

NUCLEAR REGULATORY COMMISSION/DEPARTMENT OF ENERGY
SITE VISIT ON CHARACTERIZATION OF FAULTS AND FRACTURES
NEAR YUCCA MOUNTAIN AND STRATIGRAPHY, STRUCTURE AND ROCK
PROPERTIES ALONG THE EXPLORATORY STUDIES FACILITY NORTH RAMP

YUCCA MOUNTAIN SITE, MAY 2-5, 1994

On May 2-5, 1994, representatives of the U.S. Nuclear Regulatory Commission (NRC), U.S. Department of Energy (DOE), State of Nevada, Clark and Nye Counties, Nevada, Advisory Committee on Nuclear Waste, and Nuclear Waste Technical Review Board, participated in a site visit to the Yucca Mountain candidate repository site and vicinity with the purpose of discussing DOE's progress in the characterization of faults and fracture networks at Yucca Mountain and for DOE to apprise the NRC staff of the current understanding of stratigraphic and structural data collected along the path of the Exploratory Studies Facility (ESF) prior to initiation of large-scale tunnel boring activities. DOE's participating organizations, U.S. Geological Survey, U.S. Bureau of Reclamation, Sandia National Labs, Lawrence Livermore National Lab, Science Applications International Corporation, Inc. and staff from Headquarters and Yucca Mountain Site Characterization Office (YMSCO), provided the necessary technical and logistical support. NRC attendees included staff from Center for Nuclear Waste Regulatory Analyses and staff from Headquarters and On-Site Representatives' Office. Lists of attendees, which varied day to day are given in Attachments 1a-d. The original itinerary, with purpose, and final itinerary are in Attachments 2a and 2b, respectively.

On May 2-3, updates of the following plans and activities were provided by DOE participants at the Yucca Mountain Field Operations Center (FOC) and discussions were held on these topics, among others: a) geologic surface fault mapping program, including Ghost Dance and Sundance Faults; b) stratigraphic nomenclature; c) rock engineering properties and North Ramp stratigraphy/structural geology; d) geologic mapping of North Portal area; stereophotogrammetric and Geographic Information System mapping methods; e) seismic reflection and refraction survey lines; f) ages of slip and rates of slip on major faults in the area; g) systematic drilling program; h) process that inputs site data into ESF design; priority of safety and scientific goals; i) structural model of Yucca Mtn region; structural controls on steep hydraulic gradient. Participants visited and were briefed on the ESF*, Alcove 1*, tunnel boring machine* being assembled on North Portal pad, the Large Block Experiment* and fracture pavement* at Fran Ridge, and the Ghost Dance Fault pavement* on south slope of Antler Ridge.

On May 4-5, updates of the following activities were provided by DOE participants at sites in the field and discussions were held in the field on these topics: a) softground in Trench NRT-1* b)

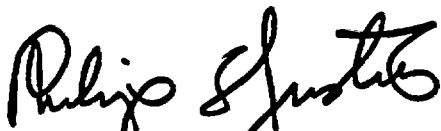
SD-12 borehole* and LM-300 dry-drilling method; c) Sundance Fault mapping project with emphasis on East Antler Ridge* and Split Wash* area exposures, including its relationship at junction* with Ghost Dance Fault; handlens-scale mapping of contacts in the Tiva Canyon Tuff; d) Paintbrush Canyon Fault exposed in Alice Ridge trench A-1*; e) Bare Mountain range-front fault investigations and preliminary results; Bare Mtn trenches BMT-1* and BMT-2*; age of alluvial and colluvial deposits; age of fault events from fault scarp angle and height; f) Solitario Fault investigations and preliminary results; Trenches SCFT-1*, SCFT-3*, T-1*; evidence for contemporaneity of faulting and volcanism; fault scarp exposure ages using geomorphology and a cosmogenic carbon-14 dating method, with emphasis on scarp exposures* near SCFT-3 and T-1; plan for development of Study Plans for Probabilistic Seismic Hazard Analysis; plan for development of preliminary tectonic model and integration of various tectonic investigations.

Representatives of the State and Affected Units of Local Government present on May 5th were afforded an opportunity to provide input into this summary; only the Clark County representative chose to do so. He expressed a concern that some age determination methods under consideration are not clearly useful.

* (Asterisk) identifies locations that were visited in the field

Enclosures:

- 1a. List of Attendees on May 2, 1994
- b. " " " " May 3, 1994
- c. " " " " May 4, 1994
- d. " " " " May 5, 1994
- 2a. Itinerary and Official Notice of Site Visit
- b. Revised Itinerary Provided on May 2, 1994



Philip S. Justus
Sr. On-Site Licensing Rep.
High-Level Waste and Uranium
Recovery Projects Branch
Division of Waste Management
U.S. Nuclear Regulatory
Commission



Corinne Macaluso
Regulatory Integration Branch
Office of Civilian Radioactive
Waste Management
U.S. Department of Energy

NRC Site Visit Attendee List

May 2, 1994

Name	Organization
Charles W. Neisenberg	SAIC USGS
Terry Crump	Weston
George J. Lindenburg	DOE/YMSCO
Shirley A. Morikawa	UNLV
Eugene I. Smith	UNLV
Alex J. Sanchez	UNLV
Gene M. Yogodzinski	UNLV
David C. Buesch	USGS
Debra Edwards	USGS
Mark C. Tynan	DOE/YMSCO
Gerry L. Stirewalt	CNWRA
John S. Trapp	NRC
Goodluck I. Ofoegbu	CNWRA
Thomas W. Bjerstedt	DOE/YMSCO
Craig M. dePolo	NBMG/UNR
David A. Ferrill	CNWRA
Stephen R. Young	CNWRA
Jerry Szymanski	TRAC-NA
Kenneth A. Foland	ACNW
A. K. Ibrahim	NRC
K. I. McConnell	NRC
R. D. Rogers	M&O/WCFS
David D. Tillson	NNWPO
Steve G. Wesnousky	UNR
Gregory T. Elbring	SNL
Robin N. Datta	M&O/WCFS
Robert W. Clayton	M&O/WCFS
Corinne J. Macaluso	DOE/RW-331
Raymond H. Wallace, Jr.	USGS/HQ
William J. Hinze	NRC/ACNW
Norman T. Simms	M&O/Duke
Victor Palciauskas	NWTRB
Philip Justus	NRC
Nick Stellavato	Nye County
William Boyle	DOE/YMSCO
Richard Spengler	USGS
Carl Johnson	Nevada
Jim Grubb	Nevada
E.V. Tiesenhausen	Clark County

NRC Site Visit Attendee List

May 3, 1994

Name	Organization
Mark C. Tynan	U.S. DOE/YMP
Gerry L. Stirewalt	CNWRA
John. S Trapp	NRC
Chuck Weisenberg	SAIC USGS
Dale Engstrom	Sandia
Chris Rautman	Sandia
Keith McConnell	NRC
Ted Johnson	NRC
Baler Ibrahim	NRC
Ken Foland	ACNW
E. V. Tiesenhausen	Clark County
Philip Justus	NRC
Goodluck Ofoegbu	CNWRA
Robin N. Datta	M&O/WCFS
Richard W. Spengler	USGS
Ray Wallace	USGS/HQ
Bill Hinze	NRC/ACNW
Stephen R. Young	CNWRA
David A. Ferrill	CNWRA
Carl Johnson	Nevada
Jim Grubb	State
David Tillson	Nevada
Steve G. Wesnousky	UNR
Norman T. Simms	M&O/Duke
Terry Crump	Weston
Ralph Rogers	M&O/WCFS
George Lindenburg	DOE/YMSCO
William Boyle	DOE/YMSCO
Debra Edwards	USGS
Craig dePolo	NBMG/UNR
C. A. Braun	USGS/SAIC
Larry Martin	USGS/SAIC
Nick Stellavato	Nye County
Mike Fahy	USBR
Steve Beason	USBR
Norma Biggar	M&O/WCFS
David Buesch	USGS
Robert W. Elayer	M&O/MK
Daniel J. Ports	USGS

NRC Site Visit Attendee List**May 3, 1994**

Name	Organization
Tim Sullivan	DOE/YMSCO
Corinne Macoluso	DOE/RW-331
Robert Dickerson	USGS/SAIC
John Wesling	Geomatrix
John R. Doyle	QATSS
John Whitney	USGS
Steve Mattson	WCFS
Tom Bjerstedt	DOE/YMSCO

NRC Site Visit Attendee List

May 4, 1994

Name	Organization
Norman T. Simms	M&O/Duke
Philip Justus	NRC
Corinne Macaluso	DOE/RW-331
Carl Johnson	Nevada
John S. Stuckless	USGS
Jim Grubb	Nevada
Robert Dickerson	USGS/SAIC
Steve Wesnousky	UNR
A.K. Ibrahim	NRC
C. A. Braun	USGS/SAIC
Larry Martin	USGS/SAIC
Craig dePolo	NBMG/UNR
Victor Palciauskas	NWTRB
Robert W. Clayton	M&O/WCFS
Ted Johnson	NRC
Keith McConnell	NRC
Norma Bigger	M&O/WCFS
Robert Elayer	M&O/MK
Dan Soeder	USGS
Thomas Bjerstedt	DOE/YMSCO
Bill Hinze	NRC/ACNW
Chris Menges	USGS
E. V. Tiesenhausen	Clark County
G. I. Ofoegbu	CNWRA/NRC
Terry R. Crump	Weston
David A. Ferrill	CNWRA
Stephen R. Young	CNWRA
G. Stirewalt	CNWRA
Charles Harrington	LANL
David Tillson	NWPO
Ray Wallace	USGS/HQ
Mark C. Tynan	DOE/YMSCO
Zell E. Peterman	USGS/GSP
Mary Margaret Coates	USGS/SAIC
John Whitney	USGS
Emily Taylor	USGS

Enclosure 1c

NRC Site Visit Attendee List

May 5, 1994

Name	Organization
Norman T. Simms	M&O/Duke
Terry Crump	Weston
Corinne Macaluso	DOE/RW-331
Mary-Margaret Coates	USGS/SAIC
Nick Stellauato	Nye County
E. V. Tiesenhausen	Clark County
Charles Harrington	LANL
Ray Wallace	USGS/HQ
Thomas Bjerstedt	DOE/YMSCO
John S. Trapp	NRC
Philip Justus	NRC
Keith McConnell	NRC
David A. Ferrill	CNWRA
P. Guewals	CNWRA
Carl Johnson	Nevada
Craig dePolo	NBMG/UNR
Chuck Weisenberg	USGS/SAIC
Debbie Edwards	USGS
Baler Ibrahim	NRC
David Tillson	Nevada
Mark C. Tynan	DOE/YMSCO
Goodluck Ofogebu	CNWRA/NRC
Chris Menges	USGS
Larry Anderson	USBR/USGS
Stephen R. Young	CNWRA
John Whitney	USGS
Alan Ramelli	USGS
Richard Spengler	USGS

Enclosure 1d



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20565-0001

APR 08 1994

MEMORANDUM FOR: Joseph J. Holonich, Chief
High-Level Waste and Uranium Recovery Projects Branch
Division of Waste Management

FROM: Charlotte Abrams, Senior Project Manager
High-Level Waste and Uranium Recovery Projects Branch
Division of Waste Management

SUBJECT: FORTHCOMING NUCLEAR REGULATORY COMMISSION/U.S. DEPARTMENT OF
ENERGY (DOE) SITE VISIT* ON CHARACTERIZATION OF FAULTS AND
FRACTURES NEAR YUCCA MOUNTAIN AND STRATIGRAPHY, STRUCTURE,
AND ROCK PROPERTIES ALONG THE EXPLORATORY STUDIES FACILITY
(ESF) NORTH RAMP

DATE: May 2-5, 1994

TIME: See agenda (Enclosure 1) for daily times

LOCATION:** Nevada Test Site and Yucca Mountain area, Nevada

PURPOSE: To discuss DOE's progress in the characterization of faults
and fracture networks at Yucca Mountain and to apprise the
NRC staff of the current understanding of stratigraphic and
structural data collected along the path of the ESF prior to
initiation of large-scale tunnel boring activities.

PARTICIPANTS:

NRC

C. Abrams
K. McConnell
A. Ibrahim
J. Trapp

DOE

C. Macaluso
T. Bjerstedt
M. Tynan

State of Nevada

T. Hickey
C. Johnson

* Meetings and technical exchanges between NRC and DOE are open to members of the public, Petitioners, intervenors, or other interested parties wishing to attend as observers pursuant to the spirit of "Open Meeting Statement of NRC Staff Policy," 43 Federal Register 28058, dated June 28, 1978, which details the open meeting policy for applicants and licensees.

** Permission to gain access to the facilities at Yucca Mountain must be obtained from DOE, Yucca Mountain Project Office (YMP). Those persons wishing to attend the site visit should mail or fax the information requested on the enclosed form (Enclosure 2) to Ms. Carlene Hill, SAIC, 101 Convention Center Dr., Las Vegas, NV 89193, Fax (702) 794-5348, Verify (702) 794-7375, at least 14 days prior (30 days for foreign nationals) to the site visit.

Meeting Notice

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Affected Local Governments

S. Bradhurst, Nye County, NV	M. Baughman, Lincoln County, NV
D. Bechtel, Clark County, NV	F. Sperry, White Pine County, NV
V. Poe, Mineral County, NV	P. Niedzielski-Eichner, Nye County, NV
C. Schank, Churchill County, NV	L. Fiorenzi, Eureka County, NV
R. Williams, Lander County, NV	J. Hoffman, Esmeralda County, NV
B. Mettam, Inyo County, CA	L. Bradshaw, Nye County, NV

Charlotte E. Abrams
Charlotte E. Abrams, Senior Project
Manager
High-Level Waste and Uranium Recovery
Projects Branch
Division of Waste Management

cc: J. Meder, NV
S. Goldberg, OMB
D. Weigel, GAO
P. Meyer, NAS
W. Barnard, NWTRB
A. Kadak, YAEK
R. Newlin, OPA

Enclosures: Site Visit Itinerary
Site access form

**DOE/NRC SITE VISIT
CHARACTERIZATION OF FAULTS AND FRACTURES NEAR YUCCA MOUNTAIN,
AND STRATIGRAPHY, STRUCTURE AND ROCK PROPERTIES ALONG THE
EXPLORATORY STUDIES FACILITY NORTH RAMP
May 2-5, 1994**

Monday, May 2, 1994*

7:30 a.m. Meet at Nevada Test Site (NTS) Gate 510 for badging

8:00 Presentations at Area 25 Field Operations Center (FOC)
Introductions

8:10** Characterization of faults and fractures; update on the study:
Structural Features in the Site Area (8.3.1.4.2.2)

8:50 Stratigraphy, structure and stratigraphic nomenclature

9:30 Rock properties and north ramp stratigraphy/structure; NRTI Trench

10:20 BREAK

10:35 Mapping of the ESF: status, results, plans

11:30 Vertical seismic profiling, reflection/refraction studies

12:30 LUNCH, discussion

1:00 North ramp reflection/refraction

1:40 Fracture network/fault studies Fran Ridge, Ghost Dance and
Sundance faults

2:40 ESF safety training

2:55 Depart FOC for North Portal

3:30 Arrive North Portal, tour ESF and test alcove

5:30 Depart for exit via Mercury Gate 100

*** Participants will be expected to provide their own lunches and beverages for the site visit. Water will be available.**

**** Times for presentations and field stops are tentative in order to allow sufficient time for discussion and questions. Ending times for each day's itinerary will be adjusted if additional time is needed.**

**DOE/NRC SITE VISIT
May 2-5, 1994**

Tuesday, May 3, 1994*

7:30 a.m. Meet at NTS Gate 510 for badging

8:00 Presentations at FOC
Seismic refraction, Windy Wash**

8:40 Status of systematic drilling program

9:20 Use of site data in ESF design

9:50 BREAK

10:05 Trenching activities; Solitario Canyon, Bare Mtn., Alice Ridge

10:45 Status of Midway Valley studies

**11:30 Structural model of the Yucca Mountain Region, significance of
northwest oriented structural features, and structural controls on
the steep hydraulic gradient**

12:30 LUNCH and discussion

1:00 Depart for Fran Ridge

1:30 Arrive Fran Ridge. Discuss pavement study.

2:30 Discussion of large block experiment

3:00 Depart for Ghost Dance Pavement, Antler Ridge

3:30 Discussion of Ghost Dance and Sundance fault systems

6:00 Depart for exit via Mercury Gate 100

*** Participants will be expected to provide their own lunches and beverages
for the site visit. Water will be available.**

**** Times for presentations and field stops are tentative in order to allow
sufficient time for discussion and questions. Ending times for each day's
itinerary will be adjusted if additional time is needed.**

**DOE/NRC SITE VISIT
May 2-5, 1994**

Wednesday, May 4, 1994*

7:30 a.m. Meet at NTS Gate 510 for badging
8:00 Depart for north side of Exile Hill, visit NRT-1 trench
8:30** NRT-1 trench discussion
9:30 Depart for SD-12 location
9:45 SD-12 location; observe borehole drilling; discussion
10:15 Depart for Sundance exposure, east end of Antler Ridge
10:30 Sundance fault, east end of Antler Ridge near UZ-16, discussion
11:10 Depart for north side of Antler Ridge (eat lunch in transit)
11:30 Arrive north side of Antler Ridge in Split Wash area for hike to location of Sundance/Ghost Dance fault systems' intersection; discussion
1:00 Walk to Sundance "discovery" outcrop, Split Wash; examine outcrop and discuss Sundance fault system
2:10 Depart Split Wash area for Paintbrush Canyon fault trenches, north end of Alice Ridge
2:40 Discussion at Paintbrush Canyon trench location, Alice Ridge
4:00 Depart Alice Ridge for exit via Mercury Gate 100

*** Participants will be expected to provide their own lunches and beverages for the site visit. Water will be available.**

**** Times for presentations and field stops are tentative in order to allow sufficient time for discussion and questions. Ending times for each day's itinerary will be adjusted if additional time is needed.**

**DOE/NRC SITE VISIT
May 2-5, 1994**

Thursday, May 5, 1994*

7:30 a.m. Meet at Steve's Pass, Crater Flat

8:00 Arrive BMT-1 trench; discussion**

9:00 Travel to BMT-2

9:30 Arrive BMT-2; discussion

10:30 Depart for east side of Crater Flat

11:00 Discussions at trenches T-8, T-10, and others (lunch at trench sites)

3:30 Closing discussions and questions

4:00 Depart NTS via Mercury Gate 100

*** Participants will be expected to provide their own lunches and beverages for the site visit. Water will be available.**

**** Times for presentations and field stops are tentative in order to allow sufficient time for discussion and questions. Ending times for each day's itinerary will be adjusted if additional time is needed.**