1 line, because I think there may be some opportunities
2 there.
3 CHAIRMAN HORNBERGER: Other questions?
4 Staff? Latif?
5 MR. HAMDAN: I read this plan cover to
6 cover. I think it is a significant effort. It is
7 comprehensive, and therefore, responsive to the ACNW.
8 I think it is very well written too. But I have
9 several concerns I would like to share with you and
10 maybe you can help me with.
11 The first thing that is missing in the plan
12 is it doesn't tie research to the current state of
13 knowledge or the current degree of uncertainty that we
14 know.
15 When you talk about multi barriers, it
16 addresses uncertainty in a general way, but there is
17 nowhere that you tie your ranking of the research to
18 the degree of uncertainty or the current state of
19 knowledge. I think that needs to be included in the
20 plan.
21 Another item that is missing that surprised
22 me, that all of us who have proposed research or
23 reviewed research projects, we all know that money,
24 that's cost and time, to execute, implement research
25 projects is always a criterion to evaluate projects.

1 Not only considered, but it is always a criterion.
2 You have a nice placeholder in Table 2 when you talk
3 about efficiency and effectiveness, but to my
4 surprise, there was no cost and no time frames that
5 you can use to evaluate the proposals.
6 Third item. While you are still on this
7 plan and the thing that came to my mind is the budget
8 that you proposed, you do not use this plan to rank
9 them. So you give me a piece of paper with some
10 maximum score, some multiplier that you don't give me
11 some background as to where this has been used, and
12 whether it has been used successfully or not. You do
13 not apply it yourself.
14 I can tell you from personal experience, and
15 many people here probably know, the devil is in the
16 detail. You can improvise. You can come up with all
17 kinds of criteria you want. When you come to apply
18 them, these projects that you have will come 3.7, 3.6,
19 3.5, 3.4. Are you going to rank your projects with
20 this number or are you going to say hum, maybe this
21 method doesn't apply or we need to do some other
22 things. So that is missing.
23 The fourth item is you know, we are not
24 really a research institution. I know the importance
25 of research to NRC and I know that the chairman has

1 been talking about it, and all of us are interested
2 in, including the committee. But what is missing from
3 this proposal is the role of the licensees. We work
4 with and require our licensees to defend their work,
5 to give us -- to use the methods they want to use to
6 solve the problems, to give us reasons why they use
7 them, again and again to defense. This is missing
8 from here.
9 You need some criteria to discriminate
10 between work that can be done by the licensees and
11 work that ultimately research, the research office
12 needs to do. I think that is important because a lot
13 of this work can possibly be done by licensees.
14 Finally, I have one last item. That is the
15 impression I get after reading this is as if we are
16 hung up on preparing plans. This plan is prepared as
17 a draft plan to prepare a plan. Cheryl mentioned
18 January. I am happy to hear that. But I am afraid
19 when you see the list of projects and the way you are
20 going about it, it's as if the plan is an object. On
21 that, I have two problems.
22 One of them, I would like to see a plan that
23 discusses how are you going to deal with the Center of
24 Nuclear Waste? How are you going to deal with NMSS?
25 Give me specifics. I want you to explore how you are

1 going to deal with the users, be it NMSS, the Center
2 in San Antonio, and maybe other people. What are your
3 successes in research and how you are going to take
4 advantage of them, and what your failures are and how
5 you are going to avoid them in the current plan.
6 So I need to see a time and budget. You
7 have a small budget. A million dollars is a lot of
8 money for me, but in real research really it's not
9 that big of money. So you really need to address
10 these issues to be effective. You need to use your
11 budget very well, and you need to spend time
12 coordinating.
13 Look at the long list of projects. Anybody
14 can come with that, with all due respect. What is
15 needed is the coordination and see to it that we move
16 the research program forward and make it useful.
17 Another point I would make on this is that
18 you know, this planning thing, there's some bad news
19 and good news for planning. They asked Eisenhower
20 about planning, President Eisenhower. He said, "I am
21 30 years in the military, and we never did anything
22 without a plan. But in 30 years I have not seen one
23 plan that did not change."
24 So the bottom line is, if you are looking
25 for a perfect plan, there is none. So don't try to

1 make the plan perfect because there is not such a
2 thing. The good news is, you don't need a perfect
3 plan. You need a plan that addresses how you are
4 going to make the most use of the money you have, the
5 budget you have, how to work effectively with NMSS,
6 how to work effectively with the Center, how to build
7 up on present knowledge and how to use the degree of
8 uncertainty to engineer and fashion a new program.
9 Thanks.
10 CHAIRMAN HORNBERGER: Other comments or
11 questions?
12 Sher, you know where all the bodies are
13 buried. You must have a question or two.
14 MS. TROTTIER: He is the cause of all the
15 problems.
16 MR. BAHADUR: I had a chance to look at this
17 program from different vantage points. At one time I
18 came in front of this committee presenting this plan.
19 MS. TROTTIER: It wasn't this plan.
20 (Laughter.)
21 MR. BAHADUR: At that time the plan was a
22 little better.
23 (Laughter.)
24 MR. BAHADUR: But this is also possible.
25 I also saw this plan when I was sitting in

1 a different division, and therefore, didn't want to go
2 much money into this plan, but it did.
3 I think your point is very well taken, jokes
4 apart. There are too many projects and too little
5 money.
6 The reason is, this program started as
7 anticipatory work. It also started as a direct
8 application to high level waste, with some money going
9 to low level waste. Gradually the research went to
10 Center. The Office of Research had to re-think the
11 direction of this plan.
12 What you see today is an excellent example
13 of how the directions can be changed into making it
14 more applicable to the current philosophy of the
15 agency.
16 What comment I heard from Latif, I think
17 they are good comments, but we should realize that the
18 object of this briefing was to give you the plan as it
19 is, not the specific project. When you come with the
20 specific projects, I am sure some of the concerns you
21 raised, Bill Ott and John will be able to address
22 those.
23 At this time, the Committee needs to see
24 this. Is this plan going to meet the challenges the
25 agency is going to face? Decommissioning is one.

1 Spent fuel is the other. Of course an oblique
2 application to high level waste and low level waste.
3 We can ask Bill Ott and John to go back and
4 look at the strategy as to how they can look at this
5 plan and also see its application into what the Center
6 is doing, what the NMSS is doing. Right now, the way
7 this plan, the way I understood this plan is it's a
8 combination of anticipatory and user need work. More
9 anticipatory than user need.
10 When the Office of Research does the
11 anticipatory work, it had to have certain independence
12 in its thinking. I think it is very well reflected in
13 the plan. That is what I just wanted to add.
14 CHAIRMAN HORNBERGER: Other comments or
15 questions?
16 MR. OTT: I would like to make one. It is
17 about the statement of too many projects and too
18 little dollars. We have come to you deliberately with
19 too many projects. In the past, we have come to you
20 with only the projects that we've funded. They said
21 well what didn't you fund? What did you select from?
22 We are trying to give you the set of things from which
23 we are going to make our decisions on prioritization.
24 We will explain how those decisions were made the next
25 time we come to you with a prioritized list.

1 But it is deliberately too many projects.
2 There are things in there that we probably wouldn't
3 have included if we thought this was going to be the
4 program we had to defend before you for dollars.
5 We'll do that at a later point. Right now we are
6 still soliciting other ideas, so the list may get
7 longer. I hope it gets longer. I hope there are
8 people out there that will give us good ideas. But we
9 will make decisions, and we will cut down that list.
10 We will identify things that we're not going to fund
11 and things we are going to fund. We will hope to
12 bring you that so that you will be able to know how we
13 did it.
14 CHAIRMAN HORNBERGER: Okay. You need to
15 come to a microphone. Identify yourself.
16 MR. REED: My name is Phil Reed. I am with
17 the Office of Research. Just two comments, and then
18 I have a question for the Committee. Actually, I have
19 two questions for the Committee.
20 CHAIRMAN HORNBERGER: That's not allowed.
21 (Laughter.)
22 MR. REED: With regard to the comment on
23 iodine 129 plumes, yes, we do plan to address the
24 longwoods fission products and the trans-uranics. We
25 do have an internal report that describes the release

1 and the transport of iodine 129, and the location
2 traveling some distance down to an aquifer.
3 With regard to the comment on fast-end
4 thinking. We actually do follow the accelerator
5 transmutation of waste program from the Department of
6 Energy. But because we didn't put it in here, it was
7 related to high level waste, but we do have it on our
8 list of high level waste things to do.
9 The question I have to the Committee is in
10 May, the expert panel of the Office of Research
11 addressed the Commission with regard to the role and
12 future directions of the Office of Research. One of
13 the recommendations that they made to the Commission
14 involved the ACNW. What they said there was that they
15 thought that the ACNW should produce a list of
16 unfunded, but must-do projects. I was just curious,
17 are you going to submit maybe a list of your top 20 or
18 30 research topics to the Office of Research for
19 consideration? Maybe the top 10, I should say.
20 CHAIRMAN HORNBERGER: The answer is that we
21 are aware that the Rodger's Committee made that
22 recommendation. The Committee has not yet discussed
23 what we will or possibly will do along those lines.
24 MR. REED: The second question is we
25 understand that you are preparing a paper on chemistry

1 that will be going to the Commission. I was
2 wondering, are you going to put any recommendations
3 for research into that particular paper?
4 CHAIRMAN HORNBERGER: That paper on
5 chemistry has to do with Yucca Mountain specifically.
6 There are in that paper, one could read in that paper
7 recommendations for work that needs to be done. But
8 there are not -- to go to the part of your question,
9 there are no recommendations that would be called out
10 specifically for anticipatory research for RES. We
11 pretty much stick to Yucca Mountain.
12 MEMBER GARRICK: There are certainly lots of
13 issues.
14 CHAIRMAN HORNBERGER: Oh there are lots of
15 issues.
16 MEMBER GARRICK: Identified in the report
17 for which research may be represented.
18 CHAIRMAN HORNBERGER: It doesn't take a very
19 close reading to understand what some of the research
20 issues would be in the chemistry field.
21 VICE CHAIRMAN WYMER: It does have an
22 overtone of anticipatory research in that we say that
23 there might be things downstream that are unearthed
24 either for technical or political reasons that will
25 change the course that DOE might take.

1 In connection with those, you may need some,
2 in the chemistry report you may need some chemistry
3 anticipatory research to deal with those. There is an
4 overtone of that in there.
5 MR. OTT: From the perspective of Farfield,
6 many of the issues that Yucca Mountain may carry over
7 into other types of disposal as well. So some of
8 those things are things that we could possibly
9 address.
10 VICE CHAIRMAN WYMER: Transport is kind of
11 a universal thing.
12 MR. OTT: Our problem is when it gets
13 heated.
14 CHAIRMAN HORNBERGER: The specific question,
15 however, had to do with the chemistry paper. The
16 chemistry paper was near field or is near field.
17 MEMBER GARRICK: I was pleased to hear that
18 you are following the ATW work, for example, because
19 I think there are some very important issues, safety
20 issues associated with some of the ATW concepts. Some
21 they have addressed, but the arguments that are often
22 used to substitute accelerators for reactors, those
23 arguments are often not very well presented in terms
24 of from a risk perspective.
25 CHAIRMAN HORNBERGER: Thank you all.

1 So we are about to -- we have a time
2 allotted to discuss our plans for conducting the ACNW
3 research review. I think we probably don't need to be
4 on the record any more. I think we are finished.
5 (Whereupon, at 4:40 p.m., the proceedings
6 went off the record.)
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CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on Nuclear Waste 128th Meeting

Docket Number: (Not Applicable)

Location: Rockville, Maryland

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

John Mongoven

John Mongoven
Official Reporter
Neal R. Gross & Co., Inc.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON NUCLEAR WASTE
WASHINGTON, D.C. 20555-0001

June 28, 2001

AGENDA
128th ACNW MEETING
JULY 17-19, 2001

TUESDAY, JULY 17, 2001, CONFERENCE ROOM 2B3, TWO WHITE FLINT NORTH, ROCKVILLE, MARYLAND

1) 8:30 - 8:40 A.M. Opening Statement (Open) (GMH/JTL)
The Chairman will open the meeting with brief opening remarks, outline the topics to be discussed, and indicate several items of interest.

2) 8:40 - 10:15 A.M. ACNW Planning and Procedures (Open) (GMH/ALL)
The Committee will discuss the items noted below.
- 2.1) Commitments from the 127th ACNW meeting
- 2.2) Issues for the 128th ACNW meeting
- 2.3) Topics for August 2001 and beyond
- 2.4) EDO responses to Committee reports
- 2.5) EDO's list of future meeting topics
- 2.6) ACNW Calendar for 2001
- 2.7) Civilian Radioactive Waste Management Systems, Management and Operating Contractor meeting topics
- 2.8) Planned attendance at outside meetings

10:15 - 10:30 A.M. ***BREAK***

3) 10:30 - 12:00 P.M. Update on Igneous Activity Issue Resolution (Open) (GMH/LFD)
- 3.1) 10:30 - 11:30 a.m. - Presentation by the NRC staff on progress in resolving the igneous activity issue.
- 3.2) 11:30 - 12:00 Noon - Discussion between the ACNW Members and the NRC staff

12:00 - 1:00 P.M. ***LUNCH***

4) 1:00 - 3:00 P.M. DOE's Supplemental Science and Performance Analysis (SSPA) (Open) (GMH/RKM)

4.1) 1:00-2:00 p.m. - DOE presentation - the Committee will hear a status report from DOE on its SSPA to be issued this summer.

4.2) 2:00-3:00 p.m. - Discussion and questions between presenter and ACNW Members

3:00 - 3:15 P.M. BREAK

5) 3:15 - 4:15 P.M. Research Plan for Radionuclide Transport Program (Open) (GMH/ RPS)

5.1) 3:00-4:00 p.m. - Briefing by the NRC RES staff on the current status of the radionuclide transport program.

5.2) 4:00-4:15 p.m. - Discussion between the ACNW Members and the NRC staff.

5.3) 4:15-4:30 p.m. - Discuss plans for conducting an ACNW Research review.

6) 4:15 - 4:45 P.M. Meeting Reports (Open) (ALL)

The Committee will hear reports from the Members and staff on meetings attended since the 127th ACNW meeting.

7) 4:45 - 6:00 P.M. Preparation of ACNW Reports (Open)

The Committee will discuss proposed reports on the following topics:

7.1) High Level Waste Chemistry (RGW/ACC)

7.2) Igneous Activity Issue Resolution (GMH/LFD)

7.3) Research Plan for Radionuclide Transport (GMH/RPS)

WEDNESDAY, JULY 18, 2001, CONFERENCE ROOM 2B3, TWO WHITE FLINT NORTH, ROCKVILLE, MARYLAND

8) 8:30 - 8:40 A.M. Opening Statement (Open) (GMH/HJL)

The Chairman will make opening remarks regarding the conduct of today's sessions.

9) 8:40 - 12:00 Noon Key Technical Issues (KTIs) - Vertical Slice Report (Open) (GMH/LFD)

The Committee members will discuss their progress and then commence drafting a report on assigned KTIs.

9.1) Saturated Zone Flow (GMH/LFD)

9.2) Container Life and Source Term (RGW/ACC)

9.3) Total System Performance Assessment and Investigation (BJG/ACC)
9.4) Thermal Effects on Flow (ML/RKM)

Noon - 1:00 P.M. LUNCH

10) 1:00 - 2:30 p.m. Greater-than-Class C (GTCC) Wastes (Open) (RGW/HJL)
10.1) 1:00-2:00 p.m. - Presentation by DOE representatives on their handling of GTCC
10.2) 2:00-2:30 p.m. - Discussion between the presenter and the ACNW Members

2:30 - 2:45 P.M. BREAK

11) 2:45 - 6:00 P.M. Preparation of ACNW Reports (Open)
The Committee will discuss proposed reports on the following topics:
11.1) High Level Waste Chemistry
11.2) Igneous Activity Issue Resolution (GMH/LFD)
11.3) Research Plan for Radionuclide Transport (GMH/RPS)
11.4) GTCC Disposal Options (RGW/HJL) (tentative)
11.5) KTI-Vertical Slice Report (GMH/LFD)

THURSDAY, JULY 19, 2001, CONFERENCE ROOM 2B3, TWO WHITE FLINT NORTH, ROCKVILLE, MARYLAND

12) 8:30 - 8:35 A.M. Opening Statement (Open) (GMH/HJL)
The Chairman will make opening remarks regarding the conduct of today's sessions.

13) 8:35 - 9:30 A.M. Preparations for October Visit to Nevada (Open) (GMH/AS)
Discussion among Committee Members of potential topics, including public outreach sessions and a visit to the Envirocare facility

14) 9:30 - 12:45 P.M. Preparation of ACNW Reports (Open)
The Committee will continue its discussion of proposed reports.

15) 12:45 - 1:00 P.M. Miscellaneous (Open) (BJG/SB)
The Committee will discuss matters related to the conduct of Committee activities and matters and specific issues that were not completed during previous meetings, as time and availability of information permit.

1:00 P.M. Adjourn 128th Meeting

NOTE:

- Number of copies of the presentation materials to be provided to the ACNW - 35.

- ACNW meeting schedules are subject to change. Presentations are frequently canceled or rescheduled to another day. If such a change would result in significant inconvenience or hardship, be sure to verify the schedule with Mr. Howard Larson at 301-415-6805 between 8:00 a.m. and 4:00 p.m., several days prior to the meeting.

U.S. Department of Energy
Office of Civilian Radioactive Waste Management

Introduction to FY01 Supplemental Science and Performance Analyses

Presented to:
Advisory Committee on Nuclear Waste

Presented by:
Carol Hanlon
Yucca Mountain Site Characterization Office
U.S. Department of Energy

July 17, 2001

YUCCA MOUNTAIN PROJECT

Presentation Outline

- Background
- Content
- Summary

Background

- Total System Performance Assessment - Site Recommendation (TSPA-SR) Revision 00 ICN 01 completed December 11, 2000
- DOE initiated work to quantify uncertainties in summer 2000
- Yucca Mountain Site Recommendation Consideration Report Volumes 1 and 2 completed fall 2000
  - Not released
  - Superceded by Yucca Mountain Science and Engineering Report and Yucca Mountain Preliminary Site Suitability Evaluation

Background
(Continued)

- **FY01 Supplemental Science and Performance Analyses report developed to capture and assess impacts of continuing work**
  - New scientific work
  - Unquantified uncertainties
  - Range of operating temperatures
  - System and subsystem sensitivity analyses

Background
(Continued)

- Initiated work on Supplemental Science and Performance Analyses report March 16, 2001
  - Contractor document
  - Prepared under Technical Work Plan
  - Document approved by DOE
- Volume 1: Scientific Bases and Analyses issued July 9, 2001
- Volume 2: Performance Analyses expected to be issued mid July 2001

Background
(Continued)

- In addition to other documents, Supplemental Science and Performance Analyses provides reference material for Preliminary Site Suitability Evaluation
  - Evaluation against DOE's proposed 10 CFR 963, Yucca Mountain Site Suitability Guidelines

Modeling for FY01 Supplemental Science and Performance Analyses Sensitivity Analysis

- Intended to supplement not supplant the analyses in TSPA-SR Rev. 00 ICN 01
- Incorporated
  - New scientific data
  - Quantified uncertainties
  - Models to represent range of temperatures
- Examined effects of alternative conditions by evaluating the repository operating modes
  - High-temperature operating mode, nearly the same as the design assumptions in the TSPA-SR base case
  - Low-temperature operating mode, chosen to keep waste package temperatures below 85°C

Prioritizing Information — Summary of Supplemental Models and Analyses

Key Attributes of System	Process Model (Section of S&ER)	Topic of Supplemental Scientific Model or Analysis	Reason For Supplemental Scientific Model or Analysis			Section of Volume 1	Performance Assessment Treatment of Supplemental Scientific Model or Analysis (Discussed In Volume 2)	
			Unquantified Uncertainty Analysis	Update in Scientific Information	Lower-Temperature Operating Mode Analysis		TSPA Sensitivity Analysis	Included in Supplemental TSPA Model
Limited Water Entering Emplacement Drifts	Climate (4.2.1)	Post-10,000-year Climate Model		X		3.3.1	X	X
	Net Infiltration (4.2.1)	Infiltration for post-10,000-year Climate Model		X		3.3.2	X	X
	Unsaturated Zone Flow (4.2.1)	Flow in PTn		X		3.3.3		
		3-D flow fields for cooler design; flow fields for post-10,000 yr climate, lateral flow; variable thickness of PTn; fault property uncertainty		X	X	3.3.4		
		Effects of lithophysal properties on thermal properties		X		3.3.5		X
	Coupled Effects on UZ Flow (4.2.2)	Mountain-scale Thermal-Hydrologic effects		X	X	3.3.5		
		Mountain-scale Thermal-Hydrologic-Chemical effects		X	X	3.3.6		
		Mountain-scale Thermal-Hydrologic-Mechanical effects		X	X	3.3.7		
	Seepage into Emplacement Drifts (4.2.1)	Flow-focussing within heterogeneous permeability field; episodic seepage	X		X	4.3.1, 4.3.2, 4.3.5	X	X
		Effects rock bolts and drift degradation on seepage	X			4.3.3, 4.3.4		
	Coupled Effects on Seepage (4.2.2)	Thermal effects on seepage	X		X	4.3.5	X	X
		Thermal-Hydrologic-Chemical effects on seepage	X		X	4.3.6		
		Thermal-Hydrologic-Mechanical effects on seepage		X	X	4.3.7		

Prioritizing Information — Summary of Supplemental Models and Analyses

(Continued)

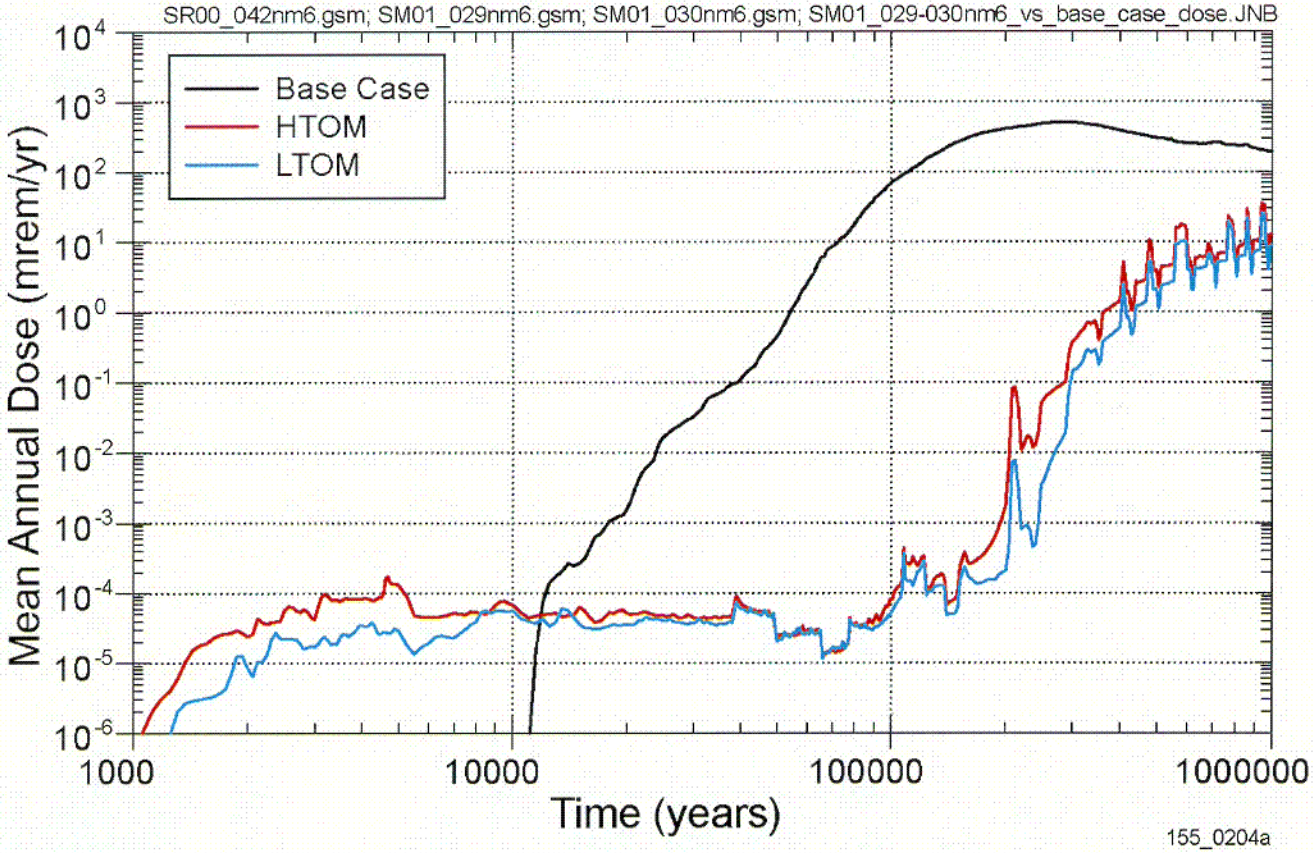
Key Attributes of System	Process Model (Section of S&ER)	Topic of Supplemental Scientific Model or Analysis	Reason For Supplemental Scientific Model or Analysis			Section of Volume 1	Performance Assessment Treatment of Supplemental Scientific Model or Analysis (Discussed In Volume 2)	
			Unquantified Uncertainty Analysis	Update in Scientific Information	Lower-Temperature Operating Mode Analysis		TSPA Sensitivity Analysis	Included in Supplemental TSPA Model
Limited Water Entering Emplacement Drifts	Coupled Effects on UZ Flow (4.2.2)	Mountain-scale Thermal-Hydrologic effects		X	X	3.3.5		
		Mountain-scale Thermal-Hydrologic-Chemical effects		X	X	3.3.6		
		Mountain-scale Thermal-Hydrologic-Mechanical effects		X	X	3.3.7		
Limited Release of Radionuclides from the Engineered Barriers	DHLW Degradation and Performance (4.2.6)	HLW glass degradation rates	X	X	X	9.3.1		
	Dissolved Radionuclide Con-centrations (4.2.6)	Solubility of neptunium, thorium, plutonium, and technetium	X	X	X	9.3.2	X	X

Supplemental Total System Performance Assessment Model Results

- General conclusions of sensitivity analyses:
  - Early waste package failures resulted in very small doses during regulatory period
  - Doses beyond 10,000 years are less
  - Peak doses occurred later in time

Supplemental Total System Performance Assessment Model Results

(Continued)



Note: Mean annual dose histories are shown for the supplemental total system performance assessment model for both high temperature and low temperature operating modes and are compared to a base case showing the mean annual dose for nominal performance from the Total System Performance Assessment-Site Recommendation

HTOM - high temperature operating mode
LTOM - low temperature operating mode

C01

Quality Status for Supplemental Science and Performance Analyses

- Prepared in accordance with requirements of the Quality Assurance Requirements and Description document
- Analysis done to provide insights
- Followed scientific and technical practice
  - Documented work performed
  - Retained data input files
  - Maintained appropriate records
- Data, models and analyses include qualified and non-qualified inputs
- Validation and quality documentation will be completed for data, codes and models carried forward

FY01 Supplemental Science Performance and Analyses Content

- Volume 1: Scientific Bases and Analyses
  - Unquantified uncertainty analyses
  - Update scientific information
    - New data, analyses and models
  - Cooler thermal operating mode analyses
- Volume 2: Performance Analyses
  - Performance assessment sensitivity analyses
  - Supplemental total system performance assessment model analyses
    - High temperature operating mode
    - Low temperature operating mode

Supplemental Science and Performance Analyses Table of Contents

- Volume 1: Scientific Bases and Analyses
- 16 chapters and 1 appendix
  - Introduction
  - Methods and Approach
  - Unsaturated Zone Flow
  - Seepage
  - Effects of Decay Heat on In-drift Thermal-Hydrologic Conditions
  - In-drift Physical and Chemical Environment
  - Waste Package and Drip Shield Degradation
  - Water Diversion Performance
  - Waste Form Degradation and Radionuclide Release

Supplemental Science and Performance Analyses Table of Contents

(Continued)

- **Volume 1: Scientific Bases and Analyses**
  - Engineered Barrier System Transport
  - Radionuclide Transport in the Unsaturated Zone
  - Radionuclide Transport in the Saturated Zone
  - Biosphere
  - Volcanic and Seismic Disruptive Events
  - Summary and Conclusions
  - References
  - Appendix A: Human Intrusion Scenario

Supplemental Science and Performance Analyses Table of Contents

(Continued)

- Volume 2: Performance Analyses
- 6 chapters and 1 appendix
  - Introduction
  - Methods and Approach
  - Supplemental Performance Evaluations of Uncertainty
  - Supplemental Performance Evaluations of New Information and Alternative Thermal Operating Modes
  - Summary and Conclusions
  - References
  - Appendix A: Data Tracking Information for Supplemental Performance Analyses

Roles and Relationships of SR Documentation

NWPA requirements → **Proposed 10 CFR Part 963 requirements** → **SR Consideration Hearings** → **Potential SR decision**

Potential SR decision
- DOE Technical Basis
- NRC and DOE Regulations
- NRC sufficiency comments
- Views of states & legislatures
- DOE responses to views
- State impact analyses
- Additional information
- Final EIS

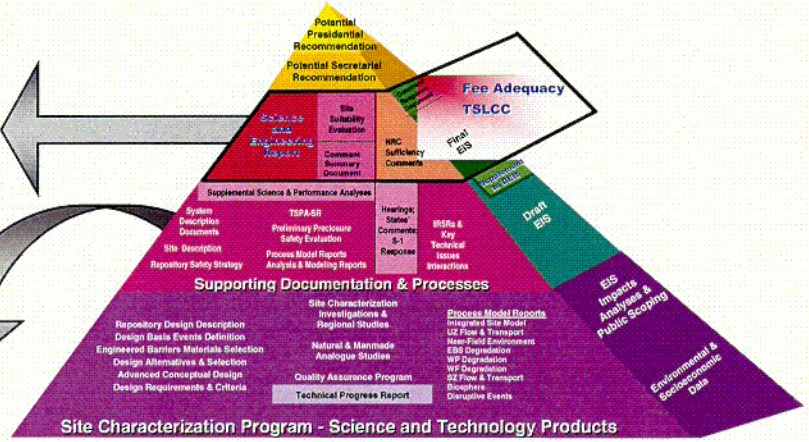
YM S&ER
- Repository description (high-temperature operating mode)
- Waste form and packaging
- Data important to safety
- TSPA-SR results

PSSE/SSE*
- TSPA method
- Criteria evaluations
- Mean dose curves for high- and low-temperature operating modes
- Sensitivity studies

TSPA-SR
- Nominal scenario
  - High-temperature operating mode
- Disruptive events scenario
- Human intrusion scenario
- Mean dose curves
- Sensitivity studies

SSPA – 2 volumes
1
- Additional data
- Additional quantified uncertainties
- Analyses for high- and low-temperature operating modes

2
- Supplemental TSPA model
- Updated mean dose curves for high- and low-temperature operating modes
- Sensitivity studies



*Pre-closure not shown here

C02

Supplemental Science and Performance Analyses Summary

- Presents
  - New data since TSPA-SR
  - Results of unquantified uncertainty work
  - Range of temperature analyses
  - System and subsystem performance analyses
- Supports Preliminary Site Suitability Evaluation as a reference
- Volume 1 available on disk and on the web
- Volume 2 expected to be issued mid-July
- Detailed briefing by Dr. Boyle at the August ACNW meeting

Backup

Summary of Supplemental Models and Analyses

Key Attributes of System	Process Model (Section of S&ER)	Topic of Supplemental Scientific Model or Analysis	Reason For Supplemental Scientific Model or Analysis			Section of Volume 1	Performance Assessment Treatment of Supplemental Scientific Model or Analysis (Discussed In Volume 2)	
			Unquantified Uncertainty Analysis	Update in Scientific Information	Lower-Temperature Operating Mode Analysis		TSPA Sensitivity Analysis	Included in Supplemental TSPA Model
Limited Water Entering Emplacement Drifts	Climate (4.2.1)	Post-10,000-year Climate Model		X		3.3.1	X	X
	Net Infiltration (4.2.1)	Infiltration for post-10,000-year Climate Model		X		3.3.2	X	X
	Unsaturated Zone Flow (4.2.1)	Flow in PTn		X		3.3.3		
		3-D flow fields for cooler design; flow fields for post-10,000 yr climate, lateral flow; variable thickness of PTn; fault property uncertainty		X	X	3.3.4		
		Effects of lithophysal properties on thermal properties		X		3.3.5		X
	Coupled Effects on UZ Flow (4.2.2)	Mountain-scale Thermal-Hydrologic effects		X	X	3.3.5		
		Mountain-scale Thermal-Hydrologic-Chemical effects		X	X	3.3.6		
		Mountain-scale Thermal-Hydrologic-Mechanical effects		X	X	3.3.7		
	Seepage into Emplacement Drifts (4.2.1)	Flow-focussing within heterogeneous permeability field; episodic seepage	X		X	4.3.1, 4.3.2, 4.3.5	X	X
		Effects rock bolts and drift degradation on seepage	X			4.3.3, 4.3.4		
	Coupled Effects on Seepage (4.2.2)	Thermal effects on seepage	X		X	4.3.5	X	X
		Thermal-Hydrologic-Chemical effects on seepage	X		X	4.3.6		
		Thermal-Hydrologic-Mechanical effects on seepage		X	X	4.3.7		

Summary of Supplemental Models and Analyses

(Continued)

Key Attributes of System	Process Model (Section of S&ER	Topic of Supplemental Scientific Model or Analysis	Reason For Supplemental Scientific Model or Analysis			Section of Volume 1	Performance Assessment Treatment of Supplemental Scientific Model or Analysis (Discussed In Volume 2)	
			Unquantified Uncertainty Analysis	Update in Scientific Information	Lower-Temperature Operating Mode Analysis		TSPA Sensitivity Analysis	Included in Supplemental TSPA Model
Long-Lived Waste Package and Drip Shield	Water Diversion Performance of EBS (4.2.3)	Multiscale thermal-hydrologic model, including effects of rock dryout	X		X	5.3.1		X
		Thermal property sets	X	X		5.3.1		X
		Effect of in-drift convection on temperatures, humidities, invert saturations, and evaporation rates	X		X	5.3.2		
		Composition of liquid and gas entering drift	X		X	6.3.1	X	X
		Evolution of in-drift chemical environment	X		X	6.3.3	X	X
		Thermo-Hydro-Chemical model comparison to plug-flow reactor and fracture plugging experiment		X		6.3.1		
		Rockfall		X		6.3.4		
	In-Drift Moisture Distribution (4.2.5)	Environment on surface of drip shields and waste packages	X			5.3.2, 7.3.1		
		Condensation under drip shields	X			8.3.2	X	
		Evaporation of seepage	X		X	8.3.1 5.3.2	X	X
		Effect of breached drip shields or waste package on seepage	X		X	8.3.3	X	X
		Waste package release flow geometry (flow-through, bathtub)	X			8.3.4	X	
	Drip Shield Degradation and Performance (4.2.4)	Local chemical environment on surface of drip shields (including Mg, Pb) and potential for initiating localized corrosion	X			7.3.1		

Summary of Supplemental Models and Analyses

(Continued)

Key Attributes of System	Process Model (Section of S&ER	Topic of Supplemental Scientific Model or Analysis	Reason For Supplemental Scientific Model or Analysis			Section of Volume 1	Performance Assessment Treatment of Supplemental Scientific Model or Analysis (Discussed In Volume 2)	
			Unquantified Uncertainty Analysis	Update in Scientific Information	Lower-Temperature Operating Mode Analysis		TSPA Sensitivity Analysis	Included in Supplemental TSPA Model
Long-Lived Waste Package and Drip Shield	Waste Package Degradation and Performance (4.2.4)	Local chemical environment on surface of waste packages (including Mg, Pb) and potential for initiating localized corrosion	X			7.3.1		
		Aging and phase stability effects on A-22	X	X		7.3.2	X	
		Uncertainty in weld stress state following mitigation	X			7.3.3	X	X
		Weld defects	X			7.3.3	X	X
		Early failure due to improper heat treatment	X		X	7.3.6	X	X
		General corrosion rate of A-22: Temperature dependency	X		X	7.3.5	X	X
		General corrosion rate of A-22: Uncertainty/variability partition	X			7.3.5	X	X
		Long-term stability of passive films on A-22	X			7.3.4		
		Stress threshold for initiation of stress corrosion cracking	X	X		7.3.3	X	X
		Probability of non-detection of manufacturing defects		X		7.3.3	X	X
		Number of defects		X		7.3.5	X	X
		Distribution of crack growth exponent (repassivation slope)	X	X		7.3.7	X	X
Limited Release of Radionuclides from the Engineered Barriers	In-Package Environments (4.2.6)	Effect of HLW glass degradation rate and steel degradation rate on in-package chemistry	X		X	9.3.1	X	X
	Cladding Degradation and Performance (4.2.6)	Effect of initial perforations, creep rupture, stress corrosion cracking, localized corrosion, seismic failure, rock overburden failure, and unzipping velocity on cladding degradation	X		X	9.3.3	X	X

Summary of Supplemental Models and Analyses

(Continued)

Key Attributes of System	Process Model (Section of S&ER	Topic Of Supplemental Scientific Model or Analysis	Reason For Supplemental Scientific Model or Analysis			Section of Volume 1	Performance Assessment Treatment of Supplemental Scientific Model or Analysis (Discussed In Volume 2)	
			Unquantified Uncertainty Analysis	Update in Scientific Information	Lower-Temperature Operating Mode Analysis		TSPA Sensitivity Analysis	Included in Supplemental TSPA Model
Limited Release of Radionuclides from the Engineered Barriers	DHLW Degradation and Performance (4.2.6)	HLW glass degradation rates	X	X	X	9.3.1		
	Dissolved Radionuclide Concentrations (4.2.6)	Solubility of neptunium, thorium, plutonium, and technetium	X	X	X	9.3.2	X	X
	Colloid-Associated Radionuclide Concentrations (4.2.6)	Colloid mass concentrations	X			9.3.4	X	
	EBS (Invert) Degradation and Transport (4.2.6, 4.2.7)	Diffusion inside waste package	X	X		10.3.1	X	X
		Transport pathway from inside waste package to invert	X	X		10.3.2		
		Sorption inside waste package	X	X		10.3.4	X	X
		Sorption in invert	X	X		10.3.4	X	X
		Diffusion through invert	X			10.3.3	X	X
		Colloid stability in the invert	X			10.3.5		
		Microbial transport of colloids	X	X		10.3.6		

Summary of Supplemental Models and Analyses

(Continued)

Key Attributes of System	Process Model (Section of S&ER	Topic of Supplemental Scientific Model or Analysis	Reason For Supplemental Scientific Model or Analysis			Section of Volume 1	Performance Assessment Treatment of Supplemental Scientific Model or Analysis (Discussed In Volume 2)	
			Unquantified Uncertainty Analysis	Update in Scientific Information	Lower-Temperature Operating Mode Analysis		TSPA Sensitivity Analysis	Included in Supplemental TSPA Model
Delay and Dilution of Radionuclide Concentrations by the Natural Barriers	Unsaturated Zone Radionuclide Transport (Advective Pathways; Retardation; Dispersion; Dilution) (4.2.8)	Effect of drift shadow zone - advection/diffusion splitting	X		X	11.3.1	X	X
		Effect of drift shadow zone – concentration boundary condition on EBS release rates	X			11.3.1		
		Effect of matrix diffusion	X			11.3.2, 11.3.3		
		3-D transport			X	11.3.2		
		Effect of coupled Thermo-Hydrologic, Thermo-Hydro-Chemical, and Thermo-Hydro-Mechanical processes on transport		X	X	11.3.5		
	Saturated Zone Radionuclide Flow and Transport (4.2.9)	Groundwater specific discharge	X	X		12.3.1	X	
		Effective diffusion coefficient in volcanic tuffs	X			12.3.2	X	
		Flowing interval spacing				12.3.2	X	
		Flowing interval (fracture) porosity	X			12.3.2	X	
		Effective porosity in the alluvium	X			12.3.2	X	
		Correlation of the effective diffusion coefficient with matrix porosity	X			12.3.2	X	
		Bulk density of the alluvium	X	X		12.3.2	X	X

Summary of Supplemental Models and Analyses

(Continued)

Key Attributes of System	Process Model (Section of S&ER	Topic of Supplemental Scientific Model or Analysis	Reason For Supplemental Scientific Model or Analysis			Section of Volume 1	Performance Assessment Treatment of Supplemental Scientific Model or Analysis (Discussed In Volume 2)	
			Unquantified Uncertainty Analysis	Update in Scientific Information	Lower-Temperature Operating Mode Analysis		TSPA Sensitivity Analysis	Included in Supplemental TSPA Model
Delay and Dilution of Radionuclide Concentratio ns by the Natural Barriers	Saturated Zone Radionuclide Transport (4.2.9)	Retardation for radionuclides irreversibly sorbed on colloids in the alluvium	X	X		12.3.2	X	
		No matrix diffusion in volcanic tuffs case				12.5.2	X	
		Presence or absence of alluvium				12.5.2	X	
		Sorption coefficient in alluvium for I, Tc	X	X		12.3.2	X	X
		Sorption coefficient in alluvium for Np, U	X	X		12.3.2	X	
		Sorption coefficient for Np in volcanic tuffs	X			12.3.2	X	
		Kc model for groundwater colloid concentrations Pu, Am		X		12.5.2	X	
		Enhanced matrix diffusion in volcanic tuffs				12.5.2	X	
		Effective longitudinal dispersivity	X	X		12.3.2	X	
		New dispersion tensor		X		12.3.2		
		Flexible design			X	12.3.2		
		Different conceptual models of the large hydraulic gradient and their effects on the flow path and specific discharge		X		12.3.1		
		Hydraulic head and map of potentiometric surface		X		12.3.1		
	Biosphere (4.2.10)	Receptor of interest	X			13.3.1		
		Comparison of dose assessment methods	X			13.3.2		
		Radionuclide removal from soil by leaching	X			13.3.3		
		Uncertainties not captured by GENII-S	X			13.3.4		
		Influence of climate change on groundwater usage and BDCFs	X			13.3.5, 13.3.7		
		BDCFs for groundwater and igneous releases		X		13.3.6, 13.3.8 13.4	X	X

Summary of Supplemental Models and Analyses

(Continued)

Key Attributes of System	Process Model (Section of S&ER	Topic of Supplemental Scientific Model or Analysis	Reason For Supplemental Scientific Model or Analysis			Section of Volume 1	Performance Assessment Treatment of Supplemental Scientific Model or Analysis (Discussed In Volume 2)	
			Unquantified Uncertainty Analysis	Update in Scientific Information	Lower-Temperature Operating Mode Analysis		TSPA Sensitivity Analysis	Included in Supplemental TSPA Model
Low Mean Annual Dose Considering Potentially Disruptive Events	Volcanism/Igneous Activity (4.3.2)	Probability of dike intersection of repository for the operating mode described in S&ER		X		14.3.3.1		X
		Scaling factors to evaluate impacts of repository design changes			X	14.3.3.2		
		Contribution to release of Zones 1 and 2		X		14.3.3.3	X	
		Sensitivity to waste particle size distribution		X		14.3.3.4	X	
		New wind speed data		X		14.3.3.5	X	X
		Explanation of method for handling ash/waste particle size and density		X		14.3.3.6		
		Volcanism inputs for Supplemental TSPA Model		X		14.3.3.7		X
		New aeromagnetic data		X		14.3.3.8		

NOTE: S&ER = *Yucca Mountain Science and Engineering Report* [DOE 2001 [DIRS *153849*]).

[a] Performance assessment treatment of supplemental scientific model or analysis discussed in SSPA Volume 2 (McNeish 2001 [DIRS 155023]).

Legend:

TSPA - Total System Performance Assessment
PTn - Paintbrush nonwelded unit
EBS - Engineered Barrier System
Mg - Magnesium
Pb - Lead
A-22 - Alloy 22
HLW - High-level waste
DHLW - Defense high-level waste
BDCFs - Biosphere dose conversion factors
GENII-S - Code for statistical and deterministic simulations of radiation doses to humans from radionuclides in the environment
3-D - Three dimensional
I - Iodine
Tc - Technetium
Np - Neptunium
U - Uranium
Pu - Plutonium
Am - Americium

Proposed Comprehensive Statement of the Basis for Recommendation

YM Science & Engineering Report, Rev. 1

- NWPA 114(a)(1)(A)-(C)
- Reflects external comments on YMS&ER, Rev 0
- Update to YMS&ER, Rev 0
- Includes Executive Summary

Final Environmental Impact Statement

- NWPA 114(a)(1)(D)
- Reflects external comments on the DEIS and Supplement
- Comment Response Document
- Includes Executive Summary

NRC Sufficiency Comments

- NWPA 114(a)(1)(E)
- Includes NRC transmittal

SR Comment Summary Document

- NWPA 114(a)(1) & (a)(1)(F)
- Summarizes public comments
- Contains states' views & comments
- Contains Secretary's response

Site Suitability Evaluation

- NWPA 113(b)(1)(A)(iv)
- Reflects external comments on PSSE
- Includes Executive Summary

Other Information

- NWPA 114(a)(1)(G)
- TSLCC & Fee Adequacy Report
- Other information Secretary considers appropriate

Nevada Site Characterization Impacts Report

- NWPA 114(a)(1)(H)
- Any report from State on impacts from site characterization

STATUS OF IGNEOUS ACTIVITY KTI

PRESENTATION TO THE ADVISORY COMMITTEE ON NUCLEAR WASTE

JULY 17-19, 2001

JOHN S. TRAPP, NRC
TEL: 301-415-8063, E-MAIL: JST@NRC.GOV

BACKGROUND

TWO ISSUES

Probability
Consequences

RECENT MEETINGS WITH DOE ON IGNEOUS ACTIVITY

NRC/DOE Technical Exchange on KTIs, 4/2000
NRC/DOE Technical Exchange on IA, 8/2000
NRC/DOE Appendix 7 Meeting on IA, 5/2001
NRC/DOE Technical Exchange on IA, 6/2001

PRIMARY DOE DOCUMENTS ON IA RECEIVED AND REVIEWED

Total System Performance Assessment for Site Recommendation, Rev 0, ICN 01
Igneous Consequence Modeling for Total System Performance for Site Recommendation, Rev 0, ICN 01
Comparison of ASHPLUME results to TEPHRA, Rev 0, ICN 0
Values for External Inhalation Radiation Exposure Analysis, Rev 1, ICN 0
Characterize Framework for Igneous Activity, Rev 0, ICN 1
Dike Propagation Near Drifts, Rev 00, ICN 1
Number of Waste Packages hit by Igneous Intrusion, Rev 01, ICN 0

DOCUMENTATION ON ISSUE STATUS

Letter to Steve Brocoum, DOE, from C.W. Reamer, NRC, SUBJECT: IA Agreements, April 2001

Summary Highlights of NRC/DOE Technical Exchange and Management Meeting on Igneous Activity, August 29-31, 2000, Las Vegas, Nevada

Summary Highlights of NRC/DOE Technical Exchange and Management Meeting on Igneous Activity, June 21-22, 2001, Las Vegas, Nevada

NRC TECHNICAL CONCERNS (4/2000 Technical exchange)

PROBABILITY

1. RECURRENCE RATES.
2. EXTENT OF YUCCA MOUNTAIN IGNEOUS SYSTEM.
3. STRESS/STRAIN AND VOLCANISM:
4. MIOCENE BASALT.
5. LITERATURE VALUES.
6. EVENT DEFINITIONS
7. RELATIONSHIP OF SOURCE-ZONES TO STRUCTURE, TECTONIC MODELS, AND GEOPHYSICS.
8. EFFECT OF NEW INFORMATION ON ELICITATION.
9. VALIDATION OF MODELS.
10. AMR MODEL.
11. USE OF PVHA DATA.

STATUS OF PROBABILITY CONCERNS (8/2000 Technical Exchange)

Two Agreements

1. Use of NRC values in sensitivity studies	Closed pending[1]
2. Review of new aeromagnetic data	Closed pending results of studies

STATUS OF PROBABILITY CONCERNS (4/2001 Letter)

1. Use of NRC values in sensitivity studies	Closed
2. Review of new aeromagnetic data	Closed pending results of studies

[1]All 11 technical concerns under probability, as listed in 4/2000 Technical Exchange, have been subsumed by Probability Agreement 1.

NRC TECHNICAL CONCERNS (4/2000 Technical exchange)
CONSEQUENCES

1. MAGMA/REPOSITORY INTERACTIONS.
2. WASTE PACKAGE/MAGMA INTERACTION:
3. WASTE FORM/MAGMA INTERACTION.
4. WIND CHARACTERISTICS:
5. MASS LOADING
6. REMOBILIZATION.
7. INHALATION - PM10–PM100.
8. SELF EVACUATION.
9. MODEL FOR AIRBORNE TRANSPORT.
10. MODEL FOR GROUNDWATER TRANSPORT.
11. INTEGRATION OF RESULTS FROM ALL PATHWAYS.
12. VOLCANIC TYPE.

STATUS OF CONSEQUENCE CONCERNS (8/2000 Technical Exchange)

Ten Agreements

1. Confirm particle density appropriate in ASHPLUME	Closed pending
2 Document sensitivity of waste particle size	Closed pending
3. Representative tephra volumes	Closed pending
4. Compare ASHPLUME to analog system	Closed pending
5. Calculation of number of waste packages intersected by conduit	Closed pending
6. Remobilization	Closed pending
7. Input values for internal and external exposure	Closed pending
8. PM10-PM100	Closed pending
9. Wind characteristics	Closed pending
10. Magma interaction	Open

Concerns related to self evacuation and integration of results from all pathways were closed. Model for groundwater transport was closed for IA with recommendation that DOE re-examine release rates.

STATUS OF CONSEQUENCE CONCERNS (4/2001 Letter)

Agreements

1. Confirm particle density appropriate in ASHPLUME	Closed
2 Document sensitivity of waste particle size	Closed pending (N/A)[2]
3. Representative tephra volumes	Closed pending (N/A)
4. Compare ASHPLUME to analog system	Closed
5. Calculation of number of waste packages intersected by conduit	Closed pending (N/A)
6. Remobilization	Closed pending (N/A)
7. Input values for internal and external exposure	Open. Additional information needed
8. PM10-PM100	Closed
9. Wind characteristics	Closed pending (N/A)
10. Magma interaction	Open. Additional information needed

[2]Documents received to date were not specifically intended to address the concerns listed as N/A.

STATUS OF CONSEQUENCE CONCERNS (6/2001 Technical Exchange)

1. Confirm particle density appropriate in ASHPLUME	Closed
2 Document sensitivity of waste particle size	Closed pending
3. Representative tephra volumes	Closed pending
4. Compare ASHPLUME to analog system	Closed
5. Calculation of number of waste packages intersected by conduit	Open. Superceded by proposed agreements
6. Remobilization	Open. Superceded by proposed agreements
7. Input values for internal and external exposure	Open. Superceded by agreements
8. PM10-PM100	Closed
9. Wind characteristics	Closed pending
10. Magma interaction	Open. Additional information needed

STATUS OF CONSEQUENCE CONCERNS (6/2001 Technical Exchange Agreements Reached)

11. Relationship between static measurements and surface disturbing activities	Closed pending
12. Extrapolation of PM10 to TSP concentrations	Closed pending.
13. Justify transition period BDCFs	Closed pending
14. Clarify deposit thickness effects on average mass load over transition period.	Closed pending
15. Clarify how external exposure considered in TSPA.	Closed pending
16. Document effects of climate change on disruptive event BDCFs	Closed pending

STATUS OF CONSEQUENCE CONCERNS (6/2001 Technical Exchange Agreements NOT Reached)[3]

1. Evaluate the stress distribution and strain response resulting from thermal loading of HLW.

2. Evaluate how engineered repository structures (e.g., drifts, waste packages, etc.) can affect magma flow processes.

3. Evaluate how repository structures may affect magma ascent, conduit localization, and evolution of the conduit and flow system.

4. Evaluate mechanical strength of natural or engineered barriers proposed to restrict magma flow.

5. Evaluate the effects of backfill or rockfall on magma flow.

6. Evaluate how ascent and flow through repository may incorporate HLW

7. Evaluate waste package response to stresses from dynamic effects

8. Evaluate aging effects on materials to basaltic magmatic

9. Evaluate waste package response to magmatic gasses

10. Evaluate the physical and chemical response of HLW and cladding

11. Provide technical basis that eolian and fluvial remobilization are bounded by TSPA assumptions.

12. Provide technical basis for the method of HLW incorporation used in DOE models.

13. Support assumption that radionuclides in the air is equivalent to radionuclides on ground.

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[3]The NRC proposed path forward for these concerns was given to DOE during the meeting. The DOE response was "DOE acknowledges the NRC proposed agreement and will address this agreement as part of a consolidated response to the NRC's proposed agreement items for the consequence subissue".

IA TECHNICAL CONCERNS - Overall Status to date

CONSEQUENCE	STATUS
1. Magma/repository interactions.	Open.
2. Waste package/magma interaction:	Open
3. Waste form/magma interaction.	Open
4. Wind characteristics:	Closed pending receipt and acceptance of calculation document
5. Mass loading/biosphere	Open. AMR ANL-MGR-MD-000001 Revision should address major concerns.
6. Remobilization.	Open
7. Inhalation - PM10–PM100.	Closed
8. Self evacuation.	Closed
9. Model for airborne transport.	Original concern closed. Concern on incorporation open.
10. Model for groundwater transport.	Closed for IA, but would recommend that DOE re-examine release rates in light of uncertainties of IA source term in TSPA-SR
11. Integration of results from all pathways.	Closed
12. Volcanic type.	Closed pending receipt and approval of Eruptive Processes AMR
PROBABILITY	
1. Use of NRC values in sensitivity studies.	Closed
2. Review of new aeromagnetic data.	Closed pending results of studies

PATH FORWARD

NRC: Continue evaluation of Magma interactions and remobilization

DOE: Provide agreement information
Provide response to NRC's proposed Agreement items for consequence subissue

Summary of the Resolution of the Key Technical Issue on Igneous Activity - Agreements Reached

Subissue #	Subissue Title	Status	NRC/DOE Agreements
1	Probability of future igneous activity	Closed-Pending	See agreements from August 29-31, 2000.
2	Consequences of future igneous activity	Open	IA.2.11 - Provide an analysis that shows the relationship between any static measurements used in the TSPA and expected types and durations of surface disturbing activities associated with the habits and lifestyles of the critical group. DOE will provide an analysis that shows the relationship between any static measurements used in the TSPA and expected types and durations of surface disturbing activities associated with the habits and lifestyles of the critical group in a subsequent revision to the AMR Input Parameter Values for External and Inhalation Radiation Exposure Analysis (ANL-MGR-MD-000001) or equivalent document. This will be available to the NRC in FY02. IA.2.12 - Provide clarifying information on how PM10 measurements have been extrapolated to TSP concentrations. This should include consideration of the difference in behavior between PM10 and TSP particulates under both static and disturbed conditions. DOE will provide clarifying information on how PM10 measurements have been extrapolated to TSP concentrations. This will include consideration of the difference in behavior between PM10 and TSP particulates under both static and disturbed conditions in a subsequent revision to the AMR Input Parameter Values for External and Inhalation Radiation Exposure Analysis (ANL-MGR-MD-000001) or equivalent document. This will be available to the NRC in FY02.

			IA.2.13 - Provide the justification that sampling of range of transition period BDCFs is necessarily conservative in evaluating long-term remobilization processes. DOE will provide the justification that sampling of range of transition period BDCFs is necessarily conservative in evaluating long-term remobilization processes in a subsequent revision to the AMR Input Parameter Values for External and Inhalation Radiation Exposure Analysis (ANL-MGR-MD-000001) or equivalent document. This will be available to the NRC in FY02. IA.2.14 - Provide information clarifying the method used in TSPA to calculate how deposit thickness effects the average mass load over the transition period. DOE will provide information clarifying the method used in TSPA to calculate how deposit thickness effects the average mass load over the transition period in a subsequent revision to the AMR Input Parameter Values for External and Inhalation Radiation Exposure Analysis (ANL-MGR-MD-000001) or equivalent document. This will be available to the NRC in FY02. IA.2.15 - Clarify that external exposure from HLW-contaminated ash, in addition to inhalation and ingestion, was considered in the TSPA. Include in this clarification the consideration of external exposure during indoor occupancy times, or provide basis for dwelling shielding from outdoor gamma emitters. DOE will clarify that external exposure from HLW-contaminated ash, in addition to inhalation and ingestion, was considered in the TSPA. DOE will include in this clarification the consideration of external exposure during indoor occupancy times, or provide basis for dwelling shielding from outdoor gamma emitters in a subsequent revision to the AMR Input Parameter Values for External and Inhalation Radiation Exposure Analysis (ANL-MGR-MD-000001) or equivalent document. This will be available to the NRC in FY02.

			..A.2.16 Document that neglecting the effects of climate change on disruptive event BDCFs is conservative. DOE will document that neglecting the effects of climate change on disruptive event BDCFs is conservative in a subsequent revision to the AMRs Input Parameter Values for External and Inhalation Radiation Exposure Analysis (ANL-MGR-MD-000001) and Disruptive Event Biosphere Dose Conversion Factor Analysis (ANL-MGR-MD-000003) or equivalent document. This will be available to the NRC in FY02.

Summary of the Resolution of the Key Technical Issue on Igneous Activity - Agreements Not Reached

Subissue #	Subissue Title	Status	NRC/DOE Agreements
1	Probability of future igneous activity	Closed-Pending	N/A
2	Consequences of future igneous activity	Open	1) Evaluate the stress distribution and strain response on existing or new geologic structures resulting from thermal loading of HLW. The evaluation should include appropriate spatial variations in overlying topography and appropriate spatial and temporal variations in thermal load. DOE acknowledges the NRC proposed agreement and will address this agreement as part of the consolidated response to NRC's proposed agreement items for the consequence subissue. 2) Evaluate how the presence of engineered repository structures (e.g., drifts, waste packages, etc.) can affect magma flow processes for the duration of an igneous event. Include in this evaluation the potential effects on initial magma flow characteristics, diversion of ascending magma into repository structures, reestablishment of multiple flow-paths to the surface, two phase flow, reaction of the geologic and engineered system to over and under pressure, gas separation, heat transfer, magma recirculation, and range of steady and nonsteady flow conditions that could occur for the duration of an igneous event. DOE acknowledges the NRC proposed agreement and will address this agreement as part of the consolidated response to NRC's proposed agreement items for the consequence subissue.

			3) Evaluate how the presence of repository structures may affect magma ascent, conduit localization, and evolution of the conduit and flow system. Include in this evaluation the potential effects of topography and stress, in addition to a range of physical conditions appropriate for the duration of igneous events. DOE acknowledges the NRC proposed agreement and will address this agreement as part of the consolidated response to NRC's proposed agreement items for the consequence subissue. 4) Evaluate the mechanical strength of natural or engineered barriers that are proposed to restrict magma flow within intersected drifts. A range of physical conditions appropriate for the duration of igneous events should be used in the evaluation. DOE acknowledges the NRC proposed agreement and will address this agreement as part of the consolidated response to NRC's proposed agreement items for the consequence subissue. 5) If significant amounts of backfill or rockfall are thought to occur in repository drifts, evaluate the effects of these materials on magma flow processes throughout the duration of an igneous event. The analysis should include the potential effects of entrainment, meltback, and displacement of backfill. DOE acknowledges the NRC proposed agreement and will address this agreement as part of the consolidated response to NRC's proposed agreement items for the consequence subissue. 6) Evaluate how ascent and flow through repository structures may incorporate HLW located along all potential flow paths that may occur during an igneous event. The evaluation should include such processes as segregation, two phase flow, heat transfer, convective flow, gas circulation of the magma, and evolution of the conduit and flow system. DOE acknowledges the NRC proposed agreement and will address this agreement as part of the consolidated response to NRC's proposed agreement items for the consequence subissue.

			7) Evaluate waste package response to stresses from dynamic magmatic pressurization, internal pressurization, gravitational loading, and heating, using appropriate at-condition strength properties and magma flow paths, for duration of an igneous event. DOE acknowledges the NRC proposed agreement and will address this agreement as part of the consolidated response to NRC's proposed agreement items for the consequence subissue. 8) Evaluate aging effects on materials strength properties when exposed to basaltic magmatic conditions for the duration of an igneous event. Include in this evaluation the potential effects of subsequent seismically induced stresses on substantially intact waste packages. DOE acknowledges the NRC proposed agreement and will address this agreement as part of the consolidated response to NRC's proposed agreement items for the consequence subissue. 9) Evaluate the response of Zone 3 waste packages, or waste packages covered by backfill or rockfall, if exposed to magmatic gasses at conditions appropriate for an igneous event. DOE acknowledges the NRC proposed agreement and will address this agreement as part of the consolidated response to NRC's proposed agreement items for the consequence subissue. 10) Evaluate the physical and chemical response of HLW and cladding after heating and potential disruption of waste package and contents, for waste packages remaining in drifts. Particular attention should be given to effects that may result in increased solubility potential relative to undisturbed HLW forms. DOE acknowledges the NRC proposed agreement and will address this agreement as part of the consolidated response to NRC's proposed agreement items for the consequence subissue.

			11) Provide a technical basis to support conclusions that the risk effects (i.e., effective annual dose) of eolian and fluvial remobilization are bounded by conservative modeling assumptions in the TSPA-SR, Rev00, ICN1. Particular attention should be paid to: (i) rate of mobilization off slopes, (ii) rate of transport in Fortymile Wash drainages, (iii) rate of transport from eolian processes, (iv) deposition rate at proposed critical group location, (v) changes in particle-size distributions during fluvial transport. DOE acknowledges the NRC proposed agreement and will address this agreement as part of the consolidated response to NRC's proposed agreement items for the consequence subissue. 12) Provide an independent technical basis for the method of HLW incorporation used in DOE models, including consideration of particle aggregation and the effect on waste transport. DOE acknowledges the NRC proposed agreement and will address this agreement as part of the consolidated response to NRC's proposed agreement items for the consequence subissue. 13) Provide support that the inherent assumption in the mass loading model that the concentration of radionuclides on soil in the air is equivalent to the concentration of radionuclides on soil on the ground does not underestimate dose (i.e., radionuclides important to dose do not preferentially attach to smaller particles). DOE acknowledges the NRC proposed agreement and will address this agreement as part of the consolidated response to NRC's proposed agreement items for the consequence subissue.

CHANGES TO EXISTING IGNEOUS ACTIVITY NRC/DOE AGREEMENTS

IA.2.02 - Document results of sensitivity studies for particle size, consistent with (1) above. DOE agreed and will document the waste particle size sensitivity study in ~~TSPA-SR, Rev. 1~~ a calculation document. This will be available to the NRC in ~~June 2001~~ FY2002.

IA.2.03 - Document how the tephra volumes from analog volcanos represent the likely range of tephra volumes from Yucca Mountain Region (YMR) volcanos. DOE agreed and will document the basis for determining the range of tephra volumes that is likely from possible future volcanoes in the YMR in ~~TSPA-SR, Rev. 1 or demonstrate that TSPA-SR results are insensitive to uncertainties in the reasonably expected volumes of tephra in the YMR~~ the Eruptive Processes AMR (ANL-MGR-GS-000002). This will be available to the NRC in ~~June 2001~~ FY2002.

IA.2.04 - Document that the ASHPLUME model, as used in the DOE performance assessment, has been compared with an analog igneous system. DOE agreed and will complete calculation CAL-WIS-MD-000011 that will document a comparison of the ASHPLUME code results to observed data from the 1995 Cerro Negro eruption. This will be available to the NRC in January 2001. DOE will consider Cerro Negro as an analog and document that in ~~TSPA-SR Rev. 1~~ the Eruptive Processes AMR (ANL-MGR-GS-000002). This will be available to the NRC in ~~June 2001~~ FY2002.

IA.2.05 - Document how the current approach to calculating the number of waste packages intersected by conduits addresses potential effects of conduit elongation along a drift. DOE agreed and will document the way in which the change in geometry of the repository drifts affects the number of waste packages incorporated into the volcanic conduit. Possible consequences of conduit elongation parallel to drifts will be documented in TSPA-SR Rev. 1, available to the NRC in June 2001. This agreement has been superceded by the proposed NRC Agreements in Attachment 2.

IA.2.06 - Develop a linkage between soil removal rate used in TSPA and surface remobilization processes characteristics of the Yucca Mountain region (which includes additions and deletions to the system). DOE agreed and will document its approach to include uncertainty related to surface-redistribution processes in TSPA-SR, Rev. 0. DOE will revisit the approach in TSPA-SR, Rev. 1. This documentation will be available to the NRC in June 2001. This agreement has been superceded by the proposed NRC Agreement 11 in Attachment 2.

IA.2.07 - Document the basis for airborne particle concentrations used in TSPA in Rev. 1 to the Input Values for External and Inhalation Radiation Exposure AMR. DOE agreed and will provide documentation for the input values in the Input Parameter Values for External and Inhalation Radiation Exposure Analysis AMR [ANL-MGR-MD-000001] Rev. 1. This will be available to NRC in January 2001. This agreement has been superceded by the NRC/DOE Agreements IA.2.11 to 2.16 in Attachment 1.

IA.2.09 - Use the appropriate wind speeds for the various heights of eruption columns being modeled. DOE agreed and will evaluate the wind speed data appropriate for the height of the eruptive columns being modeled. This will be documented in ~~TSPA-SR, Rev. 1~~ a calculation document. This will be available to the NRC in ~~June 2001~~ FY2002.

IA.2.10 - Document the ICNs to the Igneous Consequences AMR and the Dike Propagation AMR regarding the calculation of the number of waste packages hit by the intrusion. Include in these or other documents (1) the intermediate results of the releases from Zone 1 and 2, separately, and (2) the evaluation of thermal and mechanical effects, as well as shock, in assessing the degree of waste package damage in Zone 1 and 2. DOE agreed and will provide ICN 1 of the following AMRs: Igneous Consequences Modeling for TSPA-SR AMR [ANL-WIS-MD-000017], the Dike Propagation Near Drifts AMR [ANL-WIS-MD-000015], the Characterize Framework for Igneous Activity at Yucca Mountain, Nevada AMR [ANL-MGR-GS-000001], and the Calculation Number of Waste Packages Hit by Igneous Intrusion [CAL-WIS-PA-000001]. This will be available to the NRC in January 2001. DOE will provide the results showing the relative contributions of releases from Zones 1 and 2 in ~~TSPA-SR, Rev. 1~~ a calculation document. This will be available to the NRC in ~~June 2001~~ FY2002. DOE will provide the evaluation of thermal mechanical effects on waste package damage in Zones 1 and 2 in ICN 1 of the Dike Propagation Near Drifts AMR [ANL-WIS-MD-000015]. This will be available to the NRC in January 2001.