:Zr or Ti:Y ratios from microprobe analyses of some varnishes to be certain that Ti content is indeed constant.
2. Apparently bulk density of varnish can also be

determined. If this can be done routinely, perhaps one could follow what is done with soils and weathering profiles and calculate something like gm Ca depleted per cm^2 per 10^5 yr. One could then compare these results with those obtained by the VCR ratio as presently calculated to determine which method is best.

VCR Curve Calibration

Wherever a CR is used to estimate the age of a surface, the cation-ratio curve (CRC) must be tied to one or more local calibration points. K/Ar or Ar/Ar ages of varnished volcanic flows or clasts, or fission-track ages of associated tephra units are ideal and being used; but U-trend dates are likewise employed in the present research. For example, the VCR curve for the Yucca Mountain Project is based on 5 calibration points. The two oldest points are for K/Ar dated lava flows, and so should be reliable. The three younger points are for Uranium-trend-dated alluvium. The Uranium-trend-dating method seems to give reasonable age estimates for a variety of deposits and environments, but has been published only as a U.S.G.S. Open-File Report (and thus without rigorous peer review). It is also an empirical method calibrated to "dated" deposits whose true age may or may not be well established, and going into the U-trend method in detail is beyond the scope of this report. What gives the Yucca Mountain Project VCR curve validity is that it plots as a straight line when plotted against log age, as do all other published VCR curves.

The principal competing advocate of CR-dating also derives radiocarbon dates for very thin late Quaternary varnishes through accelerator mass spectrometer (AMS) analyses of varnish carbon in what is defined as the "basal layer". To get to this layer, one has to remove the "upper 90 percent" of the varnish thickness with a sharp-pointed tungsten-carbide needle. We feel that AMS radiocarbon dates are innately questionable in view of the impossibility of scraping to a layer of uniform age in a micrometers-thick varnish film of widely-varying depth that has been deposited over an uneven substrate.

Chemical Analysis of Varnish and Substrate

A major difference between the Los Alamos study of rock varnish and the previous methodology (Dorn and Oberlander, 1982; Dorn, 1983) is the means of chemical analysis of the varnish film. The originators of the CR procedure scraped the varnish film from the substrate and bombarded the resulting powder with a proton beam to give a proton-induced x-ray emission (PIXE) analysis of all included elements heavier than neon. This procedure was first developed to characterize trace elements in very small samples (nanograms/ cm^2). PIXE analysis is not as successful in measuring major elements precisely, and in

distinguishing elements having nearly coincident x-ray lines at different electron energy levels. Thus, in a PIXE analysis the Ti critical to the CR is difficult to distinguish from both V (rare in varnish) and Ba (abundant in varnish). Although both SEM and electron microprobe analyses of intact varnish films indicate Ba in all varnish--in amounts often exceeding Ti, Ca, and even Fe--Ba has not been recorded in numerous PIXE analyses of varnish powders, and may in fact be misidentified as Ti, invalidating the (Ca + K)/Ti computation.

In the Los Alamos study intact varnish films and their substrates are examined morphologically and characterized chemically by scanning electron microscopy with energy-dispersive x-ray analytical capabilities (SEM-EDAX) which allows repeat observation and measurement, as well as "zoomed" examination of anomalies and questionable spectral signatures. This is supplemented with electron microprobe analysis to distinguish Ba from Ti, and x-ray diffraction (XRD) analysis of vertical and lateral variations in varnish composition.

METHODOLOGY AND SUGGESTIONS FOR ADDITIONAL WORK

We are impressed by the scrupulous handling of specimens and by the detailed record of operations at every stage from sample collection to microanalysis. Accordingly, the history of any analysis can be retraced in detail from the field to the SEM. To the point of getting samples into the SEM for analysis, it appears that the current procedures could not be improved upon, except as noted below.

Sample Collection Procedure

VCR sample collection procedures involving sample site selection and identification, and sample collection, identification, and shipment were established for the Yucca Mountain Project in May 1987 (Appendix B, Item D). Not specifically defined, but clearly implied, in the standard-operating-procedure document (and in Harrington and Whitney, 1987) is the requirement that varnished clasts or chips of varnished rock be sampled 1) from surficial deposits associated with mappable assemblages of erosional and/or constructional landforms that are definable in temporal and genetic terms (geomorphic surfaces), or 2) from outcrops of suitable bedrock units (e.g., datable upper Cenozoic volcanics). The "geomorphic surface" concept used here follows standard practice in modern pedologic-geomorphic research in arid and semiarid parts of the western states (Gile and others, 1981).

Improvements can always be made in the quality of our understanding of a given geomorphic and surficial-geologic setting. However, VCR curve-calibration efforts to date have generally been restricted to areas where relevant field relationships have already been defined on the basis of

independent geologic, geomorphic, and pedologic studies. The one area where significant improvement could readily be made is in the basic mechanics of collecting chips of varnished rock (from large clasts or outcrops). Portable coring equipment should be available to field personnel so that they can obtain the best possible varnished specimens for laboratory analysis, no matter where the sampled surface is located. In many field situations, rock hammer and chisel methods are not suited for the precision sampling required for rock varnish work.

VCR Curve Calibration

Calibration needs to be a continuing part of the project, especially as more detailed field work or discussions with other workers suggest potentially good sites. Additional calibration points should use all suitable dating methods (tephrochronology, magnetostratigraphy, K/Ar, Ar/Ar, U-trend, U-series, thermoluminescence, etc.), particularly in a collaborative effort with the U.S.G.S. One potential new calibration site is Fish Lake Valley in central Nevada, where Marith Reheis (USGS) and Janet Slate (U. Colorado) are developing a detailed stratigraphy of alluvial fan deposits and documenting soil/geomorphic-surface relationships. Almost all of the deposits can be dated by association with volcanic ashes. Although Fish Lake Valley is in an environment different than Yucca Mountain, but still semi-arid, perhaps a VCR curve for that area would add credence to the curve used for the southern Nevada Test Site.

Geochemical Studies

We are impressed with and encouraged by the geochemical studies underway. One common criticism of the VCR method is that it does not rest on a good theoretical basis. For example, where do the Ca and K go, if they really are being depleted; or where do the massive amounts of Mn and Fe come from? The on-going studies on the chemistry and mineralogy of dust, on both a regional and micro (within varnish) basis, will help address these concerns. Planned biogeochemical research on the role of microbes (Dale Couce?) and amino acid components (Tom Stafford?) should be started as soon as possible.

The technique of deriving an average chemical composition for the varnish film (by penetrating the varnish normal to its surface with increasing electron energies until the Mn concentration peaks and begins to decline) does not seem entirely convincing in practice. It appears impractical to increase the electron voltage much beyond 30 keV (above which x-ray excitation decreases), but our observation of the SEM procedure left us unsure whether the thicker varnish films had indeed been fully averaged (completely penetrated) at 30 keV. We would feel more secure seeing a marked change in chemistry as the varnish substrate begins to be penetrated. This would require more than 40 keV--regarded as the practical limit of the technique.

Supplemental microprobe analyses, discussed in the next paragraph, may help resolve problems involving characterization of particularly thick varnish films.

The consistency of their results suggests that the Los Alamos investigators know by experience when the varnish is correctly averaged--without requiring an obtrusive display of substrate contamination. Nevertheless, we believe that there should be a check on the procedure. This could be done by expanding the role of the electron microprobe that is already employed in verifying the relative proportions of Ba and Ti in the varnish--a crucial consideration in CR dating (see note on Ba in conclusions). We suggest that for some rocks sampled, a chemical transect of the varnish film, normal to the surface, be made by electron microprobe, at intervals of 2 to 5 micrometers. The transect could be closely related to the SEM analysis by splitting off a margin of the SEM wafer and rotating it 90 degrees so that the varnish layer is viewed in cross section by the microprobe. Such a procedure would permit the problematical Ba to be compared to Ti throughout varnish transects, and reveal any significant chemical stratifications or associations at the same time that the full varnish chemistry is averaged as a check on the SEM-EDAX average. We realize that production of such transects is time-consuming, and thus suggest that they be used only as a periodic independent check on SEM-EDAX results, not as the major analytical procedure. Once the transect location is determined, the transect itself is purely mechanical and could be performed by support personnel. This would require an increase in time allotted to the varnish project by the microprobe specialist.

ADEQUACY OF APPLICATIONS

The "Study plan for rock varnish dating of geomorphic surfaces (APPENDIX B, Item C)" describes the kind of studies being pursued with rock varnish data. The VCR method is appropriate for age estimation of deposits as outlined in the seven studies of the study plan.

CONCLUSIONS

We are in agreement that the procedure for rock varnish age-determination at Los Alamos will set the standard for future work in this area. However, it is disturbing to us that the Quality Assurance Program, for all the good intentions, has resulted in a doubling of the time needed to produce VCR age estimations. We would hope that some streamlining of "paper trail" procedures can be done so that the time needed for age determinations can be significantly decreased, not increased.

We urge expanded use of the electron microprobe to produce varnish transects and chemical averages as a check on SEM results, particularly where thick varnish films may not be fully

(or unequivocally) penetrated by the 30 keV electron beam. As the enhancement of Ba in varnish, relative to ambient levels, is 1) frequently as great as that of Mn, 2) complicates the quantification of Ti, and 3) provokes questions on the relative merits of PIXE vs SEM-EDAX and electron microprobe analyses, work should be done to clarify the physical nature and mineralogy of the Ba present, its mode of enhancement, and its long-term stability in rock varnish films. The behavior of immobile elements (in addition to TiO_2) should be investigated to better define the leaching process that is the basis of cation-ratio dating.

We are impressed with the excellent work being done on VCR age determination by the LANL research and technical staff and their associates at the U.S.G.S. and the University of New Mexico. The members of this high-quality team, primarily in the ESS-1 Group, are extremely careful in all phases of the work, from the initial field sampling, through the laboratory work, to the final age estimation. Moreover, they are adequately cautious in terms of recognizing and dealing with the limitations of the method. We conclude that the VCR age determinations by C. D. Harrington and his collaborators are the best presently being done. We also encourage them to continue their pursuit of other aspects of VCR dating, as given in the reports cited in Appendix B (items B, C, and G).

REFERENCES CITED

- Birkeland, P. W., 1984, Soils and geomorphology: New York, Oxford University Press, 372 p.
- Dorn, R. I., 1983, Cation-ratio dating: A new rock varnish age-determination technique: Quaternary Research, v. 20, p. 49-73.
- Dorn, R. I., and Oberlander, T. M., 1982, Rock varnish: Progress in Physical Geography, v. 6, p. 317-367.
- Gile, L. H., Hawley, J. W., and Grossman, R. B., 1981, Soils and geomorphology in the Basin and Range area of southern New Mexico; guidebook to the Desert Project: New Mexico Bureau of Mines and Mineral Resources, Memoir 39, 222 p.
- Harrington, C. D., and Whitney, J. W., 1987, Scanning electron microscope method for rock-varnish dating: Geology, v. 15, p. 967-970.

APPENDIX A

Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

June 9, 1989
ESS-1, Geology/Geochemistry
MS D462
(505) 667-7590

WBS 1.2.3.2.3
QA N/A
TWS-ESS-1-6-89-6

Dr. John W. Hawley
New Mexico Bureau of Mines and Mineral Resources
Socorro, NM 87801

Dear Dr. Hawley:

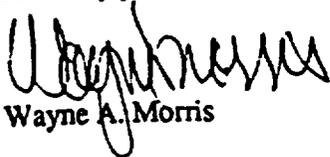
SUBJECT: PARTICIPATION IN PEER REVIEW OF ROCK VARNISH STUDIES

The Geology and Geochemistry Group in the Earth and Space Sciences Division of Los Alamos National Laboratory invites you to participate in a peer review of the program "rock varnish studies" within the Yucca Mountain Project at Los Alamos as a member of the peer review committee.

The peer review of rock varnish work at Los Alamos is being conducted because it is a new dating method involving relatively untested analytical procedures for which detailed technical criteria are not yet developed and for which there is disagreement within the technical community regarding the applicability or appropriateness of alternate means of deriving the scientific information. The peer review group will consist of individuals who are knowledgeable of, but independent of, the original work to be reviewed to assure the work is impartially reviewed. The peer review group will address, where appropriate, the validity of assumptions, alternate interpretations, uncertainty of results, appropriateness of methodology, adequacy of application, and validity of conclusions within the rock varnish work. A peer review report documenting the results of the peer review, including comments, suggestions, and conclusions is required following the peer review.

If you are willing to serve on the peer review committee, your arrival at Los Alamos is requested on June 25, 1989. The peer review of rock varnish work at Los Alamos will take place on Monday, June 26, and the morning of June 27 with scheduled departure from Los Alamos possible either late on June 27 or the morning of June 28. The Geology Group will make housing arrangements for you, if requested. Reimbursement for expenses will be made according to Laboratory travel regulations; travel to and from Los Alamos, up to the cost of a round trip coach airline fare and per diem expenses while in Los Alamos will be paid for participation in the peer review. We hope that you will be able to participate in this activity and look forward to your visit in Los Alamos during June 25-27.

Sincerely yours,


Wayne A. Morris

WAM:maj

Cy: TWS File, MS D462
RPC File, MS J521 (2)
CRM-4, MS A150
ESS-1 File

APPENDIX B

List of Supporting Documents Provided to Peer Review Group,
with notes on general content where appropriate.

- A. Organizational Diagram of LANL Rock-Varnish Studies Program showing primary tasks of key scientific personnel (page 2).
- B. Progress Report on Rock-Varnish Work by Charles D. Harrington

This undated overview of rock-varnish studies for the Yucca Mountain Project comprises:

1. Neotectonics. These studies assist in establishing the number of faulting events and in constraining their timing and include dating of geomorphic surfaces disrupted by faulting or formed by post-tectonic sedimentation.
2. Erosion studies. Determination of timing and rate of erosion of bouldery colluvium from Yucca Mountain slopes.
3. Paleoclimate studies. Paleoclimate/paleoenvironment studies use ages of hillslope, fluvial and eolian deposits to construct and refine a chronology of inferred climatic transitions for the Yucca Mountain area.
4. Volcanism and tectonics. Studies of recent volcanism and associated tectonic events include assessment of the timing, aerial extent, and complexity of volcanic eruptive episodes at volcanic centers near Yucca Mountain.
5. Rock-varnish geochemistry studies and refinement of rock-varnish dating curve. Determine geochemical basis for and processes operative in varnish formation and cation depletion with increasing varnish age.

- C. Preliminary Draft of Study Plan for Rock-Varnish Dating of Geomorphic Surfaces (NNWSI-LANL--SP 1.2.3.2.3.A)

This draft study plan defines the nature of rock-varnish studies during characterization of the Yucca Mountain repository site in support of SCP activities including:

1. Analysis of the paleoenvironmental history of the YM region (Study 8.3.1.5.1.4)
2. Distribution and characteristics of present and past erosion (Study 8.3.1.6.1.1)

ROCK VARNISH STUDIES
ROCK VARNISH DATING OF
GEOMORPHIC SURFACES

C.D. HARRINGTON, P.I.

NEOTECTONICS
EROSION,
PALEOCLIMATE

J. WHITNEY, P.I.
NEOTECTONICS U.S.G.S.

VOLCANISM
TECTONICS

B. CROWE, P.I.
VOLCANISM AND TECTONICS

D. KRIER
ROCK VARNISH DATING OF
GEOMORPHIC SURFACES

R. RAYMOND JR.
GEOCHEMISTRY OF ROCK VARNISH

F. PERRY
S. WELLS
L. McFADDEN

D. BISH - XRD

R. HAGAN - SEM, XRF

S. CHIPERA - XRD

P. SNOW - MICROPROBE

2

3. Characterization of volcanic features (Study 8.3.1.8.5.1)
4. Quaternary faulting within 100 km of Yucca Mountain, including the Walker Lane (Study 8.3.1.17.4.3)
5. Quaternary faulting proximal to the site, within northeast-trending fault zones (Study 8.3.1.16.4.4)
6. Quaternary faulting within the site area (Study 8.3.1.17.4.6)
7. Tectonic geomorphology of the YM region (Study 8.3.1.17.4.9).

The Draft Study Plan also includes expanded statements on:

1. The rationale for the overall study approach addressing concerns such as types of measurement selected and constraints related to field sampling.
2. Sample collection and preparation activity
3. Descriptions of tests and analyses
4. Schedule and "Milestones"

Of particular note is the discussion in section 2.3 (p. 3-4) on the rationale and advantages for selecting the SEM method of Harrington and Whitney (1987) for rock varnish analysis over the "scraping-PIXE" method (Dorn, 1983).

- D. Sample Collection Procedure for Rock Varnish Studies (TWS-ESS-DP-114, RO, April 14, 1987) by Charles D. Harrington

This standard-operating-procedure document contains brief statements on the purpose, scope, and principles of rock varnish dating, and expanded descriptions of quality assurance procedures for:

1. Sample site selection and identification
2. Sample collection and identification
3. Sample shipment

- E. Reprints of Refereed Journal Articles on Rock-Varnish Dating

1. Harrington, C. C., and Whitney, J. W., 1987, Scanning electron microscope method for rock-varnish dating: *Geology*, v. 15, p. 967-970.

2. Harden, J. W., Reheis, M. C., Sowers, J. M., and Slate, J. L., 1988; and Harrington, C. D., Dethier, D. P., and Whitney, J. W., 1988, Comment and Reply on above paper, *Geology*, v. 16, p. 1051-1052.
 3. Dethier, D. P., Harrington, C. D., and Aldrich, M. H., 1988, Late Cenozoic rates of erosion in the western Española basin, New Mexico: Evidence from geologic dating of erosion surfaces: *Geological Society of America Bulletin*, v. 100, p. 929-937.
- F. Abstracts of Oral and Poster Presentations at 1988 GSA and AGU Fall Meetings
1. Harrington, C. D., 1988, Recognition of components of volcanic ash in rock varnish and the dating of volcanic ejecta plumes (GSA)
 2. Raymond, R., Jr., Harrington, C. D., Bish, D. L., and Chipera, S. J., 1988, Mineralogic characterization of rock varnish from Nye County, southern Nevada (GSA)
 3. Whitney, J. W., and Harrington, C. D., 1988, Middle Pleistocene colluvial boulder flows on Yucca Mountain in southern Nevada (GSA)
 4. Harrington, C. D., and Whitney, J. W., 1988, Age discrimination of low relief geomorphic surfaces by varnish cation ratios (AGU)
 5. Raymond, R., Jr., Harrington, C. D., and Bish, D. L., 1988, Role of geologic substrate in rock varnish formation (AGU)
- G. Letter Report (TWS-ESS-1-6-8-89-8) on Calibration of the Holocene Part of the Yucca Mountain Rock Varnish Dating Curve by Charles D. Harrington
- H. Preliminary Draft of Paper on Relict Colluvial Boulder Deposits: Indicators of Climate Change and Slope Stability on Southern Nevada Hillslopes by John W. Whitney and Charles D. Harrington
- I. Abstract of Poster Presentation for 1989 Fall Meeting of GSA:
- Raymond, R., Jr., Harrington, C. D., and Reneau, S. L., An SEM view of rock varnish sedimentary micro-basins.

YMP-054-R0 YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT OFFICE
7/12/91
DOCUMENT APPROVAL SHEET

Title: QUALIFICATION OF EXISTING DATA
NO. AP-5.90
[X] Q
[] Non Q

APPROVAL

PROJECT MANAGER: Original signed by Carl P. Gertz 4/2/89
Signature Date

DIRECTOR OF QUALITY ASSURANCE: Original signed by James Blaylock 3/31/89
Signature Date

N/A : N/A N/A
(OTHER, AS REQUIRED) Signature Date

REVISION 0 EFFECTIVE DATE: 4/19/89

REVISIONS

	INITIAL AND DATE			
	REVISION 1	REVISION 2	REVISION 3	REVISION 4
PROJECT MANAGER: <i>fn</i> C. P. Gertz 6/15/90		<i>Maxwell Blaylock</i> 7-23-92		
DIRECTOR, QA: D. G. Horton 6/15/90		<i>RC Vance</i> 7/25/92		
N/A (OTHER, AS REQUIRED)	N/A	N/A		
EFFECTIVE DATE: 7/5/90		8/10/92		

Complete Revision



TRAINING REQUIRED YES N/A NUMBER OF DAYS REQUIRED FOR TRAINING 10

COMMENTS: self study for personnel required to maintain training. Discussed with M. Pendleton, 7/27/92, 10:15 AM 7/27/92

9303110105 930224
PDR WASTE PDR
WM-11

Paul Rademil EOR
RAM
TRAINING OFFICER/TRAINING MANAGER 7/27/92
DATE

1.0 PURPOSE AND SCOPE

1.1 PURPOSE

This procedure describes the methods to be used by the Yucca Mountain Site Characterization Project Office (YMPO) for the qualification of existing data that will be used directly to establish a licensing position and for which no alternative qualified data can be used. The determination of which existing data may need to be qualified and the methods for qualification will be made on a case-by-case basis throughout site characterization as components of the license application are prepared.

2.0 APPLICABILITY

This procedure applies to existing data that will be used to evaluate systems, structures, and components important to safety and for the characterization of natural barriers and the design and development of engineered barriers important to waste isolation.

3.0 DEFINITIONS

3.1 CONFIRMATORY TESTING

An evaluation conducted under a 10 CFR 60, Disposal of High-Level Radioactive Waste in Geologic Repositories, Subpart G or equivalent Quality Assurance (QA) program that investigates the properties of interest of an existing data base.

3.2 CORROBORATIVE DATA

Existing data used to support or substantiate other existing data.

3.3 EQUIVALENT QUALITY ASSURANCE PROGRAM

A QA program that is similar in scope and implementation to a 10 CFR 60, Subpart G, QA program.

3.4 EXISTING DATA

Data developed prior to the implementation of a 10 CFR 60, Subpart G, program by the U.S. Department of Energy (DOE) and its contractors, or data developed outside the DOE repository program, such as by oil companies, national laboratories, universities, or data published in technical or scientific publications. Existing data does not include information which is accepted by the scientific and engineering community as established facts (e.g., engineering handbooks, density tables, gravitational laws, etc.)

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT PROCEDURE

Procedure No.: AP-5.9Q
QUALIFICATION OF EXISTING DATA

Revision:
2

Page 3 of 7

3.5 QUALIFICATION OF DATA

A formal process intended to provide a desired level of confidence that the data are suitable for their intended use.

3.6 QUALIFIED DATA

Data initially collected under a 10 CFR 60, Subpart G Quality Assurance Program or existing data qualified in accordance with this procedure.

4.0 RESPONSIBLE PARTIES

The following YMPO individuals or organizations are responsible for activities identified in Section 5 of this Procedure:

1. YMPO Division Director (DD)
2. Technical Assessment Chairperson (TAC)
3. Peer Review Chairperson (PRC)
4. Participant Technical Project Officer (TPO)
5. Principal Investigator (PI)

5.0 PROCEDURE

NOTE: A flowchart of the following process described in this procedure is attached as Figure 1.

<u>RESPONSIBLE PARTY</u>	<u>STEPS</u>	<u>PROCEDURE</u>
DD	1.	Identify an existing data set that will be used directly to establish a licensing position. Initiate a technical assessment (TA) or a peer review to determine if these data are suitable for use in licensing in accordance with applicable procedures.
	NOTE:	Review criteria for a TA may include an equivalent QA program, confirmatory testing, and corroborative data.
	NOTE:	Peer review shall be implemented when the suitability of procedures, methods, or adequacy of existing data cannot be

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT PROCEDURE

Procedure No.: AP-5.9Q
QUALIFICATION OF EXISTING DATA

Revision:
2

Page 4 of 7

<u>RESPONSIBLE PARTY</u>	<u>STEPS</u>	<u>PROCEDURE</u>
DD		verified using established standards and practices.
	NOTE:	Attachment 1 lists relevant questions to be considered throughout the qualification process.
TAC/PRC	2.	Complete a TA or peer review in accordance with appropriate procedures. The documentation of these reviews shall include a description of the qualification methodology, the results of the review, and a recommendation for/against qualification of the existing data set.
DD	3.	Review the recommendation for qualification and send instructions to the TPO/PI. a. If the existing data set is qualified, instruct the affected TPO/PI to update project data bases in accordance with applicable procedures. b. If the data set is not qualified, provide instructions to the TPO/PI (e.g., perform confirmatory testing and perform a new TA or peer review using confirmatory data).

6.0 REFERENCES

6.1 REQUIREMENTS DOCUMENTS

Quality Assurance Requirements Document, Office of Civilian Radioactive Waste Management, DOE/RW-0214

Quality Assurance Program Description Document, Office of Civilian Radioactive Waste Management, DOE/RW-0215

NRC Generic Technical Position, Qualification of Existing Data for High-Level Nuclear Waste Repositories, NUREG 1298

YMP-053-R0
7/12/91

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT PROCEDURE

Procedure No.: AP-5.9Q
QUALIFICATION OF EXISTING DATA

Revision:
2

Page 5 of 7

6.2 INTERFACE DOCUMENTS

QMP-02-08, Technical Assessment

QAAP 3.3, Peer Review

AP-5.2Q, Technical Information Flow to and from the Site and Engineering Properties Data Base

AP-5.3Q, Information Flow Into the Reference Information Base

AP-1.18Q, Records Management: Las Vegas Record Source Implementation

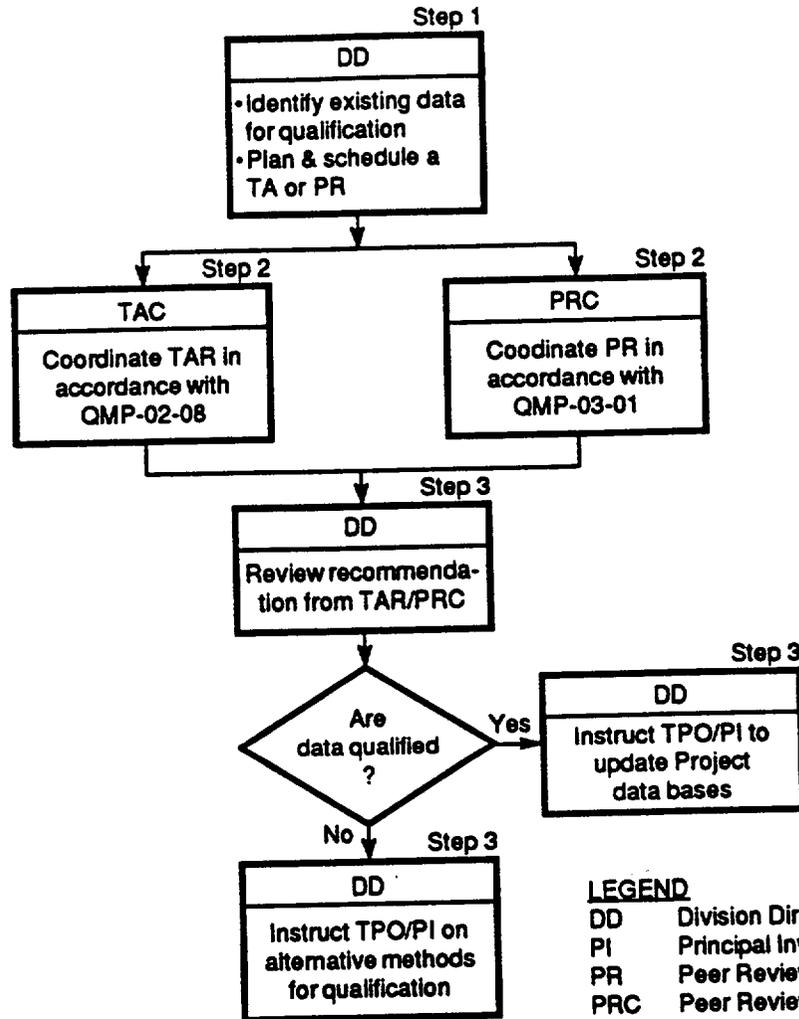
7.0 FIGURES AND ATTACHMENTS

Figure 1, AP-5.9Q Flowchart

Attachment 1, Questions to Consider in the Qualification Process

8.0 RECORDS

Records that document the qualification of an existing data set will be maintained in accordance with the review procedure that was used to complete the qualification process.



LEGEND

- DD Division Director
- PI Principal Investigator
- PR Peer Review
- PRC Peer Review Chairperson
- TA Technical Assessment
- TAC Technical Assessment Chairperson
- TPO Technical Project Officer

Figure 1 - AP-5.9Q Flowchart

QUESTIONS TO CONSIDER IN THE QUALIFICATION PROCESS

1. Will the existing data be relied on to establish a licensing position for which no alternative qualified data can be used?
2. To what extent do the controls under which the data were generated meet, in whole or in part, 10 CFR 60, Subpart G, requirements?
3. Are there existing technical or peer reviews that would lend confidence to the quality of the data? Were the data published in a referred journal?
4. What, if any, corroborative data or confirmatory testing results are available?
5. Is additional confirmatory testing necessary?