SUMMARY OF THE NRC/DOE TECHNICAL EXCHANGE ON VOLCANISM STUDIES
August 25, 1992
TRW Building, Vienna, Virginia

On August 25, 1992, members of the technical staff of the Division of High-Level Waste Management participated in a video-conference discussion linking the TRW offices in Vienna, Virginia, and the U.S. Department of Energy (DOE) offices in Las Vegas, Nevada. Those in attendance at the TRW location included representatives from the DOE Headquarters, local DOE contractors, Nuclear Waste Technical Review Board, Advisory Committee on Nuclear Waste and Nuclear Regulatory Commission (NRC) staff. Participants in Las Vegas included DOE Project Office staff, the State of Nevada, City of Las Vegas, DOE consultants, and the NRC On-Site Licensing Representative. Other affected local governments were informed but chose not to attend this video-conference. An attendance list is included as Attachment 1 and the meeting agenda is included as Attachment 2.

At this meeting, DOE presented an overview of its responses to the NRC staff's detailed review (Phase II) of Study Plan 8.3.1.8.1.1, "Study Plan for Probability of Magmatic Disruption of the Repository." NRC staff indicated it would provide clarification where necessary, to assure DOE understood the NRC rationale for its 13 comments and one question.

The meeting began with introductory remarks followed by the introduction of the attendees. DOE stated that this was not to be considered a formal meeting, but was to serve as a forum to freely exchange information. Following the introduction, DOE presented an overview (Attachment 3) of the relevant regulations and ways to address these regulations as they pertain to igneous activity. DOE next presented their approach to resolving NRC concerns.

DOE explained that this study plan was limited in scope and was not intended to be all inclusive. Other study plans would address the type of information that the NRC was requesting in its comments on the subject study plan. The NRC staff commented that DOE should more clearly explain how this study plan is integrated with other study plans. This type of information will be necessary to be produced at the time of licensing. DOE stated that it will revise the study plan to reflect this information and clarify its intent. Other areas of discussion involved expert opinion, event probability, definition of the term "event", and the process used to develop modeling methods.

DOE indicated it intended to provide its response to the NRC staff comments in late September 1992. The study plan will be revised and possibly submitted to the NRC in November 1992.

In general, based on limited feedback, this first use of the video-conference for repository activities appeared to be satisfactory for this type of activity.

09/10/92

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Repository Licensing and Quality
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Division of High-Level Waste Management
U.S. Nuclear Regulatory Commission

09/09/92

Christian E. Einberg
Regulatory Integrations Branch
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ATTENDANCE LIST
NRC/DOE TECHNICAL EXCHANGE
AUGUST 25, 1992 VIDEO-CONFERENCE
APPROACH TO RESOLVING VOLCANISM CONCERNS

TRW BUILDING-VIENNA, VIRGINIA

ORGANIZATION/NAME

NRC
Ron Ballard
William Belke
Margaret Federline
Dan Fehringer
Keith McConnell
John Trapp

ACNW
Lynn Deering

DOE
Linda Desell
Chris Einberg

Weston
Jim York

Winston & Straw
Stan Echols

M&O
Les Berkowitz
Mary Birch
Jim Duguid
Dave Fenster
Art Greenberg
Bill Griffin
Ali Haghi
Deborah Jerez

USGS
Gene Rosebloom
Ray Wallace

NWTRB
Leon Reiter

LAS VEGAS, NEVADA

NRC

Paul Prestholt

DOE

Jerry Boak
Thomas Bjerstedt
Jeanne Cooper
Susan Jones

LANL

Bruce Crowe

M&O

Steven Leroy
Abe Van Luik
Marshall Weaver

State of Nevada

Carl Johnson
Eugene Smith (UNLV)

City of Las Vegas

A. C. Douglas

Attachment 1

AGENDA

DOE/NRC TECHNICAL EXCHANGE VIDEO-CONFERENCE
DISCUSSION OF NRC CONCERNS RELATED TO VOLCANISM STUDIES

Location: Valley Bank Building, Blue Room, 101 Convention Center Drive, Las Vegas, NV and TRW Building, Room 6260, 2650 Park Tower Drive, Vienna, VA.

Date: August 25, 1992
Time: 11:00 EDT - 6:00 p.m.EDT

Welcome/Protocol/Opening Remarks	NRC, DOE, State, Counties
Overview of DOE Volcanism Studies	DOE
Discussion of NRC Comments on DOE Study Plan 8.3.1.8.1.1	
- Comments (1 and 2) Needing Clarification and Description of Technical Basis	
- Initial response to comments	DOE
- Open discussion	All
- Comments (3, 4, 8, and 9) Considered Beyond the Scope of the Study Plan	
- Initial response to comments	DOE
- Open discussion	All
- Comments (5, 6, 7, and 10) that Require Discussion and Clarification	
- Initial response to comments	DOE
- Open discussion	All
- Comments (12 and 13) on Expert Judgment	
- Initial response to comments	DOE
- Open discussion	All
- Comments on Question 1	
- Initial response to question	DOE
- Open discussion	All
Open Discussion/ Closing Remarks	NRC, DOE, State, Counties

Attachment 2

Agenda
DOE/NRC Technical Exchange
Video-Conference

August 25, 1992

Approach to Resolving Volcanism Concerns

Attachment 3

Approach to Resolving Volcanism Concerns

- Opening Remarks

  NRC
  DOE
  State
  Counties

- Overview of DOE Volcanism Studies

Approach to Resolving Volcanism Concerns

- **Comments (1 and 2) Needing Clarification and Description of Technical Basis**
  - **Initial Response to Comments** — **DOE**
  - **Open Discussion** — **ALL**

Approach to Resolving Volcanism Concerns

- **Comments (3, 4, 8 and 9) Considered Beyone the Scope of the Study Plan**

  - **Initial Response to Comments** — **DOE**
  - **Open Discussion** — **ALL**

Approach to Resolving Volcanism Concerns

- **Comments (5, 6, 7, and 10) that Require Discussion and Clarification**
  - **Initial Response to Comments** — **DOE**
  - **Open Discussion** — **ALL**

Approach to Resolving Volcanism Concerns

- **Comments (12 and 13) on Expert Judgement**
  - **Initial Response to Comments** — **DOE**
  - **Open Discussion** — **ALL**

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Approach to Resolving Volcanism Concerns

- **Comments on Question 1**
  - **Initial Response to Comments** — **DOE**
  - **Open Discussion** — **ALL**
- **Closing Remarks**
  NRC
  DOE
  State
  Counties

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COMMENT #1

Misunderstanding concerning the Scope of the Study Plan

- Focus of SP 8.3.1.8.1.1 is the probability of a disruption of the repository; priority has been on calculations supporting probability of eruptive release event
- Effects determined through SP 8.3.1.8.1.2
- Consequences will be evaluated through PA

*** DOE will modify the formulation of E1 and E2 in SP 8.3.1.8.1.1 for the case of magmatic intrusion without eruption (subsurface scenario) ***

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COMMENT #1

(CONTINUED)

DOE Disagrees with NRC's Use of "Event"

- DOE intends to continue to use "volcanic event" to denote eruptive events that result in cone formation

- DOE also recognizes a broader range of events (magmatic events) that include both surface-breaching (eruptions) and non-surface-breaching (intrusions) events

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COMMENT #1

(CONTINUED)

DOE Disagrees with NRC's Use of "Event"

- Section 3.4.2.2 includes three methods (recurrence intervals, volcanic vents counts, and magma effusion rates) for calculating recurrence rates of volcanic events

- DOE perceives that paragraph 4 of comment basis indicates NRC disagreement with the linear dike feeder model as described in numerous publications and as accepted in general by the State of Nevada; Request NRC provide the technical basis of their disagreement with the model

DOE NEEDS CLARIFICATION ON HOW MUCH TESTING SHOULD BE DONE IN SEARCH OF DATA THAT IS NOT ANTICIPATED BY THE GEOLOGIC RECORD

Preliminary Draft

COMMENT #2

- Magma output rate is well established in the literature
- Plot of magma volume versus time is useful for "testing" the evolutionary stage of a volcanic field (Crowe and Perry, 1989)
- Intrusive volume not important for determining the probability of an eruptive event
- Distinct methodology will be applied to probability calculations for events that produce only indirect effects

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COMMENTS #3 and #9

DOE Will Implement the Strategy Presented in the Study Plan

- Existing data will be examined by an independent consultant
- If evaluated data indicates possible presence of magma, DOE will

1. apply and evaluate multiple complimentary geophysical methods specifically chosen to discriminate between possible interpretations of features (magma bodies) being investigated
2. conduct any additional geophysical studies on any identified anomalies that could be subsurface magma

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COMMENT #4 and #8

- DOE agrees that 40 CFR 191 requires that all significant processes and events be considered in the evaluation of compliance

- Section 3.4.2.1, states that intrusive events will be considered in probability calculations for formation of a new volcanic center, and that this probability calculation will consider " . . . direct penetration of the repository and intrusion or eruption of magma . . ."

- The performance parameter that will be used to assess compliance against 60.113 is the probability of intrusion or eruption into the repository and is included in Table 4 of SP 8.3.1.8.1.1. DOE will add a sixth initiating event to Section 4.0, or expand the description of one of the events already identified

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COMMENT #4 and #8

(Continued)

- The application of formula 2, page 30 is specifically to address early site disqualification. However, DOE will revise the study plan to describe distinct methods for calculating the performance parameters related to different disruption scenarios

- The second paragraph of section 3.2.2.2 describes a second approach to developing the disruptive parameter. This approach uses data from the preclosure tectonics program and builds on data compiled by activity 8.3.1.8.1.1.1 gathered through SP 8.3.1.8.5.1. A review of SP 8.3.1.8.5.1 will confirm that both intrusive and extrusive features have been identified by a combination of geophysical studies, drilling, and radiometric dating

- DOE will revise procedures to address any field evidence for discrete intrusive events

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COMMENT #5

- DOE agrees that the question of exploring the minimum volume of an event and the volume distribution of events is important. This issue is explored as part of the study plan

- Minimum volume events will be established through analogue studies

- Minimum volume events will also be established through analysis of theoretical controls of dike propagation and solidification

- Technical basis of the comment needs clarification

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COMMENT #6

- Limitations described in comment have been thoroughly discussed in Crowe and Perry (1989) and Crowe et al. (1992)

- Approach used in papers and SP 8.3.1.8.1.1 is examination of cumulative probability curves for volcanic fields

- Limited data set precludes much speculation, but suggested alternate analytical technique (Ho et al., 1991) has been applied with no appreciable difference in resulting recurrence rate

- DOE needs clarification and basis for why the approach described is not valid

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COMMENT #7

Requested Information has been Provided

- Limitations described in comment have been thoroughly discussed in Crowe et al. (1992)
- Limited data a set results in the distribution model being a non-significant assumption in bounding the probability of magmatic disruption of the repository
- DOE needs technical basis for why the Non-Poissonian model is more appropriate and valid

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COMMENT #10

- Model I was intended to provide an approach not a formal calculation
  - limited data set precludes significant conclusions from this calculation
- DOE intends to examine analog volcanic fields with large numbers of events
  - similar calculations will be made
  - comparisons will be made to Yucca Mountain data set

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COMMENT #11

- DOE agrees and appreciates the NRC suggestions
- DOE will consider the NRC suggestions when the study plan is revised
- DOE needs technical basis for redefining E1, E2, and E3 as suggested in comment

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COMMENTS #12 AND #13

- Application of methods of expert opinion require separate meeting
- Request NRC respond to the concept of attempting to reduce bias in probabilistic applications of alternative models

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QUESTION #1

- The issue of silicic volcanism will not be resolved on probabilistic grounds
- DOE is waiting for completion of drilling of the final three aeromagnetic anomalies (see SP 8.3.1.8.5.1)

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REGULATORY OVERVIEW

DOE Must Consider Three Regulations

- 10 CFR 960
- 40 CFR 191
- 10 CFR 60

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REGULATORY OVERVIEW

(CONTINUED)

Three Ways to Address 10 CFR 60 Relative to Igneous Activity (CONTINUED)

- events with probabilities greater than one chance in 10,000 over 10,000 years (>10-8) can only be omitted from the total system performance assessments "if there is a reasonable expectation that the remaining probability distribution of cumulative releases would not be significantly changed by such omissions"

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REGULATORY OVERVIEW

(CONTINUED)

As Mandated By Law

- Primary focus of volcanism studies is evaluation of the potentially adverse condition of igneous activity against the postclosure system guideline (960.4-1); looking for evidence that would disqualify the site early in the siting process, as required by 10 CFR 960 (960.3-1-5) and NWPAA (42 USC 10133(c)(3))

- An extrusive event through the repository is the only igneous event potentially capable by itself of exceeding criteria in 40 CFR 191, as implemented in 10 CFR 60

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REGULATORY OVERVIEW

(CONTINUED)

Three Ways to Address 10 CFR 60 Relative to Igneous Activity

- probability of any igneous event occurring near the site is so low that 40 CFR 191 App. B provides that "performance assessments need not consider categories of events or processes that...have [a probability of] less than one chance in 10,000 over 10,000 years" ($<10^{-8}$)

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REGULATORY OVERVIEW

(CONTINUED)

Three Ways to Address 10 CFR 60 Relative to Igneous Activity (CONTINUED)

- develop a total system performance assessment model that includes direct and indirect releases due to igneous activity and demonstrate in the License Application that:
  - the probability of igneous activity has been adequately investigated to meet 10 CFR 60.122(a)(2)(i);
  - the effects of igneous activity have been adequately investigated to meet 10 CFR 60.122(a)(2)(ii); and
  - igneous activity does not significantly affect the repository's total system performance to meet 10 CFR 60.122(a)(2)(iii).

STRATEGY FOR RESOLUTION OF 10 CFR 60 ISSUES RELATED TO IGNEOUS ACTIVITY