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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON NUCLEAR WASTE

144th MEETING

(ACNW)

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THURSDAY,

JULY 31, 2003

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ROCKVILLE, MARYLAND

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The Advisory Committee on Nuclear Waste  
met at the Nuclear Regulatory Commission, Two White  
Flint North, Room T2B3, 11545 Rockville Pike, at 8:30  
a.m., Dr. B. John Garrick, Chairman, presiding.

COMMITTEE MEMBERS PRESENT:

DR. B. JOHN GARRICK, Vice Chairman

DR. MICHAEL T. RYAN, Vice Chairman

DR. GEORGE W. HORNBERGER, Member

DR. MILTON N. LEVENSON, Member

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## 1 ACNW STAFF PRESENT:

2 SHER BADAHUR Associate Director, ACRS/ACNW  
3 HOWARD J. LARSON Special Assistant, ACRS/ACNW  
4 NEIL COLEMAN ACNW Staff  
5 MICHAEL LEE ACRS Staff  
6 RICHARD K. MAJOR ACNW Staff  
7 JOHN T. LARKINS Executive Director, ACRS/ACNW

8

## 9 ALSO PRESENT:

10 DR. RUTH F. WEINER Invited Expert  
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## P-R-O-C-E-E-D-I-N-G-S

(8:30 a.m.)

CHAIRMAN GARRICK: Good morning. Our meeting will come to order. This is the third day of the 144th meeting of the Advisory Committee on Nuclear Waste. My name is John Garrick, Chairman of the ACNW. The other members of the committee are Mike Ryan, Vice Chairman, George Hornberger, and Milt Levenson. Ruth Weiner is also with us at the meeting as an invited expert, at least she is supposed to be.

Today the committee will do a number of things. We will discuss risk-informed regulations for NMSS, with representatives of the NMSS Risk Task Group. We are going to receive an update from the ACNW Summer Intern on her project, discuss the ACNW September Retreat which is scheduled during the 145th meeting, and the committee visit in November to Yucca Mountain.

We are also going to discuss proposed topics for the new ACNW meeting with the NRC Commissioners, which is presently scheduled for October 23rd. And we are going to discuss proposed ACNW reports on various issues.

Howard Larson is the Designated Federal Official for today's initial session, and the meeting

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1 is being conducted in accordance with the provisions  
2 of the Federal Advisory Committee Act. The committee  
3 has received no written comments or requests for time  
4 to make oral statements from members of the public  
5 regarding today's session, and should anyone wish to  
6 address the committee, please make your wishes known  
7 to one of the committee staff.

8 It is requested that the speakers use one  
9 of the microphones, identify themselves, and speak  
10 clearly and loudly so we can hear you.

11 I have a few announcements I want to make,  
12 a few items of interest.

13 On July 14, 2003, Dr. Bhagwat Jain and Mr.  
14 Marvin Sykes joined the ACRS/ACNW staff as senior  
15 staff engineers. They will both be working  
16 principally on ACRS issues.

17 Dr. Jain has been with the NRC for five  
18 years. Currently he is a Project Manager in Research,  
19 Division of Engineering Technology. Prior to joining  
20 NRC, Dr. Jain worked at Carolina Power & Light  
21 Company, AES Corporation, and Sargent & Lundy  
22 Engineers.

23 Mr. Sykes has been with the NRC 12 years.  
24 He is currently working in NRR, Division of Inspection  
25 Program Management. Prior to joining NRC Headquarters

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1 staff, he worked in Region II and in Alabama Power.

2 Ms. Sonary Chey has been selected as  
3 ACRS/ACNW staff secretary, replacing Barbara Whitaker.  
4 You'll get to know her very well. Ms. Chey has 13  
5 years experience with the NRC, having last supported  
6 the activities in the NRR Directorate of License  
7 Renewal and Environmental Impacts. She reported  
8 yesterday to the ACNW staff.

9 Ms. Gilena Monroe joined the ACRS staff on  
10 June 16th as a summer intern. Currently, Gilena is a  
11 full-time Graduate student attending North Carolina  
12 A&T State University. She has a B.S. degree in  
13 Computer Science and is presently majoring in  
14 Industrial and Systems Engineering with a  
15 concentration in Human-Machine Systems/Human Factors.  
16 She is working with the ACRS as a Student Engineer on  
17 topics of Human Factors Engineering and Human  
18 Reliability.

19 Members may be interested to know that the  
20 Office of Nuclear Security and Incident Response,  
21 NSIR, announced the selection of Dr. Cynthia G. Jones  
22 as the Senior Technical Advisor for Nuclear Security.  
23 She will be advising NSIR on a comprehensive range of  
24 radiation protection and nuclear safety issues related  
25 to homeland protection and incident response.

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On July 18, the White House announced that the President intends to nominate John Joseph Grossenbacher of Illinois, to be a Member of the Nuclear Regulatory Commission, for the remainder of a five-year term expiring June 30, 2004. Upon confirmation, the President intends to designate him to be Chairman of the Nuclear Regulatory Commission. Vice Admiral Grossenbacher has served in the U.S. Navy since 1970 and currently serves as Commander of the U.S. Submarine Forces in the Atlantic.

Which brings us to our agenda for this morning. This topic is Risk-Informed Regulation for NMSS: Status Report and Plans for Future Work, and this must be our rookies' week because the lead member on this is Mike Ryan. Mike is looking forward to the next member of the committee so that he is no longer referred to as the rookie but, Mike, this is your time, so would you lead our discussion on this.

DR. RYAN: Yes, indeed. Thank you very much, Mr. Chairman. I will still be the tallest member.

We are going to be informed this morning on risk-informed regulation for NMSS. We have a team of three folks who are going to be presenting. Christiana Lui will be introducing her colleagues,

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1 Raeann Shane and Alan Rubin, and will lead us off with  
2 their presentation. Good morning, all, welcome, and  
3 thank you for being with us this morning. I think  
4 everybody has a set of the handouts.

5 MS. LUI: Good morning. My name is  
6 Christiana Lui, Section Chief of the NMSS Risk Task  
7 Group. I have with me at the table today Raeann  
8 Shane, on my right, a Health Physicist on the NMSS  
9 Risk Task Group, and Alan Rubin, on my left, a Section  
10 Chief in the PRA Branch in Research. Dennis Damon  
11 (phonetic), the Senior Level Advisor for Assessment in  
12 NMSS, over there, and Ed Chow, a Senior Project  
13 Manager in PRA Branch in Research, on the right hand  
14 side of Dennis. Together, we would like to provide  
15 you a briefing on the status and future plans for  
16 risk-informed materials in the waste arena, and answer  
17 any questions you might have.

18 Before we start, let me just give you some  
19 introductory remarks and valuable information.

20 As you are aware, NMSS has been working on  
21 implementing SECY 99-100 and the Commission directions  
22 in associated SRM. Because the wealth of knowledge  
23 and experience that Research has been developing risk-  
24 informed approaches for the reactor arena, and NMSS  
25 has requested the assistance of Research in our risk-

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1 informing effort.

2 The ongoing work is challenging because  
3 the diversity of NMSS' licensee, the broad spectrum of  
4 NMSS-regulated activities, and the need to develop  
5 realistic guidelines and risk metrics for the wide  
6 spectrum of application and licensees. We want to  
7 take advantage of the risk-informed approaches taken  
8 in the actual arena, but we also recognize that those  
9 approaches may not be directly applicable to the  
10 materials and waste application. Therefore, Research  
11 and NMSS are working together to ensure that the  
12 tools, data and guidance developed will meet NMSS  
13 needs and be applicable to NMSS' situation.

14 In addition to case-by-case applications  
15 of the risk-informed approach, we have also been  
16 working on incorporating the lessons learned and  
17 developing guidance to assist the staff in  
18 consistently and effectively applying the risk-  
19 informed approach, where appropriate. In particular,  
20 we are focusing on using the risk-informed approach to  
21 help us address resource issues and issue  
22 prioritization.

23 NMSS has seen the benefit of the risk-  
24 informed approach on a case-by-case basis, and expect  
25 to continue to realize benefits by developing a

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1 systematic and transparent approach to risk-informed  
2 NMSS regulatory activities.

3 We have been coordinating with NRR, OSTP,  
4 OGC and Regions, various staff working groups and  
5 steering committees such as the PRA Steering Committee  
6 and NMSS Risk Steering Group. Although this is a work  
7 in progress, because the committee's views are very  
8 valuable to us, we would like to take this opportunity  
9 to provide you a status report and the path forward,  
10 and receive any feedback you may have regarding our  
11 work. A SECY paper on the same subject has recently  
12 been submitted to the Commission.

13 If you view our work favorably, the  
14 committee's letter of endorsement to the Commission  
15 will certainly have a very positive effect on the  
16 staff effort.

17 Unless there are any questions for me at  
18 this time, I would like to turn the presentation to  
19 Ms. Raeann Shane. Raeann is the NMSS Project Manager  
20 for the risk-informing guidance development work, and  
21 she will provide the detail on the status and our  
22 future plans.

23 MS. SHANE: Good morning. My name is  
24 Raeann Shane, as Chris said, and I am a member of the  
25 Risk Task Group.

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1 (Slide)

2 The purpose of our briefing today, as  
3 Chris mentioned, is to provide the status and the path  
4 forward for using risk-informing in the materials and  
5 waste arenas, and to do that we are going to talk  
6 about the status of the NMSS risk-informing  
7 initiatives, the value of risk-informing NMSS, our  
8 plan for future work and, as Chris said, we'd also  
9 like to request the committee's view of our approach.

10 (Slide)

11 The rest of the slides I'll go over this  
12 morning will provide you with an overview of the  
13 information contained in the SECY paper that was sent  
14 to the Commission on July 24th. The first slide  
15 covers the risk-informed decisionmaking process. To  
16 give you some background, one of the first things that  
17 NMSS realized when developing its risk-informing  
18 approach is that the ways in which risk information  
19 would be used in NMSS would vary widely across NMSS'  
20 diverse program areas. NMSS also recognized that it  
21 would not always be cost-beneficial for either the NRC  
22 or licensees to perform a risk assessment in certain  
23 areas. So, in light of this, we developed a  
24 systematic process to determine when risk-informing an  
25 activity a regulatory decision would be worthwhile.

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1 This process consists of four steps, which are listed  
2 here and depicted graphically in the next slide, and  
3 on our poster.

4 (Slide)

5 So I'll take you through that process  
6 briefly now. The first thing is we start out with  
7 identifying regulatory issues or action alternative,  
8 the top block labeled No. 1.

9 Then we move on to Step 2 and apply our  
10 screening considerations. The screening  
11 considerations consider both the benefit and the  
12 feasibility of using a risk-informed approach. To  
13 assess the benefit of using a risk-informed approach,  
14 the screening considerations test whether the use of  
15 risk information would enhance safety, improve  
16 efficiency and effectiveness, reduce unnecessary  
17 regulatory burden, or help to communicate a risk-  
18 informed decision.

19 To assess the feasibility aspects, the  
20 screening considerations test whether risk-informing  
21 could be accomplished in a cost-beneficial way, and  
22 examine whether other factors such as legislative or  
23 judicial issues would preclude the use of risk  
24 information. We have developed a guidance document  
25 for the staff use when applying the screening

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1 considerations, and I will talk more about that  
2 guidance document later in the presentation.

3 So, if the activity is screened in, we go  
4 on to Step 3, and risk information is evaluated and,  
5 if necessary, additional risk information could be  
6 developed. We have also developed a guidance document  
7 for this step.

8 So then as we move on to Step 4, the final  
9 step is the decisionmaking step. We are currently  
10 developing guidance for this step as well and, in a  
11 companion document, we are developing risk guidelines  
12 for use in this final step. The guidelines are  
13 currently a work-in-progress and, as shown in the  
14 diagram, the risk guidelines would be considered in  
15 conjunction with defense-in-depth, adequate safety  
16 margins, other competing risks, and cost-benefit  
17 analysis in making the risk-informed decision.

18 In developing the risk guidelines for  
19 NMSS, we have recognized that there are many  
20 challenging issues due in large part to the diversity  
21 of NMSS-regulated activities and to the potential uses  
22 of the guidelines. We are looking at applicable  
23 international standards and guides, relevant domestic  
24 experience including the safety goals for the reactor  
25 program, and the relationship to the principle as

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1 considerations for development of these guidelines.  
2 So that is the risk-informed process.

3 (Slide)

4 In addition to developing the risk-  
5 informed decisionmaking process and the associated  
6 guidance documents, the NMSS divisions have also been  
7 actively using risk insights to focus resources  
8 commensurately within activity safety significance.  
9 Some examples of this include in the fuel cycle arena  
10 we have ISA reviews. NMSS has sharpened its focus on  
11 safety and reduced labor rate for ISA reviews under 10  
12 CFR Part 70, by using risk insights.

13 In the materials inspection area, we have  
14 refocused the inspection effort to address the highest  
15 risk activities while maintaining overall safety and  
16 saving resources.

17 In the high-level waste area, staff has  
18 used, and continues to use, risk insights to resolve  
19 issues. The details are described in the staff's Risk  
20 Insights Report which you have previously reviewed.

21 In the decommissioning area, staff is  
22 completing a project to consolidate, update and risk-  
23 inform the policies and guidance of its  
24 decommissioning program. The project involves review,  
25 consolidation and revision of all existing NMSS

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1 decommissioning guidance documents, decommissioning  
2 technical assistance requests, decommissioning license  
3 conditions, and all decommissioning generic  
4 communications issued over the past several years.

5 In the spent fuel project area, staff has  
6 used quantitative risk insights and reduced  
7 unnecessary conservatism with better data and analysis  
8 on the issues associated with the storage and  
9 transportation of high burn-up fuels.

10 So, in addition to the previous examples  
11 that illustrate how the staff has successfully applied  
12 risk insight, more comprehensive efforts are currently  
13 underway in NMSS. For example, spent fuel storage is  
14 an area where NMSS believes there is potential to  
15 reduce unnecessary regulatory burden while maintaining  
16 safety.

17 Accordingly, the staff has initiated an  
18 effort to risk-inform standard review plan guidance  
19 for certifying casks for the dry storage of spent  
20 fuel. In this effort, NMSS has been reviewing the  
21 draft pilot PRA of a dry-cask storage system performed  
22 by the Office of Research, to identify risk insights  
23 that may have applicability to current licensing and  
24 certification requirements in inspection program.  
25 NMSS will give a presentation to you on the PRA in

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1 October.

2 In a similar effort in the fuel cycle  
3 area, NMSS expects that risk insights gained from ISA  
4 reviews will assist the staff in conducting the fuel  
5 cycle oversight program. NMSS' long-term objective is  
6 to have the licensing, inspection, assessment and  
7 enforcement programs involved, to become more risk-  
8 informed and performance-based through application of  
9 risk information contained in the ISAs.

10 The third example is in the area of  
11 control of sources, where the primary consideration of  
12 the ongoing activities is security. In fact, NMSS has  
13 considered risk insights and, in working with the  
14 Department of Energy and Agreement States, has defined  
15 radionuclides and thresholds of concern based on  
16 relative hazard and attractiveness for malevolent use.  
17 This information will be used as a basis for proposing  
18 compensatory measures in the materials arena. This  
19 study will provide insights into the broader question  
20 of how risk information might be used to re-evaluate  
21 the sealed source and device review process, or to  
22 refine categories of exempt general and specific  
23 byproduct licensees under 10 CFR 30, 31 and 32.

24 The efficiency and effectiveness  
25 initiative will examine the licensing and

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1 certification programs across the office, to identify  
2 opportunities for efficiency and effectiveness  
3 improvement.

4 (Slide)

5 As I mentioned earlier in going over the  
6 risk-informing process, we are developing a system of  
7 guidance document to help the staff apply the risk-  
8 informed process consistently and effectively. The  
9 first in the series is the screening considerations  
10 guidance document. This guidance will help the staff  
11 use the screening considerations to determine whether  
12 a regulatory issue is amenable to a risk-informed  
13 approach.

14 The next document is the risk assessment  
15 guidance document. It will provide guidance on such  
16 areas as how to determine the appropriate depth and  
17 scope of an analysis, how to determine who the  
18 recipient of risk is, and treatment of uncertainties.

19 The risk guidelines document is intended  
20 to be a companion to the risk-informed decisionmaking  
21 document and will provide the technical background and  
22 basis used in the development of these guidelines.  
23 The guidelines are intended to provide a measure or  
24 benchmark which will serve to facilitate consistent  
25 risk-informed decisionmaking and greater coherence

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1 across NMSS.

2 And, finally, we have the risk-informed  
3 decisionmaking guidance document, which will be used  
4 in the final step of our risk-informing process. The  
5 document will focus on the unique aspects of NMSS-  
6 regulated activities, while leveraging the experience  
7 gained from risk-informed regulation in the reactor  
8 arena. Principles from Reg Guide 1.174 and NUREG  
9 BR0058, the Regulatory Analysis Guidelines, will be  
10 considered, as appropriate, to support NMSS  
11 decisionmaking needs for its very diverse licensee  
12 base.

13 DR. RYAN: Excuse me for interrupting, but  
14 this might be a good time to ask this one. Do you  
15 have a rough schedule for these guidance documents and  
16 when they will be coming out?

17 MS. SHANE: Yes, I think that's the last  
18 thing we're going to do here.

19 DR. RYAN: All right. Thanks.

20 MS. SHANE: And, lastly, we are conducting  
21 pilot studies to test the concepts and methodologies  
22 laid out in the risk-informed decisionmaking guidance  
23 document. One example of a pilot study that we are  
24 conducting from the materials arena is the evaluation  
25 of chemical agent detectors owned by the U.S. Armed

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1 Services. These chemical agent detectors use small  
2 quantities of radioactive material in sealed sources  
3 to detect the presence of hazardous chemicals. These  
4 devices are subject to loss because of their use in  
5 field training and combat situations. The pilot study  
6 will evaluate the control and accountability of these  
7 devices using risk insights, and will look for any  
8 possible holes in the guidance document methodology.

9 Pilot studies will also be conducted for  
10 issues in the fuel cycle area and spent fuel area.  
11 Use of the concept laid out in this system of guidance  
12 document will result in targeting case-by-case  
13 improvements to the regulatory activity being  
14 addressed rather than wholesale reform, and will  
15 facilitate consistent transparent well-documented  
16 risk-informed management decisions in NMSS.

17 (Slide)

18 Implementation of the risk-informed  
19 approach to-date has led to an improved focus on  
20 safety, effectiveness and efficiency, and reduction of  
21 unnecessary regulatory burden on a case-by-case basis.  
22 Continuation of this work will further realize these  
23 benefits, and will ultimately lead to improvements in  
24 communication, greater transparency, and greater  
25 consistency and coherence for NMSS activities.

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1 Experience has shown that a risk-informed approach can  
2 improve both safety and efficiency at the same time by  
3 focusing resources on areas where they are most  
4 needed.

5 (Slide)

6 So, as I have just discussed, NMSS has  
7 seen benefits from risk-informing its regulatory  
8 activities, and we intend to continue this work in the  
9 following way: We will identify NMSS regulatory  
10 activities amenable to a risk-informed approach. We  
11 will develop the necessary risk metrics, methods,  
12 data, guidelines, and guidance documents. We will  
13 assess the implications for the public, NRC staff,  
14 licensees, and Agreement States, and the divisions  
15 will determine the priority, plan, and schedule for  
16 implementation of the risk-informed approaches. We  
17 will also develop and conduct staff training in risk  
18 assessment techniques and risk-informing methodology,  
19 as necessary.

20 (Slide)

21 The proposed schedule for our near-term  
22 activity is, in January we will issue the risk-  
23 informed guidance document for internal comment, and  
24 this will include updating the guidance document based  
25 on the results of the pilot studies that I described

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1 earlier.

2 In the spring, we will brief the ACRS/ACNW  
3 Joint Subcommittee regarding our progress, and also in  
4 the spring of '04 we will prepare a second paper to  
5 the Commission to detail our technical progress,  
6 policy issues, options for proceeding, and our  
7 recommendations. We will also hold public workshops  
8 after receiving Commission direction in these areas.

9 (Slide)

10 So, to summarize, we have provided the  
11 status and path forward for risk-informing materials  
12 and waste arenas. We have shown how risk-informing  
13 has benefitted NMSS on a case-by-case basis, and how  
14 more can be realized by developing and implementing a  
15 systematic and transparent process. We have indicated  
16 that we will engage the committee and subcommittee at  
17 appropriate times as we go forward, and we would like  
18 to request a letter from the committee to the  
19 Commission regarding your views of our work.

20 That concludes our formal presentation.

21 (Slide)

22 We have included a few backup slides, and  
23 this one discusses the policy issues. We are not  
24 really going to go over these, I guess.

25 MS. LUI: No. We have included backup

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1 slides, we have included three backup slides to give  
2 you more information regarding the screening  
3 considerations that we have developed, as Raeann  
4 briefly spoke of, and also highlight the differences  
5 between the characteristics of the NMSS applications  
6 and reactor applications. That is where we have to  
7 consider the existing approach from the reactor arena,  
8 whether they are applicable to our considerations.  
9 And, also, we have provided you some indication about  
10 the issues that we are currently working on, at least  
11 the areas that we are tackling right now.

12 DR. RYAN: Thank you very much.

13 MS. LUI: This is the end of our formal  
14 presentation.

15 DR. RYAN: One thought that struck me, how  
16 much of NMSS' licensees or generally or specific  
17 licensed activities will ultimately be changed by this  
18 assessment in terms of how you regulate, and what the  
19 risk-informing process might do? Do you have any kind  
20 of forecast or idea in your head on how this might end  
21 up? Will things change a lot, or a little? I know  
22 I'm asking you to predict the future and that's maybe  
23 not fair.

24 MS. LUI: I don't know to what extent  
25 other briefings from the other presentations

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1 previously, from the other staff in NMSS, have given  
2 you some indications about the path we are on.  
3 Because of the post-9/11 activities, certainly we are  
4 looking at the different byproduct materials of how we  
5 regulate them from a security standpoint. But at the  
6 same time, because we take risk insights into  
7 consideration, that will also have implications from  
8 the safety standpoint, and ultimately we have to  
9 decide whether it will be cost-beneficial to really  
10 alter the existing regulatory framework for the  
11 exempt, general license or specific license in Part  
12 30, 31, and 32, and basically in Part 30 we are  
13 looking at. So we are on a path to utilizing risk  
14 insights, but in terms of the impact we will have to  
15 assess what will be the benefit gain from the overall  
16 safety and security standpoint, but we have started  
17 working that area.

18 DR. RYAN: Thanks. Questions from  
19 members? George?

20 DR. HORNBERGER: Can you perhaps amplify  
21 a little bit, somebody, whoever is appropriate, on  
22 exactly what the screening criteria are, give me some  
23 examples of how you would screen something out? Is  
24 that a backup slide?

25 (Slide)

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1 MS. SHANE: Yes, the last slide in the  
2 package lists the screening consideration questions  
3 themselves.

4 DR. HORNBERGER: And who answers these  
5 questions?

6 MS. LUI: These questions will be answered  
7 by the staff because whatever -- as depicted in the  
8 box diagram there, first, we would look at what would  
9 be a particular action or particular regulatory issue  
10 or action alternative, and then we have to develop  
11 what would be the best way to address those decisions.  
12 Maybe the risk-informed way is not the best way, and  
13 there will be the combination way of looking at the  
14 issue. These screening considerations are formulated  
15 to help us to make that judgment on whether the risk-  
16 informed way is the appropriate way to address the  
17 issues that have been identified, and mainly we are  
18 looking at staff applying these screening  
19 considerations.

20 Raeann, do you want to go through a little  
21 bit more detail what issues of those we try to  
22 address?

23 (Slide)

24 MS. SHANE: The benefit questions, which  
25 are in the left column, are really focused on the

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1 Agency's goals as far as what question. Would using  
2 risk information help resolve a question with respect  
3 to maintaining safety, or efficiency or effectiveness,  
4 reducing unnecessary regulatory burden, or communicate  
5 a regulatory decision. As Chris said, using risk  
6 information might now really be an improvement, so  
7 these questions are designed to hopefully determine  
8 that.

9 And the feasibility questions really are  
10 do we have the data, or could we get it? Would it  
11 cost more to actually do the risk-informing than we  
12 would save in efficiency? And then there is, of  
13 course, No. 7, which catches a lot of things, and  
14 that's the other factors question. And some of our  
15 activities are just hampered by legislative  
16 requirements, so that would screen out things in that  
17 area.

18 MS. LUI: One of the examples I can think  
19 of in the most recent past is in the area of uranium  
20 recovery. I think we have been regulating that area  
21 using Appendix A in Part 40. And everybody thought it  
22 would make more sense, based on the information and  
23 the performance to actually form a new part to  
24 regulate that particular industry. But because the  
25 industry is relatively depressed and the cost-benefits

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1 they employ, it just did not make sense for us to go  
2 forward, so that particular proposal was dropped. And  
3 you can see that the screening considerations  
4 certainly take that into consideration.

5 And, also, one thing Raeann mentioned, we  
6 are conducting a pilot study to test the draft  
7 guidance that we have developed, and the two pilot  
8 studies that we are looking certainly are going  
9 through the screening considerations to help document  
10 why certain actions were taken, and we hope that  
11 through those pilot studies it will help us to modify  
12 or confirm the validity of the screening  
13 considerations.

14 DR. HORNBERGER: And then after something  
15 is screened in, your box up there, the No. 3 box says  
16 perform risk assessment, and that ties in with some of  
17 the questions you have on feasibility. So when you  
18 say conduct a risk assessment, is this a PRA, or do  
19 you have various levels?

20 MS. SHANE: Yes, I think it could be a  
21 hazard barrier type analysis, it could be just  
22 whatever fits the particular situation. It might be  
23 a PRA in some cases, but I think for most of NMSS  
24 applications it would be some less rigorous kind of  
25 risk assessment.

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1 MS. LUI: Well, the goal is to use as much  
2 existing information as possible. In fact, in a lot  
3 of different areas in NMSS, we already have some  
4 baseline in the study. For example, in the byproduct  
5 material, we have NUREG 66.42, which is studying about  
6 40 different systems that we regulate the byproduct  
7 material. So that does form some baseline risk  
8 estimates for us. And in terms of doing new analysis,  
9 we will have to look at what is the particular issue  
10 and what are the actual alternatives that we are  
11 looking at to make sure that whatever we need to  
12 develop will help us address the issue and bridge the  
13 gap, rather than just do a PRA without any good  
14 reason.

15 DR. HORNBERGER: And just a couple other  
16 questions. How about your risk measures here, are  
17 these doses to workers, to the public? I guess it  
18 depends upon the application?

19 MS. LUI: I suppose that you are asking  
20 the risk guidelines, regarding the risk guidelines  
21 area. In other words, what kind of outputs that we  
22 are trying --

23 DR. HORNBERGER: What is your risk  
24 measure, what is your measure of risk that you are  
25 looking at?

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1 MS. LUI: The NMSS arena, in addition to  
2 consideration to exposure to the general public, a lot  
3 of the activities really involve risk to the worker.  
4 And some of the events that we have seen in the past  
5 not only do we need to be concerned for latent health  
6 effects, you have acute and also injury effect. So we  
7 are taking all that into consideration and looking at  
8 developing the proper measures possibly for public and  
9 worker, and looking at latent, acute, and also injury.  
10 So that is because we want to produce indicators that  
11 would be useful to NMSS to help NMSS' regulatory  
12 activities. So we are considering risk measures in  
13 those areas.

14 DR. HORNBERGER: And just one final one.  
15 So in considering risk to public in the cases where  
16 you do that, how do you handle the different transport  
17 pathways? Do you have transport models and dose  
18 models?

19 MS. LUI: Transport in the sense of --

20 DR. HORNBERGER: Atmospheric, water, soil  
21 -- pathways to humans, if you are going to consider  
22 risk to the public.

23 MS. LUI: Okay. You brought up another  
24 good point, population at-risk certainly depends on  
25 the particular NMSS activities that we are looking at.

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1 A lot of the byproduct applications such as fixed  
2 gauges, the transport model that Dr. Hornberger  
3 mentioned may not come into play at all because it is  
4 really kind of direct exposure type of situation. But  
5 in cases such as dry-cask storage, that transport  
6 model does come into consideration and play, and in  
7 that sense we are utilizing whatever existing tools  
8 that we have available to us. For example, in the  
9 reactor arena they have consequence models, they have  
10 transport models, and that will be our preferred path  
11 to be on. However, those models may need to be  
12 modified in order to produce the results that would be  
13 relevant to the particular NMSS applications that we  
14 are looking at.

15 In terms of transportation, we have modal  
16 studies that have been done, and those will be the  
17 starting point for us to look at risk measures and the  
18 existing risk baseline.

19 DR. HORNBERGER: Thank you.

20 DR. RYAN: Thank you, George. Milt?

21 DR. LEVENSON: I think this is a very good  
22 initiative, and I think you know from previous things  
23 that the committee generally supports such activities.  
24 I have one rather basic sort of concern.

25 Our experience is that whenever you try to

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1 change the normal way that an organization does  
2 business, unless there are very unusual actions taken  
3 or what have you, no matter how good is the intention  
4 of the management, it really doesn't happen, is an  
5 incredible inertia in the system. And two things sort  
6 of bother me a little bit about the presentation. One  
7 is the fact that the determination whether it's going  
8 to be done or not has been delegated pretty far down  
9 in the organization -- that is, the setting of  
10 priorities, plans and schedule for implementation has  
11 been delegated down to managers. The list of  
12 questions you had on the board for any individual case  
13 is being left to the staff member involved, and I  
14 think I have a little concern whether under those  
15 conditions, no matter how good your intentions are,  
16 whether it will really be implemented because there's  
17 tremendous inertia for any person who is doing  
18 something to not rock his boat, let somebody else  
19 undertake the burden.

20 So the question that I sort of have is how  
21 are you going to really make sure that what your  
22 intentions and plans are come into being -- you know,  
23 the "have you stopped beating your wife" question.

24 MS. LUI: I'm glad you raised that  
25 particular question and issue. We ask ourselves that

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1 question from time to time to time. One of the  
2 reasons why we are doing the pilot studies is that we  
3 want to introduce to the NMSS staff all the tools that  
4 we have already developed, and work with them to apply  
5 the tools, and hear from their standpoint what would  
6 be most helpful to them.

7 One of the things that we are working on  
8 is to make sure that the process we are developing is  
9 transparent so people understand what we are trying to  
10 do. Based on our experience working on the pilot  
11 studies, I have to say that most of the staff are  
12 very, very cooperative in looking at the potentially  
13 different way of doing business.

14 As I have alluded to in my introductory  
15 remarks, NMSS is facing resource challenges. We have  
16 a lot of work that we would like to get done, however,  
17 we need to find some way to prioritize the work for  
18 ourselves. And the risk-informed way to the staff is  
19 a tool to help the staff to prioritize the work. And,  
20 also, the message that has come from the very top  
21 management in the office is that we want staff to work  
22 on this to figure out -- to use the available tools  
23 and to figure out priorities for themselves. Of  
24 course, the management will be available for  
25 consultation, but it is really both a management and

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1 staff initiative at this point in time.

2 So, I understand your concern that this is  
3 a potentially major change to the way we are  
4 conducting our business, but we are doing incremental  
5 improvements and progress, and we want to pass that by  
6 you on the way so it will not be viewed as something  
7 that is being mandated on the staff to make sure that  
8 we are working towards this in a collaborative way.

9 DR. LEVENSON: I understand what you are  
10 saying, but seldom is the individual worker or staff  
11 in a position to set priorities because they don't  
12 have the total picture, and the setting priorities, my  
13 personal view, really is a management responsibility  
14 to provide help and guidance to the individuals. And  
15 if you delegate that too far down, they just don't --  
16 no matter how competent they are, they don't have the  
17 background and the information. So, that's one of the  
18 things I just --

19 MS. LUI: Well, I understand, but, Mr.  
20 Levenson, you have also mentioned that the  
21 management's role is to assist and provide the  
22 necessary resources, and that is exactly what NMSS is  
23 doing.

24 DR. RYAN: John.

25 CHAIRMAN GARRICK: I want to talk a little

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1 bit about the management issue as well. As a long-  
2 time practitioner of risk assessment, I'm very aware  
3 of the challenges that are involved and the surprising  
4 fact that no everybody buys into the religion of risk  
5 assessment. And I'm sure that your program has some  
6 bumps along the road as to whether or not it makes  
7 sense and whether or not it should be implemented at  
8 any level at all.

9 You just said that as far as the staff is  
10 concerned, that you feel you've gotten considerable  
11 cooperation and support. I think what we're very  
12 interested in is at the higher level, what kind of  
13 support and challenges you are facing, and we know you  
14 are facing some, and what the impact has been on what  
15 you are trying to do.

16 So, my first question is, are you  
17 satisfied that what you're doing here and the path  
18 forward that you've laid out for the future has the  
19 full support of let's say the senior management of the  
20 NRC, including the Commission. And you don't have to  
21 name names and places, but I think it is important for  
22 us to have that kind of feedback as to whether or not  
23 this is a concept, this is a program that is being  
24 supported and, as I say, I wouldn't be at all  
25 surprised if you weren't able to share with us, that

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1 there are some definite challenges in that regard.

2 MS. LUI: Thanks for the question.

3 CHAIRMAN GARRICK: That's all right, I  
4 know you, Christiana.

5 MS. LUI: Well, at least I can share with  
6 you my personal experience in this regard. Let me  
7 start with the NMSS management. NMSS' management,  
8 from the very top level, sees the risk-informed  
9 approach is a very essential part of how we can  
10 evaluate the way we conduct our business and to focus  
11 on the important issues, and addressing the resource  
12 challenge at the same time. That is the reason why  
13 they have dedicated this particular group -- I'm  
14 talking about the Risk Task Group -- to really look at  
15 developing the guidance and to work with the divisions  
16 in finding by the way, if there are opportunities to  
17 conduct our business.

18 So, I will say that in terms of NMSS  
19 management, we have buying. And as we have mentioned,  
20 the SECY paper that we have sent forward has been  
21 reviewed by all the managers, and also whoever they  
22 have delegated to, with our concurrence, in a  
23 relatively short time, after of course a couple of  
24 months of planning and rewriting, the final product  
25 was concurrence very quickly. So, from NMSS'

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1 standpoint, I think we have general buying.

2 From an ideo level, Carl has been a  
3 supporter of our work, and we have had numerous  
4 interaction with him regarding the progress and status  
5 of our work. And over and over again he always told  
6 us "You don't have to convince me, I am a believer,  
7 but I also know that you have a lot of challenges in  
8 front of you". For example, the population at-risk  
9 that I mentioned earlier, Carl said that he had found  
10 that issue many, many, many times, but does not have  
11 the quick answer or a very direct answer is not really  
12 available. So he believes that the work that we are  
13 doing is valuable, and he is a supporter.

14 The SECY paper that we are sending up to  
15 the Commission is a consent paper. In a way, we are  
16 trying to get some reconfirmation from the Commission  
17 to make sure that the Commission -- even though in  
18 SECY 99-100 they have told us to do this particular  
19 work, we want to get reconfirmation that they still  
20 view this work as valuable and we should be on the  
21 path as we have laid out. However, if there is any  
22 concern, that would be a vehicle for us to get your  
23 viewpoint. Rather than getting viewpoint from one or  
24 several or a selected few Commissioners, we want to  
25 get the Commission's direction overall so that we

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1 don't get agitated one way or the other. We want to  
2 make sure that we are doing the right work for the  
3 Commission, and we are value-added to the work that we  
4 are doing.

5 I think we also have the support from the  
6 Research management, too, and, Alan, you may want to  
7 speak to that.

8 MR. RUBIN: There is no question that  
9 Research wants to make -- does support the work.  
10 Obviously, have been working a lot with the reactors  
11 on risk-informed activities across-the-board, and with  
12 the initiative to be more as informed across the  
13 Agency for NMSS, Research is supporting the technical  
14 work on developing guidelines, risk metrics to support  
15 the risk-informed decisionmaking process.

16 There are a lot of questions, lot of  
17 issues, you'll see one of the backup slides looking at  
18 the differences between the reactors and the waste and  
19 materials arenas. There's a vast difference if you  
20 just took reactors -- you've got different plants, but  
21 certainly in concept you've got power plants  
22 generating electricity. In materials arenas, you have  
23 across-the-board from small radiographers to large  
24 fuel cycle facilities, and whether or not all the risk  
25 guidelines will apply across-the-board in NMSS is a

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1 real question. It's one of the issues that we're  
2 looking at. It's one of the challenges that we have.  
3 But, yes, the Research management does very definitely  
4 support this activity.

5 CHAIRMAN GARRICK: You talked quite a bit  
6 about risk guidelines and that you have a schedule for  
7 those. What about the impact and influence you're  
8 having on more fundamental documents such as new rules  
9 and regulations? You recall that when we were in the  
10 development days of Part 63, the comment was often  
11 made that this is one regulation that is being crafted  
12 from the ground up in the environment of risk-informed  
13 regulatory practice.

14 Is there anything going on, or anything  
15 you're doing right now that is having a direct impact  
16 not so much just on NUREGs and guidance documents, but  
17 on rulemaking and the formulation of regulations that  
18 have the principle of risk-informed emphatically  
19 embedded in their makeup?

20 MS. LUI: In terms of rulemaking -- direct  
21 impact on rulemaking right at this time, I will have  
22 to say no, we are not doing that right now. But as  
23 Dr. Ryan's question earlier that in the work that we  
24 are doing for the security area in combination with  
25 safety concerns, it could lead to a change in the way

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1 we regulate the exempt, specific and general licensing  
2 material, so that could be on the horizon.

3 And, also, the work that we are doing with  
4 Spent Fuel Project Office, even if the starting point  
5 is to look at the standard review plan, but ultimately  
6 it may lead to changes to the regulation.

7 In terms of impacting formulation of new  
8 regulations and rules, we also have to have  
9 opportunities to do that. For Part 63, we were given  
10 the opportunity that you can start from ground up, you  
11 know, design something that would really, really make  
12 sense by using the risk insights. And in the work  
13 that we are doing now, we will be looking for  
14 opportunities to make such improvements.

15 Rules and regulations are always on the  
16 horizon, but it may take us a little bit of time to  
17 get to that place. Like you, Dr. Garrick, and Mr.  
18 Levenson have pointed out, we are really trying to  
19 implement a different way of doing our business, as  
20 appropriate, and a lot of good work has been done in  
21 the area. And when those rules and regulations were  
22 put into place, they were risk-informed at that  
23 particular point in time. Even though we have new  
24 information now, it may take us a little bit of time  
25 to convince people that based on new information we

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1 need to go back and look at the existing rules and  
2 regulations and how we do a review, how we do a  
3 certification, to make sure that we can incorporate  
4 the lessons learned and operating experiences into the  
5 current way of doing business.

6 CHAIRMAN GARRICK: In the past, of course,  
7 this committee has been a little concerned about the  
8 reactor way of thinking about risk assessment on the  
9 materials side and on the fuel cycle side and what  
10 have you. As we have gained more experience,  
11 especially in the high-level waste arena with respect  
12 to performance assessment, the closest thing to risk  
13 assessment in the waste field, there's been a  
14 tremendous evolution of the performance assessments  
15 from being somewhat purely deterministic to at least  
16 risk-informed. In my opinion, they are still very  
17 much compliance-oriented with respect to risk more  
18 than they are fundamentally risk, but there's still a  
19 lot of progress. A lot of very creative algorithms  
20 and ideas and concepts have been developed as a result  
21 of the performance assessment work.

22 Has the performance assessment work had  
23 any influence on your thinking with respect to the  
24 more detailed activities of developing guidance  
25 documents and methods of analysis and what have you?

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1 MS. LUI: Recognizing that performance  
2 assessment is definitely a pretty major activity  
3 within NMSS, high-level waste is, again, as we pointed  
4 out, one component of the entire energy process. So  
5 in terms of how performance assessment has influenced  
6 the thinking or the methodology in the other areas, I  
7 will have to say that that systematic thinking  
8 certainly has influenced how we think about doing the  
9 assessments for the other areas but, in turn, that  
10 exact methodology may not be applicable to these other  
11 areas.

12 One of the reasons why we have the Risk  
13 Task Group is that we have expertise from all the  
14 different disciplines within NMSS, and we have through  
15 this cross-fertilization learned from each other in  
16 developing guidance that division over the guidance  
17 documents that would be generally applicable to all  
18 the different NMSS activities. But as we apply the  
19 approach in the guidance document, we intend to really  
20 append those experiences to a guidance document to  
21 give us exact examples of how exactly the guidance  
22 document could be applied in their areas. So, at a  
23 high level we will have examples that can apply  
24 across-the-board, but on the detail level we will have  
25 examples that can really show the staff how to apply

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1 the risk-informed approach in their specific areas.

2 CHAIRMAN GARRICK: How do you see your  
3 business in terms of what's different now as a result  
4 of your activities? And I know you are just getting  
5 started, but what's different -- and you've said some  
6 things about that in your presentation, but in the way  
7 you conduct your day-to-day business as you transition  
8 into a risk-informed regulatory practice, what are  
9 some of the things that you do now that you didn't do  
10 in the past, or that when you move this thing along,  
11 looking to the future a little bit, that you see will  
12 be taking place that were not taking place when you  
13 ran the businesses as it's been in the past. What are  
14 a few key activities? I know George was trying to get  
15 to this with the screening questions and the  
16 performance assessment question in the risk-informed  
17 decisionmaking diagram. But could you identify a  
18 couple of specific things that are different in the  
19 way you conduct NMSS business now than in the past,  
20 that have been a direct result of this transitioning  
21 to risk-informed regulatory practice?

22 MS. LUI: As you have pointed out, this is  
23 a work-in-progress. Well, one of the most vivid  
24 examples, of course, is in the high-level waste area.  
25 Of course, high-level waste, they have their own

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1 expert risk assessments, so they are probably ahead of  
2 the rest of NMSS at this point.

3 But one of the examples I can think of is  
4 the byproduct material we are studying, NUREG 66-42.  
5 We are really -- every time there are questions come  
6 up regarding byproduct material uses, then we always  
7 look at the applicability of the results from 66-42 to  
8 at least help us get started.

9 You may or may not be aware that there was  
10 an effort in NMSS about two or three years ago, that  
11 we are looking at the way we are conducting byproduct  
12 material inspection program, and they really utilize  
13 the information in 66-42 to help them devise a  
14 different scheme of conducting byproduct material  
15 inspection. Based on the most recent result we have  
16 seen, there has been a saving on the order of 25  
17 percent of just the paperwork preparation area. So as  
18 the program becomes more and more mature, we can  
19 expect to see more and more efficiency be gained.

20 In the fuel cycle area, during the ISA  
21 review, the staff has been coming to RTG to ask for  
22 assistance in using the risk insights to help them  
23 conduct the ISA review. So that certainly has been a  
24 positive development, too. And I would like to  
25 emphasize in the Spent Fuel Project Office area that

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1 has been working with the Risk Task Group folks and  
2 really trying to pass out a guidance document and  
3 really trying to figure out where they can possibly  
4 reduce unnecessary regulatory burden while maintaining  
5 safety. So those are some specific examples.

6 CHAIRMAN GARRICK: A final comment and  
7 question. The committee, as a result of the joint  
8 Advisory Committees, is on record as having some  
9 concerns about the integrated safety analysis process.  
10 We were pleased to see that that process has some of  
11 the elements of risk thinking in it with respect to  
12 the structuring of scenarios and the addressing of  
13 issues in the way in which it is done in the front end  
14 of the risk assessment. We were a little critical of  
15 the fact that why not go all the way, particularly for  
16 fuel cycle facilities, and carry it through to the  
17 quantification process.

18 Is there any intentions to revisit the  
19 integrated safety analysis approach and take the next  
20 step, if you wish, towards making it more resembling  
21 a risk assessment?

22 MS. LUI: I have to say that we knew that  
23 you were going to ask this question, so hopefully our  
24 answer will be satisfactory to you. The integrated  
25 safety analysis is one of our first attempts to really

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1 ask the fuel cycle licensees to use a systematic  
2 approach to look at the potential vulnerabilities  
3 within their own system, and also identify what are  
4 the components of the system that they rely on for  
5 safety.

6 So, like anything that we do, we have to  
7 start from someplace. And, also, it has been very  
8 well highlighted by you and Mr. Levenson that not only  
9 within NMSS we are looking at the potential of  
10 cultural change or big change in terms of doing  
11 business from licensee community is same situation.  
12 So we see the ISA is a very good first step forward,  
13 and it will be -- it could be an intermediate step for  
14 going to where ultimately that everybody would like to  
15 be.

16 Based on my limited knowledge about the  
17 ISA review, I believe that most of the licensees have  
18 elected to use semi-quantitative methods so it is not  
19 just purely qualitative. And as we accumulate better  
20 and better information, potentially it could become a  
21 more quantitative analysis.

22 CHAIRMAN GARRICK: I think that Raeann  
23 said earlier, and this is a point that I would want to  
24 emphasize, that the risk assessment ought to be  
25 commensurate with the complexity of the problem. And

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1 I think that that's an arena where the NRC has not  
2 done a very good and creative job of analyzing. I  
3 think that there is often the expression that we don't  
4 want to do a risk assessment in every case because  
5 they are too complex. They don't have to be complex.

6  
7 The fundamental thought process is what we  
8 are talking about. We want to answer the question  
9 what is the risk in the best reasonable way, and we  
10 don't want to answer it in anymore detail than  
11 necessary.

12 I think that one area that requires maybe  
13 a little more creative thought and investigation would  
14 be how do you do risk assessments for varying  
15 complexities of systems, and you don't have to do a  
16 volume library of fault trees for every system. And I  
17 think that was one of the reasons the Joint Committee  
18 was a little critical of the integrated safety  
19 analysis process, because the arguments that seemed to  
20 becoming forward were that a risk assessment is too  
21 complicated. And I think that this is an arena I  
22 would hope that your task force would take a look at  
23 and, in the future guidelines and in the future  
24 training, begin to think of terms of applications that  
25 can be matched up with the process in such a way that

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1 convinces people that you can do limited scope PRAs.

2 MS. LUI: Yes. A lot of times, at least  
3 I have found through my own experience, the only way  
4 to convince people that it can be done is through  
5 examples. So as we move forward, as you have pointed  
6 out, Dr. Garrick, that we will certainly want to  
7 gather lessons learned and examples so that there can  
8 be illustrative examples to people that this can be  
9 done and it is not that complicated. But we have to  
10 make progress as time and the environment permits.

11 CHAIRMAN GARRICK: Thank you.

12 DR. RYAN: Thank you, John. Ruth? Just  
13 a note on time -- we're running a few minutes over,  
14 and I would like to do that, which is fine because I  
15 have a few questions myself, so, Ruth, go ahead and  
16 take it away.

17 DR. WEINER: Thank you. First of all, I  
18 defer to our Chairman, as risk analyst he is certainly  
19 far senior to me in risk analysis experience.

20 CHAIRMAN GARRICK: Be careful how you use  
21 that word.

22 DR. WEINER: And he asked high-level  
23 questions, and I have low-level ones and low-level  
24 comments. But I would first like to make a comment  
25 and a suggestion. The NRC invented risk analysis for

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1 the transportation of radioactive materials, with  
2 NUREG 01-70. This was a real breakthrough, and I  
3 suggest that you look at the approach that was taken,  
4 especially to incident-free transportation. This is  
5 one of the most unique and really creative ways of  
6 looking at risks from radioactive -- due to any kind  
7 of radioactive emissions.

8 You talk about pilot studies, Raeann  
9 mentioned pilot studies. NUREG 01-70 was issued in  
10 1977. Both the code used, RADTRAN, has been through a  
11 large number of refinements and improvements, and we  
12 have 30 years of experience of doing these risk  
13 assessments. And I would suggest that you take a look  
14 at this history and see how the approach has changed,  
15 and what is valuable about the approach, and what is  
16 not so valuable about the approach, especially if you  
17 look at it in the light of the two more recent  
18 documents, the Modal Study that was done by Lawrence  
19 Livermore and NUREG CR66-72, looking at both the  
20 approach to transportation accidents and incident-free  
21 transportation.

22 There have been -- we've had a lot of  
23 experience in this area. The world has had a lot of  
24 experience in this area. So I notice you look at  
25 pilot studies. Some of these pilot studies have

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1 already been done for you, and I'd suggest you take a  
2 look at them.

3 I did have a couple of questions -- one  
4 more comment. On your screening considerations, you  
5 talk about the benefits and the feasibility questions.  
6 It's been my experience teaching risk analysis and  
7 doing them, that communicating risk is far more  
8 difficult than communicating consequences, and that as  
9 a rule a risk-informed approach doesn't help you  
10 communicate -- people don't understand it, and they  
11 particularly don't understand the sort of risk that  
12 you get from using event-frees and then multiplying  
13 probabilities times consequences or probabilities  
14 times something else. And this in communication, this  
15 devolves into separately communicating the consequence  
16 and the probability, which is exactly what you didn't  
17 want in the first place. This is a real challenge,  
18 and I commend you for taking it on, I really do. I  
19 think that's a wonderful thing.

20 It's also going to be the case that the  
21 risk assessments are going to cost money but, again,  
22 I think that Dr. Garrick's comment that there are  
23 varying complexities and that the complexity should  
24 fit the problem. If it is not a complex problem, you  
25 don't need to do a complex risk assessment.

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1           There are a number of codes available.  
2           One of them, RADTRAN, was developed by NRC. It is an  
3           NRC code. And I would suggest that you look at the  
4           field of available risk assessment codes. Most of  
5           these codes, in one way or another, multiply things,  
6           that's all they do.

7           Finally, I have a question about one of  
8           your backup slides, and maybe you can enlighten me.  
9           The comparison of reactor and materials in the waste  
10          arenas. I don't understand -- this is probably just  
11          my lack of understanding -- I look for transportation  
12          in these things. Under radioactive materials  
13          location, you have under reactor area, "fixed" and,  
14          under material and waste area, "fixed to moving". I  
15          really don't understand that that means. Does it mean  
16          that the radioactive material is in one place and  
17          sometimes it gets moved around?

18                 MS. LUI: I think Alan will be able to  
19                 answer your question.

20                 MR. RUBIN: This table was not meant to go  
21                 into too much detail, but to answer your question,  
22                 yes, at a reactor site, you generally have the source  
23                 either in the cooler or in storage, sometimes you are  
24                 moving it between storage to an independent fuel  
25                 storage bed, but in materials and waste you have

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1 transportation. Either by train or by truck, you are  
2 transporting spent fuel from a reactor site to a  
3 storage facility, long-time storage.

4 DR. WEINER: Well, how does putting fixed  
5 and fixed to moving compare to the other entries in  
6 those columns, like "large" and "small to large", and  
7 "high" and "low to high"? What do those mean?

8 MR. RUBIN: One of the issues that I think  
9 Raeann or Christiana mentioned earlier, what is the  
10 population at-risk, and that's one of the factors that  
11 really needs to be determined when you are looking at  
12 something that is a moving source, as in  
13 transportation. You know, you have population that is  
14 exposed to the risk for only a short period of time.

15 DR. WEINER: Well, I guess it is the table  
16 that is confusing me. I don't mean to dwell on this,  
17 but if I start at the top and it says "The  
18 characteristic is the frequency of an event", "Reactor  
19 arena is low", this means low frequency of events?

20 MR. RUBIN: Of actual events and  
21 accidents.

22 DR. WEINER: And the material and waste  
23 arenas are "low to high", there is a range of event  
24 frequencies?

25 MR. RUBIN: Depending on the activity, the

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1 range of event frequency.

2 DR. WEINER: I don't want to go through  
3 this point-by-point, but it is rather confusing -- at  
4 least it confuses me -- maybe it doesn't confuse  
5 anyone else. You sort of read it as low to high risk  
6 and things like that. It's difficult to make the  
7 connection, and I'd encourage you to look at it from  
8 the point of view of somebody who didn't produce it,  
9 but is reading it without understanding it very well.  
10 That's all I have. Thank you.

11 DR. RYAN: I'll pick up on the same chart  
12 with the opposite view -- I found it helpful. Being  
13 an NMSS licensee for part of my life, I really  
14 understand what low to high means in some of these  
15 arenas. And that brings me to a point.

16 I commend you on recognizing that NMSS --  
17 of course, you clearly know this much more than I do --  
18 - that there is a wide range of regulated activities  
19 in terms of amount of material and potential risks,  
20 whether it's too a worker, to a member of the public,  
21 in transportation or whatever, you happen to find it.  
22 And trying to put together a coherent system of risk  
23 assessment that meets those broad spectrum of  
24 activities is a formidable challenge, but I think one  
25 that is very important.

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1           If I take just something simple like a  
2 low-level waste facility, which I know a bit about,  
3 you have everything from check sources in a laboratory  
4 on up to Class C irradiated hardware shipments where  
5 the contact dose rate on the waste material is 10,000  
6 r/per hour, so it is a very broad range of licensed  
7 activities for which risk assessment can be very  
8 simple, as Dr. Garrick points out, up to rather  
9 complicated and can address worker, environmental or  
10 transport issues, again, there's a complexity to it  
11 that is certainly formidable. I don't think any one  
12 chart could capture all that, but I think that's the  
13 idea you're trying to present here, is that you've got  
14 a much broader range of things to consider on the NMSS  
15 than perhaps the reactor side. There's a little bit  
16 more focus on the reactor side.

17           With that in mind, I turn to that previous  
18 question asked about schedule, and let me ask you to  
19 think about something on that slide. How about Slide  
20 9.

21           (Slide)

22           As you move things forward, I think,  
23 somehow conveying this range of need for risk  
24 assessment, something very, very simple, a small  
25 source that's handled in a specific way, in a specific

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1 use, may not need the same kind of retention as a  
2 byproduct, broad-scope licensee for some activity,  
3 conveying your perception or knowledge or ranking in  
4 some way of what's the most important subset of all  
5 NMSS activities to focus on would be helpful to those  
6 that really don't appreciate in the depth you do that  
7 broad spectrum of issues. So implementing or  
8 informing the readership of where you think the  
9 priorities ought to be, I think that would serve your  
10 case well. I think we all agree that it's good to do  
11 what you're doing, but we're trying to say of the  
12 1,000 things we face, these top 100 are the really  
13 important ones, or whatever the numbers are, that  
14 would really add to your case to be explicit about  
15 that.

16 I would certainly try and add that to your  
17 list of things for the 2004 spring paper to the  
18 Commission that you want to try and get that idea of  
19 priorities into that report as well. That would help,  
20 I think, have people see the top level of value. And  
21 we can all agree that for some licensees or licensed  
22 activities it is much more important to do this than  
23 perhaps someone else. So you presenting your view of  
24 that priority would be, I think, a helpful part of  
25 your case.

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1 MR. RUBIN: Priority to mean which area,  
2 which activity --

3 DR. RYAN: You're going to focus on for us  
4 because it is the most important, and it has the best  
5 return on enhanced protection, efficiency, and all  
6 your operational goals, so being real explicit and  
7 detailed about that I think helps your case.

8 Too, I think it's important to do what my  
9 junior high school English teacher, Bob Moyna  
10 (phonetic), of compare and contrast, and compare and  
11 contrast to the security and safeguards questions.  
12 You know, since 9/11 we've sort of been overpowered by  
13 a whole new set of questions on gauges, instruments  
14 and articles that contain curie or multiple curie  
15 quantities of radioactive material. And to me there  
16 is a fundamental question there about, on the one side  
17 of the NMSS material question, you're thinking about  
18 when something sort of goes unintentionally wrong  
19 versus something that's intentionally done with  
20 material. I think distinguishing how assessing  
21 outcomes or risks from intentional versus  
22 unintentional kinds of acts would be an interesting  
23 way to maybe address that. I think you need to  
24 somehow deal with security and safeguards questions as  
25 either how it integrates with what you are doing or

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1       how it's separate from what you're doing, again, in an  
2       explicit way so you can show the added value to your  
3       activities and risk assessment. I think that would be  
4       helpful.

5                You know, you could make a snap comment,  
6       which I wouldn't say or agree to, that, you know,  
7       we're dealing with all these things because we've got  
8       safeguards and security issues. We're kind of  
9       subsuming risk assessment into that question. Well,  
10      that may not be exactly right for all things, and it  
11      is clearly not as perhaps systematic -- could be, I  
12      guess -- but the risk assessment approach you are  
13      taking I think has a lot of systematic value that can,  
14      in fact, enhance some of the safeguards and security  
15      questions as well. So I just offer you that couple of  
16      points to think about in terms of how you communicate  
17      what it is you are about.

18               Milt, you had an additional comment?

19               DR. LEVENSON: Yes. I really have two  
20      comments applied to the same thing, and that is I want  
21      to warn you that we're now in the year 2003, and so  
22      what you do and what you write and what you publish is  
23      not technical person-to-technical person, it goes into  
24      the public arena and, if you don't do it right, it's  
25      going to come back and bite you. And I'd like to

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1 comment on the three documents that our expert  
2 mentioned -- 01-70, the Modal Study, and 66-72. The  
3 concept might have been okay in those reports. They  
4 are incredibly bad and unrealistic in estimating  
5 consequences. And I hope that nothing you do will use  
6 the model from any of those. In fact, one of those is  
7 now involved in a lawsuit against the Commission,  
8 quoting its own documents.

9 And with that thought in mind, I go to the  
10 table which has been blessed and condemned --

11 DR. HORNBERGER: I like that.

12 DR. LEVENSON: Well, I'm just going to  
13 point out that if I take this literally, I have to  
14 come to the conclusion that the material thing is  
15 considerably more dangerous than reactors because they  
16 both have the potential for high consequences, they  
17 both have the potential for large population at-risk,  
18 they both have radioactive source material that's  
19 large -- you're using the same words -- but the  
20 reactor frequency is only low, and the waste and  
21 material area can go high. And taken literally, that  
22 means that the potential in that certainly is not  
23 correct, and I don't think any of us believe it, and  
24 it's why we say "don't carry over the reactor thinking  
25 into the materials area". But you just have to be very

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1 -- completely reorient your thinking about using  
2 words. "Large" in connection with waste is a  
3 different number than the "large" in connection with  
4 reactors. You just have to be sensitive to that.

5 DR. RYAN: Milt, let me react because,  
6 again, coming from the material side of the house, I  
7 think I can offer you a different perspective. While  
8 it's true that a big event in a reactor can have a  
9 significant loss of economic value and production  
10 capability, if you will look across the history, I  
11 think -- and please correct me if I'm wrong -- that  
12 worker exposure and potential exposure to members of  
13 the general public and, in fact, worker overexposure,  
14 have occurred more often in the material area than in  
15 the reactor area.

16 MS. LUI: Somebody has actually died from  
17 those events in the past, too.

18 DR. LEVENSON: But that's a small  
19 population at risk. There's not a large population at  
20 risk compared to a reactor accident. How about people  
21 in medical applications, isn't that a large  
22 population? I bet more people have died from  
23 misapplications of medical radiation than have from  
24 reactors.

25 DR. RYAN: I get a couple of the

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1 newsletters, and medical misadministrations and gauge  
2 issues tend to dominate that arena. So the fact that  
3 it's not as individually catastrophic might not mean  
4 that the cumulative risk isn't different. I don't  
5 want to debate that to some endpoint, but the point is  
6 I agree that this chart is qualitative --

7 DR. LEVENSON: These are a lot, but the  
8 others are --

9 DR. HORNBERGER: As you can see, we all  
10 agree.

11 DR. RYAN: But nonetheless, I think the  
12 point here is that effectively communicating about  
13 this is probably the collective advice we can agree on  
14 that we're giving you, that figuring this out in a  
15 better way and to communicate it would be helpful to  
16 your effort.

17 Right, you had a question?

18 DR. WEINER: I had a very brief question,  
19 again, on this table, and I was not condemning it, I  
20 just didn't understand it. You have for dominant risk  
21 contributors, radiation and chemical. That's true,  
22 but a little bit misleading. There are cases where  
23 the chemical contribution to risk enormously dominates  
24 the radiation contribution. UF6 comes immediately to  
25 mind, and I believe that that is an area where your

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1 communications can be very, very helpful, especially  
2 to the general public.

3 The other thing is that if you have the  
4 time and the access, I would encourage you to look up  
5 William Ruckleshouse's 1982 presentation of risk in  
6 EPA standard-setting. He was EPA Administrator at the  
7 time, and he basically introduced the concept to risk.  
8 And I believe that the way it was communicated -- it  
9 was a speech to the public, and I believe that the way  
10 it was communicated might give you some insights into  
11 risk communication.

12 CHAIRMAN GARRICK: It was a speech to SRA,  
13 as I recall.

14 DR. WEINER: Yes, that's correct, it was  
15 a speech to SRA.

16 MR. RUBIN: Thank you all very much. I  
17 just want to say I appreciate very much the comments  
18 the discussion at this table has generated. Lesson  
19 learned from this for me is that to try to put  
20 something that's very complicated in a simplified  
21 table is risky.

22 CHAIRMAN GARRICK: Chronic problem with  
23 the risk sciences. And I think you now have seen why  
24 we ask you to save half of the time for discussion.

25 MS. LUI: Well, we certainly have tried to

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1 do our part.

2 CHAIRMAN GARRICK: You did. You did.

3 MS. LUI: Well, I walk away with two  
4 messages. We need to do the right thing, and we need  
5 to communicate effectively both internally and  
6 externally, to a various audience. And we certainly  
7 appreciate all of your comments.

8 MR. BAHADUR: May I ask for a  
9 clarification?

10 CHAIRMAN GARRICK: Yes.

11 MR. BAHADUR: On your Slide 9, you talk  
12 about the schedule, and you talking about coming to  
13 the Joint Committee in Spring of 2004. The NMSS, as  
14 I understand, has to deal with Agreement States as  
15 well, and in your schedule in which you are saying you  
16 are going to develop a risk-informed decisionmaking  
17 document in January, would it have gone to the  
18 Agreement States before it would come to us, or would  
19 you send it to them after?

20 MS. LUI: Well, in the SECY paper, we have  
21 explicitly asked the Commission that we share that  
22 particular SECY paper with the Agreement States two  
23 weeks after the SECY has gone to the Commission, so  
24 that will be our first step in terms of sharing any  
25 actual documentation with the Agreement States. In

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1 the past, we have been communicating with them  
2 informally, and we are going to participate in the  
3 Organization of Agreement States conference in  
4 October, and to start a dialogue. We are not  
5 envisioning the formal working group as some of the  
6 other agency's efforts, but we will be asking  
7 Agreement States through OSTP about helping us to  
8 review the documents as they are generated internally.

9 MR. BAHADUR: Okay.

10 DR. RYAN: Back to you, Mr. Chairman.

11 CHAIRMAN GARRICK: Thank you very much.  
12 We are running a little behind. A couple of us have  
13 to exit at about 10:20 to have a meeting. I would  
14 hope that, however, if Tina hasn't finished, she would  
15 just continue with her --

16 MR. LARKINS: Yes. I think you'll  
17 probably have a number of questions. We've been going  
18 back and forth -- she's made several iterations since  
19 the last time she presented to the committee, and if  
20 there's something you don't like, you can blame it on  
21 me.

22 CHAIRMAN GARRICK: Well, that we will  
23 especially do.

24 DR. RYAN: Tell us something new.

25 CHAIRMAN GARRICK: Tina, will you

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1 introduce yourself. We know you, of course, but maybe  
2 some of the members of the audience do not, and why  
3 you are here.

4 MS. GHOSH: Why am I here? That's an  
5 excellent question.

6 (Slide)

7 My name is Tina Ghosh. I am a Ph.D.  
8 candidate in the Nuclear Engineering Department at  
9 MIT. I'm working with Professor Postolakis  
10 (phonetic), and for probably the past six years I've  
11 been thinking about various model uncertainty issues  
12 in performance assessments. And from what I  
13 understand, Dr. Larkin at some point told my advisor  
14 that the ACNW could maybe use somebody to look at  
15 these issues, and so I guess that's why I'm here, and  
16 I hope to answer some of those questions. Is that  
17 enough of an introduction?

18 CHAIRMAN GARRICK: That's fine.

19 MS. GHOSH: And so I presented what I  
20 wanted to do for the summer I guess about five weeks  
21 ago, and I was really hoping I would have some answers  
22 by now, but I knew starting out there was a very low  
23 probability of that, and I can confirm that. I don't  
24 have any answers yet, but what I am working on is  
25 basically an approach to deal with how to assess the

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1       uncertainties in the models that are used in the PAs,  
2       and my title is a little bit misleading because I'm  
3       not just looking at how to assess the uncertainty, but  
4       also what to do about it. And my focus from the start  
5       has always been how the PA and the uncertainties fit  
6       into the risk-informed integrated decisionmaking  
7       framework that the NRC is trying to use across-the-  
8       board, and I guess this is a great time to talk about  
9       it because we just had a talk about risk-informed  
10      initiatives in the NMSS, and the Yucca Mountain  
11      program is a very specific example of how risk  
12      information can be used because you clearly already  
13      have a PA to start working with, you don't have the  
14      issue of whether it's worthwhile to have a risk  
15      assessment and so on.

16                   (Slide)

17               Probably most of you -- I'm sorry, Dr.  
18      Weiner, I guess you don't have my prospectus from what  
19      I had planned to do, but I think it will be obvious as  
20      I go along.

21               So my main questions were basically what  
22      would constitute an adequate assessment of model  
23      uncertainty in the PAs, how to deal with issues of  
24      incompleteness, and how to prioritize research and  
25      other important activities given the uncertainty.

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(Slide)

So the first thing I wanted to start out saying is that the performance assessment is basically, as it stands now, is really a projection of the repository behavior over time, and it's a little bit different than the focus of risk assessment as it was invented because risk assessment originally, for example, for a reactor, you are looking at just those scenarios that can actually fail your system criterion and whatever you define that to be.

So, I think the first bullet is basically what's happening now, and the second is you might want a different mode for the PA, which is basically doing more detailed sensitivity and uncertainty analyses. And what I'm saying is that these should concentrate just on those scenarios that might actually fail your system criterion, and once you find those scenarios you can identify what sets of assumptions and parameter values actually affect those scenarios, and so ultimately affect your decisions. And then just focus on evaluating the uncertainty in these factors, and this should give you a better way to estimate the safety margins. And I just wanted to point out that in practice, often a simpler version of your overall model is used for the sensitivity and uncertainty

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1 analyses, and I think a very good example of that is  
2 basically the NRC's version of the TSPA, which is a  
3 much simpler model than the DOE's version for obvious  
4 reasons. I mean, they have different purposes for the  
5 PA, but theirs is more flexible to do the types of  
6 sensitivity analyses quickly whereas the current DOE  
7 model is much more cumbersome and it's much harder to  
8 look at combined effects of different uncertainty. So  
9 that's just something to keep in mind.

10 (Slide)

11 So the first question, what constitutes an  
12 adequate assessment of model uncertainty, and I just  
13 wanted to pick up on a few things. You want to make  
14 sure that the uncertainty from the sub-models is  
15 propagated to your system-level performance. You want  
16 to make sure risk is not diluted, and what I mean by  
17 that is that you haven't screened things out that  
18 might actually be the risk scenarios.

19 The effects of incompleteness should be  
20 considered. And I think one thing that may be missing  
21 in current PAs is that the synergistic effects from  
22 the uncertainties of the sub-model level should be  
23 uncovered, and this is difficult to do when you do  
24 your sensitivity analyses looking at one uncertainty  
25 at a time because you are not looking at the combined

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1 effects. And I understand that DOE is planning to do  
2 a lot of these combined effects analyses, but I don't  
3 know yet what that is going to be.

4 And you want to be able to estimate your  
5 level of conservatism in the model, which is also  
6 related to how you think of your safety margin in your  
7 repository system. And the treatment for the sub-  
8 model should be commensurate with their importance  
9 with respect to your top level systems.

10 (Slide)

11 And just some examples of model  
12 uncertainty -- I'll just go through this quickly  
13 because everybody here knows -- you might have  
14 alternate models to represent the same physical  
15 process, and their effects could be different for your  
16 system level performance.

17 There may only be one model available, but  
18 you know that it's weak, and so what do you do about  
19 that?

20 There might be dependencies among the  
21 variables, and this is sort of the synergistic effect  
22 that I was talking about in the previous slide, or  
23 coupled processes that are decoupled in your model,  
24 and you might end up underestimating your scenario  
25 probabilities because you haven't considered these

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1 dependencies.

2 And in some cases, we see that there are  
3 inconsistencies in terms of how they are sampled in  
4 the PA with other variables. So one example, if you  
5 use a group of experts and you have elicited  
6 probability distribution for a particular sample, they  
7 may give you reasons why they think the parameter  
8 ranges in a higher range versus a lower range, but the  
9 PA doesn't take that into consideration in the  
10 sampling process, and you end up sampling a parameter  
11 range that is inconsistent with the conditions that  
12 you are sampling in another part of the PA, and you  
13 end up underestimating the variance in your system-  
14 level performance if you do this.

15 And, last, I think the hardest part is we  
16 just don't know what we don't know, and historically  
17 we've seen many examples of surprises, and this is the  
18 incompleteness in our assessment, and how do we deal  
19 with that?

20 (Slide)

21 So I guess what I'm proposing and what I  
22 want to do in this talk is just basically propose to  
23 dealing with how to assess the uncertainty and what to  
24 do about it. And I'm saying instead of starting with  
25 the tough integrated PA, let's focus in on just those

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1 parts of the PA that give us a possible failure of the  
2 decision criteria. So what we are looking for -- and  
3 this is based on sort of the risk triplet idea of risk  
4 from 1981. All we care about are just those scenarios  
5 that actually fail our system criterion.

6 So somebody might come back and say, well,  
7 that's the point of the TSPA. I mean, you have these  
8 nice curves and you can sort of assess the probability  
9 that different scenarios are going to happen, because  
10 the Latin Hypercube sampling and the Monte Carlo  
11 Simulation give you a very nice theoretical basis for  
12 the probabilities that are associated with different  
13 evolutions for the repository. But the problem with  
14 that is that this theoretical grounding is lost  
15 because you have a potential of -- you have a mixture  
16 of potential conservatisms that you are sampling, and  
17 some parts are realistic, you have some bounding  
18 analyses, and I think most importantly, not all of the  
19 important uncertainties are propagated together so  
20 that you can see the combined effect. So I don't  
21 think we have this as the PA stands right now anyway.

22 (Slide)

23 So this is what I propose should be the  
24 assessment, uncertainty assessment and the decision  
25 process, and it has to be an iterative process

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1 because, obviously, as you go along, you reassess  
2 what's happening in the other boxes. You want to  
3 identify the important uncertainties and the  
4 repository attributes, and based on those you can  
5 identify failure scenarios.

6 Once you have those scenarios, you can  
7 assess the probabilities, which is very difficult.  
8 Once you have the probabilities, you can prioritize  
9 them in terms of which ones are the dominant ones  
10 relative to each other, which ones are more likely to  
11 happen than others. Once you do that, you may want to  
12 reassess which ones are the important uncertainties in  
13 the repository attributes.

14 And after you do all this, what is  
15 ultimately important is that the risk information is  
16 just one element that feeds into your integrated  
17 decisionmaking process. So once you have the dominant  
18 scenarios and the relative probabilities, the DOE  
19 chooses how to allocate its performance and identifies  
20 what they are going to do in the performance  
21 confirmation program. And we had a lot of discussion  
22 about this in the last couple of days, and also the  
23 quality assurance and QC requirements. And I think  
24 I'm talking about QA/QC a little differently than  
25 what's there in the regulations, and I'll bring that

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1 out a little bit later.

2 (Slide)

3 And I think a really nice place to start  
4 in terms of the integrated decisionmaking is the Reg  
5 Guide 1.174, which is basically -- I know this is for  
6 the reactor arena. It's a totally different  
7 application, but the high-level concepts are very  
8 good. So I think this could be adopted for the Yucca  
9 Mountain Program.

10 So, basically, you have the risk  
11 information from PA, and you have a graded approach in  
12 terms of how you use the different elements in your  
13 integrated decisionmaking, depending on the level of  
14 risk and uncertainty that you have uncovered through  
15 the PA.

16 So, our major source of information is the  
17 PA, and then how are we going to use the defense-in-  
18 depth and safety margins, quality assurance and the  
19 performance confirmation in order to deal with the  
20 uncertainty in the PA.

21 And just to start with, as it stands now,  
22 there's plenty of defense-in-depth already built into  
23 the system because you can say the regulations have  
24 some pretty conservative criterion -- for example, the  
25 dose criterion some people would say is prescriptive

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1 and conservative. The structure of the repository  
2 itself in terms of the design incorporates defense-in-  
3 depth because you have the multi-barrier criterion and  
4 people use it. So some of that is already there. And  
5 I think that's like the structural with defense-in-  
6 depth approach at the high level. And what I'd like  
7 to deal with is how to use the rational with defense-  
8 in-depth approach at the lower level once you have the  
9 information from the PAs and so on.

10 (Slide)

11 So what I hope to do -- well, what I hope  
12 will be my final outcome -- is to demonstrate how this  
13 assessment and decision process could be implemented,  
14 and to use two examples of the hypothetical dominant  
15 scenarios. And here I wanted to use ones that the  
16 NMSS has developed. And given those scenarios,  
17 assessing the probability bounds for those occurring,  
18 and that's a very difficult part.

19 And then given those scenarios, the  
20 associated probabilities, the residual uncertainties,  
21 basically how to implement this integrated  
22 decisionmaking process in terms of the implications  
23 for the performance confirmation and the QA and QC  
24 requirements. And I would keep the current DOE  
25 assumption of having allocated a large part of the

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1 performance on the waste package. I think in the  
2 current case, they want to say about 60 percent of the  
3 safety case is based on the waste package durability.

4 (Slide)

5 Okay. So, first, how do we find the  
6 scenarios of interest? One way is to look at the  
7 current performance assessment and pick out any of the  
8 runs that might fail your decision criterion. Now, in  
9 the PA, as it stands, this almost never happens  
10 because the dose criterion is 10,000 years at about 15  
11 mrem. It might be lower for the groundwater  
12 protection requirement, but it is always at least an  
13 order of magnitude or even lower. But if we look at -  
14 - this is just one example of the PA. This was done  
15 for the EIS in 2001.

16 And what they did was in addition to the  
17 normal spent fuel and the defense waste, they said  
18 what would happen if we include the greater than Class  
19 C waste and the SPAR waste, which is special  
20 performance assessment required, and this is the run  
21 that they got. And you see that the majority of runs,  
22 nothing is happening until about 100,000 years. But  
23 what's interesting is that you have a couple of runs  
24 where you have some funny behavior where you get a  
25 dose starting at around 1100 years or something.

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1                   Now, given that most of your PA -- you're  
2 not getting anything at all, wouldn't it make sense  
3 just to figure out what is going on in those  
4 particular realizations to make that? I mean, it  
5 might be something as simple as a couple of waste  
6 package failures. But even if that is the case, you  
7 want to know why that's happening. So, that's one way  
8 to pick out the scenarios. But as I said, it's been  
9 very difficult to do that just because nothing ever  
10 fails in a given criteria.

11                   (Slide)

12                   I think another way, I think the NMSS  
13 staff has suggested a way through their tracing  
14 studies for looking at particular radionuclide release  
15 and how it travels through the system. They  
16 identified the Np-237 as an important radionuclide  
17 because of its contribution to dose. And given that  
18 it's important, they looked at just the processes that  
19 lead to release of Np-237 and its travel through the  
20 repository, and identified important attributes. And  
21 I think they started out by partitioning the  
22 realizations based on criterion and looking at the  
23 overall sensitivity analyses, and looking at which  
24 parameters CDFs were sensitive to this partitioning,  
25 and then focusing sort of combined sensitivity

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1 analyses on these parameters.

2 So, what I've done is basically just very  
3 crudely constructed some scenarios based on their  
4 findings, and I want to talk a little bit about the  
5 implications for assessing the probabilities of these  
6 scenarios and other integrated decisionmaking  
7 activities.

8 (Slide)

9 So, one example was what if we have a high  
10 influx and flow into the waste package, and we assumed  
11 we need 40 waste packages to breach at 1,000 years, a  
12 very conservative assumption, but just to start with  
13 to give you a scenario where you actually see a dose.  
14 And then, in addition, we have very low retardation  
15 factor in the Calico Hills nonvitric unit in the  
16 unsaturated zone. And if we have that, then it takes  
17 about 9,000 years for the Np-237 to get through the  
18 unsaturated zone. You've seen all this in Tim  
19 McCartin's March presentation, so maybe this looks  
20 familiar.

21 In addition, if we have low diffusion and  
22 low retardation factor in the alluvium in the  
23 saturated zone, it takes another 700 years to travel  
24 to the point where the calculation was done, which was  
25 1 km from the repository, and you end up with about 15

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1 mrem at about 11,000 years. Now, clearly, there is a  
2 series of conservative assumptions that were made in  
3 order to get this scenario, but at least you have some  
4 type of failure scenario. You can go back and look at  
5 possible model uncertainties in the PA, as it stands  
6 now.

7 And just another example of a possible  
8 scenario is if you have a 110 waste packages that are  
9 breached at 1,000 years, and you have high Np-237  
10 possibility with all other factors being the same, you  
11 end up with --

12 CHAIRMAN GARRICK: Tina, the reason that  
13 I'm interrupting is that a couple of us have to leave.  
14 You weren't here when we announced it, but a couple of  
15 us have to leave in a couple of minutes, and you can  
16 continue, but I wanted to make a comment or two.

17 Now, are these conditional? Are these  
18 scenarios conditional -- conditional on these  
19 initiating conditions, initial conditions?

20 MS. GHOSH: Yes.

21 CHAIRMAN GARRICK: So you haven't factored  
22 likelihood into --

23 MS. GHOSH: No, no, no, no, and that's  
24 what I'm getting to. First, I'm saying it's so hard  
25 to find those failure scenarios in the first place.

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1 This is one way to find them. But then you have to  
2 assess the likelihood of these things happening  
3 together. As a first cut, the probability is going to  
4 be extremely low. Maybe I should just get to that.

5 (Slide)

6 So the point is how do you assess the  
7 probabilities of these scenarios happening? As a  
8 first cut, you can just take the probabilities from  
9 the existing PA, and you're going to get an extremely  
10 low number, but what we really care about are the  
11 uncertainties that might have been left out of the PA  
12 that might have had this scenario happening together.

13 So you can look for the potential common  
14 cause or the synergistic effects among the elements in  
15 this scenario, to see if you might want to revise the  
16 probability assessment.

17 Another thing is if you do scrutinize the  
18 possible failure scenarios to this degree, you might  
19 find out that the probabilities are actually highly  
20 overestimated in the PA, and it might be also a  
21 revelation of extreme conservatism in the PA. But,  
22 basically, this is a way to get a better assessment of  
23 the probabilities for those things that might matter  
24 to the system performance.

25 CHAIRMAN GARRICK: Now, one thing that's

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1 very different here is that in the reactor side, of  
2 course, we think of scenarios in the context of an  
3 event tree, and each initial condition, each  
4 initiating event will have emanating from it hundreds  
5 of scenarios, maybe thousands, maybe millions, and  
6 each pathway through the event tree could be  
7 considered as a scenario.

8 And, in general, the approach to scenario  
9 structuring is very different between performance  
10 assessment modeling and in reactor modeling. But all  
11 I'm pointing out is that when you postulate an initial  
12 condition like a high flux rate, you are postulating  
13 a condition that could go in any one of hundreds or  
14 thousands of different directions. And, in principle,  
15 therefore, you would have hundreds or thousands of  
16 different pathways which could be interpreted as  
17 hundreds or thousands of different scenarios for each  
18 initial condition, each initiating event. That's one  
19 thing that's very different.

20 The other thing I was very happy that you  
21 pointed out, that what you get from Monte Carlo is not  
22 the probabilities, you get the process by which you do  
23 sampling and by which you do the probability  
24 arithmetic. The actual probabilities have to come  
25 from somewhere else. But it's important to look at

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1 these differences between the two types of modeling.

2 MS. GHOSH: Okay.

3 (Slide)

4 In terms of incompleteness, there could be  
5 scenarios that were willfully screened out, which may  
6 not have been appropriate to be screened out, or  
7 unimagined ones. And probabilities for various  
8 features, events, and processes could be over- or  
9 underestimated. And, historically, we see many  
10 instances of both of these in past risk analyses.

11 So the question is, how can we account for  
12 this incompleteness, and I think one of the nice  
13 things about focusing on just the failure scenarios is  
14 that you don't have infinite resources to scrutinize  
15 visually everything that you have, and if you find  
16 those scenarios where you actually might get a  
17 failure, you can focus your resources on looking at  
18 the supporting information for those scenarios to help  
19 you better quantify the uncertainties and review any  
20 incompleteness and, ultimately, get better probability  
21 estimates.

22 (Slide)

23 So, I wanted to just give an example of  
24 how you might further scrutinize the available  
25 information. So this is an example from the DOE's

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1 experts' elicitation for their UZ flux model, and this  
2 is basically water coming down above the repository  
3 which they used to ultimately determine the  
4 percolation flux into the repository drift.

5 So they did an expert elicitation, and  
6 they had seven experts, and this is basically the  
7 representation of the probability density functions  
8 from each of the experts and their aggregate estimate,  
9 which is shown on top. And in this case, they just  
10 did a simple equal weighting for each expert to get  
11 the aggregate pdf's on the top. But the thing is, if  
12 you look at their actual study, there's really a  
13 wealth of information in the elicitation report that  
14 is not captured in the summary of the pdf.

15 (Slide)

16 So one thing I did is try to decompose  
17 what each of the experts considered when they assessed  
18 the various ranges for the percolation flux. At the  
19 top we have the seven experts. I know the writing is  
20 small, but the numbers aren't important, it is just to  
21 show you.

22 And they discussed in a series of  
23 workshops the range of factors that might affect the  
24 percolation flux coming into the repository, but not  
25 all of the experts thought all of the factors were

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1 equally important, and some just disregarded some  
2 factors all together in terms of their effects.

3 So, here I tried to map which factors were  
4 considered by which experts, and just the size of the  
5 arrow is a rough idea of the strength of how much that  
6 particular expert considered the various factors, so  
7 you get a better idea of who considered what. And one  
8 of the reasons this is important is that, especially  
9 with the performance confirmation activity, you are  
10 collecting more and more information. So it might be  
11 worthwhile to reassess the distribution for the  
12 percolation flux, for example, as you get more  
13 information.

14 (Slide)

15 And the benefits of decomposition is once  
16 you can see who considered what, as you get more  
17 information you can update your sort of aggregate  
18 probability. One thing to consider would be to change  
19 the nature of the information that you sort of keep  
20 from the expert elicitation.

21 So, it's not just which factors were  
22 considered by which experts, but you want to know how  
23 they interpreted those factors in order to arrive at  
24 their estimates so that as new information comes in  
25 you may have a better idea about how to update their

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1 relative distribution. You can get an estimate of  
2 incompleteness perhaps, based on the disagreement  
3 among the experts -- anyway, you get the idea.

4 (Slide)

5 So in terms of the incompleteness in the  
6 collective state of knowledge for a particular issue,  
7 you can look at the level of disagreement among the  
8 experts. You can look at historical data on how the  
9 relevant expert community performed in terms of  
10 affecting issues in a particular subject area. And  
11 you can also use performance data on the experts  
12 themselves, if it is available. And this is a little  
13 bit controversial, but it is an interesting idea.

14 And in terms of confidence studies for  
15 those areas where you still have a lot of  
16 incompleteness, this is where your other elements come  
17 in. You have your performance confirmation  
18 activities. You have model validation activities.  
19 And the NRC has some guidance on how to do this in  
20 terms of distinguishing between different models and  
21 so on. And you have your natural analogs and  
22 experiments you might not have considered as relevant  
23 to your assessment in the first place, and an example  
24 of this is the recent fuel cask experiments that were  
25 presented at the last committee meeting, which were

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1 not done for Yucca Mountain but which may end up being  
2 useful for the Yucca Mountain project.

3 (Slide)

4 So I just want to end with an example of  
5 maybe what I'd like to do in terms of the decisions  
6 that one could make in order to deal with the  
7 uncertainties in the assessment.

8 So, once you have those, the scenarios and  
9 the associated probabilities and uncertainties, what  
10 you want is only for those that are actually  
11 important, you want to come up with some compensation  
12 activities so that you feel comfortable with it.

13 So, just as an example, in the 2001 TSPA,  
14 they assume that 20 percent chance of one early  
15 failure in the waste package; 3 percent of two early  
16 failures; and probability goes to almost zero when you  
17 go above two early failures, and this is, from what I  
18 understand, I think it's more than 10,000 packages.  
19 But the thing is, what do you need to do in order to  
20 be confident that your waste package really is going  
21 to last that long.

22 And the other thing is you want to see  
23 that even if you are wrong about the number of waste  
24 packages, maybe you still don't fail your decision  
25 criteria, so it might not be important that the

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1 assumption is that there's almost zero chance of more  
2 than two failings. And so you have to consider your  
3 entire scenario in order to be able to assess  
4 particular aspects of the safety case, and once you  
5 find that, maybe you find that actually what you  
6 really care about is to make sure that it's not more  
7 than 20 that fail in your repository. And then when  
8 you're manufacturing the waste packages, you have to  
9 have adequate sort of quality control requirements to  
10 make sure that you can prove that you're not going to  
11 have more than 20 failures. For example, like  
12 welding, I guess, is historically a touchy issue. Can  
13 you show that your welds are going to be durable  
14 enough to have less than 10 waste package failures  
15 over 50,000 years or something.

16 And, of course, with all of this, you  
17 might still have limitations in terms of the  
18 uncertainty on what you can show, and you can have  
19 your ongoing performance confirmation activities in  
20 order to increase your confidence about the technical  
21 basis for the assumptions that are necessary.

22 So that's just an example. I haven't  
23 finished going through this yet, but I plan to do so  
24 in the next few weeks. I mean, I guess maybe my end  
25 message is basically there should really be a graded

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1 approach. First, it's hard to identify those things  
2 that are important, but once you have identified those  
3 important things, you want different levels of  
4 confidence based on the uncertainty and the scenarios  
5 that you've uncovered. And I guess that's about it.

6 (Slide)

7 Well, we don't have to talk about this.  
8 This is just an example of what I think that the  
9 defense-in-depth that's already there now, and how the  
10 NMSS is using risk information combined with defense-  
11 in-depth in their prioritization activities, but I  
12 don't want to talk about that today.

13 (Slide)

14 I just want to thank all the people who  
15 really helped me. It's been great being here and,  
16 well, just thank you.

17 (Slide)

18 At the end, the last page I have a number  
19 of selected references. The things that I numbered in  
20 the presentation match the numbers of the references.  
21 I also threw in some of the other key references that  
22 I've looked at.

23 DR. HORNBERGER: Thanks very much, Tina.  
24 We have time for some questions or comments. Ruth?

25 DR. WEINER: The first comment I'd make is

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1 that maybe you can reprint your reference list in a  
2 type font that I can read with my glasses because I  
3 sure can't do it -- I can barely read it up there.

4 MS. GHOSH: I'm sorry. I'll put it on  
5 more than one page so it's bigger.

6 DR. WEINER: Thank you very much. My  
7 comment is, as you know, Latin Hypercube sampling  
8 ensures that you're going to sample the tails of the  
9 distribution. Could you put up that slide of the PA  
10 results -- it was an early slide.

11 (Slide)

12 Okay. Yes, that one. So the reason for  
13 looking at the mean and the 95th percentile and so on  
14 is precisely because you use Latin Hypercube sampling,  
15 and what you have done in picking your scenario is to  
16 take a scenario from the tail, and this is done in all  
17 of the arguments about Yucca Mountain, but is there an  
18 implicit suggestion in what you are saying, that we  
19 shouldn't make the tail so long that perhaps these  
20 very extreme scenarios should not be part of the PA at  
21 all?

22 MS. GHOSH: I think what I was trying to  
23 bring out is that I think people are uncomfortable  
24 with maybe the quality of the PA in terms of  
25 representing the whole picture right now. So one of

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1 the things we might care about is -- of course, I  
2 picked out a tail, and if you believe this picture,  
3 that tail has an extremely low probability of  
4 occurring, but the point is do you believe that that  
5 is the accurate probability given that you have all of  
6 these uncertainties in the performance assessment that  
7 you may not have considered the synergistic effects  
8 among the models or parameters that you've screened  
9 out, and so on. So that is sort of the motivation  
10 behind this, because I think, as it stands now, if we  
11 believe the TSPA, there's nothing to do, just let  
12 everything go as it is, but the thing is people are  
13 uncomfortable with whether we've accurately portrayed  
14 the probability of that tail scenario happening.

15 DR. HORNBERGER: Milt?

16 DR. LEVENSON: Can you put up Slide 5?

17 (Slide)

18 If I believe what you are telling me, that  
19 300 realizations means that each one has 1 in 300  
20 probability of occurring, I can determine absolutely  
21 what is going to occur by only doing one realization  
22 because that will have a probability of 1.

23 MS. GHOSH: I'm sorry. Obviously, I don't  
24 believe that. And the more realizations you do, the  
25 more comfortable you can feel, but isn't that -- this

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1 is an argument I've seen -- you know, when people talk  
2 about the sampling process, that's how they represent  
3 it. So there is a second issue, which is you have  
4 this guesstimate of the probability and then how much  
5 confidence you place on it because, really, there's  
6 the bounds that you have to place on these probability  
7 estimates. And the more realizations you do, maybe  
8 you can be more comfortable about the balance. But I  
9 take your point.

10 DR. LEVENSON: Okay. The next slide,  
11 Slide 6.

12 (Slide)

13 From my basic hang-up, I have to ask, how  
14 -- I get uneasy when people rank dominant scenarios  
15 based on probability only, and haven't included  
16 consideration of consequences.

17 MS. GHOSH: Right. So I guess that's why  
18 I brought up the point of the desideratum -- I mean,  
19 what do you actually care about. And I guess the  
20 typical approach has been to pick some threshold  
21 consequence and look at just that. But one might want  
22 a more graded approach. It's just that in the  
23 regulations right now, the criterion is the 15 mrem at  
24 10,000 years, so you might want to construct your  
25 whole case around that.

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1 DR. HORNBERGER: Ruth, did you have a  
2 follow-up?

3 DR. WEINER: If you go back to the 1-300  
4 that -- the previous slide, Slide 5.

5 (Slide)

6 I was just going to say that in making  
7 this presentation, a better way to -- perhaps improved  
8 way to look at that question because this statement --  
9 Milt is absolutely correct -- when you have only one  
10 realization, then it is completely random what your  
11 scenario is going to be. If you have 4 realizations,  
12 then you've stratified. And if you have the same  
13 number of realizations as your stratification, then  
14 it's random within those strata. But the more you  
15 take, the more likely you are to sample over the  
16 entire curve, and I think that's the point, the 300  
17 realizations as compared to, say, 100 realizations  
18 gives you a better sampling of everything that you  
19 have considered. That's one point I wanted to make.

20 And the question -- if you go to the next  
21 slide --

22 (Slide)

23 When you were making your presentation, I  
24 was mentally filling in, and when you said dominant,  
25 in my mind I included consequence along with

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1 probability. I think that should be explicit. And I  
2 commend you for walking through each scenario in a PA.  
3 That is extremely instructive, if you look at where  
4 each parameter was -- the way in which each parameter  
5 was sampled.

6 You also might look at something else,  
7 which is there are a certain number of parameters that  
8 -- the parameters have, as you know, different  
9 distributions, they are not all Galcean (phonetic) or  
10 whatever, and there are a certain number of parameters  
11 that are constant values, like the half-life of Np-  
12 237, that's a constant. So you might look at where  
13 the fixed value or a known value dominates the  
14 scenario, and where some kind of distribution  
15 determined by expert elicitation dominates a value.

16 DR. HORNBERGER: Tina, in listening to  
17 your presentation today, it strikes me that -- let's  
18 see if this is a correct interpretation -- that to a  
19 certain extent what you are aiming at is identifying  
20 the potential weak spots of a performance assessment  
21 almost independent of the low estimated probability of  
22 that sequence of events because, after all, probing  
23 the weak parts of a case may be a useful way to look  
24 at things, such as the example you gave, how many  
25 waste packages would have to fail to reach this

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1 extreme scenario, and then what kind of quality  
2 assurance/quality control program do you have to have  
3 in place to make sure that your welds will meet that  
4 criterion. Is that a fair assessment?

5 MS. GHOSH: Yes, that's a fair assessment.  
6 I mean, that's exactly the point, you want to find the  
7 weak spots because, as I said, you don't care about  
8 all the ways that your repository is wonderful and  
9 everything works -- I mean, that's great -- but what  
10 are the things that could defeat the system. And once  
11 you find that, you have to get an idea about at least  
12 the relative likelihood of those things happening.

13 DR. HORNBERGER: You had made a comment  
14 somewhere in your presentation -- actually, on Slide  
15 7 -- about bringing in defense-in-depth. So that was  
16 your slide where you said this was from a reactor  
17 arena, and I've had some, let's say, interesting  
18 conversations with George Apothtolokis (phonetic) on  
19 how defense-in-depth, as used in reactors, may or may  
20 not carry over to repositories. Can you amplify a  
21 little bit on your views on what you mean here? You  
22 go through your procedure of identifying the weak  
23 spots. How are you going to contribute to decisions  
24 on defense-in-depth?

25 (Slide)

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1 MS. GHOSH: Okay. You know the two views  
2 of the defense-in-depth, one is like what's embodied  
3 in the structure, the structuralist approach where you  
4 look at what's already embodied in the structure of  
5 the regulations and the structure of your design and  
6 so on. I think that structural part is already there  
7 because the regulatory requirements -- I mean, they  
8 are not all risk-based. You have the multi-barrier  
9 requirements. You have the performance conservation  
10 requirement and so on, so a very high level. That's  
11 one defense-in-depth strategy.

12 I think what I was concentrating on is how  
13 to use it at the low level -- how to use a rational  
14 approach. I think what I'm looking at is how to  
15 employ the rationalist approach to defense-in-depth at  
16 the low level, which is basically you have the  
17 information from the PA and the uncertainties and  
18 hopefully important. And what are the things that you  
19 can do in order to build confidence that those  
20 uncertainties are as low as they are, and so on. So,  
21 I hope that makes sense.

22 Now, the thing is, obviously, the  
23 repository system is very different than a reactor.  
24 The multi-barrier thing, for example, with reactors,  
25 at least they assume some independence of some of the

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1 barriers. You don't have that much in the repository  
2 system just because there area lot of coupled  
3 processes and one thing leads to another. So the  
4 structural multi-barrier defense-in-depth means  
5 something different for the repository system than the  
6 reactor. I don't think I'll be dealing that, I guess,  
7 so much in what I'm trying to do.

8 What I'm trying to do is to -- I think all  
9 the activities that you do to build confidence in your  
10 PA results, and whatever decisions you've made, sort  
11 of fall into the defense-in-depth in terms of whatever  
12 you do to convince a rational person that you have --  
13 that you are comfortable with your decision. Does  
14 that make sense? I don't know if I answered your  
15 question.

16 DR. HORNBERGER: Yes, more or less. Jack  
17 Sorenson still comes in once in a while, doesn't he?  
18 You should have a chat with Jack.

19 We have some experts in the audience, and  
20 I'll invite them, if they have any questions or  
21 comments?

22 MR. McCARTIN: Tim McCartin, NRC staff.  
23 I just wanted to offer for the committee, we  
24 appreciate the opportunity to interact with Tina on  
25 this, and it's a two-way street, and it's always good

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1 to get new ideas into the program. She went over it  
2 real quick, but her Slide 20, which you don't  
3 necessarily have to look at it now, but in terms of --  
4 as you know, we are constantly trying to find better  
5 ways to explain and communicate risk. And on Slide  
6 20, she came up with this, and I've talked a little  
7 bit with her, but as an example there, if you look at  
8 the bottom box on corrosion where there's arrows going  
9 both to the waste packages affected and cumulative  
10 release, we've talked about the synergistic effect and  
11 the kinds of things that affect multiple things.  
12 Graphically, this is a nice way to communicate. So  
13 right there is an idea that I think when we go forward  
14 with our -- as we update our risk baseline report,  
15 here's a way that -- you'll probably see it again in  
16 that report -- and there is at least one example I'll  
17 give you of a way that's a useful way to present the  
18 information. So we know -- Tina will be gone by the  
19 next time you guys meet, but I think NMSS is happy  
20 with the opportunity to help out on this effort.

21 DR. HORNBERGER: I'm very glad to hear  
22 that. Any other -- Dick?

23 MR. CODELL: Dick Codell, NRC staff. I  
24 did have one question. Looking at the worst scenarios  
25 bothers me a little bit because the rule is based on

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1 risk, and I think maybe Dr. Weiner touched on this,  
2 too, but I'd be more concerned with how the extremes  
3 of the realizations affect the mean, which is really  
4 basis of the risk and not the extremes themselves.

5 MS. GHOSH: Okay. I guess my path on this  
6 is that we want to be able to reassess the  
7 probabilities of those extreme events happening. So  
8 in the end, I guess you end up doing the same thing  
9 because what I didn't show is, ultimately, after you  
10 scrutinize sort of the tail scenarios, you want to  
11 feed back to your overall integrated PA, so you should  
12 be able to see the effect in your mean dose once you  
13 do that. I don't know if that's a satisfactory  
14 answer.

15 MR. CODELL: That's a good answer.

16 MS. GHOSH: But the motivation of this is  
17 basically let's make sure we got those probabilities  
18 right for the tail scenarios because we don't have  
19 infinite resources to scrutinize everything.

20 DR. HORNBERGER: Questions from staff?  
21 Neil?

22 MR. COLEMAN: I just wanted to mention  
23 that I saw a really good point all through your talk,  
24 but one about metals fabrication which came up in the  
25 performance confirmation meeting, about you asked the

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1 question is it possible to actually manufacture at the  
2 extremely low failure rates that are being claimed, a  
3 key point and one that the committee has expressed  
4 interest in following.

5 I just wanted to mention one other thing.  
6 I'd be interested in any suggestions you might have  
7 about how to systematically root out the synergistic  
8 effects that you were talking about, anything that  
9 would be helpful?

10 DR. HORNBERGER: That's a challenge, and  
11 it's now on the record. Other questions or comments?  
12 Sher?

13 MR. BAHADUR: George, I just wanted to  
14 place on record the fact that Tina came here as a  
15 summer intern. She had shown great insights into the  
16 issues that we are dealing with in the waste, and her  
17 contribution has been very valuable. This is just her  
18 progress report. By the time she completes her work,  
19 her term will be expiring at NRC. But in your next  
20 meeting, which is perhaps in September, we would  
21 invite Tina to come here and present her final results  
22 on this particular activity that she is doing. thank  
23 you.

24 DR. HORNBERGER: That's great, and we'll  
25 look forward to that. And I will also express for the

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1 whole ACNW, the committee, our pleasure in having had  
2 you to work here with us. We've all enjoyed it.

3 MS. GHOSH: Thank you so much. I've  
4 really enjoyed it, too. It's like the first time I've  
5 actually had a full committee of advisors.

6 DR. HORNBERGER: Well, this isn't MIT.

7 MS. GHOSH: It's been a pleasure.

8 DR. LEVENSON: Tina, I want to ask you a  
9 question that's completely outside of the study, but  
10 you may be in a unique position. There recently has  
11 been some concern about expert solicitation, and one  
12 viewpoint saying that what you should do is get from  
13 the experts their knowledge and information and not  
14 necessarily the final decision, as many people are  
15 expert in a field, but they don't necessarily know how  
16 to translate it into, say, a probability.

17 Since you are unfolding or taking apart  
18 the pieces of the expert solicitation, do you have any  
19 comment on the approach to just letting an expert give  
20 you his answer, as opposed to his being an information  
21 source?

22 MS. GHOSH: I think that's an excellent  
23 point, and probably an area of major study.

24 DR. LEVENSON: But I just wanted your  
25 opinion from what little unfolding you've done.

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1 MS. GHOSH: Sure, absolutely. I've looked  
2 at a lot of different expert elicitation techniques as  
3 well as how you summarize the information and so on  
4 and, as you know, there's a whole body of literature  
5 on how to do it right and what you get and what it  
6 means, and so on. That was one of my points of  
7 showing the decomposition of the expert solicitation  
8 because I think you're absolutely right, you don't  
9 just want the final number that you're going to plug  
10 into the PA, you want to know why they think a  
11 particular range of maybe which model they think are  
12 applicable. There's a lot of aleatory uncertainty  
13 about what's actually in the geologic formation, so  
14 you want their sort of ideas about what's going on  
15 down there, and how it affects things. And so you may  
16 choose to elicit the information at a different level  
17 and compile it to the end number. Of course, you  
18 still want to go back and make sure that once you've  
19 done that, they agree with what you've done. But,  
20 yes, I think it's a really interesting point,  
21 especially with the Bayesian framework. As you do  
22 collect more information, you want to be able to take  
23 the elicitation and update the distributions and, if  
24 all you have is the distribution, you can't do that.

25 DR. LEVENSON: I want to thank you for

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1 having undertaken to take that apart because I think  
2 that's a very valuable insight.

3 DR. HORNBERGER: Mike, one last quick  
4 question.

5 MR. LEE: Tina and I had a conversation  
6 previously about the staff position that was written  
7 a number of years ago about the use of expert  
8 judgment, and one of the things that the staff noted  
9 on the strengths of any particular elicitation was the  
10 ability to document the assumptions that went into a  
11 particular issue that was being addressed. So if  
12 you're interested in particular distribution or range  
13 of values or things like that, the more you can do up  
14 front in terms of free elicitation training to tell  
15 the particular expert that you want to understand why  
16 he came up with the distribution that he came up with  
17 is valuable.

18 DR. HORNBERGER: Okay. I believe that we  
19 will not need the Recorder any further, so this will  
20 end the recorded part of the session. We are now  
21 going to take at least -- at least -- a 20-minute  
22 break and, in fact, I'll say 10 past 11:00.

23 (Whereupon, at 10:45 a.m., the recorded  
24 portion of the meeting was concluded.)  
25

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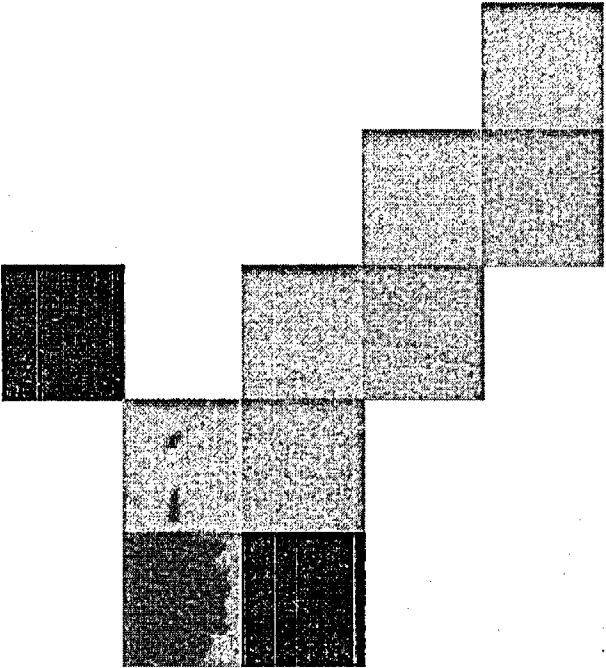
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# **Risk-Informed Regulation for NMSS: Status Report and Plans for Future Work**

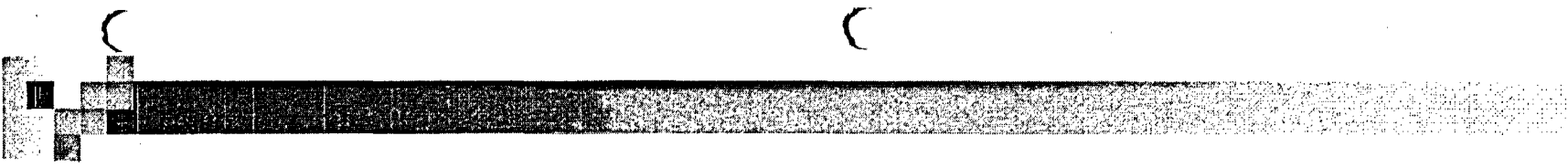
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# Purpose Of Briefing

- To provide the status and path forward for risk-informing the materials and waste arenas
  - Status of NMSS risk-informing initiatives
  - Value of risk-informing NMSS
  - Plan for future work
- To request the Committee's view of our approach



# **Risk-Informed Decision-Making Process**

- Identify regulatory issue
- Apply screening considerations
- Evaluate available risk information
- Consider risk information, risk guidelines, other factors, and uncertainty to make a risk-informed decision

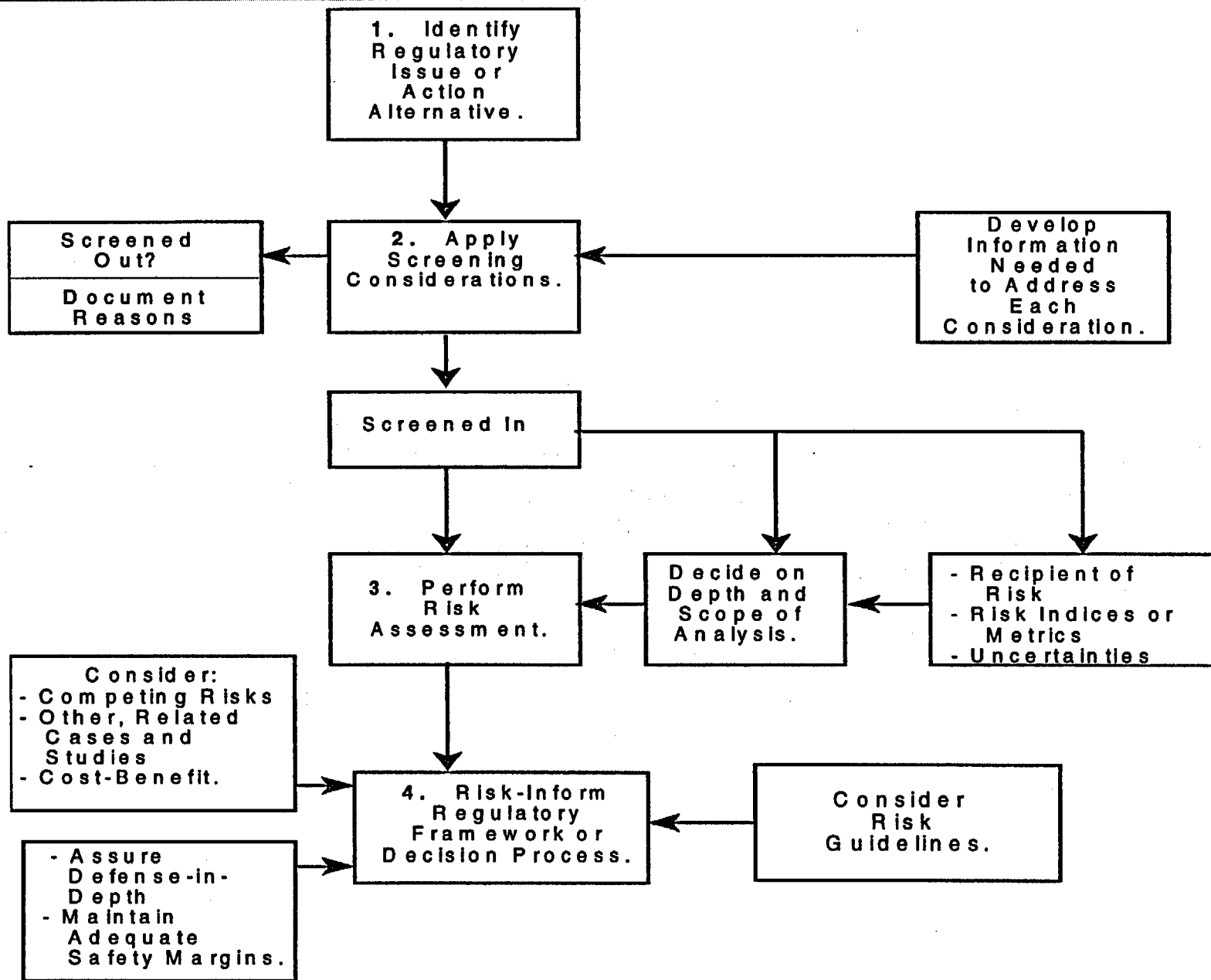


Figure 1. Risk-Informed decision-making process.





# **Successful Uses of Risk-Informing Approach**

- Integrated Safety Analysis reviews
- Byproduct materials inspection
- High-level waste
- Decommissioning
- Spent fuel transportation and storage



# **Ongoing and Planned Risk-Informing Efforts**

- Risk-inform standard review plan for certification of casks for the dry storage of spent fuel
- Fuel cycle oversight program
- Control of sources
- Refine licensing of devices containing byproduct material
- Efficiency and Effectiveness Initiative



# Guidance Development

- Screening Considerations guidance document
- Risk Assessment guidance document
- Risk Guidelines
- Risk-Informed Decision-making guidance document
  - Pilot studies to test guidance



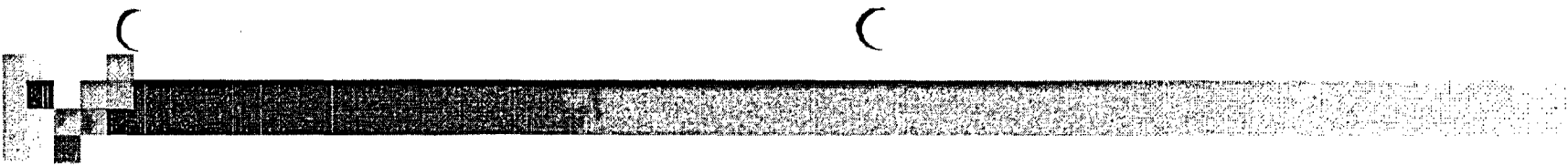
# **Benefits of a Risk-Informed Approach**

- Improvements in safety focus
- Improvements in efficiency and effectiveness
- Reduction of unnecessary regulatory burden
- Improvements in communication
- Greater transparency
- Greater consistency and coherence



# Plans for Future Work

- Identify NMSS regulatory activities amenable to risk-informed approach
- Develop necessary risk metrics, methods, data, guidelines, and guidance documents
- Assess implications for the public, NRC staff, licensees, and Agreement States
- Determine priority, plan, and schedule for implementation
- Conduct staff training



# Proposed Schedule

- January 2004, issue RIDM guidance for internal comment
- Spring 2004, brief ACRS/ACNW joint subcommittee
- Spring 2004, provide 2<sup>nd</sup> paper to Commission to detail our technical progress, policy issues, recommendations, and options
- Hold public workshops after receiving Commission direction



# Summary and Conclusion

- Provided the status and path forward for risk-informing the materials and waste arenas
- Risk-informing has benefited NMSS on a case-by-case basis and more can be realized by developing and implementing a systematic and transparent process
- Will engage the Committee/Subcommittee as we go forward
- Request a letter from Committee to Commission



# Back Up - Issues

Currently working on:

- Developing appropriate risk guidelines and applications
  - identification of population at risk
  - considerations of safeguards and security issues
  - consideration of consistency and coherence of risk-informed approaches in the materials and waste and reactor arenas
- Implications for staff, licensees, applicants and Agreement States from the use of risk guidelines



## Back Up

### Comparison of Reactor and Materials and Waste Arenas

Characteristic	Reactor arena	Materials and waste arenas
Event frequency	Low	Low to high
Accident experience	Few actual events	None to significant number of actual events
Potential consequences	High	Low to high
Population at risk	Large	Small to large
Area impacted	Large (1 to 10 mile radius)	Small to large
Radioactive material (source term)	Large	Small to large
Radioactive material (location)	Fixed	Fixed to moving (i.e., transportation)
Dominant risk to:	Public	Workers
Dominant risk contributors	Radiation	Radiation & chemical
PRA available	Available	Some to limited availability
Number of facilities	100+	Few to 1,000s
Size of companies	Large	Small to large



# Screening Considerations

## ■ Benefit Questions:

- ☐ Could a risk-informed approach:
  - Resolve a question with respect to maintaining safety?
  - Improve the effectiveness or efficiency of the NRC regulatory process?
  - Reduce unnecessary regulatory burden?
  - Help to communicate a regulatory decision?

## ■ Feasibility Questions:

- ☐ Do information (data sources) and/or analytical models exist, or could they be reasonably developed?
- ☐ Can startup and implementation be realized at a reasonable cost to NRC, applicant or licensee, and or the public and provide a net benefit?
- ☐ Do other factors exist which would limit the utility of implementing a risk-informed approach?



## **Evaluating Model Uncertainty in Performance Assessments**

**7/31/03**

**Tina Ghosh  
ACNW Summer Intern  
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## **Purpose of PAs – Risk-Inform Decisions in YMP**

**Two modes for PAs:**

- **Create most realistic integrated TSPA – project repository evolution**
- **Risk assessment targeted to demonstrate decision sensitivity; Sensitivity/Uncertainty Analyses (SA/UA)**
  - **Should concentrate on scenarios that could defeat the repository system, and their associated probabilities**
  - **Identify what sets of assumptions and parameters affect decision; these are the important model issues**
  - **Evaluate uncertainty in these factors**
  - **Can estimate safety margins**
  - **In practice, SA/UA often uses a simpler version of PA model<sup>1</sup>**

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## **What Constitutes an "Adequate" Assessment of Model Uncertainty?**

### **From uncertainty at the level of sub-models:**

- Uncertainty is propagated to system-level performance, the top desideratum
- Risk is not diluted
- Effects of incompleteness are considered
- Synergistic effects among sub-models are uncovered
- Level of conservatism and "safety margins" can be estimated
- Treatment for a given sub-model (or set of sub-models) is commensurate with importance

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## **Examples of Model Uncertainty**

- Alternate models available to represent a physical process
- One model is available, but it is known to be weak
- Dependencies among variables and/or coupling between processes not considered or omitted, hence underestimating scenario probabilities
- Inconsistencies – e.g., use of parameter sample ranges that don't fit with the conditions in mind when experts provided distributions; can underestimate system-level variance
- We don't know what we don't know

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## Focus on Failure Scenarios (Risk<sup>2</sup>)

- What we care about are those scenarios that can fall the system performance criteria
- All the different ways that the system works is not important, EXCEPT to help establish probabilities associated with different failure scenarios
  - LHS/MC simulation provides theoretical basis for establishing these probabilities – i.e., 300 realizations means each one has 1/300 probability of occurring
  - But this theoretical grounding is lost anyway when mixture of (potential) conservatism and realism is employed and all important uncertainties are not propagated

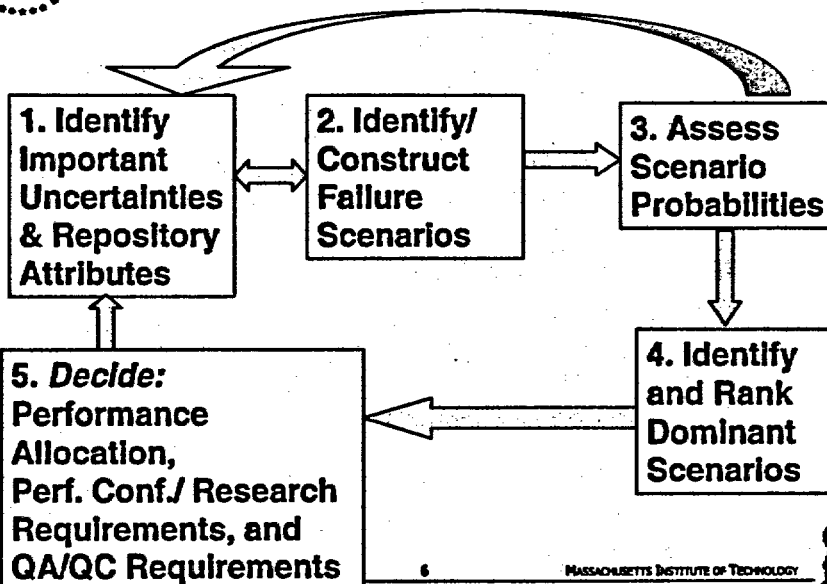
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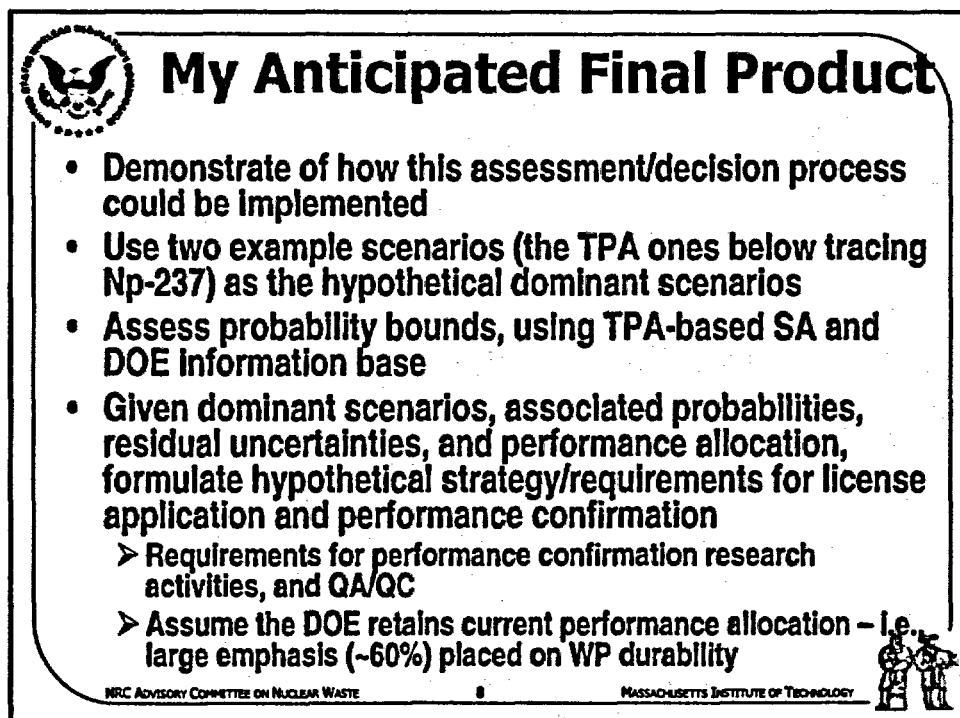
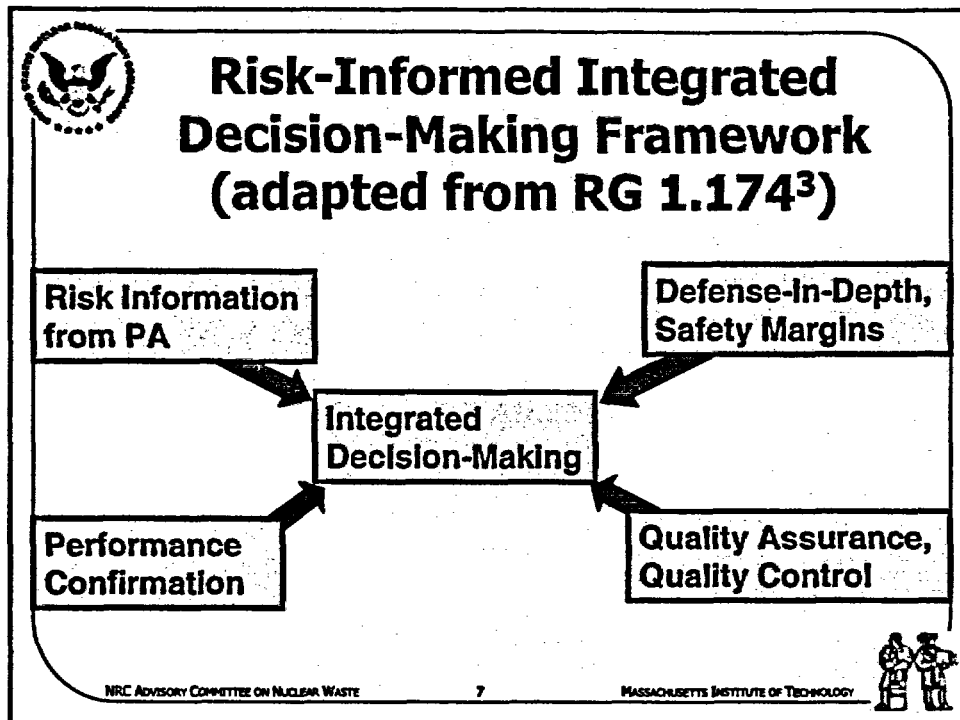


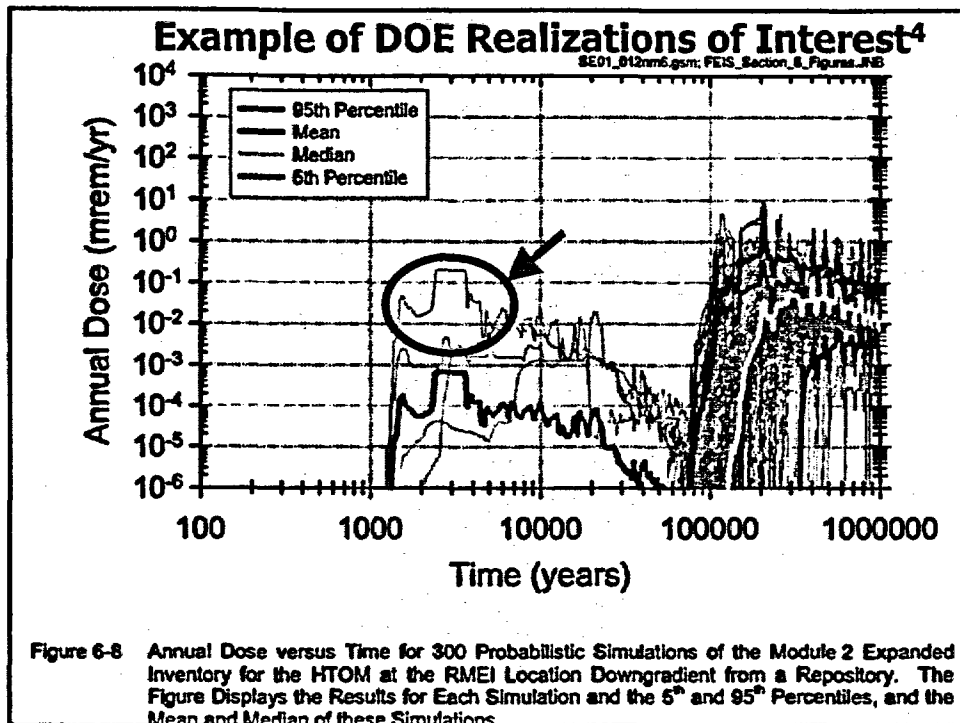
## Assessment/Decision Process



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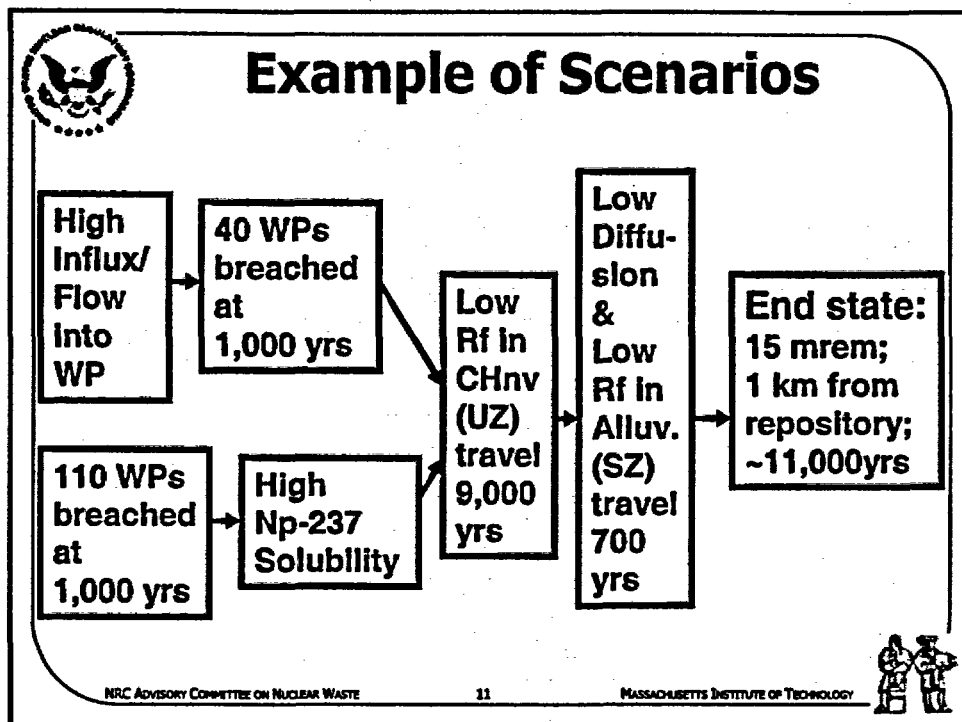




## 2. Constructing Failure Scenarios

- NMSS staff traced radionuclide release and transport through system<sup>5</sup>
  - Np-237 is an important radionuclide because of its contribution to dose (long half-life)
- Important attributes (sensitivities) identified, e.g., by partitioning realizations based on decision criterion<sup>6</sup>; then focused SA (Step 1)
- Construction of scenarios based on these preliminary studies (Step 2)
- Implications for 3. assessing probabilities, 4. ranking scenarios, 5. research priorities?

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**1. Important Sensitivities**

- Tracing studies<sup>5</sup> revealed following important sensitivities/uncertainties for Np-237:
  - Solubility limit
  - Water flow into WP
  - Waste form degradation rate
  - Sorption in Calico Hills vitric unit
  - Retardation (variation) in SZ
- In terms of ranking scenarios, e.g., we see that high solubility requires 110 breached WPs whereas high flow into WP requires 40 breached WPs, other factors being equal

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### 3. Assessing Probabilities

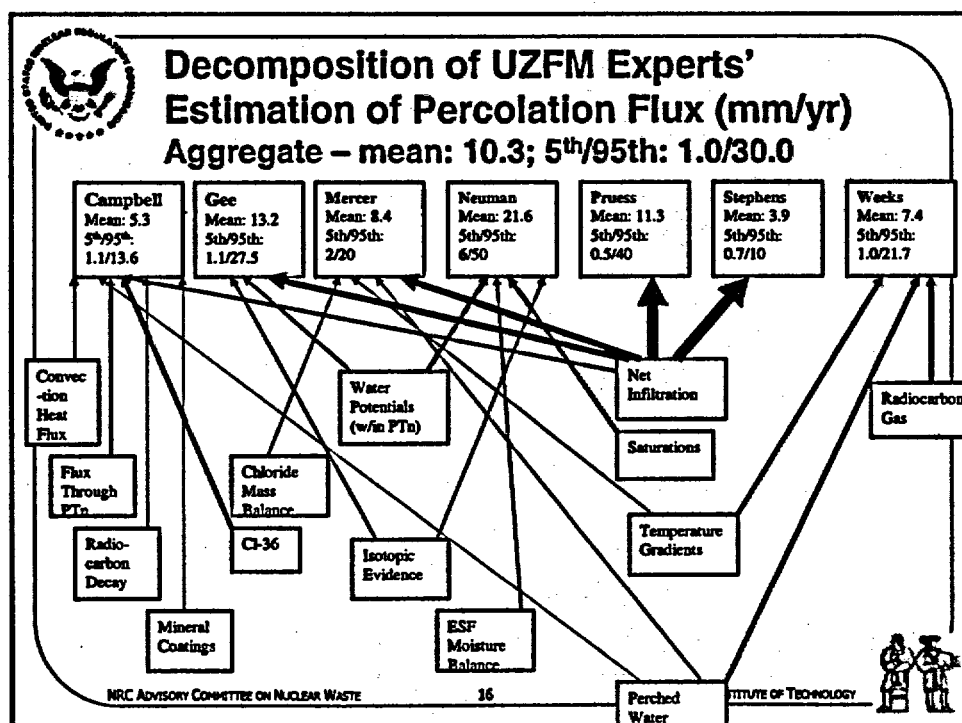
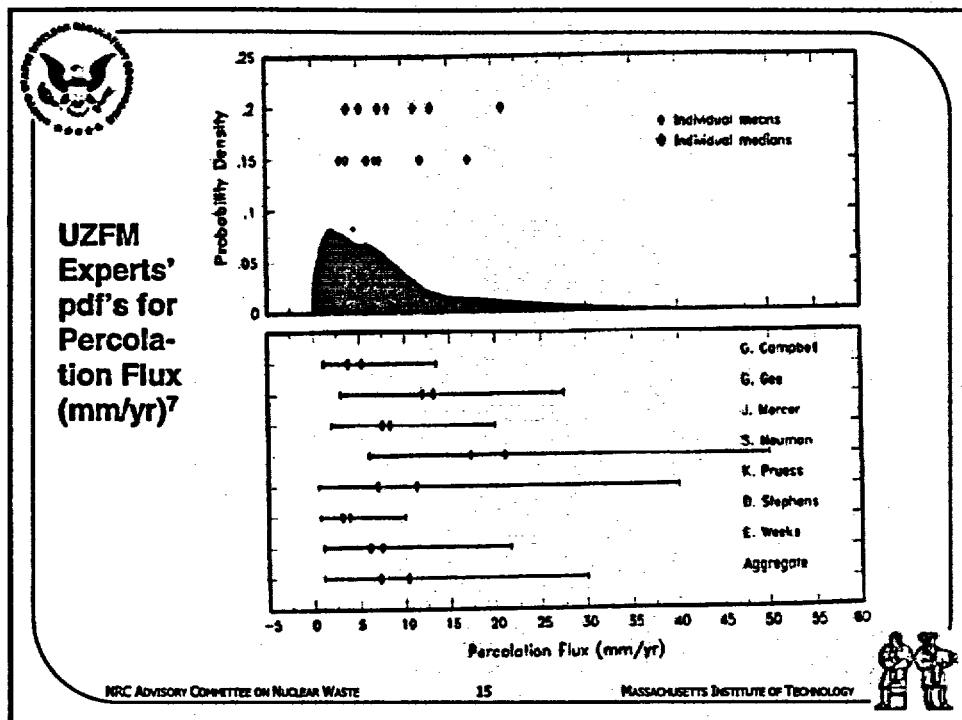
- Analysis focused on just failure scenarios
- What set of assumptions and parameter values led to these realizations of interest?
- As first-order estimate, can use existing TSPA modules to assess probability of given event/process – e.g., Pr(40 WPs failed at 1,000 years)
- Are there potential common-cause or synergistic effects for the important elements in this set? e.g., high infiltration also increases WP degradation/failure rate?
- Are there conceptual uncertainties in related sub-models that could affect the probability of this scenario?
- Considering these factors, should the probability (or probability bounds) for this scenario be revised?
- How should formal expert judgment elicitation be used to answer these questions and then 4. rank the scenarios?



### Incompleteness

- Types of incompleteness:
  - Scenarios willfully (but improperly) screened out, or unimagined
  - Probabilities under- or over-estimated because of unknown FEPs
- Historically, many instances of both of these
- How can we account for incompleteness?
- Focusing study on failure scenarios of interest may improve use of available information, help reveal common-cause and synergistic effects, and produce better estimates of associated probabilities







## Benefits of Decomposition

- Identify the underlying factors<sup>8</sup> supporting each expert's (or model's) analysis (results)
- Understand how different experts interpreted the same data, in terms of its relevance to estimating the quantity of interest
- Can estimate incompleteness
- Understand how new information, and uncertainty in information sources, affect individual and aggregate estimates
- Assist formulating a Bayesian framework (e.g., GLUE<sup>9</sup>) for on-going re-assessment of probabilities



## Dealing with Incompleteness

- Ways of estimating incompleteness in collective state of knowledge, based on:
  - Level of disagreement among experts
  - Historical data on expert community's performance in subject matter area
  - Performance data on experts<sup>10</sup> (e.g., through seed variables), if available
- Confidence studies and estimating completeness in the TSPA
  - Performance confirmation activities to build confidence
  - Model "validation"<sup>11</sup>
  - Natural analogs, experiments outside YMP – e.g., recent fuel cask experiments





## 5. Integrated Decisions (example)

- Compensation activities for the different scenarios depends on how close they come to desideratum
- 2001 TSPA<sup>4</sup> assumes 20% chance of 1 early WP failure; 3% chance of 2 early failures; 0.2% chance of 3 early failures; almost 0% chance >3 early failures, out of >10,000 packages
- What are the bounds on acceptable number of early failures (i.e., would still meet regulatory requirement)?
  - Entire scenario must be considered to assess this
- What would be the operational testing and QC requirements (manufacturing) to ensure this level of WP integrity, particularly in weld areas? Is it attainable?
- What on-going research activities (PCP) are necessary to ensure technical basis of assumptions?

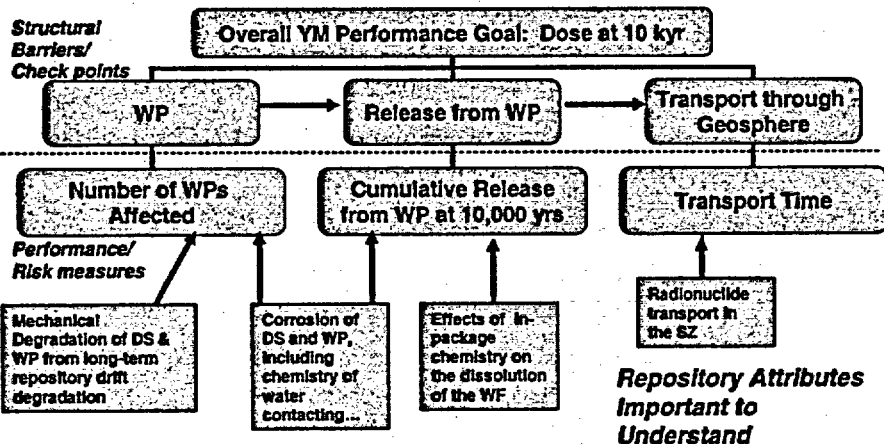
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## Integration of Defense-in-Depth and Risk Information in Prioritization of KTI Agreements



Cross-cutting meta-issue: Development of confidence in the model abstractions used in the PA

Disruptive events that have the potential to affect all barriers: Volcanic activity

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## Back-up Slides



## NRC's Principles of Risk-Informed Integrated Decision-Making (from RG 1.174<sup>3</sup>)

1. Change meets current regulations unless it is explicitly related to a requested exemption or rule change.

2. Change is consistent with defense-in-depth philosophy.

3. Maintain sufficient safety margins.

Integrated Decisionmaking

5. Use performance-measurement strategies to monitor the change.

4. Proposed increases in CDF or risk are small and are consistent with the Commission's Safety Goal Policy Statement.



