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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

JANUARY 14, 2000

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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MEETING: ACRS/ACNW JOINT SUBCOMMITTEE

White Flint II

Room T-2B3

11545 Rockville Pike

Rockville, Maryland

The subcommittee met, pursuant to notice, at 8:30 a.m.

MEMBERS PRESENT:

THOMAS KRESS, Co-chairman, ACRS Member

JOHN GARRICK, Co-Chairman, ACNW Chairman

GEORGE APOSTOLAKIS, ACRS Member

RAYMOND WYMER, ACNW Member

P R O C E E D I N G S

[8:33 a.m.]

DR. KRESS: Let's please come to order.

This is the second day of the meeting of the Joint Subcommittee of the Advisory Committee on Reactor Safeguards and the Advisory Committee on Nuclear Waste.

Once again, I'm Thomas Kress, Co-Chairman of the subcommittee, and on my right is Dr. John Garrick, also Co-Chairman of the joint subcommittee.

Joint subcommittee members in attendance are George Apostolakis of the ACRS and Dr. Ray Wymer of Oak Ridge, Tennessee, and the ACNW. Also present is Dr. Milton Levenson, consultant to the ACNW. I guess we have two invited experts left, Dr. Robert Budnitz and Dr. Robert Bernero, Mr. Robert Bernero.

DR. APOSTOLAKIS: Is Tom coming?

DR. KRESS: I don't know. That's why I stumbled over this.

This meeting is going to continue the discussions we had yesterday on defense-in-depth in the regulatory process and particularly focus on its role in licensing a high level waste repository, but also its role in revising the regulatory structure for nuclear reactors that make it more risk-informed, and how the two are related to each other, if at all.

The subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full committees. We always have to read that.

Michael Markley is the Designated Federal Official for the initial portion of this meeting, that's Mike over there.

Rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register on December 21, 1999.

A transcript of the meeting is being kept and it is requested that speakers first identify themselves, name and affiliation, and speak with sufficient clarity and volume so they can be readily heard.

With that out of the way, our agenda says we're going to continue our general discussions and that Tom Kress and John Garrick will review the goals and objectives of this meeting.

John, do you have anything?

DR. GARRICK: Let me just comment a little bit about some of the thoughts that we had when we were planning this meeting; that if we could achieve those, it would be very constructive.

It was pretty obvious from yesterday's proceedings

that from an implementation standpoint, there are vast differences between the reactor problem and the materials problem, and we also know there is a vast difference between different categories of materials problems.

Much of what we have been talking about and discussing has been narrowed to the high level waste repository issue and the reactor safety issue, but we can't forget that on the materials side, there are all these other categories of things that we have to be concerned about and be prepared to offer advice to the Commission on how defense-in-depth might apply to those.

So maybe one of the things that we can discuss a little more today are the non-high level waste issues and what the role of defense-in-depth is.

The other thing that I would hope maybe we can discuss is that we had a bit of a vision coming into this that what we would like to do would be to agree on some overarching issues and philosophy about the application of defense-in-depth that would be applied regardless of the application, and then realize that when we start talking about how it's done and we start focusing on implementation, that we need to specialize to the areas that we're going to apply it to.

So I would hope that one of the things that might come out of our discussion today would be some overarching

things that we could agree on as to what we mean by defense-in-depth that are applicable regardless of application, and then recognize that we've got to split it up into the two primary issues and deal with it accordingly.

So that's it.

DR. KRESS: That's a good suggestion, I like both of those. George, do you have any thoughts on what we should be doing this morning?

DR. APOSTOLAKIS: I agree with John. Are we going to write a letter?

DR. KRESS: That's probably something we need to decide.

DR. APOSTOLAKIS: Because if we are going to write a letter, I think we should spend -- we should structure the discussion this morning around specific points we want to make, not just general discussion of defense-in-depth.

DR. KRESS: Absolutely. Does the joint subcommittee, at this point, actually see a need for a letter? What would -- I'm sorry.

DR. BUDNITZ: I just want to comment about something. John, your remarks seem to assume, as a predicate, that it's possible to come up with something that would be agency-wide and, more to the point, that it's desirable and useful to do so, and I think, the best I can tell, that's still an open question for discussion.

DR. GARRICK: You always have to have a goal.

DR. BUDNITZ: I understand. I've been thinking about this a lot and it's more than not clear to me. It's pretty clear that to try to do that may impede what the various arenas individually need.

DR. GARRICK: I know Bob has --

DR. BUDNITZ: Without arguing that I'm -- I have an open mind about some suggestions that might overcome those difficulties.

DR. GARRICK: Right.

MR. BERNERO: I would suggest -- in fact, I put together a brief outline of topics for discussion framed in such a way as to discern whether or not there is some kind of growing or evident consensus on the overarching philosophy and on particular applications of that overarching philosophy.

Put simply, I would suggest that an approach of discussion that if it merits going to a letter or whatever format, fine, because ultimately that would be desirable, but start with what I would call the characterization of defense-in-depth.

There was a lot of discussion yesterday of is it a policy, is it a strategy, is it a philosophy, is it an approach, to really discuss that carefully, so that one has the bounds of what it is and can establish that.

Then in my own thinking, it goes to a policy of no undue release rather than multiple barriers as a definition, and then the relationship of defense-in-depth to risk-informed regulation. They are two different concepts and I think that has to be very clear.

Risk-informed actions are appropriate to the consideration of defense-in-depth approach or philosophy, and I think we should discuss that, and what are the implications of applying risk information; in other words, willingness to reconsider either the existence or the modification of traditional barriers, things like we discussed yesterday with the AP-600.

Then having discussed the overarching, go to application in specific fields, in reactors, materials regulation, low level waste or decommissioning, and high level waste, because those last two are quite different. So that's what I would suggest.

DR. APOSTOLAKIS: I think that's an excellent suggestion.

DR. GARRICK: I think it's an extension of just what we've been talking about.

DR. APOSTOLAKIS: Yes.

DR. BUDNITZ: Just to amplify what I said two minutes ago in another field, I've never been on a code committee to try to develop regulations to design public

facilities against earthquakes, but I have had discussions with those that have wrestled with that for years.

For a long time, those code committees and the people who are involved in such policies thought about whether they could come up with some overarching philosophical approach to such design, design, again, public facilities, buildings, bridges and so on, refineries, against earthquakes.

It turns out that while you can do it, it's not terribly beneficial to do that, and the reason is that the design problems are so different in California, coastal California, than they are in, let's say, Florida. And why is that? It's because the Bay Bridge, which I go across from time to time, earthquakes are the principal threat. But a comparable bridge in Florida, they are by no means the principal threat. They're something you've got to do anyway, also.

And whether something is a principal threat or not governs the design philosophy in important ways, and that could be the case here. Certainly I couldn't see necessarily the same philosophy applying to smoke detectors as I would to a nuclear power reactor, just to use a couple extremes.

You have to be careful about whether, in striving for that, you do a disservice to all of it. That's to

support my skepticism, without saying that I have open ears to some ideas.

MR. HOLAHAN: This is Gary Holahan, on the staff. If I may add a thought. Back in March, after some discussion with the ACRS and the ACNW, the Commission issued a white paper with a bunch of definitions in it and one of them is this thing we talked about yesterday, which is, in effect, the definition of defense-in-depth.

I think if the committees say nothing, then that definition is left in place. So I think one of the things that needs to be addressed is the fact that we already have an expression by the Commission of a sort of philosophy and definition of defense-in-depth and if the committee likes it, that's one thing; if the committee doesn't like it, then I think that frames the issue that the committee or staff or someone needs to tell the Commission that a change is in order.

So in part, the fact that that is an existing document frames part of this issue.

DR. GARRICK: Not only that, Gary, we reviewed that document in its preparation and one could take that review as our endorsing that definition.

MR. HOLAHAN: Yes. And I think if the committee says nothing or the staff says nothing, it ought to be interpreted as a re-endorsement or at least not an argument

against leaving that definition.

DR. GARRICK: Maybe it's a good idea to put that definition back up on the screen.

DR. KRESS: Yes, I was going to suggest that.

MR. MARKLEY: It's in your books, tab ten.

DR. KRESS: I don't have a notebook.

DR. APOSTOLAKIS: There was one transparency. Would it help to put it up there? I believe Norm had it.

DR. GARRICK: Here it is.

DR. APOSTOLAKIS: We should also be able to see it.

MR. BERNERO: The second bullet is my own words.

DR. KRESS: I personally don't have any problems with that definition. It just lacks quantification, which most definitions do, but as a concept, I don't have any problem with it.

DR. APOSTOLAKIS: I don't know why I should disagree with this.

MR. BERNERO: There are a couple of things that you really ought to think about. This is a definition that -- and as I said when I put it up, I don't quarrel with it, but what does it mean and how is it applied. The rest of the sheet music isn't written yet.

So the purpose of this dialogue and further dialogue would be, okay, what are the implications of this,

not wholly dependent.

DR. APOSTOLAKIS: I think there is more to it than just the implications. The more I think about it now, I'm coming up with ways to modify it.

I think a fundamental issue here is the fact that defense-in-depth, which is what it says there, has the intent of managing uncertainty. Unless we say that, unless we bring uncertainty in the issue here, we can't really go very far.

The reason why that's important is because when this was put together 40 years ago, the uncertainty in the probabilities of accidents, frequencies of accidents was not quantified. This is a key element. And now a part of it, a good part of it is quantifiable and that's why we're revisiting the issue.

DR. GARRICK: Yes. It should be pointed out, George, and, of course, you know this, that in that same paper, they did offer a definition of risk that did make reference to uncertainty and quantification and what have you.

DR. APOSTOLAKIS: But this defense-in-depth should do the same.

DR. GARRICK: Right. There is one thing about this, and I kind of like the definition, too, with the interpretation that we're giving to it regarding risk. But

I think one word, key word is missing in that sentence that talks about the net effect of incorporating defense-in-depth into design, construction, maintenance and operation, and that's the word management.

I think most of the cleanup and the strides that have been made in elevating the U.S. plants into the top ten group of the world recently has been principally driven by a change in the culture, a change in the management, and attitude of the people at the plants.

So I would just make the simple addition there that the net effect of incorporating defense-in-depth in the design, construction, maintenance, management and operation --

DR. APOSTOLAKIS: I guess operation is implied.

DR. GARRICK: I think it's more than operation, because the one thing the nuclear plants learned is that there's got to be much more at the plant than just the plant manager and the operations manager. The plant is very strongly dependent upon support services, on engineering, on a whole bunch of other things, and so I think that would embrace that concept.

DR. KRESS: I would have narrowed that and just said design, construction and operation. Those are parallel activities that incorporate both management and maintenance and it's just different phases of the reactor life.

DR. BUDNITZ: George, I want to amplify your notion about uncertainty, because I think you might have missed something. If have it wrong, you'll tell me.

Let me postulate for a minute that for a large facility, it might be a gaseous diffusion plant or something, that actually, in the analysis, in the PRA analysis, all important uncertainties are quantified; that is, we know them, which really means that they're dominated by something that we really know and there are some unquantified things that we don't know, but they're known to be less important.

I don't think that the fact that you and I and others around this table could say that with confidence is necessarily enough for the general public. The general public are skeptical of engineers and scientists. The phrase intellectual arrogance comes to mind, because from time to time, assurances have been given in other arenas and, in fact, in the '50s and '60s and even in the '70s, just go see what Dixie said after WASH-1400, they were said in this arena.

That mistrust means that the general public may seek additional assurance in the defense-in-depth arena, even if the uncertainties are quantified well and we really know what they are.

DR. APOSTOLAKIS: Yes, but that's a separate

issue. That's what to do when you have quantified. All I'm saying is --

DR. BUDNITZ: Wait, wait. But I want to argue to you that in that arena, a driver for a defense-in-depth approach to design and operation could be to provide that assurance to the public over and above our need for it as engineers.

DR. APOSTOLAKIS: Right, over and above.

DR. KRESS: That's one of the reasons I came up with the allocation concept in my definition.

DR. APOSTOLAKIS: I think that's the next issue. We're discussing now the definition. I mean, somebody wants to find out what is defense-in-depth and I think this doesn't tell that person that the whole intent of the philosophy is to manage the uncertainty associated with reactor safety.

DR. BUDNITZ: Because, in fact, I argue that that may not be the whole intent.

DR. APOSTOLAKIS: No.

DR. BUDNITZ: Yes. Now, let me just argue. An important objective could be, and I argue that it ought to be --

DR. APOSTOLAKIS: Convince the public.

DR. BUDNITZ: -- to make transparent to the public --

DR. APOSTOLAKIS: That you have managed the uncertainty.

DR. BUDNITZ: No, no.

DR. APOSTOLAKIS: Yes.

DR. BUDNITZ: No, no. That notwithstanding the above, we have an additional barrier, notwithstanding the above. In other words, even if we convinced ourselves we didn't need a containment, not withstanding the above, we give you this additional thing, because people can understand what --

DR. APOSTOLAKIS: But the whole driver of this is the uncertainty. The public also has uncertainty, they don't believe us.

DR. BUDNITZ: In which case, that doesn't capture that either. I'm just trying to make a point that --

DR. APOSTOLAKIS: I understand the point.

DR. BUDNITZ: -- if, in fact, the technical community has understood its uncertainty and know what it's doing and really don't think we need this thing, it may be that that's the only way to get the public to accept technology that they believe is dangerous.

DR. APOSTOLAKIS: But I don't think the definition should say we're doing this in order to convince the public.

DR. BUDNITZ: I didn't say to convince them. I said that an objective could be, and I propose that you

think about whatever it should be --

DR. APOSTOLAKIS: It's ensure. Ensures. Defense-in-depth philosophy ensure that safety will not be -- you want to put the words --

DR. BUDNITZ: I'm not a wordsmith here, although I could try it. I'm just trying to make a point about --

DR. APOSTOLAKIS: And that's a good point.

DR. BUDNITZ: I'm trying to say that it's more than just managing what we engineers and scientists think is unquantified uncertainty.

DR. KRESS: George, I am always reluctant to disagree with you, but let me throw this out to you. I think, as a technical activity that's hazardous, society values both preventing the accident from happening in the first place. They value being able to stop it before it gets very far. They value protection in case these things fail and it goes so far that you've got to mitigate it, and they value being able to have alternative means to protect themselves.

And I say that defense-in-depth is just providing those multiple layers because that's what we value, and not because there's lots of uncertainty in each step. And at the same time, it turns out to be a way to manage the uncertainty as a byproduct.

DR. APOSTOLAKIS: And I think about it in the

complete opposite.

DR. BUDNITZ: I understand.

DR. APOSTOLAKIS: That the driver here is the uncertainty and the reason why we value these things, and I agree with you, is because we believe that that's a reasonable way, a convincing way of handling that uncertainty. If you didn't have that uncertainty, the public would not be asking you for all these.

DR. BUDNITZ: I don't agree with that. That's what I don't agree with.

DR. APOSTOLAKIS: Why aren't they asking for defense-in-depth when it comes to an airliner?

DR. BUDNITZ: Because we've got data.

DR. APOSTOLAKIS: And the public is convinced that it's ten-to-the-minus-X.

DR. BUDNITZ: Because we have data for airliners.

DR. APOSTOLAKIS: And what does that mean because we have data? That we have eliminated a lot of the uncertainty. That's the driver, that's the fundamental issue.

DR. BUDNITZ: The data are acceptable.

DR. APOSTOLAKIS: The fundamental issue is the uncertainty and if the public has uncertainty, some people have lied or misguided the public in the past. So now other things come from it. But the fundamental reason why we had

this was to manage the uncertainty associated with reactor accidents.

MR. BERNERO: Could I interrupt with a thought? This is a joint subcommittee meeting of two committees. This dialogue betrays that this definition is essentially a reactor safety approach.

DR. APOSTOLAKIS: It is.

MR. BERNERO: And it basically falls apart seriously when you try to apply it to the materials side or the waste management side. I think that's an important point for the committee to consider.

DR. APOSTOLAKIS: Yes.

MR. BERNERO: My understanding of the white paper is it was intended to be an overarching one.

DR. APOSTOLAKIS: Yes.

DR. KRESS: Yes.

DR. GARRICK: I'm certainly a disciple of uncertainty being a highly visible part of the process and that it is the keystone, if you wish, of the whole issue of risk.

On the other hand, the reason I kind of like this definition is that I think it communicates well. I think it's absent of a lot of esoteric terms and a lot of systemese language that sometimes offends people.

Sometimes the whole notion of risk and uncertainty

unfortunately does that. So I don't have a big problem with it. I wouldn't have a big problem either with modifying it to put some emphasis on that.

DR. APOSTOLAKIS: Yes. It's not an issue of rejecting this.

DR. GARRICK: Right.

DR. APOSTOLAKIS: So how about if defense-in-depth is an element of the NRC safety philosophy that employs successful compensatory measures to manage the uncertainty associated with accidents in nuclear facilities, and then go on to say that you prevent accidents, bla, bla, bla, bla, bla.

DR. GARRICK: Well, the only thought I have about that is the public might say I don't care about managing uncertainty, I care about ensuring my safety.

DR. APOSTOLAKIS: What's the difference?

DR. GARRICK: You and I understand that.

DR. BUDNITZ: But, George, let me just go to the repository for a minute.

DR. APOSTOLAKIS: But aren't we arguing for the public?

DR. BUDNITZ: But let's talk about the repository for a minute. We all know that it's going to be a non-trivial job for the Department to demonstrate, to their satisfaction and to the NRC's, that they can meet the 10,000

year thing, right? But I think most of us would have no problem with the Department saying we got high assurance for 1,000 years that nothing is going to come out. You do that with a can, right?

And that's high assurance. But I know members of the public that think that a thousand years is an awfully long time and that it's arrogant beyond credibility for any scientist to claim a thousand years for something that hasn't lasted a thousand years and no one has built a can in the year 1000. These are, in fact, then extrapolations. So we have to recognize there are people out there, thinking members, not just unthinking, thinking members of the public, who don't trust our extrapolations, even though we have very little uncertainty.

DR. APOSTOLAKIS: Look, I'm having a problem here what we're trying to do. This is becoming a risk communication session.

DR. BUDNITZ: No, no, no.

DR. APOSTOLAKIS: I am not saying that it's not important to communicate to the public, but let's not forge the technical community, too. We are trying to define a concept that has been hailed as the cornerstone of the safety philosophy of this agency.

DR. BUDNITZ: Sure.

DR. APOSTOLAKIS: And if I manage to communicate

both to the public and the staff what that philosophy is, then I'm a great guy. But let's first try technically to define it and understand what it means ourselves and then worry about communicating to laymen. I don't think that's a secondary --

DR. BUDNITZ: I'm not talking about communication. I would argue to you that if Yucca Mountain only had a thousand year thing, we still might want to have multiple barriers, even though we had confidence you didn't need them.

DR. KRESS: George, as a pure rationalist, do you not have trouble with the second sentence?

DR. APOSTOLAKIS: The second sentence.

DR. KRESS: A pure rationalist has trouble with it.

DR. APOSTOLAKIS: I have a -- sure. I'm willing to give a little bit for this, because this is an overarching principal, but the -- what I'm trying to say here is there are certain fundamental things that have to be mentioned and the fundamental reason why this approach was developed by the pioneers before the NRC, before anybody else, was the recognition that there was a lot of uncertainty in what we're doing. We cannot quantify it. Here is a way to make sure that it's managed, that the frequency of the accidents is indeed small.

This is how the whole thing started and the reason why we're going back to it now is because that uncertainty is quantified, or a good part of it, as I keep saying.

Unless that is here, I don't see why we bother to put this up there. Now, whether that is meaningful to the public is a good question, but an equally good question is, first, let's make sure that the two committees, the staff and all offices and so on agree that this is a reasonable definition, so we all speak the same language, and then worry about how to communicate it to other people.

MR. BERNERO: I think the real issue is not -- I share your feeling, that later worry about communication. What you have to focus on here is agree on the language and how to apply it in the scientific consideration.

DR. APOSTOLAKIS: Absolutely right. You're absolutely right.

DR. KRESS: In effect, I don't like value judgments placed in definitions and I would have marked out the second and third sentence, and because the first sentence is the definition. The second and third just throw in things that give people some warm feeling, but it's not part of the definition. It's a value judgment and description.

MR. BERNERO: Do you want to go back and rewrite this or do you want to decide whether you can live with it

and apply it? That's the basic point.

DR. KRESS: All I'm saying is I think we ought to concentrate on the first sentence only, because that's the definition. Those other things are just riders that go along and have no essential impact on what you do.

DR. APOSTOLAKIS: How about if we end the first sentence, you know, after "a nuclear facility," put a comma, so that the probability of accidents remains acceptably low or something to that effect.

DR. GARRICK: Or the likelihood of accidents remains.

DR. APOSTOLAKIS: Or likelihood. Wordsmithing is okay, but the thought. So you're doing all these things in order to make sure the probability is low. Now, Ray disagrees.

DR. WYMER: I do disagree.

DR. APOSTOLAKIS: Okay. Why is that?

DR. WYMER: I think that's off the point. It seems to me that even if the uncertainty is very small or negligible, you still want to do what it says in that first sentence.

DR. APOSTOLAKIS: And I would argue that you can never get to low probabilities unless you do what's in the first sentence.

I don't know. I can make such a strong

containment that I can get there without doing too much about CDF and other things.

I don't know what that means.

DR. BUDNITZ: You see, again, I'm not arguing about wordsmithing here, but something about, in the last sentence, it says "such that the net effect is the facility tends to be more tolerant and is demonstrably so." There is this point here. It's not just that it's so, but it's demonstrably so. And demonstrably, I'm not sure whether I like that word or not, but the idea is to be able to convey to smart people who aren't risk engineers.

DR. GARRICK: I think we've made a lot of progress if we can agree on the first sentence, because I do think that -- what I like about this definition is that it communicates well and the second and third sentence are helpful to people not in the business, because it tells us a little more of what it means.

DR. APOSTOLAKIS: Make them separate bullets perhaps.

DR. GARRICK: Yes, yes. But I agree that as a guiding overarching definition, that if we could agree that the first sentence does that, then we've made one important step.

DR. APOSTOLAKIS: Not as it is. I disagree.

MR. LEVENSON: John, might I suggest that this is

already out. So diddling with these words is an interesting exercise, but I'm not sure what it means.

DR. GARRICK: Well, what it means --

MR. LEVENSON: Well, let me finish my thought. That is that the thing -- the problem I have with this definition that nobody has mentioned is that it lumps all nuclear facilities in the same bag, and that, I think, is a big mistake, and that it might be more valuable if, rather than worrying about these words, this definition is out, it might be more profitable to work on a statement as to how this overarching statement applies to different facilities and make it very clear that it applies completely differently to reactors than it does to repositories.

DR. KRESS: In application, certainly.

MR. LEVENSON: Well, let me read you a couple of words I diddled down here while everybody was talking. Presently, defense-in-depth is a concept utilized in nuclear reactor design and licensing to help assure the safety of a dynamic high energy system. It is utilized as one of the tools to deal with uncertainties and factors that have time constants shorter than practical intervention times.

A repository, on the other hand, is not a high energy system, does not contain large amounts of stored energy, and has extremely long time constants. Therefore, defense-in-depth, as applied to reactors, is not appropriate

for application to a repository.

The use of passive multiple barriers may be a more appropriate method of coping with repository uncertainties than is DID.

DR. KRESS: I think that's a good statement.

DR. GARRICK: Except that last, than is DID.

DR. APOSTOLAKIS: Passive barriers are DID.

DR. GARRICK: That's what I mean.

MR. LEVENSON: I'm saying I think it is a form of, but I think if you don't dissociate these two, the repository is continually going to be hung up with things coming from the reactor side of the house. You have to dissociate them. You can use whatever words you want.

DR. APOSTOLAKIS: But the first sentence has both.

DR. KRESS: It would fit that very well, the first sentence would.

DR. APOSTOLAKIS: You don't want to say accidents, though.

DR. BUDNITZ: At the end, you shuck DID, whereas you might instead say it means this for the repository, rather than just shuck it.

MR. KING: Can I jump here a little bit, too?

DR. KRESS: Yes, sure.

MR. KING: This is Tom King, from the staff. I think Mr. Levenson's suggestion is a very good one. Gary

and I were just talking also that this came out a year ago, this definition. If you use the analogy that consider this the rule and what you guys ought to be working on is the reg guide and how do you apply this and why shouldn't you be talking about, okay, given this definition, what are all the points that ought to be addressed in an application.

The application can vary across the regulated activity. It's an attempt to manage risk, as George said, prevention versus mitigation, all these points that you think are important that aren't really covered very well in this broader definition, but you think ought to be addressed if somebody went to apply it.

To me, those would be the things you ought to be focusing on in this committee and then once you get those identified, then the next question would be how should those be communicated; should we go back and modify the white paper to put some sort of application statements in there, should you recommend a separate policy on defense-in-depth, what is the right vehicle to put this down and communicate it to the staff and to the public.

But I wouldn't go back and fool with the definition at this point.

DR. WYMER: I agree with that. I think that there is a big difference --

DR. APOSTOLAKIS: What if the definition bothers

you?

DR. WYMER: Let me finish. There is a big difference between a definition and implementation of the concept, and I think that we ought not to mix the two up.

DR. APOSTOLAKIS: I still think that we are embracing the notion of successive compensatory measures without asking why that has to be there.

DR. KRESS: It's because we value prevention and mitigation both.

DR. APOSTOLAKIS: And we value those because we are uncertain.

DR. KRESS: No, no. We value them in the absence of uncertainty.

DR. APOSTOLAKIS: Absence of uncertainty?

DR. KRESS: You're never going to have an absence of uncertainty, but even with very small uncertainty, we would still do this, because we want to prevent accidents and we want to mitigate accidents. We would still do this.

DR. GARRICK: The truth of the matter is that defense-in-depth has been in the gospel of how the NRC assures safety or reaches a finding of reasonable assurance of safety has been in the context of successive compensatory measures. The earliest discussions about defense-in-depth were synonymously associated with successive measures of protection.

So I don't know. If we wanted to do surgery on it and change what it fundamentally means, sure, we could do that, but I think as a concept that has been discussed and found its way into print, that has been so well documented for us for this meeting, it has been in that context.

DR. APOSTOLAKIS: Right. But the point is that now we want to look at it again under the current state of knowledge and understanding why it was put together that way is fundamental to this. There is nothing magical about successive compensatory measures. We are not doing it because we like successive compensatory measures. We do it because we are not confident enough that the risk has been managed.

DR. GARRICK: I think maybe we're overplaying the compensatory measure issue because even if you think of a single barrier, it isn't a single barrier, because we have monitoring, we have maintenance, we have all kinds of things that give us insight into the performance of that single barrier.

So I don't get too hung up on this single element thing because a single element could be a transducer. It could be any one of a number of things.

DR. BUDNITZ: I have a suggestion for how to overcome --

DR. APOSTOLAKIS: Speak into the microphone, Bob.

DR. BUDNITZ: Excuse me. I have a suggestion for how to overcome some of this cross-talking a little in the conversation. It seems to me that the title of that shouldn't be what is defense-in-depth, but it really answers two questions; what is defense-in-depth and what does it accomplish.

The first sentence defines what is, the second sentence is what does it accomplish, and there is a third thing you people ought to be doing, which is how is it applied.

DR. APOSTOLAKIS: Sure.

DR. BUDNITZ: So if you said to yourselves the white paper says what it is, sentence number one; the white paper says what it accomplishes, it ensures and it does, right? Then you can say what's needed is now how is it applied in the different arenas and you could make a major contribution by writing down arena by arena what you think would be a useful agency policy on how is defense-in-depth to be applied in these arenas.

And there, the sort of things that Milt read to us are a jumping-off point for the difference, for the rationale for why there is a difference; there's a lot of high energy, maybe there isn't, there's a lot of time, maybe there isn't, which then drives how it's applied.

So if you think about it in that way, you

shouldn't be -- and playing with this doesn't talk about how it's applied. It's not intended. It only talks about what it is and what it does.

DR. KRESS: It also restricts its application to nuclear facilities. I would be hard-pressed to call some things, like an X-ray machine at a nuclear facility --

MR. BERNERO: You have to be careful. Legally, facilities are, production or utilization facilities, under Part 50 and now under Part 76. But the -- what John said earlier, even if you take an extreme case, the one I mentioned was the spent fuel shipping cask, that is nominally just one barrier.

DR. BUDNITZ: It's not a facility.

MR. BERNERO: And I -- but never mind, it's a nuclear practice or it's a nuclear situation, call it what you will. I don't have gas pains with facilities with lower case "f." But the point is it's not just a single barrier. It is a very high quality barrier. You are depending on a massive, robust mechanical containment and that's it.

You go out in any environment, ship it, we do modal or NRC does modal studies to see if it got caught in the Caldecot tunnel fire, that it would have melted or not and that kind of consideration, but I would feel more comfortable if it were unduly dependent on a single barrier or a barrier.

But the key to it is you have to have a systematic consideration and not have, yes, it's a barrier, I'll walk away and forget about it, unless there are -- and if you go to smoke detectors, you'll find buried in the analysis, it's not a single barrier.

DR. GARRICK: Yes. And I think that the crafters of this definition knew all of that and discussed all of that when they did it and it's probably why you don't find the word barrier following single up there, and the more strategic choice of the word element, because that gives us a great deal of freedom and flexibility. An element could even be the issue of uncertainty.

MR. BERNERO: It could be a model.

DR. WYMER: It could be a monitoring system.

MR. BERNERO: It could be an initiating event. It could be any number of things.

DR. APOSTOLAKIS: Well, the ACRS wrote a letter May 19th of last year and it says this philosophy has been invoked primarily to compensate for uncertainty in our knowledge of the progression of accidents at nuclear power plants. Later on it says when defense-in-depth is applied, a justification is needed that is as quantitative as possible for both the necessity and sufficiency, not just the sufficiency, both the necessity and sufficiency of the defense-in-depth measures.

If you question the necessity, then you cannot make it part of the definition that you will have successive compensatory measures.

DR. KRESS: Because that says it's necessary.

DR. APOSTOLAKIS: That's right, it says it's necessary. I don't think that this is a definition. It's a definition of what used to be defense-in-depth. The word uncertainty has to be there in the first sentence. First of all, the first sentence, I agree, has to be a separate bullet, but this is really the key. It was developed primarily to compensate for uncertainty in our knowledge of the progression of accidents at nuclear power plants.

Now, it goes on to say improved capability to analyze nuclear power plants as integrated systems is leading us to reconsider the role of defense-in-depth. Now, this is a little broader than what I was saying about uncertainty, as integrated systems.

Defense-in-depth can still provide needed safety assurance in areas not treated or poorly treated by modern analysis or when results of the analysis are quite uncertain.

So I hope this letter is not going to go against several letters that the committees have written independently.

MR. LEVENSON: Yes. But, George, I don't think

that's at all in conflict in the sense that this is a definition and the statement that when this is applied, it should be applied only when there are indications that it is necessary.

So I don't think you have to put that in the definition.

DR. APOSTOLAKIS: But the issue of necessity, if you make it part of the definition that successive compensatory measures are part of the definition, then automatically they are necessary. The burden is on the staff or the licensee to argue why they don't need them.

DR. GARRICK: But, George, I think the point that I'm trying to make, and not very well, is that I can't think of a situation where there aren't successive compensatory measures.

DR. APOSTOLAKIS: I can't either. But can you put the word uncertainty in the first sentence, John? Then you satisfy me and I shut up. Just put the word uncertainty there.

DR. GARRICK: Okay.

DR. APOSTOLAKIS: Because that's the reason --

DR. GARRICK: Well, I'm as much a disciple of that as you are.

DR. KRESS: Is that enough of a concern to you, George, that we need to make a big deal of it in a letter to

the Commissioners?

DR. APOSTOLAKIS: Yes, because otherwise this whole meeting doesn't make sense to me. This whole meeting, this whole effort of writing a new letter is meaningless to me unless I recognize that here is a practice, a philosophy that was developed to manage uncertainty and what's new now is I can quantify that uncertainty. Otherwise, I don't understand why we are revisiting it or visiting the issue.

DR. GARRICK: It's not out of order or out of the question to take something like this and evolve it with new ideas and time and what have you. So I don't -- I think if we are pretty much in agreement that this is a definition that, with minor surgery, would satisfy us all, if we limit it to pretty much one sentence, that we could address that.

MR. BERNERO: You don't have the freedom to do that, I think. I think you ought to forward with the dialogue and say there are misgivings about this or that, the lack of the word uncertainty or whatever, but this is certainly not a statute. But the committee is facing a need to talk about the philosophy of safety control or safety regulation and this is sort of a given.

The committee had a shot at it before.

DR. GARRICK: Yes, we did.

DR. APOSTOLAKIS: At least the ACRS said that this is something that's evolving, don't put anything down on it.

So it's not that we have blessed it in the past implicitly.

MR. BERNERO: I'm not saying that it's blessed. I think for any progress to be made, there ought to be a focus on are there general principles here and amplify on them for an overarching philosophy that's applicable to all practices that the NRC authorizes.

DR. APOSTOLAKIS: And I guess that's my problem, Bob, that I don't see the rest of you recognizing that a general principle here is that we are trying to manage uncertainty.

DR. WYMER: Maybe that's a clue.

MR. BERNERO: But, George, are you recognizing the principle that successive elements, not successive mechanical barriers, not successive design controls, but successive elements is a fundamental principle; that the fuel shipping cask, I think, is a golden example because mechanically it's one barrier, a highly complex, robust, high quality barrier.

But the elements are the quality is a separate element. The design, the management.

DR. APOSTOLAKIS: Sure, sure, sure.

MR. BERNERO: The restrictions are --

DR. GARRICK: I think he just wants recognition of uncertainty as a key element of the whole process.

MR. BERNERO: And there's nothing wrong with

saying that.

DR. BUDNITZ: George, I think I can make another distinction. Defense-in-depth is, in fact, a tool. Let me say to you, what's a screwdriver? A screwdriver is a piece of metal this long that's got a point on this end and a handle or something, right? Why do we need the tool to manage uncertainty? That's a why, it's not a definition.

So this doesn't bother me. If you then want to go why do I need it, that's a perfectly appropriate thing for you, the ACRS/ACNW to discuss. You need it for -- there is a different "why" for a low level repository versus a high level.

DR. APOSTOLAKIS: I gave Holahan a thought experiment some time ago. I asked the following question. If we were absolutely certain that you would have a core damage event if you tossed six dice and they all came up with sixes, would you still put a containment around it. His answer was make them seven dice and I will not. That, to me, says there is absolutely no epistemic uncertainty. Right?

DR. BUDNITZ: Right, sure.

DR. APOSTOLAKIS: In fact, I made sure that the seven dice were thrown independently in Los Angeles, San Francisco, another one in Paris. So there is absolute independence.

If they are all sixes, now, you can calculate it, it's one over six to the seventh, this is the frequency of core damage, there is no uncertainty about it, he might consider not putting a containment.

So that tells me --

MR. BERNERO: Who said this?

DR. APOSTOLAKIS: Gary here. He made them seven.

MR. BERNERO: Guilty as charged.

DR. APOSTOLAKIS: So isn't that the fundamental thing? Now, in order to settle this, another way of doing it is we can accept this and I can write separate comments.

DR. BUDNITZ: But of course. That's why we don't need five barriers for a smoke detector.

DR. APOSTOLAKIS: Somehow we don't want to say that. That's what I am perplexed about.

DR. BUDNITZ: No, no. The question is the screwdriver looks like this. Then later on you say why do I have it, how do I use it, when do I use it and for what?

DR. APOSTOLAKIS: That's next, that's next. I agree that's next.

DR. GARRICK: John?

DR. LARKINS: Might I suggest that you probably would have more impact of value to the Commission if you could talk about implementation of the defense-in-depth philosophy and then afterwards, if you feel it's totally

inconsistent with the definition, you can come back and review the definition.

But I think with the Commission recently debating this definition and going through several iterations, that unless there is a vehement objection to the current wording, I would suggest that you try to --

DR. APOSTOLAKIS: John, that is a vehement objection, I think.

DR. LARKINS: I understand.

DR. APOSTOLAKIS: We are talking about communicating to the public, we should be communicating to the stakeholders.

DR. LARKINS: I think you need to do both.

DR. APOSTOLAKIS: The most important stakeholders for us are the Commissioners.

DR. LARKINS: But I think the Commission has already made a point that you need both. I mean, the Commission has raised the issue of risk communication.

DR. APOSTOLAKIS: I believe that it's of extreme importance for all five Commissioners to understand -- not that they cannot understand it, but to make sure that we are all speaking the same language and that defense-in-depth was developed to manage uncertainty. We all have to agree to that.

MR. MARKLEY: But, George, couldn't that be

clarified in a policy statement or something?

DR. APOSTOLAKIS: Sure it could.

MR. MARKLEY: As opposed to revisiting the definition? Because this is --

DR. APOSTOLAKIS: I have no problem with that.

MR. MARKLEY: -- a losing battle. You're not going to get much value-added from it, that you couldn't do the same in a policy statement.

DR. APOSTOLAKIS: Yes. I'm not arguing for going to the Commission and say change the white paper. But since we all seem to agree on this, we can take this and put it in our letter and let the Commission decide how they want to proceed.

DR. LARKINS: I'm not sure you have a majority position on that right now.

DR. GARRICK: The way we can do that, because -- to get off this subject, if we can -- is that we can put it in the context with this definition, if it's interpreted as follows, this is how we support it.

MR. MARKLEY: Yes, and you could customize it for the various applications in that respect, with elements or sub-elements, however it would be uniquely applied.

DR. GARRICK: Well, I think if we can do that, then we've done the one thing that at least I commented about earlier this morning, is what can we agree on that is

overarching in terms of widespread application for nuclear applications.

Now, we may still want to talk a little bit about the non-high level waste component of the materials, of the materials side, and what we need to do there and whether the concept really is even relevant.

MR. BERNERO: I think you've got to agree to the overarching principle that risk-informed application of defense-in-depth is a key to intelligent use of it, and if it's risk-informed, it addresses what are your uncertainties, have you improved them or do you have a basis to -- it actually -- I don't know the facts on the AP-600 containment spray, but a risk-informed application should at least make it possible to say I don't need a containment spray.

DR. GARRICK: Yes. I think the point of view of risk-informed defense-in-depth is something we'd want to talk about.

MR. BERNERO: Yes. But it's key to applying defense-in-depth.

DR. APOSTOLAKIS: It seems that we almost came to a consensus earlier. I said use the word uncertainty there and Ray objected. Now, the ACRS said primarily to compensate. If we put the word primarily, would you agree?

DR. GARRICK: Why don't we, George, try to do in

the context of --

DR. WYMER: That's moving in the right direction.

DR. GARRICK: -- implementation and how this is interpreted, as a first step?

DR. KRESS: We can go back to see whether to put the -- yes. In terms of application to the reactor side, I certainly think we ought to call it or refer to it as a risk-informed defense-in-depth and maybe even risk-informed design defense-in-depth, and I think what was presented yesterday to us by Gary and Tom King was a great step in the right direction of having a risk-informed defense-in-depth in the reactor side of the house and it fits this definition, because what they do is they look at prevention and mitigation and they decided how much of each they needed and how to apply it to the different sequences and how -- and George has made a suggestion on how to deal with the uncertainties and that is not just have one line, one area, but three areas, and I think that's a great step and is in the right direction for risk-informing the reactors.

So that would be how I would proceed from here to the reactors area.

DR. GARRICK: Right.

DR. KRESS: And then we have to do something about how would we proceed from here to the Yucca Mountain and the others.

DR. APOSTOLAKIS: Well, there is more than reactors, because there is the issue also of the unquantified uncertainties.

DR. GARRICK: But the other thing I would like to say about that, and I think it's another supporting reason for why we don't want to talk about the quantification of subsystems as a part of this in the waste field, and that is one of the reasons that Gary and Tom can put those numbers up there is that we have approximately 100 Parse to work with.

We have lots of experience that has helped us calibrate what we can expect to receive out of the performance of these systems.

DR. KRESS: I think the main reason they can put them up there is we already have the numbers.

DR. GARRICK: That's what I'm getting at. We don't have those numbers in the waste field and I think that our strategy has been that we ought to be pushing the Commission, given that we're supposed to be moving in the direction of a performance-based and risk-informed philosophy of keeping focused on whatever we've decided is the measure of performance, and not on surrogates of that measure.

It might well be that as we do more PA work, as we learn more about how to analyze these systems, that some

sort of yardstick where that's calibrated will surface and then we can talk maybe about what kind of possible thresholds make sense for a given application.

But I fundamentally think that that's not the way to go because it's too site-specific, it's too design-specific, A, and, B, we don't have the experience in the calculation of those systems that we have in the reactor side.

So I think this position that we've taken on subsystems is the right position and I would like to think that that might be one of the areas where the two problems are very different, and they're different because of the implementation, not because of a violation of an overarching, underlying philosophy, which we should agree on.

DR. APOSTOLAKIS: Well, I guess what you're saying is that we don't know enough; therefore, we have large uncertainty regarding the performance of each of the barriers and so on. I think what is happening here is that you will end up with words like unduly, not wholly dependent or something to that effect, and you are postponing the problem.

And eventually, at some point, which may be a wise decision at this time, because maybe we don't know enough, somebody will have to say, yeah, because of these results, I

am not relying on a single barrier.

DR. GARRICK: As you know, George, we continue to emphasize, much more than in the past, that we need to quantify the performance of these barriers.

DR. APOSTOLAKIS: Sure.

DR. GARRICK: So how can we make a dumb decision if we have before us good knowledge about how these particular barriers perform? We're not going to make a dumb decision.

DR. APOSTOLAKIS: No, nobody is saying you're going to make a dumb decision. You're just postponing the decision as to what is the right allocation.

DR. GARRICK: Yes. Right.

DR. APOSTOLAKIS: That's all.

DR. GARRICK: Right.

MR. LEVENSON: Let me introduce an additional slight thought, and that is I think we all agree that the uncertainty is extremely important, but it's important only if the consequences of that uncertainty are serious consequences. We've got to be very careful about focusing entirely on the uncertainties. It's only uncertainties that have big consequences.

DR. BUDNITZ: Yes. A way of putting that in a different light is I don't know whether a low level waste burial ground under Part 61 is a facility, but let's define

it as one for these purposes and let's assume here for the moment that the Commission had such a Part 61 facility in mind when they wrote this.

I'm not arguing for smoke detectors, but let's talk about a Part 61 low level waste burial ground, like Barnwell, which is operating today under Part 61.

Now, the question is how much defense-in-depth do you need? It's not just to manage the unquantified uncertainty. You also have to recognize the total risk, if the whole thing went to hell in a handbasket, is only this much compared to a reactor and, therefore, only this much is necessary, even if you were really very unsure of the details.

DR. APOSTOLAKIS: See, that brings up the issue of --

DR. BUDNITZ: So there is more to it than just that.

DR. APOSTOLAKIS: Let's clarify my position here. There are two or three different ideas that are floating around, so let me tell you. The first idea is that fundamentally, regardless of quantification, this philosophy was developed to manage the uncertainty. That means keep the probabilities low and the epistemic uncertainties reasonably small, fundamentally.

The second point now that I was arguing yesterday,

and I'm willing to go away from it a little bit, the implementation issue. When you have quantified the uncertainties, you still use successive compensatory measures and so on, but now you have a way of limiting and deciding the necessity and sufficiency.

If you don't have quantified the uncertainty, then you are invoking this principle again and say thou shall do this and this and that, sorry if I'm imposing on you, but that's life.

DR. BUDNITZ: That's right. In fact --

DR. APOSTOLAKIS: So defense-in-depth is -- I try to keep the term only for the unquantified uncertainties. I see today it's a losing battle, so I'm willing to concede the point.

DR. BUDNITZ: That's right.

DR. APOSTOLAKIS: If you call it risk-informed defense-in-depth, when you have quantified, I'm happy.

DR. BUDNITZ: That's right. To talk about Part 61, we know, even if we -- even though I argued we were ignorant about certain --

DR. APOSTOLAKIS: I'm ignorant?

DR. BUDNITZ: No, no. I'm sorry. Even though I was arguing -- let's postulate that we were ignorant in Part 61 about Barnwell's performance or something, that was in the context that I know what all the radioactivity is in

there and I have a -- we, the community, has a handle on what's the worst it could be, and that -- it's in that light that we're never really ignorant, so ignorant.

MR. BERNERO: There is one part of defense-in-depth that I think gets lost here. In reactor safety and in nuclear facility, like fuel cycle facility, safety, there is a concern about accidental outcome, the risk of accident.

As you go into material distribution licensing or go to waste management, Part 61 or Part 63, you're concerned with routine release, expected outcome, and it raises a different element of risk, the tolerability of uncertainty or of lack of knowledge of what you have.

DR. APOSTOLAKIS: But here we had Dana Powers yesterday sending us a message that because we have lots of data for these activities, there is no need for defense-in-depth.

DR. GARRICK: Another way of saying that, George, is --

DR. APOSTOLAKIS: Is uncertainty.

DR. GARRICK: If we have lots of -- in fact, there is -- if we have enough data, we don't need to do risk analysis, because we know what the risk is.

DR. APOSTOLAKIS: Which supports my earlier point. I also want to make a request, Mr. Chairman, that the

subcommittee members have been at it since 8:00. Would you consider taking a break soon for a cup of coffee or something?

DR. KRESS: I will take that under consideration.

MR. BERNERO: Give him the credit for conceding points.

DR. KRESS: We are scheduled to have one at 10:00. Would you like to have one now, George?

DR. APOSTOLAKIS: I would, yes.

DR. KRESS: My target for today, George, is to shoot to end this at 11:00 or thereabouts.

DR. APOSTOLAKIS: Fine with me.

DR. KRESS: So let's keep it to a ten-minute break maybe and get started again. So let's take a ten-minute break.

[Recess.]

DR. KRESS: We are going to try and end this meeting at 11:15, so let's get started again.

Before we start back into the roundtable discussion, I've had a request from Norm Eisenberg to make a few statements. Is he here?

MR. EISENBERG: I just wanted to mention a couple of points. In considering the white paper definition of defense-in-depth, please recall this was in the context of the white paper, which is risk-informed performance-based

regulation. This is not necessarily a general exposition on defense-in-depth.

A more important point is there was a lot of discussion about what was in or what was not in the particular definition, and there was a lot of focus on uncertainty and whether or not it treated uncertainty.

The other part of the question, which is very important for the materials activities, is that it also talks about safety and perhaps you should give some consideration to what the white paper and what you mean by safety, because as Mr. Bernero alluded to, for a lot of materials activities, we're talking about very small quantities, very low levels of activity, very small risks, and we're essentially talking about environmental degradation, not essentially immediate threat to a person's health and safety.

In thinking about an approach for both the high level waste program and for materials in general, this is a crucial consideration. You do not want to have the same types of provisions to prevent an excess dose of between 25 millirem and 26 millirem that you want between, say, up to 500 rem. If you're talking about 500 rem, then you have a real safety problem.

DR. KRESS: Right. I think those are really good comments and that's why, actually, in my definition that I

proposed yesterday, I had the words it's a strategy to achieve acceptable risk and you define what acceptable risk your target is and if it's -- and if your acceptable -- if the number you're dealing with is just a degradation of the environment to a small extent and not a risk to the health and safety of the public, your strategy is different, because it wouldn't have to involve so many measures and to such extent.

So I would have actually added that into my definition. That's another place where I kind of disagree with the definition a little.

MR. EISENBERG: So I wanted to at least bring that up. I'm certainly for some materials, say you had a truckload of ore, the consequences of an accident and throwing it all over the highway are not very significant.

You would not expect the same kinds of multiple barriers or defense-in-depth there that you would expect for a nuclear power plant. It just doesn't make sense.

Somehow this needs to be included in whatever conclusions you all come to, I believe, because I think it's very important in materials. Not to belabor the point.

DR. APOSTOLAKIS: The driver is the risk.

DR. KRESS: We're glad you're feeling better today.

MR. EISENBERG: Thank you.

DR. GARRICK: A quick recovery, I must say.

DR. KRESS: And also before we continue the roundtable discussion, Ray Wymer had a few thoughts that I think we ought to get onto the record before it's time to call it quits.

DR. WYMER: Thank you, Tom. I think since we've had all these high powered people around the table here and in the audience for a day and a half, it would be nice to think about producing a product of all of this effort, and I personally am in favor of seeing if we can't draft some kind of a letter based on these discussions.

In my view, the letter should start with a general statement of what we mean by defense-in-depth, kind of along the lines of this definition, and maybe some other principles, as George has mentioned, and then split it cleanly into two parts, one relating to reactors and DID as it applies to a reactor situation, and then the other part as it applies to the high level waste and other nuclear materials.

And with some trepidation, I have prepared a half a dozen comments that I think might form the basis for the ACNW half of this letter, which I will pass around here.

DR. APOSTOLAKIS: That actually raises an issue. I wonder whether -- how much can both committees say and how much should be left up to the individual committees. For

example, the material that Tom and Gary presented yesterday I'm sure will come before the ACRS at some point, so the ACRS will write a letter on this.

Do we really need to bother to comment in detail here and request approval from the ACNW? The same thing applies perhaps to high level waste. Maybe we can say something, but then leave the bulk of it up to the ACNW, so that the ACRS will not have to bother reading that part of the letter.

I think we have to do it in whatever way --

DR. WYMER: I think that's John's decision for the ACNW, but my personal view is to separate them into two separately conceived and approved sections.

DR. APOSTOLAKIS: Right.

DR. WYMER: That would be the right way to go.

DR. APOSTOLAKIS: And maybe send a message to the Commission that they are indeed separate and this is appropriately the function of this subcommittee, and both committees should agree, but I wouldn't get too much into the details of managing --

DR. WYMER: That would certainly expedite getting them out.

DR. APOSTOLAKIS: -- Yucca Mountain or you shouldn't get much into the Gary and Tom presentation, which I'm sure the ACRS will have to write a separate letter on.

DR. WYMER: What I would like to do next is, I have these half a dozen things, for the benefit of people who don't have them, I'd like to read these.

MR. LEVENSON: Ray, just one second. I want to comment on George's comment. Again, an important part of this letter could be not that it's done separately, but it sends the message to the Commission that both committees agree that the issues are quite different.

DR. APOSTOLAKIS: Yes. Yes.

DR. LARKINS: I think, George, if you can -- that this joint subcommittee can agree, as much as possible, on both areas, it would be very good, because you're sending a message to the Commission that there is some coherency in your thoughts. So there is some agreement basically on some of these ideas.

Where there are some specifics that you may want to get into further at separate committees, that's fine, but if you could reach some agreement.

DR. WYMER: That's the introductory part, the overarching part.

DR. APOSTOLAKIS: Yes. I think we're in agreement, but I wouldn't want the ACRS to get into the details, for example, of why, for the high level waste repository, we are not giving subsystem requirements.

DR. WYMER: The same thing is true in the other

direction.

DR. APOSTOLAKIS: And in the other direction, as well.

DR. WYMER: Now, let me go to this now. I want to read these off and I'd like to read them all with as little interruption as possible, and then we can talk about it.

DR. KRESS: Are you asking us to keep our mouths shut?

DR. WYMER: I want to say one other thing. We've been looking at this issue sort of through an electron microscope for the last day and a half. I'd like to back off. This is more or less a handheld magnifying glass approach to the whole thing, and they're pretty simple statements. So I will read them.

I have entitled this "Defense-in-depth Issues," emphasizing the Yucca Mountain repository. That puts the emphasis on the ACNW. Number one, we hold these truths to be self-evident. There are uncertainties in Pas. There is much less experience or data with waste repositories than with reactors, so uncertainties in repository system performance are larger for waste repositories. That's number one.

Number two, performance and risk assessment requirements are not as well understood for waste repositories as for reactors. We need to elucidate and

explain these many differences and recognize them in the defense-in-depth philosophy statements.

Number three, there should be several lines of defense, and that's defense-in-depth, against release of radioisotopes and the resultant radiation exposures. The types and numbers of lines of defense should be directly related to the uncertainties and relative hazards of system performance.

Number four, defense-in-depth requirements for waste and nuclear materials are different in very important ways from defense-in-depth for nuclear reactors. For example, in the case of the Yucca Mountain repository, after closure, there is little probability of an accident of the type that reactors may have, and this is related to the physical nature of the systems and to the fact that there are very large time dependent and potential energy differences.

Number five, this -- now we're getting to Bob Budnitz's point. NRC should specify clearly how the performance assessment and probability risk assessment should be done by DOE in its license application for the Yucca Mountain repository and what it should include. If the NRC guidance is good, then the assessment should be able to be done well, without further specific NRC guidance. So I wouldn't go quite as far, Bob.

And finally, again to Bob's point, because of the nature of the interactions between NRC and licensed applications for complex systems, there will always be a strong possibility of an iterative licensing process. That is, there will always be overtones of "bring me another rock."

I think we can talk about those, but that's a starting point for what we might put --

DR. APOSTOLAKIS: I see a strong underlying theme here about uncertainties.

DR. WYMER: Nobody questions that there's uncertainties, George, and I deliberately put that in. I just didn't want it in the definition.

DR. KRESS: One of the things, I think, that ties into all of this, and it was sort of pointed out to me by Joe Murphy during the break, is that this definition we've been referring to was really not in the main document of the white paper, but a footnote in the white paper, and that the text that was in the main document, in fact, does risk and uncertainty and some of the language is that the concept of defense-in-depth has always been and will continue to be a fundamental tenet of regulatory practice in the nuclear field, particularly regarding nuclear facilities.

And risk insights can make the elements, risk-insights can make the elements of defense-in-depth more

clear by quantifying them, to the extent practical, although the uncertainties associated with the importance of some elements of defense may be substantial.

The fact that these elements and uncertainties have been quantified can aid in determining how much defense makes regulatory sense.

That's very logical and that's kind of what we have been saying where the emphasis ought to be is on the quantification of these so-called lines of defense.

Decisions on the adequacy of or the necessity for elements of defense should reflect risk insights gained through identification of the individual performance of each defense system in relation to overall performance. It's almost as if I wrote it myself.

So I think that is a perspective that, in the preoccupation with the footnote --

DR. APOSTOLAKIS: I am completely perplexed now, but I will not say anything else. So let's go on. I'm lost, because the whole discussion clearly support my point that the whole business here is one of managing uncertainty.

DR. KRESS: Sure.

DR. APOSTOLAKIS: And the fact that you guys feel it's not important enough to put it in the so-called definition leaves me at a loss.

DR. WYMER: It isn't that, George. It's the fact

that defense-in-depth, in my view, has a very strong element of uncertainty, but it goes beyond that in some ways.

DR. APOSTOLAKIS: I understand that. I'm willing to put primarily.

DR. WYMER: That's a big help.

DR. APOSTOLAKIS: But I think we should move on, because we'll never do anything else.

DR. GARRICK: Yes, right.

DR. KRESS: Let's move on. What direction would you like to go in?

DR. APOSTOLAKIS: The implementation, and I still don't know what we're going to say about the non-repository facilities.

DR. GARRICK: Well, it seems to me that a couple of things have been identified. I think that if we are genuine about the concept of a risk-informed approach, I think the notion of risk has always got to be the prevailing notion. So it just seems that it's more of a matter of degree than kind here, that you certainly don't need to have more defense-in-depth for sealed sources than make sense from a risk perspective.

DR. APOSTOLAKIS: Exactly, and that is kind of the letter that I had in mind. It would start out by saying that the main idea here is to manage risk. Remember, we have to wordsmith all this, but manage risk. And the

diagram that Norm showed yesterday did that very well.

For cases where the risk is high, and that includes the timing issue, energetics and so on, you clearly have to do something. So we have all these activities in the reactor area. Then you move on to the waste repository. Now, you don't have accidents as energetic and they're happening in long time-scales and so on. So defense-in-depth takes a different flavor.

Then you have the other NMSS activities, where the risks now are low. You don't -- you have the issue of voluntary risk, that's very important there in some medical applications. The magnitude of the consequence is not as high. So defense-in-depth now takes a different flavor from the other two.

So, you see, that would give some coherence to the letter, a common theme, and it would make very clear the point that the implementation is really an important element and it's very different in these different areas.

DR. WYMER: I tried to capture that in item number three there.

DR. APOSTOLAKIS: Right.

DR. KRESS: I thought three was your best item.

MR. LEVENSON: George, I would have -- I would quarrel with one word. Since no matter what we say, we need to consider communications with the public, manage risk is

really an unfortunate choice of words. What we really want to use is minimize risk.

DR. APOSTOLAKIS: Minimize --

DR. KRESS: We banned the word minimize from our letters. Reach acceptable risk levels is a possibility.

DR. APOSTOLAKIS: Assure that the risks are --

MR. LEVENSON: Because manage has no connotation of attempt to minimize.

DR. APOSTOLAKIS: I understand. The reason I use manage is to send a message that it will be low enough, but also the uncertainties about it.

MR. LEVENSON: I accept that.

DR. APOSTOLAKIS: So let's go on then.

MR. BERNERO: I would just like to add, for the practices, material licenses, it's important to understand the concept. There is a deliberate radiation exposure, deliberate placement of radioactive material in the biosphere, and the defense-in-depth or management is to ensure that you don't significantly exceed the deliberate exposure.

DR. APOSTOLAKIS: Yes.

MR. BERNERO: In other words, that the release, whether it's an industrial gauge, you make sure the worker can't get inside of it to get very serious radiation doses and sealed sources have to have a certain robust character,

so that the machine doesn't break them open and unduly contaminate.

And it becomes very complex to use the terminology carefully. For instance, you will frequently find, instead of the word facilities, you will find practices, radioactive material usages or uses, practices, things like that. Activities is another good word for it, too.

DR. KRESS: As a way to focus, I don't know if this is appropriate or not, but I was going to ask our invited experts and our consultant if I would be out of line in asking -- going around the table, as a way to end this thing, and say what are your impressions today, what thoughts do you have of what might be in the letter, and maybe even ask you later on if you could put this down in writing for us.

I don't know if I -- we do that with consultants, but with invited experts, why, it would be a big help to us.

DR. APOSTOLAKIS: If you say "we beg you," maybe they will do it.

DR. KRESS: I think right now, since you have the floor, Bob. I haven't given you time to gather your thoughts maybe, but if you're ready.

MR. BERNERO: I am prepared and I'd be happy to document this afterwards.

DR. KRESS: Okay. Great. Why don't we do that

right now then?

MR. BERNERO: Basically, as I see it, I see the white paper as the appropriate starting point and that the overall agreement that at least I believe is discernable is it is a policy, a strategy, a philosophy and approach, it's a sense of direction and it's not a specific exact requirement.

I think George has some excellent arguments about it is dealing with uncertainty in a sensible way or a sufficient way, but at the same time, there is the recognition of diverse elements, alternative elements of defense that is in defense-in-depth, because there is a virtual commitment that one will never achieve the level of certainty that allows wholly dependent reliance on one element.

So I think a very important thing is to have an evaluation mechanism in applying this that there is not undue reliance on any single element, and element in the broad sense, not just barrier. The risk-informed application of it does require a balance, a scale, not too close, not too far, not too much, not too little.

An evaluation that would leave open -- and, again, I repeat, I don't know the facts on the AP-600 containment spray, but it should leave open the possibility of either removing a traditional or expected barrier and it should

also leave open resistance to application in a new field of a traditional barrier, such as emergency preparedness.

You don't apply emergency preparedness to a repository because it doesn't apply. It's irrelevant.

The application to reactors is, I think, appropriately done as a balance, a review, and I would suggest that siting is an element that is -- at least doesn't appear to me to get that kind of treatment.

The materials, the principles of this apply, but the application for materials licensing is quite different. I think a very good example to illustrate material licensing issues for risk-informed application of defense-in-depth is the spent fuel shipping cask. Practically everyone knows it, practically everyone understands it.

On its face, it is a single mechanical barrier, but the elements of defense-in-depth are diverse.

For waste management, I think the committee, and this, of course, is directed to ACNW, the committee should be careful that it is not applying defense-in-depth, risk-informed application and all that to the high budget, high activity, intense performance assessment atmosphere of the high level waste repository.

There is a very large population of what I would call decommissioning activities, DOE sites, licensed sites elsewhere, burials, near-surface, near-biosphere, including

institutional controls, where the stuff -- if you ever get into uranium mill tailings, you will find stabilized tailings piles that are remote, isolated, that have very little risk associated with failure, and yet they are under perpetual custody and active maintenance with NRC oversight.

So you will find very great disparities in the low level or near-surface disposal and the disparities are profound between radioactive near-surface disposal or management and hazardous waste, RCRA, CERCLA hazardous waste management.

So I think the committee should be very careful about defense-in-depth applied with the risk-informed approach on things like low level, which are very different from high level.

That's basically it.

DR. BUDNITZ: Where is that slide with the definitions?

MR. BERNERO: I put it back.

DR. BUDNITZ: I'm going to take a different tact, and try to turn this on its head. I think it is an error for these committees to take an approach that would elevate defense-in-depth to a higher level than a lot of people in the agency and elsewhere think. I think it would be a better strategy to see if you can figure out a way to downplay it, and downplay, its role is a principle of one of

the ten commandments or whatever.

Its evolution, as we learned -- just go back to Cliff Beck -- is that sound engineering principles were used in the original concepts that led to the early reactors, and people in the agency at the time and in the industry, the General Electric and Westinghouse, explained those sound engineering principles in terms of this phrase.

And then WASH-1250, Joe Hendrie wrote WASH-1250 -- it never was issued in final, it's only -- I still have the draft from 1973. WASH-1250 said it was attempting to explain -- it was that yellow book -- attempting to explain it to the public and it was a wonderful piece of work -- said that -- go read it -- that the sort of things that sound engineering practice had led to lead to these multiple barriers which make sound engineering sense, and we call it defense-in-depth.

Now, that was 27 years ago. I was here just 20 years ago and defense-in-depth certainly hadn't been elevated to a principle at that time. It was more an explanatory thing. And I think it is an error that the agency, at the highest level, and this all -- it's an error that happened in the context of risk-informed, you know, 1174 and those discussions, in error that these ideas have been elevated to the point where after you've done the rest of what you ought to be doing, you go back and make sure

this gets done, too.

It's an error that Part 63 has used the phrase defense-in-depth for what it's trying to do, as opposed to not saying that and saying what we're really going to do in Part 63 is we're going to do that analysis and the bottom line Amergosa Valley doses, and, besides that, we're going to do some multiple barrier stuff, but let's not call it defense-in-depth, because it ain't.

So I think that what I would recommend that the committee would do, if I was writing your letter for you -- thank God I don't have the responsibility, though -- would be to downplay the connotation that it's some sort of a principle, but instead to explain that it emerges in different arenas, low level waste is very different than high level waste, never minding transportation or a fab facility or a reactor, it emerges in different manifestations as different facilities use sound engineering practices, analysis, design, monitoring or whatever, to accomplish managing the risk to an acceptable level in light of the uncertainties, bla, bla, bla.

And if you then see it as emerging from sound engineering practice, which the agency always wants to make sure its licensees use and which it wants embedded in its things, then it doesn't come down from the top. It emerges from activities which you're doing anyway.

I would like to then hope that through such an approach, those who don't understand what I just said would understand it better and not invoke it as a separate principle, but use it as a way of explaining to themselves and to their colleagues and, of course, to the applicants and licensees and the public, that it's a way of explaining an element of sound engineering practice, which, by the way, goes far beyond this arena.

That way, the fact that it's a policy or a strategy or a philosophy is in light of a thousand years of engineering practice and history and not in light of something special for radiation or the role of this agency.

If you accept that, then as a practical matter, and not arguing about the definition for a moment, the way to approach that here could be for this committee, these committees together, to explain that in application, and the applications vary by arena, in application, in each arena where it's applied, it manifests these sound engineering practices and principle in a different way, because, of course, the arenas are different.

They may have all the different characters or different -- as we know they are. And in each one, it's a way of explaining rather than a way of designing or operating.

That's the thing that bothers me, and so maybe

I'll just quit with that. The thing that bothers me is I don't see that you can operate, design even, design using engineering principles, then you observe that, of course, this is a way of explaining that kind of in an overarching way.

It's almost as if you can't design a reactor to assure adequate protection, which is, by the way, what the original statute in 1954 asked the AEC to do, which remains the fundamental charter of the Nuclear Regulatory Commission's activities in this area, which they can't design with an adequate protection, but adequate protection is a way of explaining what you are trying to think about when you were doing what you're actually doing.

And if you think about it that way, you will adopt an approach in your letter that could diffuse rather than amplify possibilities that elevating into a principle could cause the havoc that we don't want.

DR. APOSTOLAKIS: Ode to Joy ought to be playing while you are talking.

DR. BUDNITZ: I'd prefer Springstein myself, but you can vote for Ode to Joy if you want. Excuse me.

DR. KRESS: Very good. Milt, do you have a few words of advice for us?

MR. EISENBERG: I think I've already expressed most of my thoughts. I think it's very, very important to

separate the reactor -- I was going to change that to say not the reactor field, because as I think about it, it's related to the characteristics of the reactor, not because it's a reactor.

We ought to be careful, because for instance, somebody might come in with some off-the-wall accelerator application which, as radioactive stuff at 2000 psi and a lot of other things, so we should differentiate on a basis of two things, the uncertainty and the potential risk to the public to separate, but that if that is done right up front, I'm not very optimistic that you're going to get rid of the term defense-in-depth, with all of its baggage.

But it seems to me that this letter might be a useful device to present proliferation of defense-in-depth to fields other than the reactors.

And whatever kind of words we want to use, that the defense-in-depth, as presently understood and utilized, applies to high energy, high risk facilities and that the generic concept of not depending on a single failure for other facilities, like a repository, is provided by having multiple passive barriers or something equivalent.

But I strongly urge that you try to prevent the proliferation of this to other facilities.

It's also very important that it not just be a two-part split, reactors and Yucca Mountain, because there's

a large number of other facilities, clearly more in number than either of these, but if the -- if basically we say it's tied to how significant is the risk, then that allows you to have different rules for lesser facilities.

MR. BERNERO: Could I add just one element? There has been an undertone for the day and a half of risk assessment or performance assessment embracing the element, so that there is a -- I'll call it an assessment result that comprises the basis of judgment on adequate safety. One of the points that I had buried in my slides was that the performance assessment is one part of the body of information upon which one judges the acceptability of a high level waste repository.

As demonstrated in the WIPP, the intrusion scenario is a real consideration. It's part of the body of information in judging acceptability and it does not lend itself to analytical performance assessment treatment.

Similarly, in reactor safety, we now have some terrorist threat in the United States. We now have a design threat for reactors that takes into account the possibility of a vehicle bomb getting close enough to cause core melt, large containment release, and so forth, and that does not lend itself to the typical PRA assessment either.

So there is a large body of judgment of acceptable safety and safeguards and in this particular case, it's more

safeguards, that is outside the performance assessment or PRA arena and shouldn't be forgotten.

DR. GARRICK: I think the comment I would make to that is what you're talking about is scope. That as we have done performance assessments and as we have done PRAs, there has emerged a certain scope of things that we consider. But I would not want to have the record suggest that you can't include those kinds of things in a risk assessment or a performance assessment, because anything you can think of you ought to be able to include, as long as it's relevant to what you're trying to analyze.

DR. BUDNITZ: I could comment that what Bob just said compliments what I said very nicely. The fact is that in the vehicle threat arena, the approach has been to take the facts and the problems and the potentials and use sound engineering principles of various kinds, so that the agency carries out its mission of -- by the way, that's part of the common defense and security part of the agency's mission. There is more than just public health and safety. There's common defense and security and the environment. All those words are there.

All of those things apply commonly accepted engineering principles of different kinds, one of which is risk assessment, but it is not the only, and in some arenas, it's the principle, but in some arenas, it's not even the

principle method used.

That then goes along with my -- and this very much compliments my notion that this should be downplayed as sort of a ten commandments principle.

MR. LEVENSON: Let me just comment. I did not use the word risk assessment, Bob. I used the word risk --

DR. BUDNITZ: I know you did.

MR. LEVENSON: -- and that is --

DR. BUDNITZ: I agree with you.

MR. LEVENSON: -- for the large number of things, the hospitals, the sources, et cetera, we don't want any implication that they need to do a PRA, no matter how simple it is. But there are ways of -- risk, as a generic term, includes both what Bob Bernero was mentioning and --

DR. APOSTOLAKIS: Now, there is one other point I want to make, since we are talking about differences between reactors and other areas. You are using the term performance and performance assessment for something that we would never use the word for, like the release or the dose after so many years and so on.

I guess that's a performance measure for the waste area. Core damage frequency of the quantitative health objectives are never called performance measures in the reactor area. The reason -- although they are used perhaps in the same way, I think the reason is that we reserve the

term for performance indicators, which, by their very definition, mean that you are measuring real data from the plant, you are collecting real data, do some simple calculations, and compare against the performance measure at that level, a threshold.

That's the process that was presented yesterday, the new oversight process and so on relies heavily on those. So this word is used in different contexts, I think, in the two areas, and I don't know whether we want to say that in this letter.

DR. BUDNITZ: George, you've just made a point that, again, I think compliments what I was trying to say. Look, the reactor has what we call normal operation every day and then there's a spectrum of upsets from, you know, little things to the larger things.

And what has consumed NRR for all this time, and appropriately, is to assure that the biggest upsets don't occur or occur with manageable consequences or are kept at very low probabilities per year.

Now, at a low level waste burial ground, a Part 61 facility like Barnwell or certainly at Yucca Mountain, we use the word performance because you don't think of it in sort of it has normal performance and then an accident comes along.

What you're trying to do at a Barnwell is trying

to figure out, for the next 50 or 150 or 400 years, what the normally expected behavior, which they call performance, is, as opposed to what the normal things with accidents put on top.

DR. GARRICK: Yes, but they do mean safety performance.

DR. BUDNITZ: Yes, they do. They do mean safety performance, but because the upsets are of a different character -- by the way, you could have -- the analog of an accident is, you know, a plane lands on Barnwell 200 years hence. That's an accident, right? And that is considered in the design in terms of probability and consequence. So it is considered.

But the word performance is used because in the other area, really the way one thinks about these things is in that more different light.

DR. KRESS: Now, I don't want to put anybody on the spot, but we would welcome some summary comments from the staff, if you care to make them, and both on the NMSS side and the reactor side.

MR. HOLAHAN: This is Gary Holahan. I guess I could say a few things and then if Tom and Norm would like to say something, I guess they could speak for themselves.

I think a lot of the things that have been said in the last day or so are helpful in shedding some more light

on a concept that's been around for a long time, and I think if the committee were to write some of these things down, not necessarily in the context of rewriting the white paper or rewriting the definition, but in more of an explanatory sense, I think it would be helpful to the staff and the Commission, because we do have a number of activities going forward.

Certainly, in the reactor area, the concept is being used in our license amendments, in risk informing the regulations in various processes. And to the extent that we can have a clearer understanding of what it is and what it's not, I think we're probably better off.

One of the things that -- I think Bob Budnitz expressed it, sort of in the strongest sense I've heard, but we had other sort of versions of it, and that is that defense-in-depth is not an absolute, and I think when we talk through a number of examples, defense-in-depth is a way of addressing uncertainties where that is important.

We have examples where either the consequences are very low or the frequency of events are very low and the staff has never applied defense-in-depth in those cases, and you can go and you can sort of work those examples out.

So I don't object to the idea that we should shed a little more light on defense-in-depth and make people aware that it is not a fundamental concept. It is a way of

addressing uncertainties. The fact that you are addressing uncertainties is a more fundamental concept. If it's a principle, it's a derived principle, it's not a fundamental thing.

And I think that would be helpful. Whether it's designed in or explained afterwards, I think those are interesting thoughts, but I don't -- I'd have to think about it a while before I would rewrite anything on that point.

But the point that uncertainties are the more important issue and that as we move forward, we're using this tool, where appropriate, and if the committee would shed some light on the state-of-the-art and the appropriateness of defense, of where defense-in-depth has its largest role, that would be of some value.

Now, whether those thoughts would be reflected in an edited white paper or just some other arena, I think, I don't know and maybe that's a matter for the Commission to decide.

DR. KRESS: Thank you, Gary. Tom?

MR. KING: Let me add to what Gary said. I think a lot of what Budnitz said, at one time, I thought maybe this was a subject that was worthy of a Commission policy statement, but after the discussion, I don't think that's the case.

I think what we're talking about is a practice

that the Commission has employed over the years. Policy statements, to me, are more to state Commission expectations, not to document practices. I think the issue that really needs to be addressed is how should this practice be applied, so that it's applied consistently, recognizing the various -- it may vary depending on the regulated activity you're talking about, but there probably are some elements of consistency, what is its purpose and so forth.

We have other practices that the agency employs, just like defense-in-depth. They employ safety margins, they employ use of codes and standards and so forth. We don't have policies for those things.

To me, the real question is not so much -- I think you've talked about a lot of the various elements of application that would be worthy of writing down. The question to me is where do you write them down. Should it be a separate white paper, should it be a modification of the existing white paper, should it be something else? I think that's -- any light the committee could shed on that would be useful, but I think it's worth writing them down somewhere, if we find the appropriate place to write them down.

MR. EISENBERG: This is Norman Eisenberg. I think one of our big concerns is that there not be some

overarching principle that would be geared toward reactor regulation and imposed on materials regulation. Everybody understands our concerns and has responded positively to that. So that's very good.

NMSS is going to move further into risk-informing its regulations and risk-informing its regulatory practices. This is not an easy thing to do necessarily and some of the traditional concepts of safety and defense-in-depth, I believe, is one such concept, have to change in that environment.

And some of the things that I've talked about would be, I think, helpful if the subcommittee could endorse to some degree. For example, how do you handle uncertainties in a risk-informed performance-based regulatory environment and how does the degree of hazard or the degree of risk play into those decisions.

So that, for example, in a deterministic environment, you want your expected performance, the load bearing capacity of the crane to be above the load, the expected load. When you do a probabilistic calculation, the question is how do you do the comparison and do you still need the same amount of margin or if the consequences of exceeding the limit -- for example, if the limit is 25 millirem, can we use the mean value of a dose distribution to demonstrate compliance.

This is something that I think is a difficult policy issue that the staff grapples with every day, that demonstration of compliance with a standard, does that have no relationship to what the standard is protecting against and do you need the same degree of assurance for lower risk activities as you do for higher risk activities.

This certainly plays into all the discussion that I've heard about uncertainty. But this -- maybe this is not the letter that this should be addressed in, but this certainly is an issue that this subcommittee is going to be involved in, because as NMSS moves to risk-inform its regulatory activities, we're going to confront this again and again.

So I would bring that up as something to think about.

DR. KRESS: Thank you. I'd like Steve Hanauer to make a few comments for us.

MR. HANAUER: Mr. Chairman, ladies and gentlemen. For the record, my name is Steve Hanauer. I've served as a member and Chairman of the ACRS, as a staff member in the Atomic Energy Commission, and NRC regulatory staff. I am now an employee of the Department of Energy, in the Yucca Mountain program.

But what I'm going to say is my own opinion and I do not speak for DOE.

I've been listening to the discussion particularly today. In my opinion, the various discussions over-estimate the state of knowledge and, therefore, under-estimate the contribution that defense-in-depth and multiple barriers, whatever you want to call it, make to achieving acceptable levels of safety.

I think performance assessment and probabilistic risk assessment are very important and very useful. They are the only way to deal with rare events or with 10,000 years of projected performance.

But the uncertainties involved, I believe, are greater than risk analysts generally believe. The unanticipated challenges, the unexpected behavior and failure modes and the bizarre human behaviors continue to occur and should be acknowledged.

It seems to me that defense-in-depth and multiple barriers or whatever you would like to call them is necessary to achieve acceptable levels of safety for some applications. I think the public understands this.

That the public skepticism for some pronouncements from the technical community is justified and that defense-in-depth and multiple barriers are a legitimate technical response to this legitimate skepticism.

I would observe, I would recommend a certain acknowledgment of the real uncertainties involved as we

proceed with our analyses of these things.

Thank you.

DR. KRESS: Steve, while we have you up there, could I ask a couple of questions about that? You seem to be very receptive of the concept that defense-in-depth in terms of multiple barriers is a good way to compensate for large and basically unquantified uncertainties and that, therefore, it would be very appropriate to apply defense-in-depth principles to Yucca Mountain, which is a little different than what I heard from some of the other people.

MR. HANAUER: That's why I asked to address the subcommittee.

DR. KRESS: Where do you think the assessment of the potential risk that is associated with Yucca Mountain ought to fit into the thinking on how much defense-in-depth is necessary or how good the barriers have to be or whatever?

MR. HANAUER: Well, I've been looking at calculations like that in the last few weeks. To the extent that one has defense-in-depth and to the extent that the models represent what will happen, then when you do the calculations, you find that the results are very low or even zero risk, because of the overlapping protection provided by the multiple barriers or the defense-in-depth or whatever

you want to call them.

And therefore, it's rather difficult to use probabilistic risk assessment to give a quantitative estimate of defense-in-depth, although Norm Eisenberg's suggestion of a year or more ago on barrier neutralization, if carried beyond single barriers, enables one to evaluate where the design is strong and weak, again, to the extent that the models represent reality, and to tell you where to spend your money.

The recent addition of the drip shield to the proposed Yucca Mountain design is an example of this. It turned out that we were, in many people's opinion, including mine, becoming overly dependent on the performance of the waste package and even on the details of this performance, and the drip shield was, therefore, added to decrease the dependence of the overall performance of the repository on this one element.

So that you can use this as a tool. You mustn't believe everything you get, but you get insights from it and both the risk assessment and the defense-in-depth I view as tools to achieve using somewhat different approaches, the necessary high degree of safety.

DR. APOSTOLAKIS: If I could make a comment, Tom. I think what Steve is telling us is consistent with what seems to be the consensus of the subcommittee. I think that

his point is that the unquantified uncertainties are still very large. So that defense-in-depth, a risk-informed defense-in-depth is something that cannot play a major role right now, that you have to apply it almost as a principle, because the unquantified uncertainties are very large.

I don't know enough about the repository, but for reactors, I'm not sure that's the case. I think a compromise has to be found because it is true that people do stupid things, still it is true that every now and then something happens that we hadn't thought of, but its risk significance, I would argue, is not such that it would make me worry about the validity of the PRAs.

And I think as I mentioned yesterday, the work that the former AEOD is doing collecting data and so on goes a long way towards convincing me that a good part of the PRA, in fact, do represent what happens out there. And it's too bad that the AEOD has not figured out a way to advertise, to publicize what they are doing, because most of the community are not aware of it, including PRA analysts.

So I think the words that you are giving us can serve as a caution, so we don't become too enthusiastic about PRA and its results. But I do believe that in the reactor arena, for example, putting a defense-in-depth, applying defense-in-depth at the level that Gary and Tom presented yesterday, and maybe some other levels, is a

reasonable way to proceed.

In other words, I would give more credence to the results of risk assessment for reactors, because we have been doing them around the world. We've been collecting data, and there seems to be a consensus there that this is it.

DR. KRESS: I would certainly agree.

DR. APOSTOLAKIS: Now, when it comes to severe accidents, I think you are right. I think your words acquire more weight as we move into those exotic areas where experience is not very strong.

DR. KRESS: Bob?

DR. BUDNITZ: Can I ask Steve a question?

DR. KRESS: Yes.

DR. BUDNITZ: Steve, I wonder what your reaction is to the following thought. Gary Holahan said something a few minutes ago I thought rung a very nice bell with me. He said that defense-in-depth is, to him, not a fundamental principle, but it's a derived principle.

Let me just postulate something. Imagine, Steve, that you are in control of the design, which you're not, but you're part of the senior management of the project at Yucca Mountain, and you and your colleagues observed that a great reliance on that canister was being placed in the earlier design and you and they felt nervous that maybe you didn't

have as much confidence as you'd like to have, so the drip shield was evolved as a means of your achieving more confidence.

Now, if the principle of defense-in-depth had never been enunciated by us or anybody else for reactors, I suspect you would have done that anyway. But now you have observed that it is, in fact, for you, a manifestation of this defense-in-depth idea that I know you've known about for 40 years in your previous life as one of the great experts on reactor safety.

So I'm going to ask the question. Do you see it, also, what Gary said, as it's derived or it's sort of a manifestation of sound -- what I was saying, sound engineering approaches, or does it rise to a higher level?

MR. HANAUER: I don't really think that those words matter. It's almost angels on the head of a pin.

DR. BUDNITZ: That's a fair comment.

MR. HANAUER: Whether it's a fundamental or derived, I think it's a tool, a very useful tool.

DR. BUDNITZ: Okay. Well, the reason why I think the distinction does matter is that not everybody either in the design organizations of the licensees and applicants, nor on the staff, have the experience and wisdom of a Steve Hanauer.

DR. APOSTOLAKIS: But they do matter, Steve,

because you just said it's a tool. You downgraded it. De facto, by declaring it a tool, you downgraded it. See, when we were writing four years ago the risk-informed guides, we had long discussion around this table as to whether the principle of defense-in-depth should be preserved, and we settled with philosophy.

So it does matter. I think it doesn't matter because, in your mind, it's just a tool.

DR. BUDNITZ: No, no. It doesn't matter to Steve because Steve -- forgive me, Steve -- has experience and knowledge. By the way, he's not unique in this, but Steve has experience and knowledge which isn't -- and understanding, which, by the way, is not unique, but certainly is greater than your average designer out in the field somewhere or your average regulatory staffer.

DR. GARRICK: I think we're quibbling now. I don't think this is --

DR. APOSTOLAKIS: I think Steve made his point very well.

DR. BUDNITZ: I'm just worried about it being elevated.

DR. APOSTOLAKIS: It would not be, unless I'm removed from this committee.

DR. KRESS: I also worry, though, Steve, that another person with equal experience, but a different

perspective, might come in and say I am still uncomfortable with all the uncertainty, particularly when the stuff gets into the ground and travels through the ground water and so forth, and I want more defense-in-depth. I want you to put another barrier, I want you to fill the cask with depleted uranium and I want better diagnostics to know what's going on and I want a controlled environment inside my cask. I want to be sure there's no moisture in there when I seal it in the first place.

There are all sorts of things that I can postulate that would give me a more comfortable feeling, and those are all in the name of defense-in-depth. Where do I stop this process and how do I know when to quit?

MR. HANAUER: In fact, such proposals, as you must know, are made every day and I don't think -- you can use PRA as a tool to work on this question and you can use defense-in-depth as a tool to work on this question, but in answering such things, the result is determined by judgment, and not necessarily technical judgment.

These are social and political problems and, in fact, theological problems, and I'm not licensed to practice sociology, politics or theology, and, therefore, one has to apply judgment. There is no substitute. There are prominent and influential people pushing depleted uranium and so forth.

The project decision-makers, the program decision-makers may, in fact, decide to do it and the decision will not be entirely technical.

DR. KRESS: Thank you. We have one other speaker I'd like to call on. Janet, would you like to make a few words?

MS. KOTRA: Thank you.

DR. KRESS: Please identify yourself for the record.

MS. KOTRA: My name is Janet Kotra, and I would like to speak as an earnest, average regulatory staffer, who is speaking as a member of the team preparing the draft final rule for Part 63.

And I want to address specifically Dr. Budnitz's comment about the need not to invoke defense-in-depth in Part 63. I want to note here that an earlier Commission in 1983, in promulgating the generic regulations for a repository, already invoked defense-in-depth and went so far as to say that the imposition of quantitative subsystem performance criteria were essential to the insurance of defense-in-depth, and that one example, which, as far as I'm aware, is now 17 years old, is unique, where this equation has been made in the context of a rulemaking.

We've been discussing it in the context of my colleagues from NRR, in the context of a practice and the

discussion here has circulated on how that practice or principle or philosophy is implemented. But the Commission, in promulgating that generic rule, said that it was incumbent upon them in order to ensure defense-in-depth to make this additional test.

The Commission more recently, a different Commission, has now said it wants to go a different direction. So it is incumbent upon those of us in the staff to provide the Commission with a justification for that.

So I don't believe that it is possible for us not to -- to walk away from that argument and we have to justify why we believe health and safety and protection of the environment are ensured, and I think we also have to recognize, as Mr. Bernero has pointed out repeatedly, that the Congress has said that our criteria have to include requirements not for defense-in-depth, but for multiple barriers.

And we have discussed and Norm has laid the groundwork for why the use of multiple barriers is a way to implement a philosophy of defense-in-depth, but I'm kind of at a loss as to how, with a straight face, we can put forward a final rule that does not address this issue and we would certainly -- you know, and in that regard, guidance wherever we can find it on how to implement defense-in-depth and a multiple barrier provision in the context of high

level waste disposal is certainly of interest to us.

Thank you.

DR. KRESS: Thank you.

DR. APOSTOLAKIS: Okay. That's it.

DR. KRESS: I guess before I close, I will ask the subcommittee members if they would like to make any closing remarks. You're welcome to do it or not to. We've already said a lot.

DR. APOSTOLAKIS: Who is writing the letter?

DR. KRESS: So this is not a requirement. Who is writing the letter, I don't know. Do you want to write it, George? I think we can discuss this off-line and come up with some process to write a letter.

DR. APOSTOLAKIS: We can write pieces and send them to one person.

DR. KRESS: Send them to each other or send them to one person. Are there any closing comments from the subcommittee members?

DR. GARRICK: The only thing I wanted to say was one way to get a sense of who agrees with you and disagrees with you is to write something down. I did that, passed it around to my colleagues, and much to my expectation, I got some disagreement, but also got some agreements.

And what I was trying to do is nurture this idea of what can we agree on of a broad-based nature, and what I

was hearing was -- and what I put through my logic engine and came out with was things like supporting the notion that defense-in-depth is a philosophy for assuring safety. It should not be converted to an algorithm or an analytical process, do not support making DID a formal requirement, that's my view.

I guess I would continue to strongly encourage that the emphasis be on trying to quantify defense-in-depth. I think the advantage the reactor side has that the waste side does not have, the repository side does not have, is they have a basis for calibrating that measurement. We don't have much of a basis for doing that, but we sure have a basis for trying to improve our measurements.

Let's get our yardsticks out there before we decide what the levels should be, except for the overall performance.

On this issue of allocation, which is a red button for me, because I don't believe in reliability allocation, based primarily on my reliability analysis experience, it's not just on my risk experience, it has not worked very well. But if we mean by allocation guidance on the quantification of protection system, our lines of defense, and if we mean by allocation being more specific about form of PRA and PPA results, probabilistic performance assessment results, then I'm favor of it.

I do not favor prescribing individual system performance, for reasons that you've heard us talk. I continue to believe that we should put the emphasis on understanding what that contribution is, but in context of the performance measures that we're obligated to calculate.

I think that one of the things that we as technical people should always strive to do, because we do that better than anything else, is try to calculate what we're doing. Tom Pickford has always -- his answer is always the same, well, what do you do about that, his answer is, well, we try to calculate it, and I'm a great believer in that, that we have to, in the spirit of what Steve Hanauer and others have said, recognize that our calculations are just calculations.

In addition to the uncertainties, there are other things that have to be considered in making decisions, that risk assessment is not a decision analysis.

So anyway, that's a few of the things. I think that one of the things that I'm concerned about if we attempt to define defense-in-depth, that it will be narrower than we want it to be as soon as we think about it.

I think in serving on several nuclear plant safety committees, one of things that has impressed me just absolutely greatly is the impact that improving people performance has had on the performance of plants, without

any changes in the performance of equipment.

And to me, there is an element of defense-in-depth that is quite fundamental and extremely important and to the extent that we can begin to bring that into the process of the quantification exercise, we ought to try to do that, as well.

But I, as the Co-Chairman, appreciate what we have done in the last two days. There are some views that I have that have certainly been affected by what we've heard and we will do our best to see if we can provide some sort of documentation of this in a manner that is constructive for the Commission.

DR. APOSTOLAKIS: Maybe next time the ACNW meets with the Commission, you should mention the word safety culture.

DR. KRESS: Good idea. As Co-Chairman of this, I would like to express our appreciation to all the participants for this very interesting and stimulating discussion and, I think, very useful one. I'm anxious, and that's the right word, anxious to see what we may -- how me make use of all this when we put something down on paper. It certainly has been stimulating to me and quite a good discussion, I think.

So with that as the final thing, I am going to declare this subcommittee closed, adjourned.

[Whereupon, at 11:06 a.m., the meeting was concluded.]

REPORTER'S CERTIFICATE

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

NAME OF PROCEEDING: MEETING: ACRS/ACNW JOINT SUBCOMMITTEE

CASE NO:

PLACE OF PROCEEDING: Rockville, MD

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

Mark Mahoney

Official Reporter

Ann Riley & Associates, Ltd.

(SECOND DAY)

INTRODUCTORY STATEMENT BY THE CHAIRMAN OF THE JOINT SUBCOMMITTEE OF THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS AND THE ADVISORY COMMITTEE ON NUCLEAR WASTE
11545 ROCKVILLE PIKE, ROOM T-2B3
ROCKVILLE, MARYLAND
JANUARY 13-14, 2000

The meeting will now come to order. This is the second day of the meeting of the Joint Subcommittee of the Advisory Committee on Reactor Safeguards and the Advisory Committee on Nuclear Waste.

I am Thomas Kress, Co-Chairman of the Joint Subcommittee. On my left (right?) is Dr. John Garrick, also Co-Chairman of the Joint Subcommittee.

Joint Subcommittee members in attendance are Dr. George Apostolakis of the Advisory Committee on Reactor Safeguards, and Dr. Raymond Wymer of the Advisory Committee on Nuclear Waste. Also present is Dr. Milton Levenson, a consultant to the Advisory Committee on Nuclear Waste, and three invited experts, Mr. Robert Bernero, Dr. Robert Budnitz, and Dr. Thomas Murley.

The purpose of this meeting is for the Joint Subcommittee to discuss the defense-in-depth philosophy in the regulatory process, including its role in the licensing of a high-level waste repository, its role in revising the regulatory structure for nuclear reactors, and how the two applications should be related to each other. The discussion will also include the role of defense in depth in the regulation of nuclear materials applications, and other related matters.

The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions as appropriate, for deliberation by the full Committees.

Michael Markley is the designated Federal Official for the initial portion of this meeting.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register on December 21, 1999.

A transcript of the meeting is being kept. It is requested that the speakers first identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

NOTES ON DEFENSE IN DEPTH

B. John Garrick
January 14, 2000

- Support the notion that defense in depth is a philosophy and approach to assuring safety to the public of nuclear facilities. It should not be converted to an algorithm or analytical process. Do not support making DID a formal requirement.

- As a philosophy, prefer that DID not be explicitly defined for fear of the surrogate syndrome–i.e., putting licensing emphasis on surrogates rather than on the required overall performance or risk measure. We should support the concept of transitioning to a risk-informed, performance-based regulatory approach.

- Favor allocation if by allocation is meant guidance on the quantification of protection systems (lines of defense) and the form of PRA and PPA results. Do not favor prescribing the performance of individual protection systems or protective barriers. We should continue to put the emphasis on quantifying the role and contribution of individual protection systems to the overall measures of risk and safety performance.

- In the spirit of quantifying the performance of protection systems, which includes quantifying uncertainty, we should seek assurance that the protection systems contribute to the bottom line measures of performance and risk, including allowance for "unquantified uncertainties".

- We should continue to embrace the concept of total system performance, where total captures not only the physical systems involved, but the support infrastructure as well, including human performance, procedures, software, and the quality assurance and administrative process.

DID ISSUES EMPHASIZING THE YUCCA MOUNTAIN REPOSITORY

1. There are uncertainties in PAs. There is much less experience (data) with waste repositories than with reactors, so uncertainties in repository system performance are larger for waste repositories.

2. Performance and risk assessments requirements are not as well understood for waste repositories as for reactors. We need to elucidate and explain these many differences and recognize them in the DID philosophy statements.

3. There should be several lines of defense (DID) against release of radioisotopes and the resultant radiation exposures. The types and number of lines of defense should be directly related to the uncertainties in system performance.
and relative hazards of

4. DID requirements for waste (and nuclear materials) are different in very important ways from DID for nuclear reactors. For example, in the case of the YM repository after closure there is little probability of an accident of the type that reactors may have. This is related to the physical nature of the systems and to the fact that there are very large time-dependent and potential energy differences.

5. NRC should specify in clearly how the PA/PRA should be done by DOE in its LA for the YM repository, and what it should include. If the NRC guidance is good then the assessment should be able to be done well without further specific NRC guidance.

6. Because of the nature of the interactions between NRC and license applications for complex systems there will always be a strong possibility of an iterative licensing process (i.e., overtones of "bring me another rock").