# OUTLINE FOR TOPICAL REPORT ON EROSION RATES AT YUCCA MOUNTAIN GEOLOGIC SETTING: METHODOLOGY AND RESULTS

Submitted to

The U.S. Nuclear Regulatory Commission

by

The U.S. Department of Energy

Yucca Mountain Project
Las Vegas, Nevada

Revision 0

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OUTLINE FOR TOPICAL REPORT ON
EROSION RATES AT YUCCA MOUNTAIN GEOLOGIC SETTING:
METHODOLOGY AND RESULTS

# 1.0 DOE POSITION

## 1.1 Purpose of Report

This report provides the basis for concluding that extreme erosion did not exist at Yucca Mountain during the Quaternary Period. Based upon data presented in this report, the potentially adverse condition of extreme erosion as identified in 10 CFR 60.122(c)(16) is shown not to be present at Yucca Mountain and thus removes this issue from further consideration as a potentially adverse condition for Yucca Mountain. Furthermore, erosion would not prevent the U.S. Department of Energy's (DOE) compliance with other regulations promulgated by the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Environmental Protection Agency (EPA).

## 1.2 Statement of Position

The information presented in this report, shows that erosional processes at Yucca Mountain coupled with the climatological and geomorphic conditions expected over the next 10,000 years, will not negatively impact the waste containment and isolation capabilities of the site. Based on this information, the DOE advances a position that there is no evidence of extreme erosion during the Quaternary Period and thereby removes from further consideration a potentially adverse condition given at 10 CFR 60.122(c)(16). Other aspects of 10 CFR 60 that are tangential to the issue, but not explicitly addressed in 60.122(c)(16), will be addressed in support documentation from the site characterization program, other than this report.

This report also provides reasonable assurance that extreme erosion will not deter compliance with requirements for the geologic setting, repository seals, repository monuments or markers, the engineered barrier system, repository depth, and repository system. The text of these requirements and corresponding DOE positions are presented in the report's regulatory basis (Chapter 2).

## 1.3 History of Issue

Several previous studies are identified below which discuss the potential impacts of erosion on the Yucca Mountain site. Each of these studies reports information which was available at the time the particular report was published. They are presented in chronological order of development such that each succeeding study reports new or more current data on erosional processes at Yucca Mountain.

### 1.3.1 Position Taken in Environmental Assessment

This section discusses the position presented in the Yucca Mountain Environmental Assessment (EA)(DOE, 1986). Estimates of the average erosion rates for Yucca Mountain during the Quaternary Period had not yet been determined, because the field data necessary for such calculations was not then available. However, measurements of the the depth of stream incision in dated alluvial deposits and in tuff in the vicinity of Yucca Mountain had been calculated. Based upon erosion rates measured in the past in the vicinity of Yucca Mountain and the rates expected in the future, modern denudation rates at the site are not considered extreme. Evidence indicates that there were few or no periods of extreme erosion at the site during the past 300,000 years.

### 1.3.2 Position Taken in Site Characterization Plan

This section discusses the DOE position presented in the Yucca Mountain Site Characterization Plan (SCP)(DOE, 1988). The SCP discusses the impact of geomorphic processes on the Yucca Mountain area and estimates the rates of erosion from long-term averages. As provided in the SCP, this section concludes that extreme erosion rates have not existed at Yucca Mountain during the Quaternary Period and are not expected to exist over the next tens of thousands of years.

This section also discusses comments and responses made with respect to information presented in the SCP. This section reports how each of the comments relating to erosion has been addressed. The erosion program outlined in Section 8.3.1.6 of the SCP will be discussed.

### 1.3.3 Position Taken in Early Site Suitability Evaluation

This section discusses the most recent position on erosion as presented in the Early Site Suitability Evaluation (ESSE)(SAIC, 1992). After examining several lines of evidence and numerous studies, the conclusions in the ESSE support the position that extreme erosion is not present at Yucca Mountain.

## 2.0 REGULATORY BASIS FOR THE DOE POSITION

This chapter presents six groups of provisions from NRC and EPA regulations that require assessments of erosional impacts. Conceivably, erosion could negatively impact the repository's geologic setting, seals, monuments, engineered barrier system, repository depth, or the repository system. The extent of any impact would, in turn, influence the DOE's compliance with NRC and EPA provisions that govern the natural and engineered structures mentioned above.

Corresponding to each group of provisions, the DOE advances six positions which collectively assert that there is no evidence of extreme

erosion at Yucca Mountain. Furthermore, the insignificant erosion that has been observed, if continued over the next several thousand years, would not prevent the DOE from complying with NRC and EPA regulations.

For each of these positions, the DOE will address, in the context of each provision, evidence that erosion evaluations are supported by adequate investigations. In accordance with 10 CFR 60.122(a)(2), this discussion includes the extent to which potentially adverse erosion conditions may be present and still be undetected, taking into account the degree of resolution achieved by the investigation of erosion rates. Also, evidence will be presented for each provision to demonstrate that erosion processes have been adequately evaluated using analyses that are sensitive to components of the processes and are not likely to underestimate its effects.

## 2.1 Impact of Erosion on the Geologic Setting

Governing provisions (Key words are underscored):

"Geologic setting means the geologic, hydrologic and geochemical systems of the region in which a geologic repository operations area is or may be located." (10 CFR 60.2).

"A geologic setting shall exhibit an appropriate combination of the conditions specified in paragraph (b) of this section so that, together with the engineered barrier system, the favorable conditions present are sufficient to provide reasonable assurance that the performance objectives relating to isolation of the waste will be met." (10 CFR 60.122(a)(1)).

"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." (10 CFR 60.122(c)).

One of the potentially adverse conditions listed is "Evidence of extreme erosion during the Quaternary Period." (10 CFR 60.122(c)(16)).

"Controlled area means: (1) A surface location, to be identified by passive institutional controls, that encompasses no more that 100 square kilometers and extends horizontally no more that five kilometers in any direction from the outer boundary of the original location of the radioactive wastes in a disposal systems; and (2) the subsurface underlying such a surface location." (40 CFR 191.12(g)).

The DOE Position:

Provisions at 10 CFR 60.122(c) identify several conditions which are potentially adverse conditions if they are characteristic of the controlled area or may affect isolation of wastes within the controlled area. One such adverse condition, item 16, states: "Evidence of extreme erosion during the Quaternary Period"

(emphasis added). To determine whether this condition is characteristic of the controlled area, the meaning of "extreme erosion" will be defined and applied to Yucca Mountain's geologic setting.

The current information, presented in Chapter 3, demonstrates that "extreme erosion" is not characteristic of the controlled area and will not affect isolation of wastes within the controlled area. Consequently, additional information on erosion will not be gathered during site characterization.

## 2.2 Impact of Erosion on Repository Seals

Governing Provisions:

"Seals for shafts and boreholes shall be designed so that following permanent closure, they do not become pathways that compromise the geologic repository's ability to meet the performance objectives for the period following permanent closure." (10 CFR 60.134(a)).

"Materials and placement methods for seals shall be selected to reduce, to the extent practicable ... the potential for creating a preferential pathway for groundwater to contact the waste packages or for radionuclide migration through existing pathways." (10 CFR 60.134(b)(1) and (2)).

The DOE Position:

The purpose of repository seals will be discussed and the potential impacts of erosional processes on the ability of the DOE to comply with the requirements for seals will be addressed. This discussion supports the position that the probability of compromising the integrity of seals due to local erosional processes, burial, or subareal erosion is insignificant.

## 2.3 Impact of Erosion on Repository Monuments and Markers

Governing Provisions (Key words are underscored):

"...The monuments provided for by this part are sufficiently permanent to serve their intended purpose... " (10 CFR 60.2).

"...[The license application will include]... a conceptual design of monuments which would be used to identify the controlled area after permanent closure." (10 CFR 60.21(c)(8)).

"The records ... shall include at least ... surveys of the underground facility excavations, shafts, and boreholes referenced to readily identifiable surface features or monuments ... and ... details, methods of emplacement, and location of seals used." (10 CFR 60.72(b)).

"Disposal sites shall be designated by the most permanent markers, records and other passive institutional controls practicable to indicate the dangers of the waste and their location." (40 CFR 191.14(c)). (Note: This assurance requirement does not apply to NRC-licensed facilities. However, the NRC will promulgate similar requirements when it conforms 10 CFR 60 to 40 CFR 191.

The DOE Position:

The plans for monuments or markers will be discussed and the potential impacts of erosional processes on the ability of the DOE to comply with the above provisions will be addressed. The discussion supports the position that the impact of local erosional processes, burial, or subareal erosion on the monument system is insignificant.

2.4 Impact of Erosion on the Engineered Barrier System

Governing Provisions (Key words are underscored):

"Engineered barrier system means the waste packages and the underground facility." (10 CFR 60.2).

"Waste package means the waste form and any containers, shielding, packing and other absorbent materials immediately surrounding an individual waste container." (10 CFR 60.2).

"Underground facility means the underground structure, including openings and backfill materials, but excluding shafts, boreholes, and their seals." (10 CFR 60.2).

"Anticipated processes and events means those natural processes and events that are reasonably likely to occur during the period the intended performance objective must be achieved. To the extent reasonable in the light of the geologic record, it shall be assumed that those processes operating in the geologic setting during the Quaternary Period continue to operate but with the perturbations caused by the presence of emplaced radioactive waste superimposed thereon." (10 CFR 60.2).

"... The engineered barrier system shall be designed so that assuming anticipated processes and events: (A) Containment of HLW will be substantially complete during the period when radiation and thermal conditions in the engineered barrier system are dominated by fission product decay..." (10 CFR 60.113(a)(1)(i)(A)).

"Any release of radionuclides from the engineered barrier system shall be a gradual process which results in small fractional releases to the geologic setting over long times. For disposal in the saturated zone, both the partial and complete filling with groundwater of available void spaces in the underground facility shall be appropriately considered and analyzed among the

anticipated processes and events in designing the engineered barrier system." (10 CFR 60.113(a)(1)(i)(B)).

The DOE Position:

The technical data presented in Chapter 3 of this report will demonstrate that "extreme erosion" is not an anticipated processes or event as defined at 10 CFR 60.2. Therefore erosion does not influence the design of the engineered barrier system.

## 2.5 Impact of Erosion on the Repository's Depth

Governing Provisions (Key words are underscored):

"A geologic setting shall exhibit an appropriate combination of the conditions specified in paragraph (b) of this section so that, together with the engineered barrier system, the favorable conditions present are sufficient to provide reasonable assurance that the performance objectives relating to isolation of the waste will be met." (10 CFR 60.122(a)(1)).

One of the favorable conditions states, "...Conditions that permit the emplacement of waste at a minimum depth of 300 meters from the ground surface. (The ground surface shall be deemed to be the elevation of the lowest point on the surface above the disturbed zone)." (10 CFR 60.122(b)(5)).

The DOE Position:

The geomorphology of the Yucca Mountain site supports the emplacement of waste at a minimum of 300 meters from the ground surface which meets the favorable condition of 10 CFR 60.122(b)(5). However, DOE currently envisions a portion of the repository to lie less than 300 meters below the surface of the ground. DOE prefers the shallower depth because it conforms better to the Yucca Mountain stratigraphy and places more rock between the waste and the underlying aquifer which may result in better overall repository performance. Because there is no evidence of extreme erosion in the past, no adverse impact due to erosion has been identified which would preclude decreasing the depth of the overburden, if raising the overall repository level improves the repository's performance.

Extrapolation of measured long-term hillslope degradation rates from Yucca Mountain suggests that degradation will be less than half a meter over the next 10,000 years. If climatic conditions were optimal for maximum stream incision in the small tributary valleys of Fortymile Wash above the proposed repository block over the next 10,000 years (an unlikely scenario), then a channel might downcut no more than 10 meters. A more reasonable stream incision depth is about 5 meters, and it is possible that if cooler conditions return to the southern Great Basin, that the channels will not erode, but actually aggrade. With an assumption of 10

meters of channel incision, the waste will still be separated from the closest ground surface by as much as 200 meters or more.

## 2.6 Impact of Erosion on the Repository System

Governing Provisions (Key words are underscored):

"OVERALL SYSTEM PERFORMANCE OBJECTIVE FOR THE GEOLOGIC REPOSITORY AFTER PERMANENT CLOSURE. The geologic setting shall be selected and the engineered barrier system and the shafts, boreholes and their seals shall be designed to assure that releases of radioactive materials to the accessible environment following permanent closure conform to such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency with respect to both anticipated processes and events and unanticipated processes and events." (10 CFR 60.112).

"Anticipated processes and events means those natural processes and events that are reasonably likely to occur during the period the intended performance objective must be achieved. To the extent reasonable in the light of the geologic record, it shall be assumed that those processes operating in the geologic setting during the Quaternary Period continue to operate but with the perturbations caused by the presence of emplaced radioactive waste superimposed thereon." (10 CFR 60.2).

"Unanticipated processes and events means those processes and events affecting the geologic setting that are judged not be reasonably likely to occur during the period the intended performance objective must be achieved, but which are nevertheless sufficiently credible to warrant consideration. Unanticipated processes and events may be either natural processes or events or processes and events initiated by human activities other than those activities licensed under this part..." (10 CFR 60.2).

"Disposal systems for spent nuclear fuel or high-level or transuranic radioactive wastes shall be designed to provide a reasonable expectation, based upon performance assessments, that the cumulative releases of radionuclides to the accessible environment for 10,000 years after disposal from all significant processes and events that may affect the disposal system shall:

(1) Have a likelihood of less than one chance in 10 of exceeding the quantities calculated according to Table 1 (Appendix A); and

(2) Have a likelihood of less than one chance in 1,000 of exceeding ten times the quantities calculated according to Table 1 (Appendix A)." (40 CFR 191.13(a)).

"Individual Protection Requirements. Disposal systems for spent nuclear fuel or high-level or transuranic wastes shall be designed to provide a reasonable expectation that, for 1,000 years after

disposal, undisturbed performance of the disposal system shall not cause the annual dose equivalent from the disposal system to any member of the public in the accessible environment to exceed 25 millirems to the whole body or 75 millirems to any critical organ. All potential pathways (associated with undisturbed performance) from the disposal system to people shall be considered including the assumption that individuals consume 2 liters per day of drinking water from any significant source of groundwater outside of the controlled area." (40 CFR 191.15).

"Ground water protection requirements. Disposal systems for spent nuclear fuel or high-level or transuranic wastes shall be designed to provide a reasonable expectation that, for 1,000 years after disposal, undisturbed performance of the disposal system shall not cause the radionuclide concentrations averaged over any years in water withdrawn from any portion of a special source of ground water to exceed ... [certain values]." (40 CFR 191.16(a))

The DOE Position:

Although some or all of the above requirements will change when the EPA repromulgates 40 CFR 191, the key words and their context are not expected to change. Therefore, DOE expects that the the positions advanced in this report will remain relevant when EPA issues a new 40 CFR 191.

The technical data presented in Chapter 3 of this report will demonstrate that "extreme erosion" is not an anticipated or unanticipated process or event as defined and used in 10 CFR 60. Nor is extreme erosion a significant process or event as used in 40 CFR 191. Therefore erosion does not influence compliance with the EPA containment requirement at 40 CFR 191.13(a).

The EPA also specifies individual (40 CFR 191.15) and groundwater (40 CFR 191.16) protection requirements, but erosion applies to neither. The requirements are imposed only on an undisturbed repository and erosion constitutes a disturbance.

# 3.0 TECHNICAL BASIS AND SUPPORTING ANALYSIS

## 3.1 Technical Basis

This section provides the technical basis for determining that the potentially adverse condition of extreme erosion does not exist at Yucca Mountain. In presenting this data, the provision at 10 CFR 60.122(a)(2) is considered to be met for erosion. That condition states: "If any of the potentially adverse conditions specified in paragraph (c) of this section is present, it may compromise the ability of the geologic repository to meet the performance objectives relating to isolation of the waste. In order to show that a potentially adverse condition does not so compromise the performance of the geologic repository the following must be demonstrated: (i) The potentially adverse human activity or natural condition has been adequately investigated, including the

extent to which the condition may be present and still be undetected taking into account the degree of resolution achieved by the investigations; and (ii) The effect of the potentially adverse activity or natural condition on the site has been adequately evaluated using analyses which are sensitive to the potentially adverse human activity or natural condition and assumptions which are not likely to underestimate its effect; and (iii)(A) The potentially adverse human activity or natural condition is shown by analysis pursuant to paragraph (a)(2)(ii) of this section not to affect significantly the ability of the geologic repository to meet the performance objectives relating to isolation of the waste are met, or (C) The potentially adverse human activity or natural condition can be remedied."

Based on the data presented in this section, the potentially adverse condition is shown not to be present, and therefore does not have to be remedied and will not be further evaluated.

### 3.1.1 Geologic and Climatic Setting of Yucca Mountain

This section discusses the geologic and climatic setting of Yucca Mountain. The discussion establishes the context in which to describe modern geomorphic processes in the semiarid southern Great Basin. Under present semiarid conditions, small volumes of debris are eroded off hillslopes during convective thunderstorms. These storms are infrequent and generally of short duration, which results in net aggradation in Fortymile Wash and its tributaries.

### 3.1.2 Distribution of Quaternary Deposits Around Yucca Mountain

This section discusses the distribution of Quaternary deposits around Yucca Mountain. A generalized surficial geologic map of the Yucca Mountain area shows that unconsolidated deposits at the base of most Yucca Mountain ridges are of early to middle Quaternary age. Deposits of late Quaternary age are chiefly confined to present stream valleys. The lack of late Pleistocene and Holocene deposits at the base of Yucca Mountain hillslopes suggests that erosion rates from these slopes have been low during the past 100,000 years. Confinement of late Quaternary deposits to valleys and channels suggests the volume of material eroded off hillslopes has been smaller than during the early and middle Quaternary. Entrenchment of streams through older deposits suggest slow uplift of Yucca Mountain or slow subsidence in adjacent basins. Alternatively, stream incision may reflect changes in fluvial processes due to Quaternary climate changes. The present well-defined drainage channels suggest that future stream incision will be confined to the present valleys well beyond the 10,000 year post-closure period.

### 3.1.3 Quaternary Climate Changes in the Southern Great Basin

This section discusses how geomorphic processes change in response to climate changes in the southern Great Basin. This section emphasizes that hillslopes are weathered and aggrade during cooler, wetter climates and are eroded or stripped during drier climatic episodes. Evidence of earlier climatic cycles of hillslope colluvial aggradation is preserved on Yucca Mountain.

### 3.1.4 Preservation of Colluvial Boulder Deposits on Yucca Mountain Hillslopes

This section discusses colluvial boulder deposits on Yucca Mountain hillslopes which were formed under colder climatic conditions than exist at present or during the last Pleistocene glacial maximum about 18,000 years before present time. Age estimates based on rock varnish thickness and chemistry suggest these deposits were formed during the early and middle Pleistocene. The stability and preservation of hillslope deposits of such antiquity suggest a general long-term climatic and tectonic stability of these hillslopes.

### 3.1.5 Cation-Ratio Dating of Yucca Mountain Hillslope Deposits

This section discusses the cation-ratio dating of Yucca Mountain hillslope deposits. The calculation of erosion rates on Yucca Mountain hillslopes is chiefly dependent on a knowledge of the age of surfaces below which degradation can be measured. For the Yucca Mountain region a cation-ratio dating curve was constructed by obtaining cation ratios from rock varnish on uneroded surfaces on deposits that were dated independently by isotopic dating techniques (Harrington and Whitney, 1987). A technique was developed at Los Alamos National Laboratory (LANL) to calculate cation-ratio age estimates by a non-destructive technique that uses a scanning electron microscope with an EDAX analyzer.

### 3.1.6 Age Estimates of Darkly Varnished Boulder Deposits on Hillslopes in the Yucca Mountain Area

This section discusses hillslope deposits that were coated with the darkest and thickest rock varnish and believed to be the oldest deposits on a slope. Rock varnish samples were taken for dating from undisturbed surfaces. Cation-ratio dating of the rock varnish on these deposits yielded age estimates from 170,000 years to greater than 1 million years old. Evidence to support these age

estimates includes: varnish thickness, correlation to deposits of similar ages in adjacent basins, and a surface-exposure age estimate by a corroborating cosmogenic dating technique.

3.1.7 Hillslope Erosion Rates on Yucca Mountain, Skull Mountain, Little Skull Mountain, and on Buckboard Mesa

This section discusses activities related to measurements of the amount of channel incision and general hillslope degradation which was measured at twelve colluvial boulder deposits on seven different slopes. Results from these measurements indicates that maximum channel incision is low and will be identified. Hillslope degradation adjacent to these deposits ranges is also minimal and results of investigations will be reported. Long-term erosion rates for hillslopes with relict early-middle Quaternary boulder deposits have been calculated and will be discussed.

3.1.8 Comparison of Yucca Mountain Erosion Rates with Other Semiarid Environments

This section compares Yucca Mountain erosion rates with other semiarid environments. Published long-term erosion rates for New Mexico and California range from 10-43 mm/1000 years on hillslopes underlain by resistant rock types. Erosion rates similar to Yucca Mountain have been calculated in the southern Mojave Desert. Erosion rates for less resistant rock types not present at Yucca Mountain and for shorter time periods are as much as two orders of magnitude larger.

3.1.9 Reasons for Low Erosion Rates at Yucca Mountain

This section discusses the various reasons why low erosion rates are evident at Yucca Mountain. These reasons include:

1 - Hillslopes are underlain by erosionally resistant welded tuffs;

2 - Rock varnish coatings on surface boulders inhibit erosion;

3 - Low rates of Quaternary tectonic activity in the Yucca Mountain range;

4 - Relatively small fluctuations in climate during the late Quaternary Period;

5 - Past episodes of cooler and wetter Quaternary climates resulted in sediment storage and hillslope aggradation;

6 - Colluvial boulder deposits on hillslopes serve as a protective cap and inhibit removal of fine grained sediment; and

7 - Hillslope channels isolate colluvial deposits by topographic inversion and remove them from active erosion by run-off.

### 3.1.10 Stream Incision Rates on Fortymile Wash and Tributaries

This section discusses stream incision rates on Fortymile Wash and its tributaries and relates these rates to the geologic setting at Yucca Mountain. Maximum stream incision rates can be approximated by comparing dated terrace surfaces to the base of valley alluvium as defined in boreholes. These rates assume the unlikely scenario that each episode of incision scoured the valley to the bedrock floor. Stream incision rates are substantially less upstream in tributary valleys where the thickness of alluvial fill is only a few meters. Future stream incision can be expected to be confined to the present valleys because major aggradational events that would be necessary to move a channel are very unlikely in the present semiarid environment.

### 3.1.11 Alternative Erosion Models

This section discusses the basis for the calculational models of erosion rates at Yucca Mountain. The field measurements assume that the measured hillslope deposits represent the average land surface position at the time they were emplaced. Alternative hillslope erosion rates can be calculated from reasonable hypothetical models that assume the general hillslope surface may have been 1.5 - 2.5 times higher than the low relief model. These conditional models will yield higher erosion rates than the measured rates; however, these rates will clearly demonstrate that degradation under the worst-case scenario will lower hillslope surfaces an insignificant amount over the next 10,000 years.

### 3.1.12 Summary of Yucca Mountain Erosion Rates

This summary demonstrates that both hillslope degradation and stream incision rates have been very low for the last several hundred thousand years, and are lower than those rates measured in nearby regions. Furthermore, because of unique combinations of dry, semiarid climate, low rates of tectonic deformation, and resistant volcanic rock types, these are reasonable rates to project into the future for the next 10,000 years.

### 3.2 Alternative Interpretations

This section examines different opinions, lines of evidence and dating methods that weaken or strengthen the DOE position. For example, opinions, evidence and dating methods used by DOE-sponsored investigators are compared to those used by NRC-sponsored investigators.

### 3.3 Qualification of Data and Methodology

This section provides a general discussion of the background of the existing data, a discussion of the Quality Assurance (QA) program which was in place when the existing data was gathered, and identifies the reasons why it is necessary to programmatically re-evaluate the existing data with respect to the current NRC approved QA program. This activity will provide the basis for qualifying data under the current QA program. Much of the current data was gathered and/or generated prior to approval of the current QA program. Through formal processes, this data will be evaluated and a determination of qualification made with respect to appropriateness for use in supporting this report.

## 4.0 CONCLUSIONS

This section summarizes the technical details presented above, draws conclusions with respect to compliance with regulatory requirements and resolves the issue from an NRC and license application perspective.

Based upon the technical data presented in the report, the conclusion will state that erosion is not a potentially adverse condition (as described at 10 CFR 60.122(c)(16)) within the Yucca Mountain area. Moreover, erosion is a natural process that is expected to continue at its current rate and will not prevent DOE from complying with EPA and NRC regulations.

## 5.0 REFERENCES


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DRAFT AGENDA
DOE/NRC Technical Exchange
MGDS Topical Report (TR) on Erosion
May 27, 1992
White Flint Building
Rockville, MD

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|---|---|---|
| Welcome/Protocol (Begin at 8:30) | DOE RW-331 | (5 min) |
| Opening Remarks | NRC<br>State of Nevada<br>Counties | (  )<br>(  )<br>(  ) |
| Opening Remarks and Introduction to the Purpose of the TR and the DOE Position (TB) | DOE | (15 min) |
| Regulatory Basis for DOE Position (CP) | DOE | (15 min) |
| Questions and Answers | All | (15 min) |
| Dating of Yucca Mountain Quaternary Deposits (CH) | DOE | (40 min) |
| Questions and Answers | | (15 MIN) |
| Break | All | (  ) |
| Measurement and Determination of Erosion on Hill-Slopes and Valley Incision at Yucca Mountain (JW) | DOE | (40 min) |
| Questions and Answers | | (15 min) |
| Qualification of Data and Methodology (BD) | DOE | (40 min) |
| Questions and Answers | | (15 min) |
| Lunch | All | (  ) |
| NRC Presentation<br>(Would like NRC's response to TR outline and preliminary impressions of DOE technical basis) | NRC | (  ) |
| State of Nevada Presentation | | (  ) |
| Open Discussion | ALL | (60 min) |
| Summary Remarks | DOE<br>NRC<br>State of Nevada<br>Counties | (10 min)<br>(  )<br>(  )<br>(  ) |