



Department of Energy  
Washington, DC 20585

SEP 03 1992

Mr. Joseph J. Holonich, Director  
Repository Licensing & Quality Assurance  
Project Directorate  
Division of High-Level Waste Management  
Office of Nuclear Material Safety  
and Safeguards  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555

Dear Mr. Holonich:

Enclosed is the Department of Energy's (DOE) response to two U.S. Nuclear Regulatory Commission (NRC) comments made in its Phase I review of Site Characterization Study Plan 8.3.1.16.1.1, "Characterization of Flood Potential and Debris Hazards of the Yucca Mountain Site." Enclosure 1 is the NRC Phase I letter with the comments identified, and Enclosure 2 is DOE's response to the comments.

The Yucca Mountain Site Characterization Project (YMP) uses Administrative Procedure 1.1.4, Revision 1, "Disposition of Comments on the Site Characterization Program," to respond to comments on DOE-approved study plans. DOE forwarded the comments to the U.S. Geological Survey's (USGS) technical project officer and principal investigator for an assessment of potential impact on the planned study.

The first NRC comment concerns the amount of detail provided for the field channel surveys. This concern had been previously addressed in a telephone conference on April 15, 1991, between the NRC, DOE/Headquarters, the Yucca Mountain Site Characterization Project Office, Weston, and the USGS. A follow-up letter (Enclosure 3) further clarified this issue. That letter should be referred to for DOE's response to this comment.

The NRC also raises a concern about the use of the unit hydrograph method for determination of a flood hydrograph and a standard method for the determination of a water level, and suggests that more sophisticated methods may be required. The DOE agrees with this comment but already considers these options to be built into the plan.

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122-8  
WM-11

If you have any questions, please contact Mr. Chris Einberg of my office at 202-586-8869.

Sincerely,



*JPR*

John P. Roberts  
Acting Associate Director for  
Systems and Compliance  
Office of Civilian Radioactive  
Waste Management

Enclosures:

1. Ltr., 5/8/91, Linehan to Shelor
2. DOE response to NRC Comments
3. Ltr, 8/15/91, Shelor to Linehan,  
w/encls

cc: w\enclosures  
Alice Cortinas, CNWRA, San Antonio, TX

cc: w\enclosures  
C. Gertz, YMPO  
R. Loux, State of Nevada  
T. Hickey, Nevada Legislative Commission  
M. Baughman, Lincoln County, NV  
J. Bingham, Clark County, NV  
B. Raper, Nye County, NV  
P. Niedzielski-Eichner, Nye County, NV  
G. Derby, Lander County, NV  
P. Goicoechea, Eureka, NV  
C. Schank, Churchill County, NV  
F. Mariani, White Pine County, NV  
V. Poe, Mineral County, NV  
E. Wright, Lincoln County, NV  
J. Pitts, Lincoln County, NV  
R. Williams, Lander County, NV  
J. Hayes, Esmeralda County, NV  
M. Hayes, Esmeralda County, NV  
B. Mettam, Inyo County, CA  
C. Abrams, NRC



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

MAY 8 1991

Mr. Dwight E. Shelor, Acting Associate Director  
for Systems and Compliance  
Office of Civilian Radioactive Waste Management  
U.S. Department of Energy, RW 30  
Washington, D.C. 20585

Dear Mr. Shelor:

SUBJECT: PHASE I REVIEW OF U.S. DEPARTMENT OF ENERGY (DOE) STUDY PLAN FOR  
CHARACTERIZATION OF FLOOD POTENTIAL AND DEBRIS HAZARDS OF THE YUCCA  
MOUNTAIN SITE

On October 11, 1991 the DOE transmitted the study plan entitled "Characterization of Flood Potential and Debris Hazards of the Yucca Mountain Site" (Study Plan for Study 8.3.1.16.1.1) to the U.S. Nuclear Regulatory Commission (NRC) for review and comment. The NRC has completed its Phase I Review of this document using the Review Plan for NRC Staff Review of DOE Study Plans, Revision 1 (December 6, 1990), which has superseded the draft Study Plan Review Plan provided to DOE on January 15, 1988. The Phase I Review encompasses, in modified form, the Acceptance and Start-Work Reviews described in the draft Study Plan Review Plan.

The material submitted in the study plan was determined to be for the most part substantively consistent with the agreement on content resulting from the NRC-DOE agreements made at the May 7-8, 1986 meeting on Level of Detail for Site Characterization Plans and Study Plans (hereafter the Agreement).

However, there was one area, field channel surveys, in which the NRC staff considered that the amount of detail provided was extremely limited. In the study plan, it is mentioned that floodplain and channel geometries may be field surveyed, but little information was provided about these surveys. The NRC staff considers that specific field surveys, covering at least all control sections in stream channels as well as topography around planned structures, may be necessary, and that such surveys are, in terms of the Agreement, to be regarded as tests. Therefore, if such surveys are to be done, those items required by the Agreement to be described or referenced for tests (e.g., equipment; technical procedures; precision required) should be included in this study plan. Before DOE conducts such surveys, the NRC staff expects that, consistent with the Agreement, appropriate details will be provided to NRC for its review.

Comment 1

A major purpose of the Phase I Review is to identify concerns with studies, tests, or analyses that if started could cause significant and irreparable adverse effects on the site, the site characterization program, or the eventual usability of the data for licensing. Such concerns would constitute objections, as that term has been used in earlier NRC staff reviews of DOE's documents related to site characterization (Consultation Draft Site Characterization Plan and Site Characterization Plan for the Yucca Mountain site). The Phase I Review of this study plan identified no objections with any of the activities proposed.

Enclosure 1

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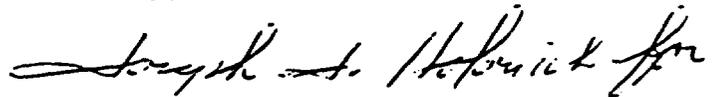
There is one technical matter related to the types of analyses proposed in the study plan that the NRC staff wishes to call to the attention of DOE. The study plan specifically refers to the unit hydrograph method for determination of a flood hydrograph and the standard step method for determination of water level. Although both procedures can be conservatively applied, more sophisticated procedures may be required to model sediment and debris transport along with rainfall and runoff. The NRC staff suggests that DOE consider the use of kinematic flow or other unsteady flow hydraulic methods and the possible coupling of such methods with an erosion and transport model.

Comment 2

After completion of the Phase I Review, selected study plans are to receive a second level of review, called a Detailed Technical Review, based on the relationship of a given study plan to key site-specific issues or NRC open items, or its reliance on unique, state-of-the-art test or analysis methods. We have decided not to proceed with a Detailed Technical Review of this study plan.

If you have any questions concerning this letter, please contact King Stablein (FTS/[301]-492-0446) of my staff.

Sincerely,



John J. Linehan, Acting Director  
Repository Licensing and Quality  
Assurance Project Directorate  
Division of High-Level Waste Management  
Office of Nuclear Material Safety  
and Safeguards

cc: R. Loux, State of Nevada  
C. Gertz, DOE/NV  
S. Bradhurst, Nye County, NV  
M. Baughman, Lincoln County, NV  
D. Bechtel, Clark County, NV  
D. Weigel, GAO  
P. Niedzielski-Eichner, Nye County, NV

U.S. Department of Energy (DOE) Response to  
U.S. Nuclear Regulatory Commission (NRC) Comment on  
Study Plan 8.3.1.16.1.1 (Characterization of Yucca  
Mountain Unsaturated-Zone Gaseous Phase Movement)

NRC Comment No. 1

There was one area, field channel surveys, in which the NRC staff considered that the amount of detail provided was extremely limited. In the study plan, it is mentioned that floodplain and channel geometries may be field surveyed, but little information was provided about these surveys. The NRC staff considers that specific field surveys, covering at least all control sections in stream channels as well as topography around planned structures, may be necessary, and that such surveys are, in terms of the Agreement, to be regarded as tests. Therefore, if such surveys are to be done, those items required by the Agreement to be described or referenced for tests (e.g., equipment; technical procedures; precision required) should be included in this study plan. Before DOE conducts such surveys, the NRC staff expects that, consistent with the Agreement, appropriate details will be provided to NRC for its review.

DOE Response

The concern expressed in this comment had been previously discussed in a telephone conference on April 15, 1991, between the NRC, DOE Headquarters, DOE Yucca Mountain Project, and Weston. This telecon was followed up by a letter from DOE to the NRC dated August 15, 1991. Please refer to that letter with enclosure for DOE's responses to this comment.

NRC Comment No. 2

The study plan specifically refers to the unit hydrograph method for determination of a flood hydrograph and the standard step method for determination of water level. Although both procedures can be conservatively applied, more sophisticated procedures may be required to model sediment and debris transport along with rainfall and runoff. The NRC staff suggests that DOE consider the use of kinematic flow or other unsteady flow hydraulic methods and the possible coupling of such methods with an erosion and transport model.

DOE Response

The study plan refers to the unit-hydrograph and standard-step methods only as a component of the assessment of a probable maximum flood (PMF). These methods are key components of a standard U.S. Bureau of Reclamation PMF assessment technology. Therefore, we believe they should remain in the description of PMF methodology. However, the ultimate use of kinematic-flow or other unsteady-flow-hydraulic methods to portray flood-flow mixtures of water and sediment is not precluded from the part of the study activity that

follows that preliminary PMF assessment. The study-activity strategy stresses the need to collect adequate data to calibrate predictive models. It then states that the available data must be competently analyzed, and that the selection of the best analytical techniques is of fundamental importance. Finally, a flood-prediction methodology, or methodologies, will be selected. If none are adequate, we will explore the possibility of developing a new technology or modifying an available technology to achieve an acceptable technology. This plan allows the consideration and application of the more sophisticated techniques suggested by NRC. The key to success is to improve the understanding of the hydrogeologic and hydraulic processes involved, and to collect good data to calibrate both simple and/or sophisticated predictive models.

The use of sophisticated hydraulic methods of flood prediction coupled with erosion and sediment-transport models is a worthwhile objective. DOE plans to utilize this type of technological approach contingent on the availability of applicable modeling technology and, most importantly, on the quantity and quality of adequate calibration data that will accrue as the products of several surface-water related studies.



Department of Energy  
Washington, DC 20585

AUG 15 1991

Mr. John J. Linehan, Acting Director  
Repository Licensing and Quality  
Assurance Project Directorate  
Division of High-Level Waste Management  
Office of Nuclear Material Safety  
and Safeguards  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555

Dear Mr. Linehan:

On April 15, 1991, a telecon was held between the U.S. Nuclear Regulatory Commission (NRC), the U.S. Department of Energy (DOE) Headquarters, Weston, Yucca Mountain Site Characterization Project Office, and the U.S. Geological Survey (USGS) staff to clarify some elements of two study plans that had been submitted to the NRC.

Questions on Study Plan 8.3.1.16.1.1, "Characterization of Flood Potential at the Yucca Mountain Site," concerned planned channel-survey techniques proposed for use. Additional questions focused on Study Plan 8.3.1.17.4.1, "Historical and Current Seismicity." Based on the telecon, the two USGS principal investigators involved--Mr. Patrick Glancy and Ms. Joan Gomberg--agreed to provide some clarifications with respect to their questions on each plan.

Enclosure 1 is a letter from Mr. Glancy that fulfills the request. Mr. Glancy's reply is a clarification of existing information.

Enclosures 2 and 3 are memoranda from Ms. Gomberg with her clarifications. In Enclosure 2, we intend to track Items 1 through 4 identified by Ms. Gomberg as comments on Study Plan 8.3.1.17.4.1, and Items 1 and 3 as commitments which would be acted upon if the Study Plan is revised. Items 2 and 4 in Enclosure 2 present explanations for how these concerns are addressed in the Study Plan, or why incorporation of a proposed revision is not appropriate.

In Enclosure 3, we intend to track Item 2 as a commitment. Item 1 is an explanation for which no commitment is identified.

9-108300-62-2P  
Enclosure 3

DOE anticipates that this documentation is sufficient, unless otherwise notified. Should you have any questions, please contact Sharon Skuchko of my office at (202) 586-4590.

Sincerely,



Dwight E. Shelor  
Associate Director for  
Systems and Compliance  
Office of Civilian Radioactive  
Waste Management

**3 Enclosures:**

1. U.S. Geological Survey Clarification dated April 16, 1991, Channel-Survey Techniques for Study Plan 8.3.1.16.1.1, with its enclosure, Scientific Notebook Plan, "Techniques for Measuring Severe Stream-Channel or Hillslope Erosion and (or) Resultant Sediment Deposit"
2. U.S. Geological Survey Clarifications dated April 30, 1991, for Study Plan 8.3.1.17.4.1
3. U.S. Geological Survey Clarifications dated May 29, 1991, for Study Plan 8.3.1.17.4.1

**cc w/Enclosures:**

- C. Gertz, YMPO
- R. Loux, State of Nevada
- K. Whipple, Lincoln County, NV
- M. Baughman, Lincoln County, NV
- J. Bingham, Clark County, NV
- D. Bechtel, Clark County, NV
- S. Bradhurst, Nye County, NV
- B. Raper, Nye County, NV
- P. Niedzielski-Eichner, Nye County, NV
- R. Campbell, Inyo County, CA
- R. Michener, Inyo County, CA
- G. Derby, Lander County, NV
- P. Goicoechea, Eureka, NV
- C. Schank, Churchill County, NV
- C. Jackson, Mineral County, NV
- F. Sperry, White Pine County, NV
- L. Vaughan, Esmeralda County, NV
- K. Hooks, NRC



# United States Department of the Interior



## GEOLOGICAL SURVEY

### WATER RESOURCES DIVISION

Room 224, Federal Building  
705 North Plaza Street  
Carson City, Nevada 89701

April 16, 1991

Mr. Rex Westcott  
Weston, Inc.  
Thru: Dave Dobson  
U.S. Department of Energy  
Las Vegas, NV

Dear Mr. Westcott:

I am responding to the concern you expressed during our April 15 telephone-conference call regarding the level of detail and standardization of channel-survey techniques in Study Plan 8.3.1.16.1.1 - "Characterization of the Flood Potential and Debris Hazards of the Yucca Mountain Site". Many of the hydrologic data being collected to satisfy the goals of this activity are expected to be collected as part of the "Characterization of the Yucca Mountain Regional Surface-Water Runoff and Streamflow" activity described in SP 8.3.1.2.1.2; as such, they are collected according to the Quality Assurance (QA) tenets outlined in that study plan. However, some of the data used in 8.3.1.16.1.1 will also be collected as part of this activity, and they too will be collected following the same quality-assurance criteria as those for activity 8.3.1.2.1.2.

The streamflow and debris-transport data that will be used to carry out SP 8.3.1.16.1.1 comprise two basic types of information: 1) peak streamflow rates, and 2) hazardous transport of debris by severe runoff. Measurements of peak streamflow are done according to standard U.S. Geological Survey (USGS) techniques governing the measurement of peak-discharge by indirect methods. The quality-assurance technical procedures for indirect measurements of streamflow are based on and referenced to a number of U.S.G.S. techniques manuals, including Benson and Dalrymple's 1967 "General Field and Office Procedures for Indirect Discharge Measurements". This "Techniques of Water-Resources Investigations of the United States Geological Survey" manual, Book 3, Chapter A3, of the "Techniques" series, spells out rather specifically the technical requirements for stream-channel data collection. Other manuals in the series including: "Measurements of Peak Discharge at Culverts by Indirect Methods" and "Measurement of Peak Discharge by the Slope-Area Method", likewise set U.S.G.S. channel-surveying standards and methodologies that form the foundation for our QA technical procedures in the Yucca Mountain Project (YMP). Thus, I am confident that your legitimate concern regarding adherence to accepted U.S.G.S. standards for channel surveying during the collection of peak-streamflow data should be satisfied.

The collection of data on the hazardous transport of debris by severe runoff is not nearly as technically advanced and (or) standardized by U.S.G.S. investigators; in fact, this type of data collection has not been done routinely in conjunction with flood studies by U.S.G.S. or by most other government hydrologic agencies, nor by most private consulting firms. The recognized need for these data, in conjunction with flood studies for the YMP prompted the design of a flood-study task to address and include the potential hazards of debris transport as part of the assessment of

Enclosure 1

hydrogeologic hazards to the transport and storage of high-level nuclear wastes. The general lack of standardized, investigative techniques that are available for application to this aspect of flood-hazard investigations prompted us to approach the task as a research element of the streamflow- and flood-study plans. This approach should allow us the flexibility to test and develop investigative techniques and measurements to address specifically the potential for fluvial-debris hazards to the YMP. Thus, QA control of data collection and handling was incorporated initially within a "Scientific Notebook Plan" that allows the development and refinement of those investigative techniques and measurements that should best define and delineate those potential debris-transport hazards peculiar to the YMP. As the development and adaptation of techniques evolves, we hope to be able to standardize measurement practices, including the surveying standards, with which you are specifically concerned. Until these standards have been developed and set, we will conduct our channel surveys in congruence with those being performed during the standardized measurements of peak-discharge, streamflow measurements. I trust this will satisfy your concerns in this matter.

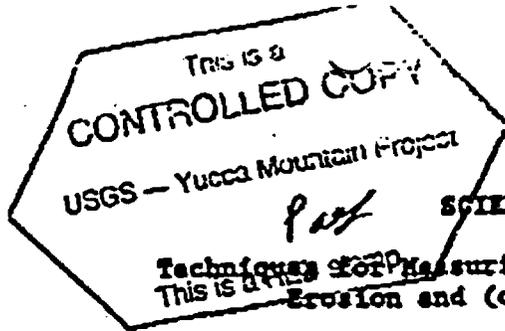
I am enclosing a copy of Scientific Notebook Plan NWM-USGS-HP-197T,R0, "Techniques for Measuring Severe Stream-Channel or Hillslope Erosion and (or) Resultant Sediment Deposit" for your information.

Sincerely,

*Patrick A. Glancy*

Patrick A. Glancy, P.I.

cc: W. Carswell  
S. Keller  
D. Beck



SCIENTIFIC NOTEBOOK PLAN

Techniques for Measuring Severe Stream-Channel or Hillslope Erosion and (or) Resultant Sediment Deposit

1.0 **PURPOSE:** This Scientific Notebook Work Plan has been prepared to meet the requirements of YMP-USGS-QMP-5.05 for documenting activities conducted under Study Plan No. 8.3.1.2.1.2.2, Title: Transport of Debris by Severe Runoff, for the purpose of documenting (1) catastrophic erosion that results in debris-charged surface runoff, (2) hazardous movement of debris after mobilization, and (3) deposition of debris. Modifications to the activities introduced here shall be documented, in accordance with QMP-5.05, Para. 5.4.1.2, and controlled in the notebook specifically assigned to the PI for conduct of this work.

2.0 **OBJECTIVE:** The planned objective is to document occurrences and magnitudes of severe erosion caused by runoff from intensive storms, and (or) sediment deposits that result from this erosive activity, and when possible, to collect data pertaining to the sediment-transport processes.

3.0 **PROPOSED WORK PLAN:** This activity shall be conducted as follows:

After a severe storm, areas of known intensive precipitation and (or) severe runoff should be reconnoitered to determine if erosion of a significantly severe magnitude has occurred. Sites of significantly severe erosion that are discovered during the reconnaissance will be identified on appropriate topographic maps and (or) aerial photographs. Erosion scars, flood-flow paths, and (or) resultant sediment (debris) deposits may be further documented, if deemed necessary and appropriate by the field investigator, by photographing all or parts of the scars and deposits or by contracting or otherwise obtaining new aerial photography. During or following the field reconnaissance physical measurements of the sizes of select scars and sediment deposits and select clasts of transported debris may be made. Measurements can be made using graduated tapes, rules, rods, taglines, photogrammetric techniques, or plane surveying techniques. The measurements, or estimates, will be used to determine the volumes of material eroded and (or) deposited, and the general size characteristics of the debris transported.

The character of the land surface where erosion, transport, and deposition occurred may be described either qualitatively, quantitatively, or both. The description may include some, or all, of the following: slope, depth to bedrock, bedrock lithology, slope of the flow path, size and character of the drainage catchment, and character and slope of the depositional area.

Samples of deposits and source materials may be obtained for size determination and (or) petrology. When samples are collected, they will be sealed in a cloth, plastic, or other material bag, and identified by a unique identifier, listed in the notebook. An example of a unique identifier would be the investigator's initials, the date, and a sequential number for that day. Following their collection, samples will be handled and tracked in accordance with YMP-USGS-QMP-8.01 (the revision in effect at the time of sampling).

4.0 **PERSONNEL:** Persons responsible for the work are Patrick A. Glancy and David F. Meyer, Principal Co-Investigators and other contributing investigators who

may be delegated responsibilities appropriate to their qualifications and training. Any special qualifications and training required for key contributing investigators, or other personnel, include training in the conduct of measurement techniques for severe streamchannel or hillslope erosion and resultant sediment deposits, or documented experience in the same.

## 5.0 EQUIPMENT:

### 5.1 Essential equipment and materials:

- o Compass
- o Hand level (Normal eyesight range, +/- 0.1 ft. in 10 ft.)
- o Topographic maps and (or) aerial photographs
- o Surveying level (Range dependent on atmospheric conditions, +/- 0.1 ft. in 200 ft.)
- o Camera
- o Measuring tape (0-100 ft., +/- 0.15 ft.)
- o Measuring rule (0-6 ft., +/- 0.005 ft.)
- o Tagline (100-500 ft., +/- 1.0 ft.)
- o Surveying rod (5-50 ft., +/- 0.005 ft.)

All items are not required for each application. Any additions or deletions from this list shall be documented in the notebook.

### 5.2 Calibration Requirements: All instruments and methods or systems shall be calibrated in accordance with the Instrument Calibration Procedure (YMP-USGS-QMP-12.01) prior to start of work.

#### 5.2.1 Equipment requiring calibration includes the surveying level and the hand level which will be calibrated as follows:

The surveying level shall be peg tested daily when in use. Establish two points, A and B, near ground level, 200-300 feet apart (10 feet for calibrating hand levels). Set up exactly halfway between A and B. Take a rod reading a on stake A and a rod reading b on stake B. The computed elevation difference, a-b, is the true difference, regardless of instrument error. Set up close enough to A so that a rod reading can be obtained either by reading through the telescope in reverse or by measuring up to the horizontal axis of the telescope by steel tape. Take a rod reading c on stake A and a reading d on stake B. If the instrument is in adjustment, (c-d) will equal (a-b). If the instrument is out of adjustment, compute what the correct rod reading e on B should be (e-b+c-a) and adjust the instrument to obtain that reading. The hand level will be calibrated at least once a year, or more often if the operator determines the instrument is out-of-adjustment. Calibration of the hand level will be done using the same methodology as described for the surveying level. Equipment not listed in Para. 5.1 that may be deemed necessary for the study, and that is subject to operational variation, will be calibrated as necessary, and calibration records will be maintained in the notebook. Schedules for calibration will be determined at that time, and listed in the notebook.

### 6.0 POTENTIAL LIMITATIONS: The limitations of this procedure include the identifiability of the presence and limits of erosion scars or sediment deposits, variability common in erosional and depositional landforms, the scale and

details of available topographic maps, and the physical accessibility to areas affected.

- 7.0 QUANTITATIVE/QUALITATIVE CRITERIA: This plan is generally applicable to all scales of erosion and deposition. Precise measurements are rarely necessary to document severe erosion and (or) deposition because natural variability of erosion and deposition parameters commonly exceeds 100 percent of the mean of any given parameter. Erosion scars and deposits range in size from a few to thousands of feet on a side. Many accurate, but imprecise measurements of an erosion scar or deposit are more useful to describe the landform than a few precise measurements.
- 8.0 IMPACTS ON OTHER ACTIVITIES: This work will have no foreseeable impact on other activities. Minor surface disturbance will be restricted to hand tools, and off-road reconnaissance will generally be on foot. Other activities, especially construction and "clean up" of debris following severe runoff could destroy erosion scars and deposits needed for this activity.
- 9.0 APPROVAL: The above items are subject to review and control in accordance with QMP-5.05. All subsequent activities will be detailed in USGS Scientific Notebook No.: USGS-SN-0002, of which this documentation becomes a part. The following signatures authorize starting the described work following the effective date. This Scientific Notebook Plan supersedes technical procedure NWM-USGS-HP-174, R1, "Technique for Measuring Severe Stream-Channel or Hillslope Erosion and (or) Resultant Sediment Deposits."

David F Meyer 4/12/90  
Preparer: D.F. Meyer Date

[Signature] 4/25/90  
YMP-USGS QA Manager Date

John B. Czarnacki 4-24-90  
Reviewer: J.B. Czarnacki Date

[Signature] 4/26/90  
Technical Project Officer: Date

Department of the Interior  
U.S. Geological Survey  
Branch of Geologic Risk Assessment, MS 966  
Box 25046, Denver Federal Center  
Denver, CO 80225-0046

April 30, 1991

*N. J. Gombayg*  
Memo from: Joan Gombayg, Branch of Geologic Risk Assessment,  
Geologic Division, USGS

To: David C. Dobson, Branch Chief, Regulatory Interactions Branch,  
Yucca Mountain Project, DOE

*WLL*  
Through: William Langer, Study Plan Coordinator, Geologic Division,  
USGS

Subject: Corrections/clarifications to Study Plan 8.3.1.17.4.1, Historical  
and Current Seismicity

The following clarifications and/or corrections to Study Plan 8.3.1.17.4.1, Historical and Current Seismicity were requested by the NRC staff during a telephone conference call held on April 15, 1991. Please transmit this information to the appropriate personnel at the NRC.

1. Two earthquakes were omitted from table on page 2-1; the information that should be added to the table is

Lat. (N)	Long.(W)	Date	Time	Magn.	Dist.(km) from YM
36.5	118.0	Mar. 26, 1872	?	7.9	150-200
37.081	116.074	April 26, 1973	17:15:01.0	5.6	0-50

2. There was a request to add a statement after the second sentence of the first paragraph on page 3-2 such as

"To the extent permitted by the available data, additional information will be also compiled for historical earthquakes with magnitude less than 5.5."

The intent of the latter half of the statement already in the text, "Important earthquakes are those which have a magnitude of 5.5 or greater, or which may have had a substantial impact on the site." was to allow for compilation of additional data for events with magnitude smaller than 5.5 in cases where such a compilation would be useful (e.g. compilation of spectral amplitudes for magnitude 1.0 earthquakes would not necessarily be of any use in assessing site suitability even though such compilation is possible). Thus, we do not feel that addition of a new statement as written above is necessary.

3. The first sentence of the last paragraph on page 3-6 should say "necessary to decrease" rather than "necessary to increase".

4. The NRC reviewers questioned why no requirements for tolerance, accuracy, or precision have been explicitly specified for this activity (section 3.2.4 on page 3-7). As indicated in the Study Plan and in our Technical Procedures, estimates of the precision

Department of the Interior  
U.S. Geological Survey  
Branch of Geologic Risk Assessment, MS 966  
Box 25046, Denver Federal Center  
Denver, CO 80225-0046

May 29, 1991

From: Joan Gomberg, Branch of Geologic Risk Assessment, Geologic Division, USGS

To: David Dobson, Branch Chief, Regulatory Interactions Branch, Yucca Mountain Project, DOE

Through: William Langer, Study Plan Coordinator, Geologic Division, USGS

Subject: Final clarifications to Study Plan 8.3.1.17.4.1, Historical and Current Seismicity

I have spoken with B. Ibrahim of the NRC regarding the clarifications to Study Plan 8.3.1.17.4.1, Historical and Current Seismicity as described in my memo of April 30, 1991. This memo is a response to his request for some final modifications/clarifications to that memo.

1. The magnitude of the 3/26/1872 (Owen's Valley) earthquake listed in the table on page 2-1 is a moment-magnitude ( $M_w$ ) that I obtained from a recent report (unpublished) by C. DePolo, D. Clark, D. Slemmons, and A. Ramelli from the Nevada Bureau of Mines and Geology and the Center for Neotectonic Studies at the University of Nevada, Reno. The more commonly reported magnitude is a local magnitude ( $M_L$ ) of 8.25. However, the moment-magnitude is generally believed to be more accurate for large events (it does not saturate) and that is why I chose to include it in the table. If you feel it is more important to maintain consistency with the other magnitudes listed in the table (moment-magnitudes are not available for the other events) and in the SCP please change the value to 8.25.
2. Please modify the statement on page 3-2 that states "Important earthquakes are those which have a magnitude of 5.5 or greater, or which may have had a substantial impact on the site" so that it states "Important earthquakes are those which have a magnitude of 5.5 or greater, or earthquakes with smaller magnitudes which may have had a substantial impact on the site".

of hypocenters, magnitudes, etc. (all parameters estimated as part of our routine monitoring) are derived as well as the parameters themselves. Our approach is to include all parameter estimates together with their associated precision estimates in our catalog of earthquake characteristics. We feel that keeping all data and parameter estimates with an assessment of their reliability is preferable to omitting them because they do not meet some cut-off criteria. This allows for the greatest flexibility in future analyses since cut-off criteria may change depending on the analysis being performed.

cc: Kaye Shedlock