

Mr. Ronald A. Milner, Acting Director  
 Office of Program Management and Integration  
 Office of Civilian Radioactive Waste Management  
 U.S. Department of Energy  
 1000 Independence Avenue, SW  
 Washington, DC 20585

February 7, 1995

SUBJECT: SUMMARY FROM THE NOVEMBER 29 TO DECEMBER 1, 1994, TECHNICAL EXCHANGE ON GROUNDWATER FLOW AND TRAVEL TIME

Dear Mr. Milner:

The purpose of this letter is to transmit the summary for the November 29 to December 1, 1994, technical exchange between the Nuclear Regulatory Commission and the U.S. Department of Energy (DOE). Representatives from the State of Nevada, affected units of local government, and DOE program participants also participated in the technical exchange.

Should you have any questions regarding this summary, please contact Mr. David Brooks (301/415-7284) of my staff.

Sincerely,

John H. Austin, Chief  
 Performance Assessment and Hydrology Branch  
 Division of Waste Management  
 Office of Nuclear Material Safety  
 and Safeguards

Enclosure: As stated

- cc: R. Loux, State of Nevada
- J. Meder, Nevada Legislative Counsel Bureau
- R. Nelson, YMPO
- C. Einberg, DOE/Washington, DC
- M. Murphy, Nye County, NV
- M. Baughman, Lincoln County, NV
- D. Bechtel, Clark County, NV
- D. Weigel, GAO
- P. Niedzielski-Eichner, Nye County, NV
- B. Mettam, Inyo County, CA
- V. Poe, Mineral County, NV
- W. Cameron, White Pine County, NV
- R. Williams, Lander County, NV
- L. Fiorenzi, Eureka County, NV
- J. Hoffman, Esmeralda County, NV
- C. Schank, Churchill County, NV
- L. Bradshaw, Nye County, NV
- W. Barnard, NWTRB
- R. Holden, NCAI
- E. Lowery, NIEC
- S. Brocoum, YMPO
- R. Arnold, Pahrump, NV

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 \* SEE PREVIOUS CONCURRENCE

OFC	PAHB*		PAHB*		PAHB				
NAME	JAPohle/km		DJBrooks		JHAustin				
DATE	01/26/95		02/03/95		02-07-95		/ /95		/ /95

SUMMARY OF THE NRC/DOE TECHNICAL EXCHANGE ON GROUNDWATER FLOW AND TRAVEL TIME

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OFC	PAHB	PAHB	PAHB				
NAME	JAPohle/km	DJBrooks	JHAustin				
DATE	01/1/95	01/3/95	01/ /95		/ /95		/ /95

SUMMARY OF THE NRC/DOE TECHNICAL EXCHANGE ON GROUNDWATER FLOW AND TRAVEL TIME

## DOE/NRC TECHNICAL EXCHANGE GROUND-WATER FLOW AND TRAVEL TIME

November 29 to December 1, 1994  
Denver, Colorado

On November 29 through December 1, 1994, staff from the Nuclear Regulatory Commission (NRC), the Department of Energy (DOE), NRC and DOE program participants, the State of Nevada, and affected units of local government conducted a technical exchange to discuss groundwater flow and travel time (GWTT). The agenda is attachment A; attachment B is the list of attendees.

On Tuesday, November 29, 1994, the morning session was devoted to presentations, by DOE program participants, on site characterization activities (infiltration studies, unsaturated zone studies, and regional and site-scale saturated zone studies). The afternoon session focused on prototype testing for mechanisms of fracture flow. Presentations were made by both NRC and DOE program participants.

On Wednesday, November 30, 1994, the morning session continued the previous day's discussions on prototype testing and included discussions on infiltration scenarios, fault control of groundwater flow and results of isotopic studies. Presentations were made by NRC, DOE, and State of Nevada program participants. The afternoon session focused on thermal effects related to definition of the disturbed zone. Technical presentations were made by both NRC and DOE program participants. The NRC staff initiated a discussion of the purpose underlying the disturbed zone concept and its relationship to determining compliance with the GWTT performance objective.

On Thursday, December 1, 1994, discussion topics included DOE's calculational approach to GWTT, including model development and consideration of uncertainty. The NRC staff presented an approach under consideration to determine the "fastest path" of likely radionuclide travel.


The exchange was particularly well focused because the NRC staff had communicated to DOE specific questions to be addressed and made requests for specific investigators to make presentations. DOE investigators responded to NRC's questions in their presentations. The discussions were open and candid in that DOE and NRC program participants discussed preliminary data and analyses. The meeting highlighted the need for more frequent focused interactions allowing more spontaneous discussions among technical specialists. The NRC concluded that DOE is making progress in investigating unsaturated fractured flow, and in modeling saturated and unsaturated flow. Improvement was also noted in the integration of laboratory-, and field-scale investigations with modeling activities. However, concern was expressed by both the State of Nevada and the NRC staff that current time schedules may limit necessary feedback and interaction between modeling efforts, and collection of site data. The treatment of uncertainties in this integrated effort will provide early sensitivity analyses of important site scale parameters. In addition, the DOE investigators informed the NRC staff that their investigative strategies have evolved considerably beyond those documented in their "study plans." DOE believed that the three-day proceeding yielded positive results in supplying guidance for how far DOE could make compliance demonstrations for the disturbed zone, and initiating discussions

on how to implement a methodology for calculating GWTT. For the disturbed zone, DOE believed that progress was made. NRC clarified that the intent of 10 CFR Part 60 was to place importance on a comparison of GWTT calculations; the first calculation under ambient conditions (without thermal signal), and the second with a thermal signal (or a selected range of thermal loads). This approach places emphasis on the models depicting the physical system, and deemphasizes reliance on expert judgement in defining a boundary that demarcates the disturbed zone.

For a methodology to calculate GWTT, DOE believed that little progress was made, and was confined to NRC's discussing a potential methodology for application. The potential methodology focused on analyzing the central tendency about a range of the "fastest water particle" travel times as the measure of the performance objective. DOE believed that this approach placed reliance on those simulations on which one would have the least confidence (the tails of the distribution), rather than focusing on the central tendency showing the true variability of the natural setting. Both DOE and NRC agreed that discussions should be held in the near future in order to continue to develop an approach for the calculation of GWTT.



David Brooks  
Performance Assessment and  
Hydrology Branch  
Division of Waste Management  
Office of Nuclear Material Safety  
and Safeguards  
U.S. Nuclear Regulatory Commission



Christian Einberg  
Regulatory Integration Division  
Office of Program Management  
and Integration  
Office of Civilian Radioactive  
Waste Management  
U. S. Department of Energy

**ATTACHMENT A - AGENDA**

**AGENDA**  
**DOE/NRC TECHNICAL EXCHANGE**  
**GROUND-WATER FLOW AND TRAVEL TIME**

November 29, 1994

Denver, Colorado

**Site Characterization and Ground-Water Flow (Patterson DOE Moderator)**

<b>SCHEDULE</b>	<b>TOPIC</b>	<b>PRESENTER</b>
8:00 am	Opening Remarks	All
8:30	Introduction--Site Characterization Activities and Relation to Travel Time	DOE (Hoxie)
9:00	Infiltration Studies	DOE (Flint)
9:45	Unsaturated Zone Studies	DOE (Kwicklis)
10:30	BREAK	
10:45	Regional and Site-Scale Saturated Zone Studies	DOE (Luckey)
11:30	LUNCH	

**Mechanisms of Fracture Flow (Ford/Nicholson NRC Moderators)**

1:00	Pneumatic Testing at Apache Leap, and Uncertainty and Scale Effects in Flow and Transport	NRC (Neuman)
1:45	Bulk Fracture/Matrix Flow Parameters	DOE (LeCain)
2:30	BREAK	
2:45	Introduction and Laboratory Testing of a Fractured Block	DOE (Kwicklis)
3:45	Laboratory Characterization of Fracture Flow	DOE (Glass)
4:30	Fracture Characterization and Discrete Fracture Representation	DOE (Anna)
5:15	Open Discussion	All
5:45	ADJOURN	

**AGENDA**  
**DOE/NRC TECHNICAL EXCHANGE**  
**GROUND-WATER FLOW AND TRAVEL TIME**

November 30, 1994                      Denver, Colorado

**Mechanisms of Fracture Flow (Continued, Ford/Nicholson NRC Moderators)**

<b>SCHEDULE</b>	<b>TOPIC</b>	<b>PRESENTER</b>
8:00	Centrifuge Determination of Unsaturated Parameters	DOE (Conca)
8:45	Chemical Transport at Apache Leap	NRC (Bassett)
9:30	Prototype Testing at the Raymond Quarry Site	DOE (Karasaki)
10:15	BREAK	
10:30	Infiltration Scenarios and Fault Control of Ground-Water Flow	NV (Lehman)
11:15	Status of <sup>3</sup> H, <sup>14</sup> C, and Stable Isotope Studies in the Unsaturated Zone	DOE (Yang)
11:45	Ground-Water Flow and Travel Time Based on <sup>36</sup> Cl Studies	DOE (Fabryka-Martin)
12:15	LUNCH	

**Thermal Effects Related to Definition of the Disturbed Zone (Duguid M&O Moderator)**

1:45	Numerical Experiments in Nonisothermal Flow	NRC (Green/Wittmeyer)
2:15	Calculational Approach	DOE (Duguid)
2:45	Thermal Effects on Flow	DOE (Tsang)
3:30	BREAK	
3:45	Thermal and Mechanical Effects	DOE (Tsai)
4:15	Thermal Effects on Geochemistry	DOE (Glassley)
5:00	Open Discussion	All
5:30	ADJOURN	

**AGENDA**  
**DOE/NRC TECHNICAL EXCHANGE**  
**GROUND-WATER FLOW AND TRAVEL TIME**

December 1, 1994

Denver, Colorado

**Ground-Water Travel Time (Smistad/Patterson DOE Moderators)**

<b>SCHEDULE</b>	<b>TOPIC</b>	<b>PRESENTER</b>
8:00	Introduction	DOE (Smistad)
8:30	Interpretation of Regulations and Calculational Philosophy	DOE (Berkowitz)
9:00	Calculational Approach	DOE (Duguid)
9:30	Implementation of Approach	DOE (Barnard)
10:00	<b>BREAK</b>	
10:15	Site-Scale Unsaturated Zone Model	DOE (Bodvarsson)
10:45	1994 Fast Path Flow Modeling in the Unsaturated Zone and the Saturated Zone Model	DOE (Barnard)
11:45	<b>LUNCH</b>	
1:15	Uncertainty in Compliance Demonstration	NRC (Codell) ✗
1:45	Stochastic Analysis of Flow and Transport	NRC (Bagtzoglou)
2:15	<b>BREAK</b>	
2:30	Application of FEHM to the Saturated Zone	DOE (Zyvoloski) -
3:15	Open Discussion	All
3:45	NRC Comments	NRC
4:15	State of Nevada Comments	NV
4:45	Closing Remarks	All
5:15	<b>ADJOURN</b>	



**ATTACHMENT B - ATTENDEES**

**NRC/DOE TECHNICAL EXCHANGE  
GROUND-WATER FLOW AND TRAVEL TIME  
NOVEMBER 29, 1994**

	PRINT NAME	COMPANY	TITLE
1	NORMAN T. SIMMS	NRC	REG. LICENSING
2	Ray Wallace	USGS	Hydrologist
3	E. V. TUBERMAN	Clark County	ENR. SPEC.
4	Richard Costell	NRC	sr. Hydraulic Engineer
5	Brad Mettum	Inyo County	Project Coordinator
6	HOMI MINWALLA	WESTON	sr. Project Engineer
7	JOHN KESSLER	EPRI	MGR. HLW Disposal
8	Jim Conca	WSU	Assoc. Prof.
9	Chris Einberg	DOE	REG. Int. Division
10	Russell Patterson	DOE	Acting Team Leader - Hydro.
11	THOMAS J. NICITOLSON	NRC/EPRI	Senior Hydrogeologist
12	LARRY MCKAGUE	CNURA	GEOLOGICAL SETTLEMENT MANAGER
13	CARL JOHNSON	NEVADA	MGR. TECH. PROB.
14	LINDA LEHMAN	NEVADA	" " "
15	JENN. R. WILLIAMS	DOE	Dep. of AMOF
16	SHLOMO NEUMAN	VA/NRC	Professor
17	Tim McCartin	NRC	Modeling Analyst
18	Gene Rusboom	USGS	Scientist Emeritus
19	LARRY ANNA	USGS	Hydrologist.
20	Dan Gillies	USGS	UZ Team Chief
21	Ning Lu	USGS	UZ Hydrologist
22	William Dudley	USGS	Branch Science Advisor
23	Zell Peterman	USGS	Geologist
24	Mal Murphy	Alto City	Reg. Licensing Advisor

**NRC/DOE TECHNICAL EXCHANGE  
GROUND-WATER FLOW AND TRAVEL TIME  
NOVEMBER 29, 1994**

	PRINT NAME	COMPANY	TITLE
1	David Brooks	NRC	Hydro Section lead
2	PAT Tucci	USGS	SZ Modeling Unit Coordinator
3	Gordon Wittmeyer	CNWRRA	Sr. Res. Scientist
4	JEFFREY PALLE	NRC	SR HYDROGEOLOGIST
5	Lance R Wolf	NRC	Attorney
6	LESTER BERKOWITZ	TRIO/LLCO	Sr Proj ENGR
7	William Paul	NRC	Hydrologist
8	HARVEY FROELICH	WLL	CONF, PA + HYDROLOGY BRANCH
9	R J Glass	SNL	Scientist
10	NEIL COLEMAN	NRC	HYDROGEOLOGIST
11	JOE ROUSSEAU	USGS	Project Chief / Hydrologist
12	ALBERT YANG	USGS	Hydrologist
13	Larry Hume	USOR	TDU
14	Bill Nelson	PMO/INTERA	Staff Consultant
15	Kenzi Karasaki	LRL	Staff Scientist
16	Brian Marshall	USGS	Hydrologist
17	Jerry L. King	MDO/SAIC	Senior Scientist
18	Jim Daguid	INTERA	
19	Dwayne Chouat	LLNL	Sr. Science Advisor
20	Wu-Ling Zhao	CU	Res. Associate
21	Thomas Berstest	DOE/VMSCO	
22	Ron Green	CNWRRA	Sr Res Sci
23	DIANA PERFECT	USGS (MFP)	hydrologist
24	VICTOR PALCIAUSKAS	NWTRB	

**NRC/DOE TECHNICAL EXCHANGE  
GROUND-WATER FLOW AND TRAVEL TIME  
NOVEMBER 29, 1994**

	PRINT NAME	COMPANY	TITLE
1	Thomas H. Rogers	M40/WCFE	Senior Project Geologist
2	JERRY FARLEY	M40/WCFE	HYDROGEOLOGIST
3	RONALD M. LINDEN	M40/SAIC	HYDROLOGY TEAM
4	Dwight T. Hoxie	USGS	Hydrologist
5	Susan Altman	SNL	Senior Member of Technical Staff
6	CLIFF HO	SNL	"
7	Richard Luckey	USGS	Hydrologist
8	ALAN L. FLINT	USGS	RESEARCH HYDROLOGIST
9	Mick Aptel	IITC	Geochemist
10	Yvonne Tsang	LBL	Staff Scientist
11	Gary Le Cain	USGS	Hydrologist
12	Gary L. Patterson	USGS	Hydrologist
13	A. C. Douglas	CLU	Sr Geologist
14	Jayna Downing	ACUW/ NRC	SR. Staff Scientist
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**NRC/DOE TECHNICAL EXCHANGE  
GROUND-WATER FLOW AND TRAVEL TIME  
NOVEMBER 30, 1994**

	PRINT NAME	COMPANY	TITLE
1	Dwayne A. Chesnut	LLNL	Sr. Science Advisor
2	Raymond H. Wallace, Jr.	USGS	Hydrologist
3	Cliff Ho	SAIL	Sr. non tech staff
4	SUSAN ALTMAN	"	"
5	CARL JOHNSON	NEVADA	Mgr Tech Probs
6	Jim Duquaid	INTERA	
7	NORMAN T. SIMMS	MADONKE	REG. & LICENSING
8	JOHN KESSLER	EPRS	Mgr. HLW DISPOSAL PROG.
9	JEFFREY POHLE	NRC	Sr. Hydrogeologist
10	Tim McCartin	NRC	Performance Analyst
11	<del>Wendy</del> Maxie	USGS	Hydrologist
12	Thomas W. Brewster	DOE/MSFC	
13	Gene Roseboom	USGS	Supervisor
14	Chris Einberg	DOE/HQ	Gen. Engineer
15	Nathan Moffitt	MAI Nevada	?
16	Bill Niereff	INTERA	-
17	ROBERT FROELICH	NRC	Branch Chief Hydrology & PA
18	Dennis P. Williams	DOE	DEPUTY AMSP YMPD
19	Zell Dekman	USGS	Geologist - YMPD
20	ERIC SMISTAD	DOE	PA - MOLT
21	LESTER BERKOWITZ	NEO/TRW	Sr. Proj. Engr
22	NEIL COLEMAN	NRC	HYDROGEOLOGIST
23	Joe Rousseau	USGS	HYDROLOGIST
24	Bill Glassley	LLNL	Geologist

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	PRINT NAME	COMPANY	TITLE
1	E. J. TIESENHAGEN	CLARK COUNTY	ENG. SPEC.
2	H. LAWRENCE MCKAGUE	CNUWC ENRCA	ELEMENT MANAGER <sup>SETTING</sup> GEOLOGIC
3	Agnes Deery		
4	June Fabyh-thum	LANL	Staff
5	Ralston Barnard	SNI	SMTS
6	John Whelan	USGS	PE
7	Pat Tucci	USGS	MUC
8	Yvonne Tsang	LBL	staff scientist
9	Bill Nelson	PMD	Sr. Advisor Staff
10	JERRY FAIRLEY	MFO/WFS	<sup>HYDROGEOLOGIST</sup> HYDROLOGY TEAM
11	Roger Billman	Hyman + Laser, Ltd	general partner
12	Frank C. Tsai	MFO/WFS	Y-12 - Sr. Geohydrological Egr.
13	MD Voegelé	HHO/BAC	Op. Mgr
14	RON LINDEN	MFO/SAIC	PMD / HYDROLOGI TEAM
15	DAVID BRADEN	NRC	Hydro System Lead
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