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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

507th MEETING (ACRS)

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THURSDAY, NOVEMBER 6, 2003

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ROCKVILLE, MARYLAND

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The Advisory Committee met at 8:30 a.m. at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, Dr. Mario V. Bonaca, Chairman, presiding.

COMMITTEE MEMBERS:

MARIO V. BONACA Chairman
GRAHAM B. WALLIS Vice-Chairman
GEORGE E. APOSTOLAKIS ACRS Member
F. PETER FORD ACRS Member
THOMAS S. KRESS ACRS Member
GRAHAM M. LEITCH ACRS Member
DANA A. POWERS ACRS Member
VICTOR H. RANSOM ACRS Member
STEPHEN L. ROSEN ACRS Member-at-Large
WILLIAM J. SHACK ACRS Member

COMMITTEE MEMBERS: (CONT.)

| | |
|---|---|
| JOHN D. SIEBER | ACRS Member |
| MICHAEL T. RYAN | ACNW Member |
| RUTH WEINER | ACNW Member |

ACRS STAFF PRESENT:

| | |
|---|---|
| JOHN T. LARKINS | Executive Director-ACRS/ACNW |
| SHER BAHADUR | Associate Director-ACRS/ACNW |
| MAGGALEAN W. WESTON | Staff Engineer |
| SAM DURAISWAMY | Technical Assistant, ACRS/ACNW, Designated Federal Official |
| HOWARD J. LARSON | Special Assistant, ACRS/ACNW |

ALSO PRESENT:

| | |
|---|---|
| Alex Murray | NMSS/FCSS/SPIB |
| Allen Notafrancesco | RES/DSARE |
| Bob Palla | NRR/DSSA |
| Bob Youngblood | ISL |
| Brian Richter | NRR/DRIP |
| Bruce Mrowca | ISL |
| Cathy Nancy | NRR/DRIP |
| David Brown | |
| David S. Hood | PDIII/DLPM/NRR/NRC |
| David Solorio | NRR/DRIP/BPLB |
| David Skoen | NRR/DRIP/RPRP |
| Devender K. Reddy | NRR/DSSA/SPLB |

ALSO PRESENT: (CONT.)

| | |
|---|---|
| Don Dube | RES/OERAB |
| Duncan Brewer | Duke Energy |
| Edwin S. Lyman | Union of Concerned Scientists |
| George Lanik | RES/DSARE/REAHFB |
| Greg Cranston | NRR/DRIP |
| James Peterson | AmerGen |
| James Kenny | GE, BWROG |
| Jodine Jansen | AEP |
| Joe Giitter | |
| John Flack | NRR |
| John Kauffman | RES/DSARE/REAHFB |
| John Butler | NEI |
| John Lehner | Brookhaven |
| Ken Meade | FENOC (BWROG GSI-189 Committee) |
| Lane Hay | Bechtel Power Corp. |
| Margaret Chatterton | |
| Mark Rubin | NRR/DSSA/SPSB |
| Mary Drouin | |
| Mohammed Shwaibi | NRR/DLPM |
| Patricia Campbell | Winston & Strawn |
| Phillip Ray | NRR/DRIIP/RPRP |
| Rex Wescott | NMSS/FCSS |
| Richard Dudley | |

ALSO PRESENT: (CONT.)

| | |
|---|---|
| Robert Pierson | NMSS/FCSS |
| Rounette Nader | Duke Energy |
| Samuel Hernandez | NRR/DIPM |
| Scott Gordon | NMSS/FCSS/SPIB |
| Spyros Traiforos | LINK |
| Stewart Schneider | NRR/DRIP |
| Sunil Weerakkody | NRR |
| Tom King | NRC |
| Trevor Pratt | Brookhaven |
| Vinod Mubayi | Brookhaven |
| Warren Lyon | NRR/DSSA/SRXB |
| William Troskoski | |

# I-N-D-E-X

P-R-O-C-E-E-D-I-N-G-S

(8:31 a.m.)

CHAIRMAN BONACA: Good morning. The meeting will now come to order. This is the second day of the 507th meeting of the Advisory Committee on Reactor Safeguards.

During today's meeting, the committee will consider the following: Proposed resolution of generic safety issue 189, "Susceptibility of ice condenser and Mark III containments to early failure from hydrogen combustion during a severe accident"; regulatory effectiveness of the resolution of unresolved safety issue (USI)-A45, "Shutdown decay heat removal requirements"; mixed oxide fuel fabrication facility; advanced non-light water reactor licensing framework; subcommittee report on the Ginna license renewal application; report on the NRC safety research program; proposed ACRS reports. A portion of this meeting will be closed to discuss a proposed ACRS report on safeguards and security.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Mr. Sam Duraiswamy is the designated federal official for the initial portion of the meeting.

We have received no written comments or requests for time to make oral statements from members of the public regarding today's sessions. A transcript of portions of the meeting is being kept. It is requested that the speakers use one of the microphones, identify themselves, and speak with sufficient clarity and volume so that they can be readily heard.

Before we start with the first item on the agenda, I would like to point your attention to items of interest in front of you. You have a number of speeches from Chairman Diaz, Commissioner of Merryfield, and a number of right-in-front issues described in this document.

With that, we will move to the first item on the agenda is the proposed resolution of generic safety issue 189. Dr. Kress will take us through this presentation.

MEMBER KRESS: Thank you, Mr. Chairman.

## 6) PROPOSED RESOLUTION OF GENERIC SAFETY ISSUE 189, "SUSCEPTIBILITY OF ICE CONDENSER AND MARK III CONTAINMENTS TO EARLY FAILURE FROM HYDROGEN COMBUSTION DURING A SEVERE ACCIDENT"

### 6.1) REMARKS BY THE SUBCOMMITTEE CHAIRMAN

MEMBER KRESS: The information on this

issue you will find under tab 6 of your handout book. You will also find an addendum there for this part of the meeting. I particularly want to call your attention to a letter from the PWR owners' group that you might want to read on this issue. It's a short letter. So you can probably read it sometime during this meeting.

I remind the members that we had a previous letter on this subject. The staff came to us with a regulatory analysis on the need for backup powers to igniters as well as backup power to fans. They also did an uncertainty analysis for those.

If you recall, the cost-benefit part of the regulatory analysis was indeterminate, would be the best way to put it, with the certainties that crossed both the negative and positive sides.

The cost-benefit for the fans part really failed the regulatory analysis. The issue came down to just adding the backup power to the hydrogen igniters for both Mark III's and for ice condenser containments.

The final decision at that time and in our letter was that, even though the cost-benefit was iffy, we thought that this was a reasonable defense-in-depth addition but that it probably didn't

warrant full rulemaking and that we suggested the staff talk to the impacted plants and see if there is any possibility of adding this into the severe accident management guidelines.

And they did go talk to the plants and discuss that. I think what we are going to hear now is their discussion of what they found out and what their current position is on this.

With that, I guess I will turn it over to -- is it Greg Cranston will start with the NRR?

MR. CRANSTON: Yes. I thank you, Dr. Kress.

6.2) BRIEFING BY AND DISCUSSIONS WITH REPRESENTATIVES OF THE NRC STAFF

MR. CRANSTON: My name is Greg Cranston. I am the lead technical reviewer for generic safety issue 189, which is the susceptibility of ice condenser and Mark III containments to early failure from hydrogen combustion during a severe accident.

With me today on my left is Sunil Weerakkody, the section chief, who will be also making a brief presentation this morning. And on my right is Bob Palla with the PRA group, who provided a lot of assistance and worked with me in conjunction with the review of this generic safety issue.

We are here this morning to inform the ACRS of the status of generic safety issue 189 for review and comment prior to presenting any recommended resolutions to the commission. And we wanted to provide the ACRS the opportunity to receive comments also from applicable licensees, general public, and other stakeholders regarding this particular issue.

A brief background. In 1985, rulemaking retrofitted 13 plants with AC-powered igniters. This included nine PWRs, condensers and four BWR Mark III containers. These igniters were provided to provide a control burn of hydrogen to prevent possible deflagration or detonation should the hydrogen concentrations reach a certain level. This is a beyond design basis accident scenario.

In reviewing the situation since the installation back in 1985, it became clear, two things: one, that obviously during a station blackout, you will not have the igniters; and also the probability of station blackouts might be higher than what some thought originally.

Because of that, in response to the SECY 00-189, which is risk-informing 10 CFR 50.44 standards for combustible gas control, the generic safety issue 189 was generated.

Based on that, research conducted a technical assessment which included a cost-benefit analysis. Basically the analysis used enveloping data for NUREGs for generic application with some input from the licensees to ensure that the parameters that were considered were below.

Based on research's analysis and discussions with the ACRS, the ACRS concluded, as Dr. Kress pointed out, that regulatory action was warranted, which recommended that we consider defense-in-depth, which is one way of dealing with a lot of the uncertainties that were associated with the analyses, which I will be discussing later in the presentation, consider public confidence, and also consider approaching licensees in conjunction with using severe accident management guidelines versus either order or rulemaking.

At that time I would like to turn the presentation over to Sunil to give you kind of an overview also of our approach here.

MR. WEERAKKODY: Yes. I just want to take a few minutes to go over a couple of the key high-level points. Then that will take about five minutes. Then Greg is going to take the presentation back.

The four bullets that I have put up here, the policy issue, difference in that, backfit rule mitigation, prevention, I'm not going to necessarily be talking in the order of those bullets, but I am going to talk about a couple of high-level issues that pertain to those bullets.

First off, I apologize. Suzy Black, our regional director, could not be here, but we had the staff and management from the rulemaking and policy branch back in the audience. We are from the technical branch, but there is staff and management. If you have any questions on rulemaking and policy, we can answer those, too.

To start where Greg ended, when you wrote a letter in November 2002 to the EDO, the EDO's leader responded and said the staff is considering the resolution of 189 following our management directives. It's point four. And we will look at the full range of directives from no action to the development of a proposed rule.

What I would like to focus on is the rulemaking option because, at least for the time being, the information that we have in front of us, we are leaning towards that option. And I want to give some details as to why we are leaning toward that

option.

I also want to emphasize that, even though we are considering or leaning toward that option, we are keeping a very open mind because any proposals which the industry could come up with or anybody else could come up with that could achieve the final objective of the issue resolutions.

We had a public meeting on this issue a couple of months ago, received some feedback from the industry, one being if you go down the path of rulemaking, the need to control, carefully control, costs so that the cost part of the equation does not overwhelm the licensees and cause unnecessary burden.

These were from different licensees made different proposals. A second licensee said, how about we use that money to reduce the core damage frequencies further and get the benefit from there?

Obviously the first proposal we know we are going to take under serious consideration. The second proposal does not serve the argument good, which is I think, as you correctly pointed out, the difference in that part because in this particular issue, we are looking at the container barrier. Reducing the core damage frequency further does not serve that.

One of the things I would like to focus is that based on my history of making these kinds of presentations and discussions with different committees, because we have expended a lot of time and effort on cost-benefit, even though I started a discussion on defense-in-depth, it ends to be discussions of uncertainties and cost-benefit. I think some of that is part of the issue, but I am going to focus today on the defense-in-depth part of it.

First off, we know that the backfit criteria must be satisfied to justify imposing requirements on any licensee. We also know that if we use defense-in-depth as the argument to demonstrate that there is substantial increase in the protection of the public health and safety and that the direct and indirect cost of implementation for that facility is justified in view of increased protection, our colleagues in the policy and rulemaking program have accurately pointed out to us that this is a critical policy matter. It's not a frequent occurrence where we make rules based on defense-in-depth.

This is because the defense-in-depth argument is not normally associated with the addition of new requirements to mitigate accidents. Therefore,

this would be discussed with the commission as a policy issue.

Again, I emphasize that the rule and policy-making branch has pointed out to us that since this is a policy issue, we should. If we go down that path for commission approval, the commission paper will articulate this fact for commission attention and approval clearly.

We also have been told and if we agree with our colleagues in the rulemaking branch that if we did agree to go down the path of rulemaking using defense-in-depth, then we must be very, very clear to ensure that we are not using the defense-in-depth argument in a cavalier fashion because it has happened before and we have done some research using some of the publications from the ACRS.

We finally relied on three documents to ensure that we are not using defense-in-depth in a cavalier fashion. At the internal process/procedure level, we relied on reg guide 1.174. The first key principle on defense-in-depth in reg guide 1.174 states, and I quote, "Reasonable balance should be preserved among prevention of core damage, containment failure, and consequence mitigation."

We are also guided by NUREG BR-0058, which

is the regulatory analysis guidelines.

MEMBER KRESS: Excuse me. How do you interpret what is meant by "reasonable balance"?

MR. WEERAKKODY: I don't think I can give you a numerical answer, Dr. Kress, but when I go sit with the leaders of presentation, if I take an example, if I have a containment failure probability on a core damage sequence that could be 90 percent of the total core damage and the best knowledge of the containment failure probably is a .5 or a .9 or .7 or .3, I don't think there is reasonable balance.

MEMBER KRESS: It's sort of in the eye of the beholder?

MR. WEERAKKODY: Well, I wouldn't necessarily agree. You have to have some guidance. In fact, if you go to NUREG 0058, there is some additional guidance. It's not a requirement, but in that document, it says, "Containment, conditional core failure probability greater than .1 requires greater staff action."

MEMBER APOSTOLAKIS: Is that, though, an average over all sequences or should it be on a per-sequence basis?

MR. WEERAKKODY: Could you answer that?

MR. PALLA: Yes. It is an average overall

sequence. It's a set of old core densities.

MEMBER APOSTOLAKIS: So for some sequences, it can be much great?

MR. PALLA: Interfacing system LOCA and steam generator tube ruptures have conditional failure probabilities of one.

MEMBER KRESS: It's an average that is weighted by the core damage frequency.

MR. PALLA: It is a weighted average.

MEMBER KRESS: So if station blackout, for example, were a dominant core damage frequency, it would weigh heavily in that average.

MR. PALLA: Yes, sir, which it is in Mark III's and --

MEMBER APOSTOLAKIS: It is a dominant for core damage.

MR. PALLA: Even in the ice condensers, it's dominant.

MEMBER APOSTOLAKIS: So if you don't have the X of power, what is the conditional -- well, are you going to get to those things?

MR. WEERAKKODY: Yes.

MEMBER APOSTOLAKIS: An another point, you say that your argument will be based on defense-in-depth and you will try to avoid

cost-benefit considerations. Is that right?

MR. WEERAKKODY: My next bullet is on that. I wouldn't --

MEMBER APOSTOLAKIS: Well, they go together in my view.

MR. WEERAKKODY: Yes. In fact, like I've summarized, when the uncertainty is high, as was the case in this situation where depending on the assumptions, it may or may not be cost-beneficial, then you definitely have to look for the defense-in-depth.

MEMBER APOSTOLAKIS: Would you call that realistic conservatism or --

MR. WEERAKKODY: You mean the two approaches?

MEMBER APOSTOLAKIS: Well, what you just said, that the uncertainties are large. Then we go to defense-in-depth.

MEMBER KRESS: Yes, that's reasonable.

MEMBER APOSTOLAKIS: That's an attitude, right?

MR. WEERAKKODY: Well, I think I could quote that from you, actually.

MEMBER APOSTOLAKIS: No. The Chairman I think uses, what, realistic conservatism?

MR. WEERAKKODY: Realistic, yes.

MEMBER APOSTOLAKIS: Realistic conservatism.

MR. WEERAKKODY: Well, my final long sentences would be we looked at a third document. The third document we relied on at a philosophical level was a letter from a number of ACRS members, Dr. Apostolakis, Dr. Powers, and Dr. Kress. It is like a 1998 paper, but I think all of you are still here.

MEMBER APOSTOLAKIS: It was actually addressed by the full committee. It was an attachment to a letter.

MR. WEERAKKODY: Yes. The letter had basically --

MEMBER APOSTOLAKIS: It was an attachment to a letter. So the committee has blessed it.

MR. WEERAKKODY: I'm not going to go over the details of the paper, but we made sure that when you proceed, the party proceeds, it is consistent with the philosophy in that letter.

MEMBER KRESS: Let me ask you a bit of a hypothetical question on your first bullet there, the reg guide 1.174. If these particular plants had the backup power to their igniters in place already and they would come in and say, "We want to remove this.

We want to use reg guide 1.174 as a basis for changing it to our licensing basis," will it pass? Would they be able to remove it or not?

MR. CRANSTON: Actually, you're kind of getting into --

MEMBER KRESS: We're going to get into that area?

MEMBER APOSTOLAKIS: See, that's what happens when you give an overview.

MR. CRANSTON: That is an excellent lead-in to the next portion of the presentation. When NRR received the generic safety issue in conjunction with our review, we wanted to look at the regulatory significance, the regulatory basis, as well as what the regulatory options would be in conjunction with resolving the generic safety issue.

As Sunil pointed out, we looked at two key areas. We looked at defense-in-depth. We felt that would play a vital role in conjunction with this particular issue because of the uncertainties associated in the cost-benefit analysis and some of the other analyses.

We did look at the cost-benefit. Even though it wasn't decisive, one of the things that had been mentioned in conjunction with the ACRS review was

that external events, for example, had not been considered. And there were some other factors that we might be able to evaluate.

There was some data available in the analyses run by the laboratories for RES that gave us some information and other information. Working with Bob Palla here, we were able to gain some information there to try to quantify a little bit more some of these issues to reach a conclusion that we felt both the defense-in-depth and the cost-benefit analysis would apply in this particular case.

This particular graph is from the information provided in the analyses done for research. Where it shows the contribution of internal events in the solid color, the solid cylinder, the solid line for the two ice condenser plants labeled 1 and 2 also was available in the analysis data that we had.

There was no external event data available for the Mark III's. Therefore, we kind of estimated it based on a combination of past practice of in some cases just doubling the internal event value or ratioing it in proportion to what the external events were to the internal events at the ice condenser plants.

So, again, the reason those lines are shown as dashed is it's kind of based on best engineering judgment to kind of put things in perspective as far as --

MEMBER APOSTOLAKIS: Can you remind me what averted cost means?

MEMBER KRESS: The person rims, George, person rims.

MEMBER APOSTOLAKIS: No. But the word "cost."

MEMBER KRESS: It's the $2,000 per-person rim, I think.

MEMBER APOSTOLAKIS: Oh, that kind of thing? Okay. The averted risk?

MEMBER KRESS: Yes, the cost of the averted risk.

MEMBER APOSTOLAKIS: Yes, the averted risk, not the averted cost.

MEMBER KRESS: Well, that's what we call it in regulatory analysis.

MR. PALLA: Costs are assigned. They're assigned monetary values.

MEMBER APOSTOLAKIS: The terminology is consistent with the procedure, the analysis itself.

MEMBER KRESS: Yes. As best I recall,

some of the estimated costs were about 300, Gary?

MR. CRANSTON: Yes.

MEMBER KRESS: Just in case we wanted to stick another line on there.

MR. CRANSTON: And I will have a graph later that does throw the costs up there as well against the benefits.

MEMBER KRESS: Okay.

VICE-CHAIRMAN WALLIS: For number 3, you don't have external events. You can't throw them out. There are going to be external events. Simply because the internal events are so large you didn't bother to put anything to it?

MR. CRANSTON: Well, I could have put a dashed line on top of that. Then you go off --

VICE-CHAIRMAN WALLIS: Still maybe?

MR. CRANSTON: The reason I did put that one up is the third example was, as you pointed out. It was in this case, the internal event was very significant.

VICE-CHAIRMAN WALLIS: But if we did add external events, it would be off scale or off towards the top of the graph somewhere?

MR. CRANSTON: That's correct. Yes, sir.

MEMBER ROSEN: Now, what are the numbers

1, 2, 3? Different plants?

MR. CRANSTON: Those are different plants, yes.

MEMBER ROSEN: Thank you.

VICE-CHAIRMAN WALLIS: I found this impression. I mean, it was sort of touch and go before. Now external events make a significant difference.

MR. CRANSTON: I think it did kind of shift the tide. And even though there are still uncertainties for the cost-benefit that did fluctuate quite a lot, it kind of narrowed it down a little bit as far as --

MEMBER APOSTOLAKIS: Can you give me some idea of what the uncertainties are, some idea? I mean, when you say 500 what? Thousand?

MR. CRANSTON: Well, in some cases, the values on the benefits went as high as a million dollars, for example.

MEMBER APOSTOLAKIS: So it's a factor of two?

MR. CRANSTON: It would be a factor of two. And then the other way, of course, it could swing down.

MEMBER APOSTOLAKIS: That's up and down,

factor of two?

MR. CRANSTON: Yes. As far as the regulatory significance, in doing our research, certainly loss of off-site power, common cause failures of the emergency diesels, and station blackouts have occurred. So it's certainly credible.

MEMBER APOSTOLAKIS: Would you remind me of what the probability of this is?

MR. CRANSTON: The probability of what?

MEMBER APOSTOLAKIS: The loss of off-site, common cause failures of diesels, the frequency of SBOs.

MR. WEERAKKODY: I would be making an approximate guess. I would say one in a thousand.

MEMBER APOSTOLAKIS: One in a thousand? No.

MR. WEERAKKODY: You said station blackout.

MEMBER APOSTOLAKIS: Yes, station blackout. It can't be one in a thousand.

MR. WEERAKKODY: Lose off-site power and then lose the --

MEMBER APOSTOLAKIS: The diesel is --

MR. WEERAKKODY: -- the diesels, common cause failure of both diesels would be around .01.

MEMBER APOSTOLAKIS: It's too high.

MEMBER KRESS: It's like $10^{-6}$, I think.

MEMBER APOSTOLAKIS: To have a station blackout?

MEMBER KRESS: It's on the next slide? Okay. Thank you.

MEMBER APOSTOLAKIS: The next slide is core damage frequency. It's not just --

MR. CRANSTON: We're on station blackout. It shows both. It shows the total core damage frequency. And then it shows the SBO portion.

MEMBER APOSTOLAKIS: Where is that? Oh, the red.

MR. CRANSTON: The red is the --

MEMBER APOSTOLAKIS: That's the contribution of SBO to core damage. So what else does it include in addition to the actual blackout?

MR. WEERAKKODY: It's the boiling water reactor. It includes your --

MR. CRANSTON: We also looked specifically for the --

MEMBER APOSTOLAKIS: So what was the message in the previous slide?

MR. CRANSTON: Oh, I'm sorry. The station blackout can be a significant portion of your core

damage frequency. That's the guise that we used in conjunction with what we have. Translate that into the cost-benefit analysis.

MEMBER ROSEN: So it's more than either the -6 for ice condensers, considerably more?

MEMBER KRESS: Yes.

MR. CRANSTON: We also specifically looked at the conditional containment failure probability without the igniters. For ice condensers, this varied from a .02 to approximately .9. For the Mark III's, loss of containment only, it was about .5.

Losing both the drywall and the containment, which would translate into a large early release, it was around .2, exceeded the containment performance safety goal, which is the NUREG 0058, which Sunil had talked about earlier, where values greater than .1 required greater staff action.

This kind of gets back to Dr. Kress' question. I also mention it in conjunction with reg guide 1.174 in an upcoming slide. Primarily these documents do discuss situations where if you have something, can you remove it? And you apply the criteria.

We didn't really find anything that says, do you have to add something.

MEMBER APOSTOLAKIS: Where are you? Which document are you referring to?

MR. CRANSTON: Both reg guide 1.174 and NUREG 0058. Really, their approach is from the standpoint of providing criteria that one would use in conjunction with making a decision to allow a plant to take something out, rather than applying that criteria to saying, do you need to add something?

MEMBER APOSTOLAKIS: I understand that about 1.174 but 0058?

MR. CRANSTON: Generally the way you read --

MEMBER APOSTOLAKIS: Is that the regulatory analysis document?

MR. WEERAKKODY: Yes. That's all --

MEMBER APOSTOLAKIS: Backfit? Yes. So --

MR. PALLA: That document is more structured towards additional requirements.

MEMBER APOSTOLAKIS: Additional, yes.

MR. PALLA: When do you stop? It's a comprehensive assessment. It could go both ways. 1.174 is largely structured in the reverse direction.

MR. CRANSTON: It's called regulatory analysis guidelines. And where we are involved is mainly in section 3.32, the containment performance.

MEMBER APOSTOLAKIS: I understand that, but it's not just removed.

VICE-CHAIRMAN WALLIS: Can you move to another slide here somewhere?

MR. CRANSTON: I'm sorry. That was a backup slide. That's not in the package. Provide a little bit more information about the --

VICE-CHAIRMAN WALLIS: So here you say, "Containment failure probability without igniters." What is it with igniters?

MR. CRANSTON: It goes to essentially zero.

VICE-CHAIRMAN WALLIS: So the value added is very big?

MR. CRANSTON: Yes.

VICE-CHAIRMAN WALLIS: In terms of public perception, the idea that there is a 90 percent failure of containment doesn't sound good at all.

MR. CRANSTON: That's true.

VICE-CHAIRMAN WALLIS: Whatever you multiply it by your other terms and so on, it doesn't look so important. But the idea that this containment, which is supposed to be an important safety feature, has a 90 percent probability of failure is not a good thing to put before the public.

MR. CRANSTON: And that's one area that we discussed internally, too, in conjunction with -- it's a conditional containment failure probability you have to have the --

VICE-CHAIRMAN WALLIS: I know that.

MR. CRANSTON: But, again, looking at considering the amount of money that would have to be spent to provide the backup power supply, which, again, I will talk about a little bit later, if you use that for prevention, rather than mitigation, yes, you can maybe influence CDF a little bit or some other factor a little bit, but it still doesn't help you on the mitigation side of it. That still doesn't go away. So that's why we probably still have to stay on that side of the fence.

MEMBER APOSTOLAKIS: These numbers are very uncertain, aren't they? I remember from NUREG 1150. I mean, essentially it was between .1 and 1.

MR. PALLA: Yes. Let me just say something about that. These numbers, you have to realize, for example, here and a good example, the ice condenser numbers. These are derived from a Sandia study on direct containment heating. As input to these numbers, you have to determine whether the reactor vessel fails at high pressure or low pressure.

So that will make a difference.

So obviously you've got uncertainties about whether temperature-induced depressure rupture of the RCS system, does it occur/doesn't it occur, operator actions to depressurize if they're viable. They go into that.

And lower-pressure failures result in the lower-end values here, the upper-end values are driven by an assumption in that NUREG. That study was done to address direct containment heating. And it made some assumptions that were bounding insofar as it would give you a high direct containment heating load. And then if you were able to deal with that, the direct containment heating issues result.

One of the assumptions implicit in that study was that random ignition of hydrogen that's released prior to vessel breech does not occur. So you will accumulate all of the hydrogen that is released prior to vessel breech. And then at the time of vessel breech, coincident with the blow-down of the RCS, you are going to burn that hydrogen.

So you tend to see high numbers in these high-pressure sequences. And some of that is due to kind of the forced assumption that you're not burning this hydrogen prior to that by some random source.

Now, random ignition, of course, is an uncertainty. That study bounded that uncertainty by assuming it just didn't occur. But if you wanted to try to get realistic and if you went to some plant-specific PRAs, you could credit random ignition with some likelihood. So if you gave credit for random ignition, you could drive these numbers down.

So what we are trying to do here is this improvement will help to reduce some of these uncertainties that are kind of hard to deal with. In the 1150 numbers that you mentioned, Dr. Apostolakis or within that range, they are towards the low end. I think they're around .3 is my recollection.

MEMBER APOSTOLAKIS: Well, my point was that these numbers are highly uncertain, as I remember. Just to say about .5, I'm not sure that that is an accurate representation. And if you really look at the results, the figures of NUREG 1150, you have --

VICE-CHAIRMAN WALLIS: Any number above .1 is something that public --

MEMBER APOSTOLAKIS: This is a good argument. I think Bob just said it. The proposed fix really eliminates a lot of that. It is very clear.

MR. CRANSTON: And, again, the

uncertainties, as you mention, varied, but they varied above .1. And, again, the uncertainty, the term "uncertainty," kept bringing us back to defense-in-depth, too.

MEMBER APOSTOLAKIS: So you guys are convinced that you understand the common cause failure of three diesels so well that these numbers above SBO frequency are credible?

I mean, we just went over it. It just loss of off-site power and common cause failure of emergency diesel generators, 75 SBO. That's about one in a thousand a year. Is there strong evidence to support that the diesels will just go like that?

MR. CRANSTON: Well, there have been common cause failures. I mean, it's not something that hasn't ever happened.

MEMBER APOSTOLAKIS: Yes.

MR. CRANSTON: And yes, the probability is very low. In making a risk-informed decision and in looking at the consequences, it led us to where we are today.

MR. WEERAKKODY: If I may give you some knowledge I have based on my previous life in research in the operation, what used to be AEOD, where we collected data and analyzed it.

One of the reports I have is the diesel. We have this report. I had to look very carefully, again in my previous life, at the loss of off-site power frequency. Those reports are created based on actual experiences.

We have had a number of common cause -- I don't know the previous failures, Dr. Apostolakis, but it's credible. I know that.

MEMBER APOSTOLAKIS: So if we go with a beta factor, is it about one in ten for diesels? I don't remember.

MR. WEERAKKODY: I can't remember the number, but --

MEMBER APOSTOLAKIS: Or is it worse?

MR. WEERAKKODY: What I could do is --

MEMBER APOSTOLAKIS: I'm sure you can find it.

MR. WEERAKKODY: Yes, I can find it, but, for example, when you think of the diesel common cause failure, even though you have diesels, two diesels or three diesels, there are a number of commonalities like --

MEMBER APOSTOLAKIS: You see, that's an interesting point.

CHAIRMAN BONACA: I'd like to ask about

the operating experience. Does it include cases that we have seen where you have a diesel that was found not to run for a long enough time, you know, started but run for just a short time, and found that the maintenance of the diesel was the cause for the fact that it would not run for a long time? And then they didn't look at the other ones, but they knew that the same maintenance had been done to the other one. And, therefore, that would have been a common cause failure.

Does the operating experience you are referring to include those cases?

MEMBER APOSTOLAKIS: Yes.

CHAIRMAN BONACA: It does include those cases?

MEMBER APOSTOLAKIS: It includes everything. The problem with evaluating the operating experience is that you have to make a lot of assumptions --

CHAIRMAN BONACA: Right.

MEMBER APOSTOLAKIS: -- because many times you don't have a completed common cause failure. You suspect. One is a failure. You suspect the other might. It is going to be your judgment is what I am referring to.

MR. WEERAKKODY: But if I stay with the example Dr. Bonaca gave, I have known and actually spent a couple of months analyzing an actual event where in a particular plant, one diesel basically is a failure after the third or fourth plant because of low maintenance.

And then obviously one of the things that a licensee is required to do, after the fact or at some point, is look at --

MEMBER APOSTOLAKIS: The other ones.

MR. WEERAKKODY: And you found that number.

MEMBER APOSTOLAKIS: Sure.

MR. WEERAKKODY: In this particular case, they found it because of that same thing with the diesel.

MEMBER APOSTOLAKIS: I think this also points up a problem with the way we quantify common cause failures because now a licensee who wants to come and say, "Well, I'm going to spend the money making sure common cause failure will not work."

They have no way of demonstrating that even if they spend a billion dollars, the beta will go down because there is no model that tells you how beta changes with whatever you do to the plant. It's a

fudge factor, really.

Just remember my words. This will come back many times, many times. And the reason I am saying that, there is a similar problem with an advanced reactor that I am involved with, the beta factor. The designers are saying, "I am going to do something about this."

The answer from the PRA guy, "You can't do anything about it. Data is fixed."

MEMBER ROSEN: Recognizing these arguments, what I take away from this slide is that the containment, conditional containment, failure probability is greater than .1.

MR. CRANSTON: Yes. And also I can refer you to NUREG CR-950, which is a reliability study on the emergency diesel generators. Between 1987 and '93, there were 20 accident sequence precursors in which either no diesels were available or the conditional or the common cause failure of multiple diesels occurred.

Eleven of those reported at nine different plants, including an ice condenser and a Mark III plant, had a conditional core damage probability of greater than $1^{-4}$. So that was based on that particular NUREG. We were looking for a number

earlier if that's helpful.

But, as you mentioned, we're still looking at a number greater than .1.

MEMBER LEITCH: Okay. While we are talking about diesels, do any of these plants have SBO diesels?

MR. CRANSTON: No.

MEMBER LEITCH: They do not?

MEMBER APOSTOLAKIS: I don't understand. What --

MR. CRANSTON: I don't think they have a station blackout diesel. Correct me if I am wrong.

MEMBER APOSTOLAKIS: What does that mean? All of them have to have a station blackout diesel.

CHAIRMAN BONACA: They have emergency diesels.

MEMBER LEITCH: I mean in addition to the emergency diesels, I'm talking about a non-safety grade --

MEMBER APOSTOLAKIS: Station blackout diesel.

MEMBER LEITCH: -- station blackout diesel. Do a number of these plants have such equipment?

MR. PALLA: I think it is fair to say if

they had it, it would be modeled in the core damage frequency estimates that we are providing.

MEMBER APOSTOLAKIS: But you would wipe it out again with a common cause failure. The most you can get is something like .6. Gamma is usually .6, .5.

MR. PALLA: These may be diverse, though.

MEMBER LEITCH: Yes, they're usually diverse.

MEMBER APOSTOLAKIS: They're diverse, I agree, but the maintenance issue is always a current one.

MEMBER LEITCH: I don't quite understand this, George. Do you mean no matter how many diesels you add, you've still got the same kind of common kind cause?

MEMBER APOSTOLAKIS: No.

MEMBER ROSEN: No, not if the diesels are extremely different. For example, if the subplants have a jet, diesel for a backup, turbine, gas turbine. Some plants have a lake, a hydro plant. So in those cases, you would credit some --

MEMBER APOSTOLAKIS: You would credit it but not to the extent that you would expect because of this common cause. The problem here of adding the

common cause failure factor is to put a lower bound on the --

VICE-CHAIRMAN WALLIS: Something like polluted fuel or something that affects all of the diesels, no matter how much they are?

MR. PALLA: That has been observed, that very thing.

MEMBER APOSTOLAKIS: You don't specify the cause, which is good from the assessment point of view, but from the designer's point of view, it's not good.

VICE-CHAIRMAN WALLIS: What if you had a gasoline engine, instead of a diesel? That's no longer a common cause.

CHAIRMAN BONACA: But what is important, for clarification, because in all of these meetings we have had, we have not clarified that to recognize the many plants and I don't know if all of them, but if you had the standard diesels, generators, then because of station blackout concerns, many plants added a station blackout diesel. I would expect --

MEMBER LEITCH: Or some other --

CHAIRMAN BONACA: That's right.

MEMBER LEITCH: -- alternate, like a hydro plant.

CHAIRMAN BONACA: That's right. In many respects, this category of plants would have, in fact, implemented those. Now, given that we also have this additional layer of protection, when you make the station blackout, then you have to assume that your normal diesel generators are not running and also your blackout diesel is not running. And so this is a third layer. I mean, you have an additional requirement now for another diesel to just operate igniters.

MEMBER LEITCH: You see, that's what bothers me about this whole thing. When you say a station blackout, what I am thinking about is an event where off-site power is loss and none of the emergency, the safety-grade emergency, diesel generators worked.

I think in a station blackout, you assume the station blackout diesel doesn't work. I mean, if that's the case in a station blackout, you would assume that this diesel that we're now proposing wouldn't work either. I mean, how many --

MEMBER POWERS: There's a chance it won't.

MR. CRANSTON: I'm not aware of a designated either like a gas turbine like they have at Salem or some other station-specific component that's

designated as a station blackout energy source. Maybe a --

MR. BREWER: I'm Duncan Brewer. I'm the PRA group supervisor for Duke Power Company. We have McGuire and Catawba nuclear stations, which are both two-unit ice condenser plants.

Included in those station blackout core damage frequencies is the likelihood that we will lose our off-site power, the likelihood that we will fail both of the emergency diesel generators, the likelihood that we will fail our station blackout diesel, or the turbine-driven pump, and then also the likelihood that we would fail to recover power with core damage.

So in the scenarios where you are looking at potentially adding some type of power system to power the igniters, you would have already had all of those failures. It has to be something that would work.

The frequencies are those similar to what was shown on that slide, in the neighborhood of one times $10^{-5}$ or higher. I think the high plant that was there was Sequoyah from NUREG 1150.

I just want to point out that most utilities have worked very hard to reduce station

blackout core damage frequency because that was one of the insights with the IPE. And that is what we focused our attention on.

So, as a result, that high core damage frequency for Sequoyah is from NUREG 1150, which is about 15 years old now, I think. It's very possible that they have worked to reduce that number.

So I just wanted to point that out, that that may not consider all of the plant-specific feature that they have put in place to try and reduce that number.

We do have a station blackout diesel generator. And to get to core damage, it has to also fail.

MEMBER APOSTOLAKIS: And do you assume any potential common cause failure between the station blackout diesel and the other diesels?

MR. BREWER: Yes. We look at the ones in the common cause database for which we would apply that measure. Things include, for example, fuel and common maintenance practices, but they are diverse in that they are not the same manufacturer, they are different sizes, and things like that.

So you have to go through the common cause database and figure out which ones you think would

apply and which ones wouldn't. And you would do the same thing, I think, for this diesel.

You would then go through and identify how diverse is this backup power supply, what are the common failure modes that have been seen in the database that would apply to both it and your other diesels. So you could calculate it.

But you're right. There would also be some potential that whatever caused failure of your other diesels is going to fail this backup power supply as well.

VICE-CHAIRMAN WALLIS: Unless you use a completely diverse power supply.

MR. BREWER: If there were something completely different, yes

VICE-CHAIRMAN WALLIS: Right, like the hydro power that was mentioned before.

MEMBER ROSEN: Well, even those completely diverse sources may have to go through the same buses eventually.

VICE-CHAIRMAN WALLIS: So there are some mechanisms for common cause.

MEMBER ROSEN: Yes.

MR. WEERAKKODY: One other thing I wanted to point out is when the station blackout was

implemented and the different plants did different things, for example, the diesel generator has that diesel and then the other two units cross-tied the diesels they had. And you had two plants, eight diesels. So it varies from plant to plant.

But the key factor here is what are the sources that lead to power the different things? There is no independence between the policy applied for the containment barrier and what is powering the mitigating systems for core damage frequency.

So if you said I don't have a diesel and on that diesel at the site, you put a diesel that is very similar to the site, the one you have on the site, and then use it to power your core damage frequency, mitigating frequency, less the containment, you don't buy anything.

However, if you find a diesel that is big enough or small enough, you can see just to do that independence, then you build a lot.

MEMBER LEITCH: But when you say that the containment failure probability would go to virtually zero with power supply, that means assuming that power supply is viable.

MR. CRANSTON: That's correct.

MEMBER LEITCH: I mean, this diesel,

whatever the diesel is you're proposing also has an unreliability associated with it.

MR. CRANSTON: Yes. And part of the analyses that were done for RES did look at a portable system like that to look at reliability aspects of it. We considered it to be very close to one.

MEMBER APOSTOLAKIS: Well, it's above one in a hundred that it would fail, right, for diesel generators? So essentially they're dividing the number they show by 100?

MR. CRANSTON: By 100, yes.

MEMBER KRESS: I noticed we have quite a few slides left to go. And we're rapidly approaching a time constraint. So I wonder if we could --

MEMBER APOSTOLAKIS: I'm not sure this applies, though.

MEMBER KRESS: What do you mean? It's a reverse 1.174 analysis.

MEMBER APOSTOLAKIS: 1.174.

MEMBER KRESS: It says if we had this thing in place --

MEMBER APOSTOLAKIS: And we wanted to remove it.

MEMBER KRESS: -- and somebody wanted to remove it, we would deny it on the basis of 1.174.

MEMBER APOSTOLAKIS: That's a very innovative --

MEMBER KRESS: Yes. That's very --

MR. RUBIN: This is Mark Rubin from the staff.

If you think back to five years ago, one of the things that -- and we discussed it with the committee then -- we were going to prevent was having a change that would be acceptable for 1.174 that would then put us in backfit space. Well, we would take it out. Oh, with a regulatory assessment, we would put it back in.

MEMBER ROSEN: Why does this surprise you, George?

MEMBER APOSTOLAKIS: We went to a lot of discussion on --

MR. CRANSTON: I'm going to skip ahead a little bit on the slides.

MEMBER APOSTOLAKIS: Let's move ahead.

MR. CRANSTON: I think I can show it graphically here, the point I was going to make in conjunction with 1.174. Where it shows ice condensers there, it's basically a kind of a range of the numbers that we got for the analyses as far as where the LRF values would fall as far as ice condensers are

concerned.

MEMBER KRESS: That is for containment events only.

MR. CRANSTON: Yes. And I kind of put it there to show that if we are going to take something out, where it would fall on that curve that's in reg guide 1.174.

I did the same thing also on the next slide for the Mark III's. You can see for LRF, it is down in region 2. Their values are somewhat lower.

If you consider just an early release, where you only lost containment but you will get some scrubbing through the drywall, it does kind of pop up into the no change allowed area.

That was kind of what you call reverse logic or however you want to apply an approach we took to see if it would pass that particular test.

MEMBER KRESS: Once again, this is only for internal events, right?

MR. CRANSTON: Yes.

VICE-CHAIRMAN WALLIS: I understand these boundaries and this notorious plot from 1.174 are fuzzy.

MR. CRANSTON: Yes.

VICE-CHAIRMAN WALLIS: So there is some

interception. There is.

MR. CRANSTON: Again, for the basis for the direction we are heading, we looked at defense-in-depth containment performance goals we discussed with NUREG 0058, the LRF values, and then the cost benefit.

Defense-in-depth I think we discussed a little bit. So I will go try to go through these slides pretty quickly. Where defense-in-depth provides multiple means to accomplish the safety functions and prevent release of radioactivity, as Sunil pointed out, it's a balance between core damage prevention, containment failure, and consequence mitigation.

Again an account for uncertainties, where it be in human performance equipment, PRA numbers, which we have been discussing, and external events here, which we have some information and are missing information for other plants and had to make some engineering judgments, defense-in-depth preserves containment capabilities and system redundancy independence and diversity.

As the ACRS mentioned when they passed the generic safety issue over to NRR for review, certainly defense-in-depth is a consideration that warrants

further action.

VICE-CHAIRMAN WALLIS: Well, you could say that defense-in-depth means that none of your barriers should have a conditional failure core failure bigger than something, whether it's .5 or .1 or whatever it is. If you lose one completely, you have lost that part of defense-in-depth.

MR. CRANSTON: Yes.

VICE-CHAIRMAN WALLIS: So it seems a fairly strong argument, although defense-in-depth is always a little bit undefined.

MR. CRANSTON: Yes. That's one thing we did struggle with, too. As we mentioned earlier, with the igniters provided, these numbers we're talking about, we will get below. It looks like we'll get below the .1 value preventing the loss of containment with the associated release of radioactivity.

I think I have already covered this large early release thing previously. We did go back and look at cost-benefit considerations. In this case, we looked at some way to imply some values for external events.

And even if we determined that the costs, we felt the costs were relatively low, and here I have taken the graphs that I had before and added on a

column that shows some estimated cost ranges, the column 7, which is the cost of the vertical line, which goes up to almost around $150,000, represents a small portable system or just a portable generator, but basically an extension cord and you plug it in to the panel.

This was a system that was installed at Sonnes. They installed a backup power system for steam generator level based on a severe accident scenario and station blackout. What they felt comfortable with there was just basically a small portable generator. They did get two per plant with an extension cord.

The higher portion of the column, which is up around 250 and may go a little bit higher because that is an estimated range, is for a pre-stage system, where you actually have the generator installed at some location, with some hard wiring and switch panels so that there is less impact on operators. The core is actually aiming the install at an in-service.

VICE-CHAIRMAN WALLIS: Remind me of the kilowatts you require. How many kilowatts do you require?

MR. CRANSTON: It's in the range of 4,000 to 20,000 watts.

VICE-CHAIRMAN WALLIS: So it's four kilowatts?

MR. CRANSTON: Yes, 4 to 20 kilowatts depending on --

VICE-CHAIRMAN WALLIS: That's not a very big generator at all.

MR. CRANSTON: No, no. It's basically --

VICE-CHAIRMAN WALLIS: The commercial one is much cheaper at 150,000 bucks.

MR. CRANSTON: That's basically the size that most people probably get if they want one for their home.

VICE-CHAIRMAN WALLIS: That's right. I mean, we've got one, and it cost a fraction of the amount that you put up on the screen here.

MEMBER KRESS: That's not nuclear-qualified.

VICE-CHAIRMAN WALLIS: Well, you have something more reliable if you buy it from the hardware store than if you try to qualify it nuclear-wise.

MR. CRANSTON: We include estimated costs of training, writing procedures, maintenance.

VICE-CHAIRMAN WALLIS: Okay.

MR. CRANSTON: We tried to cover the whole

nine yards here. In conjunction with the regulatory options, as far as implementing some type of backup power, we looked at generic communications, which included generic letters, information notices.

Let me back up a little bit. On generic letters, generally they are there for compliance issues. This is not a compliance issue. Information notices transmit information. Regulatory issue summaries again basically transmit information. And so it is a voluntary participation.

The bulletin is reserved for usually urgent and significant issues. This is not an urgent issue, even though we feel it is justified.

VICE-CHAIRMAN WALLIS: What is the regulatory cost of all of this? It's a rather small amount we're talking about.

MR. CRANSTON: It depends on which way we end up going as far as whether it would be a rulemaking or --

VICE-CHAIRMAN WALLIS: But it looks as if the cost of the NRC and the industry are wrangling about this and eventually getting something done is going to be just as large as the cost of actually installing the equipment.

MR. CRANSTON: I think you're right.

MR. PALLA: There is a regulatory cost embodied in the cost estimates. It would be divided by all of the plants.

VICE-CHAIRMAN WALLIS: The more you wrangle, the more that goes up. And the less benefit you get.

MR. PALLA: It was not a big factor, but yes, if you argued a lot and dragged it out, it might cost more.

MR. CRANSTON: We did pursue possibly issuing an order, but, again, we deferred from that because there was little public involvement. We did want to have public involvement, and we had a public meeting. And orders are also usually reserved for urgent compliance issues.

We did discuss the management guidelines at the public meeting that we held in June of this year. We did receive some feedback from the licensees that they felt that severe reaction management guidelines might be implemented too late in the accident sequence and might not be appropriate, that they would have to actually incorporate any type of procedural changes and activities in their EOPs.

In fact, at San Onofre, that's what they did there. For their particular system, they

incorporated it into their EOPs. Then we also looked at rulemaking. Of course, the final action would be no action.

As I mentioned, we had the public meeting in June. We did receive licensee feedback. As was pointed out earlier by Sunil, the licensees thought that that they could maybe better spend their resources on prevention, rather than mitigation. As I mentioned, the SAMGs may not be viable due to timing. They were considering that, even though it is the least cost option, that the portable generators may create an operator burden. So they were leaning more toward a pre-stage system if, in fact, they might want to go that way.

They did, of course, have additional design guidelines, which basically was as far as the NRC is concerned, what San Onofre did in conjunction with installing that system was adequate.

As far as regulatory action, based on feedback from ACRS, the action was warranted. Currently the staff is leaning towards rulemaking, as we discussed earlier.

In summary, we don't see that it is an immediate safety concern because it is a low-probability event. However, pursuing some type of

action requiring backup power is consistent with a defense-in-depth policy, as we see it.

We see it as a substantial safety enhancement from the standpoint of the conditional containment failure probability should you get to that point, that it will meet the NRC risk acceptance and safety goal guidance consistent with the NRC goal of maintaining safety.

We think the costs are justifiable. And we think that rulemaking may be appropriate.

MR. WEERAKKODY: I just want to emphasize don't repeat the last bullet, I want to reiterate this is the option we are leaning towards. The reason we are here today is to listen very carefully and learn whatever we can from any other presenters or from you. And if a different option can get us to the goal line in an effective way, obviously we will do that.

VICE-CHAIRMAN WALLIS: One option would be for industry to simply do it.

MR. WEERAKKODY: What is that?

VICE-CHAIRMAN WALLIS: If industry did it, then you wouldn't need a rule.

MR. WEERAKKODY: That's correct.

VICE-CHAIRMAN WALLIS: And that would save everybody a lot of time and money.

MEMBER LEITCH: Greg, can you help me with one problem that I am left with? I mean, we talk about the station blackout in that. Then to protect against that, the utilities, many of them, put in station blackouts, diesels, or some other means of providing a diverse source of power in that eventuality.

Now, here when we're talking about station blackout, it sounds like we're assuming that that station blackout diesel is lost as well. It seems like there is something illogical to this.

In other words, the station blackout doesn't lose the station blackout diesel, does it? I mean, I thought the station blackout diesel was there to function in that situation.

MR. WEERAKKODY: That's where I think we really need to clarify. That's a subtlety. Like I said before, if you go to a site where they had two diesels before the station blackout tool and then after the station blackout tool they came up with a procedure or out of the diesel just like the ones they have --

MEMBER LEITCH: In some cases, that was not. It was a different kind of diesel.

MR. WEERAKKODY: Yes. It was a different

kind.

MEMBER LEITCH: But another key point there is that even if the licensee has another diesel that powers the containment but it has monitors as well as the mitigation equipment that previous core damage, the net benefit is minimal.

I think what we are looking at is in a way gaining independence by having low-cost, low-voltage diesels that are dedicated to the hydrogen igniters.

MEMBER LEITCH: Perhaps it's not the case now, but couldn't the station blackout diesel power these hydrogen igniters as well? Would that be an acceptable solution or are we assuming that in the station blackout event, the station blackout diesel is lost, too?

MR. WEERAKKODY: Yes, we are. In all the core damage frequency numbers in all our arguments, we presented a station blackout means you have lost all emergency AC power on site.

MEMBER LEITCH: So if that's the case, then why don't we lose this other diesel you're proposing, then?

MR. WEERAKKODY: One of the reasons, if the diesel that you add is diverse --

MEMBER LEITCH: I'm saying we already did

that. We added these diverse station blackout diesels or some other means of coping with the station blackouts. Didn't we already do that?

MR. WEERAKKODY: No. I don't think that's necessarily true for all sites under consideration. I don't --

MEMBER LEITCH: Well, perhaps the --

MEMBER ROSEN: For a site for which it is true that they have already added a station blackout diesel that is diverse, they could power the hydrogen igniters from that diesel or they have already powered the hydrogen igniters from that station blackout diesel? Haven't those plants already complied with what you're asking for? It sounds to me like they have exactly complied. It is different from plant to plant.

A plant that is as I just described would be in compliance already with what you are asking for. Would it not?

MEMBER LEITCH: That's exactly what I was saying, yes.

MR. RUBIN: If I could add? This is Mark Rubin again from the staff. It is certainly a good point. It is something I think we will need to look at, that the quantification of the SBO risk, the

plant-specific quantification, of course, takes into account all of the on-site sources if they're in the modeling -- and generally with the updated models, they are in the model. That would include an alternate diesel if there is one, even combustion turbine if there is one. Those are to a large degree diverse, as is the BWR-6 small HPCI diesel.

Even with the diversity, there is failure probability, both independent and random. And, as was pointed out earlier by one of the committee members, some commonality in the distribution system, maintenance commonalities to some degree, fuel commonalities to some degree, that can give you some common cause failure contribution. And those are modeled in the PRA. They give you essentially the CDF values that were presented.

The plants with the alternate AC sources clearly have lower SBO contributions for the most part. I have to be a little careful here.

Then the plants that are the coping plants with four-hour, eight-hour batteries with load shift, even with the alternate sources, you will have some SBO contributions.

The alternate AC power sources, the small one we're talking about, is completely diverse, very

little to no commonalities at all. And it's supporting the other pillars, so to speak, the mitigation, the containment integrity, defense-in-depth pillar.

I think the point that was raised is a good one. And we would need to consider that in rulemaking. But the difference in diversity level and the difference in the defense-in-depth support are very different in the alternate AC sources, which already have bought quite a lot because the SBO risk, of course, before was quite elevated compared to what it is now.

MEMBER LEITCH: It just seems to me this little diesel that we buy at Sears and Roebuck, we're kind of assuming that that is going to be more reliable than this --

MR. RUBIN: No, no, of course not. No, no. You're absolutely right. Of course, it's not going to be more reliable. But even if it's 80 percent reliable, 60 percent reliable, that's a significant recovery potential for an SBO event that doesn't exist now.

MEMBER KRESS: I think we need to continue with the meeting now. We're running out of time. The next thing on the agenda is to hear from the industry.

I guess the first presenter would be Ken Meade with the BWR owners' group.

MR. MEADE: Thank you and good morning.

MEMBER KRESS: Would you like to stay back there or come up here?

MR. MEADE: Yes, I will. My name is Ken Meade. I am the licensing unit supervisor at Perry Nuclear Power Plant. My background is that of a senior reactor operator who has been trained in the plant emergency procedures. I thank you for the opportunity to speak to you this morning on behalf of the boiling water reactor owners' group.

If you will look on your handouts in slide 2, the BWR owners' group recently formed a committee to review the impact of GSI 189 on the Mark III containment owners. This was prompted because of the differences between the BWR Mark III containment plants and the PWR ice condenser plants.

The committee focused on the benefits and costs associated with GSI 189. The results of the review were communicated to the NRC in a letter from the BWR owners' group dated October 23, which I believe you have there today.

BWR owners' group letter 3053 addresses issues related to the potential benefits and costs

associated with the NRC proposal. The letter also provides information from the BWR plant emergency guidelines as it relates to hydrogen control.

The third slide. Reviewing the results of the NRC report, which was entitled "The Benefit-Cost Analysis of Enhancing Combustible Gas Control Availability at Ice Condenser in Mark III Containment Plants," the committee noted, -- and I'll paraphrase from the report -- using lifetime averted off-site costs for internal events for the example cases; i.e., the mean NUREG 1150 case, the ice condenser cost estimate with late failure is $320,000 while the Mark III lifetime averted cost for the mean NUREG 1150 case is estimated at only $10,000.

In other words, the results from the ice condensers are higher than the Mark III's by a factor of roughly 30. Thus, there is a great difference between the PWR ice condenser and the BWR Mark III plants.

The committee also noted that none of the four Mark III containment plants were required to calculate a core damage frequency for external events.

So the cost-benefit analysis is skewed by using an unjustifiably large external event contribution to CDF. So the BWR owners' group

committee has concluded that the benefits associated with GSI 189 do not warrant the cost of a BWR plant modification.

If you look at slide four, our emergency operating procedures currently specify that hydrogen concentration must be known to be below the hydrogen deflagration over-pressurization limit prior to energizing or reenergizing the hydrogen igniters.

This is determined by using one of three means, the first being determining that water level has remained above the top of active fuel. The second would be hydrogen analyzer indication. And the third would be a chemistry sample.

Both the second and the third options require electric power. And for some plants, this is required to open containment isolation valves, as it is in my plant. The plants also have heat tracing on the sample lines. And you also need power to power up the analyzers, which has a sample pump and analyzer unit.

Some installed hydrogen analyzers also need cooling water in order to cool a sample from a steam-laden containment atmosphere. In that case, backup power supplies would need to be much larger to energize the support equipment. And power routing

schemes would be much more complex.

Larger generators are less portable and so require more sophisticated fuel cooling and exhaust arrangements. Consideration, then, must be given to these backup power supplies on their effects of other system structures and components in their vicinity should they be pre-staged.

VICE-CHAIRMAN WALLIS: I'm not quite clear on this.

MR. MEADE: Okay.

VICE-CHAIRMAN WALLIS: If you have a Sears Roebuck portable generator, why do you need all of these other things to go with it?

MR. MEADE: Well, in our plant --

VICE-CHAIRMAN WALLIS: If it cools itself, it's air-cooled and --

MR. MEADE: Well, in our case, if we have the hydrogen analyzers and we need an assembly letter that we sent and an attachment. If we need the cooling water, the support systems for the cooling water system; that is, the lake systems, we're talking more like 1,200 kilowatts.

VICE-CHAIRMAN WALLIS: You mean to cool the analyzers?

MR. MEADE: To cool the analyzer, yes.

That is the biggest electrical load, the support equipment to cool the analyzers. So that would really entail a very large machine, about 1,200 kilowatts.

I will move on to slide 5. Operating coolers don't have unlimited manpower. And so procedures for station blackouts currently prioritize the restoration of power by directing operators to attempt to locally start failed diesel generators.

In our plant, for example, we have two light generators and a third HPSI diesel generator, which is by a different manufacturer of diverse design.

VICE-CHAIRMAN WALLIS: Excuse me. What plant did you say that was?

MR. MEADE: This is my plant is Perry.

VICE-CHAIRMAN WALLIS: Perry?

MR. MEADE: Yes. And, again, that's my particular unit.

Secondly, the operators are directed to line up the plant to receive off-site power. This entails opening feeder and load breakers and walking down power transformers and the like, which is fairly labor-intensive.

The emergency response organization helps the operating crew to assess the plant's status and to

prioritize restoration activities with the goal of avoiding or mitigating damage to the core.

And so, finally, on the last slide, therefore, the BWR owners' group, GSI 189, committee requests that the NRC review the need for rulemaking from our three plants.

From the information found in the NRC benefits and cost study, combined with the uncertainties and risk contributed from external events, we feel that the benefits do not justify the cost. We feel that the issues raised by GSI 189 can be addressed within the emergency response organization.

That concludes my comments. Thank you.

VICE-CHAIRMAN WALLIS: I am puzzled by why this wasn't sorted out before. Now it seems we have very competing views here, which appear before the ACRS without having been resolved.

MR. CRANSTON: Yes. I would like to comment on that. Referring back to slide 21, which kind of talks about the cost, we did have a discussion with the BWR owners' group in conjunction with the letter they sent.

Previously, the external event values that I have been using at the public meetings and

discussions were based on the assumption that maybe the external event factor is about the same for any plant, whether it be ice condenser or a Mark III.

So originally I had a magnitude about equivalent to this stacked on top of these particular columns. After discussions with them, we felt that based on their input and doing some research, that a lower value would be appropriate. So for the presentation today, this was brought down.

Also, as was mentioned in the presentation, as far as the benefit, for plant number four is low, as you can see here. For other Mark III's, it is a big higher. Yes, in both cases, even with external events here, from a pure cost-benefit analysis, it's lower. But the cost-benefit criteria is not. But the benefits exceed the cost. It has to be that the benefits are commensurate with the cost.

So one could argue that from a pure math standpoint, but, of course, there are uncertainties in both of these numbers as far as how these stacks could go up and down both over here and over here. We still felt we were looking at the overall cost of the backfit still in the ballpark as far as justifiable costs for the safety gain.

We also discussed their concern about

having to have additional power for the hydrogen analyzers. What we asked them to consider -- and they hadn't had time, I think, since we just had the discussion shortly after receiving the letter -- we asked them to consider, if your plant is operating and something happens and now you lose power and you lose power to your indication as far as your hydrogen analyzers are concerned, would that not be the appropriate time to just go ahead and turn on the igniters peremptorily? And then you don't have to worry about it.

By flying blind, if you don't know what's in there, eventually something is going to happen anyway. Even if you had analyzers on it that said it was going to build up, you would want to make sure you had those igniters on before you got to that point.

So we did ask them to consider that as an option to just turn the igniters on grantily. Then the problem of not having analyzers goes away. And the additional associated power requirements would go away.

MEMBER SIEBER: I would think that that would be the obvious solution. Just don't worry about the analyzers. Turn them on.

MR. CRANSTON: So we asked them to suggest

that as an alternative.

VICE-CHAIRMAN WALLIS: So that cost estimate of a million dollars would come back down to something like your cost estimate --

MEMBER SIEBER: Forty-nine, ninety-five.

VICE-CHAIRMAN WALLIS: -- if you didn't have to keep the analyzers going. Is that true?

MR. CRANSTON: Yes.

VICE-CHAIRMAN WALLIS: It is more like a million.

MR. MEADE: If I could tell you what we do right now, currently in hydrogen control, we are directed to first start the analyzers as soon as the plant goes into the plant emergency procedures for any reason. That's the first thing you do, is start the analyzers, because it takes a few minutes to get a sample.

Once the level either becomes unknown, level drops to level one, which is 16 inches above the top of reactive fuel, then in practice, we do start the igniters right away.

We have an allowance currently that says that if we're below the top of active fuel for up to ten minutes, we can start the igniters. So we have gone below the top of active fuel. And we turn on the

igniters.

Within ten minutes, we're okay. But what that requires is to get those. If we have a diesel or whatever, it would almost have to be pre-staged and up and running. Again, that's operator action, which we have limited crews to do that. So they would probably be diverted from trying to start a diesel generator to go over and start this thing.

As far as cost, we have tried to do simple modifications before. One time we installed a charging pump that was basically an off-the-shelf pump, put it on a slab inside a building, use the welding receptacle to power it up and a temporary hose to run it into the high-pressure core injection line. That was nearly a million dollars for the design. The actual cost of the pump wasn't that much, but the actual analysis for seismic considerations and everything that went along with it was very high. So that's my two cents on that.

MR. CRANSTON: Again, I just wanted to point out that as far as this backup system is concerned, it does not have to be safety-related. As far as any seismic considerations, we did check with Sonnes as far as their costs associated with it. And they are in a very high seismic area.

The only thing they added for any other considerations was where they locate as a portable generator, they strapped it down. And where they located the gasoline in their flammable locker, they made sure that that locker literally was strapped down. That was the only additional considerations they had for a basic non-safety system.

MEMBER KRESS: Are we still talking about a portable generator or one that's actually installed and wired up and ready to go?

MR. CRANSTON: At Sonnes, it was portable, totally portable.

MEMBER KRESS: But that's not your recommendation at this time?

MR. CRANSTON: Yes. We're comfortable with --

MEMBER KRESS: You're still comfortable with --

MR. CRANSTON: The feedback that we're getting is that from an operator standpoint, they might want to enhance the system.

MEMBER KRESS: Okay. I think now we need to go on to the presentation from Duncan Brewer with Duke Energy. I think he's speaking not for the PWR owners but for Duke Energy, I think.

MR. BREWER: As I mentioned before, my name is Duncan Brewer. And I am from Duke Power Company. I am the manager of the group that does the PRA analysis for Duke Power Company. And we have McGuire and Catawba nuclear stations, both of which have ice condenser containments.

And we have actually been working in this area with the NRC for some time. We provided quite a bit of analysis to support the research work that was done. And a lot of the numbers that you see on the slide represent our core damage frequency and also some of our cost estimates.

In regards to the history, Duke started doing PRA work back in the 1980s. And whenever we were requested to do the IPE study, we provided an update to the PRA study that we already had for those stations.

We had already identified that for ice condenser containments, station blackout was a major contributor to the core damage frequency and that for those scenarios, the igniters would not provide hydrogen control. So what we attempted to do was model it in a similar fashion to NUREG 1150.

When we did that, we still saw that early containment failure was dominated by hydrogen burns.

So we investigated at that time whether or not there was a cost-beneficial way of addressing hydrogen control independent of the core damage station blackout.

What we concluded was -- and some of the same things that I have heard you discuss here are how can you provide power to the igniters when we have already assumed that many of the safety-grade diesels and even your station blackout diesel have failed?

What we see is that the case becomes very marginal because we have put so much emphasis in trying to reduce the core damage frequency from station blackout.

And the only thing that really is feasible is a very low-cost option. When we looked at it, we weren't looking at the low-cost option. We were looking at a more major something that was more substantial.

So the focus of my presentation today is to discuss some of the issues that we feel need to be addressed if we proceed with the idea that the low-cost option does provide benefit.

So we are not really going to talk about the averted cost or the risk associated, the averted risk cost, as George called it. We want to talk a

little bit about how you implement a change that would provide benefit.

When the ACRS provided guidance to the NRC that they felt like it was a significant enough issue to proceed, the primary focus I think of the ACRS was that something in SAMGs was the appropriate way to go because of the marginal benefit that was seen.

We really see problems with that type of a philosophy because the SAMGs, severe accident mitigation guidelines, the way that the PWR permitted those, they really don't take place until you have already started in the core damage. And by that time, it would be too late to try and put in place hydrogen control.

So the primary focus needs to be if we feel like this is a low-cost option, it still needs to go into the emergency procedures. And, as we were just talking about, you can't wait for monitoring hydrogen because the hydrogen monitoring won't be available. It has to go in place well before any core damage occurs.

And so as a result, we believe that a pre-staged emergency power supply needs to be the way to go, not one that is portable, not one that is brought out in the midst of an accident, where

currently the station blackout core damage frequency is dominated by external events, possibly a tornado or a large seismic event. So we believe that pre-stage needs to be the case.

Also, whenever you put it into the emergency procedures, it brings about a myriad of other activities associated with nuclear power plants.

For example, training requirements are different. It scopes into the maintenance rule as a risk-significant system. So you have to monitor the availability and reliability.

To be able to make a change to the emergency procedures, you have to be able to pass 50.59. Is there an adequate basis for showing that powering this supply without the air return fans doesn't create a potential threat that hasn't been analyzed by the utility? And would it pass the 50.59 questions?

Those are all issues that we see that need to be addressed whenever we talk about how are we going to implement a change that would provide benefit.

That was a lot of our discussion when we presented in June. And I guess that is still our primary focus from Duke Power Company, that if we

proceed, then it needs to be very clear that the NRC has justified this as a low-cost option. And if we go forward with rulemaking, it needs to be clarified what that low-cost option really needs to look like.

The reason I say that is in many cases, when we have attempted to voluntarily put in place low-cost options, what we see is that the first time an inspector comes to the site and looks at what we have done, he starts raising questions about, well, why didn't you do this and why didn't you do that? So --

MEMBER POWERS: Let me ask you a question.

MR. BREWER: Yes.

MEMBER POWERS: You say the inspector raises questions. Do you just give him an answer?

MR. BREWER: No. They don't accept that. For example, if we were to say that it doesn't need to be used for a seismic event but our station blackout core damage frequency is dominated by seismic event, if it is not clarified that it doesn't need to be seismically designed, then the inspector is going to say, well, I think it should be seismic.

Now, if it's clearly described that it doesn't need to be seismically designed, that's what we're looking for. If it's clearly described that it

doesn't have to be a safety-grade diesel, then that's the type of guidance that we're looking for.

MEMBER POWERS: But wouldn't it be?

MR. BREWER: What?

MEMBER POWERS: Wouldn't it be?

MR. BREWER: What?

MEMBER POWERS: Clearly described as doesn't need to be seismically qualified or whatever.

MR. BREWER: We don't know yet. We don't really know how the NRC is going to --

MEMBER POWERS: You have a licensing basis somewhere for this. And it says -- and you show it. And he's happy at that point.

MEMBER ROSEN: Well, I think what you're assuming, Dana, is that they need to have the authority to put it in the plant with a design basis different than other safety-related equipment.

MR. BREWER: Different than the current system the way that it is designed.

MEMBER ROSEN: Right.

MR. BREWER: For example, the current system the way that it was licensed requires the air return fans to be operating in order to verify that you have adequate hydrogen control. Well, the NRC's attempting to justify this change is not requiring the

air return fans. So it needs to be clearly described that this backup power doesn't meet the supply power to the air return fans.

MEMBER ROSEN: I see this as an entirely reasonable plea to make sure that if we go to rulemaking, whatever the rule says is consistent with the analysis, the cost-benefit analysis.

MR. BREWER: That's correct.

MEMBER ROSEN: It doesn't trump the cost-benefit analysis in the end game.

MR. BREWER: That's exactly what we're seeing, that we need to be very careful that if it's justified on the basis of a low-cost option, something like the San Onofre portable generator, then it's clearly specified in whatever guidance implements the rule that that is what we need. And whenever we do that, then we're not second-guessed by inspectors and other people who come in and say, "Well, why isn't it this?"

MEMBER ROSEN: And that comes back to Dana's point that if you go through that whole process and put it into a licensing basis with the clarifications that it doesn't trump the cost-benefit analysis and you're sure of that, you make sure everybody understands it and the inspector who may not

understand it, for instance. A new inspector is directed to the right documents. And eventually he --

MEMBER SIEBER: That's correct. But that has to be a part of the rulemaking.

MEMBER ROSEN: Right.

MEMBER SIEBER: That's where it's set out.

MEMBER ROSEN: And I think that is what Duncan is saying. He wants to require the design criteria are well-defined.

MR. BREWER: Well-defined design criteria is the primary focus of both our last meeting and also this meeting from the point of view of Duke Power Company.

MEMBER ROSEN: Is the staff opposed to well-defined design criteria? Okay. Then you're pushing on an open door. I think it's a good push.

MR. BREWER: Well, I haven't seen much progress on defining those criteria yet. So I guess that's the reason that we're bringing the same message back.

MR. WEERAKKODY: Duncan is right. What we are trying to do is address and then get to the safety enhancements, but we do not want to put undue or unnecessary burdens. So from that context and also from the context you said, the cost-benefit has to be

consistent with the same criteria.

So we take Duncan's feedback very serious. And we tend to agree with the high level, yes.

MR. BREWER: Okay. The only final comment that I have is that I think that one thing that has been talked about here is that this is for defense-in-depth and that this is an independent way to prevent containment failure independent of preventing core damage.

Really, all it would do is remove the threat of hydrogen burns early in the containment and prevent some potential challenges to the containment early on.

It doesn't remove heat from the containment. And, as a result, even if this is in place, it can't prevent containment failure. So I'm not sure that that point has been clear in our discussion this morning. It would only remove the threat of hydrogen burns early in the scenario.

It wouldn't remove heat from containment. And, as a result, many of the core damage scenarios that we're identifying as station blackout would eventually lead to containment failure anyway.

VICE-CHAIRMAN WALLIS: So their statement that the containment failure probability, initial

probability, would go essentially to zero? You are taking issue with that?

MR. BREWER: Yes. And I think they would agree that it doesn't really go to zero. The threat from hydrogen burns goes to essentially zero.

MR. PALLA: We were focused on the large early release frequency there. We would admit that, yes, if you don't have any heat removal, you will get late failure eventually if you --

MEMBER POWERS: This is not unusual for any reactor. Unmitigated core meltdown accident has a containment failure probability of one sooner or later.

MEMBER ROSEN: Right. But that's why we have emergency plans to --

MEMBER POWERS: Sure. That's why there's another element of it.

MR. PALLA: We would stick by the statement that this deals with large early release frequency and reduces it close to zero, the reliability of the generators themselves and the human actions to the monitors.

MEMBER KRESS: At this time I think we want Ed Lyman of Union of Concerned Scientists, who wants to make some comments.

MR. LYMAN: Thank you. I appreciate the opportunity to say something at this meeting.

Edwin Lyman from the Union of Concerned Scientists. I would just like to emphasize that we believe that it is really time to act and make a final decision, get some resolution on this issue. And I am glad that there does seem to be some apparent progress at this meeting.

Now, just to underscore why I think it is really time, it is actually long overdue, to see some action on this is I have gone through the chronology. I am not going to point out everything here, but the first time I became aware of this issue was 1998, when there was the first mention that the direct containment heating resolution was not going so well for the ice condensers and that the conditional containment failure probabilities were coming out greater than .1 for some plants.

It wasn't until April of 2000 when NUREG CR-6427 was finally published after a long delay and a number of bureaucratic hurdles that had to be passed. But no matter how the numbers were tweaked, they couldn't make this high conditional containment failure probability go away for the ice condenser plants.

So finally once that document came out, the staff did propose the establishment of GSI 189 September of 2000. It wasn't until December of 2001 when the commission requested an expeditious resolution on this issue.

It wasn't until November 2002 at the ACRS meeting that Jack Rosenthal said there's already been enough number crunching over 20 years. It's time to make a decision.

Yet, here we are. I'll just stick to the punch. It's already November 2003. And there still is no decision, even though there was time enough to modify 10 CFR 50.44 or risk-inform it to publish a final rule that only included reduction of regulatory burden and did not include anything that would increase burden because it was still being deliberated on in this GSI process.

I think if you could get the rule out, then you're well on your way to where there really is a new impetus to resolve this issue in a timely fashion.

Now I would like to add my support for the notion that defense-in-depth is not optional for nuclear power plants in this country. I think we all know that public acceptance of nuclear power in the

U.S. post-Chernobyl is largely predicated on the understanding among the public that U.S. reactors have containments that will resist the kind of high pressures that we're seeing during a Chernobyl-type event.

Unfortunately for SBO sequences for the ice condensers and, in particular, for some sequences, they have no containment at all because of the high conditional containment failure probabilities.

And I believe that a function of containment is not a safety enhancement, as it has been characterized in the past at these meetings, but is actually an adequate protection requirement. I think that the high delta LRFs that we have seen that the staff has calculated underscores that.

As far as focusing on prevention only, there is one issue that hasn't been discussed at this meeting today. And that's the fact that reducing the probability of SBO is only good insofar as you don't have a deliberate event. And you have to also address common mode vulnerabilities that can be exploited by terrorists.

For that reason, focus on prevention can only go so far if you have an adversary who can counter your preventive action. And, in particular,

the common mode failure represented by station blackout at ice condensers leading to almost certain containment failure is potential vulnerability that could be exploited by terrorists. It has to be closed. Now --

MEMBER POWERS: Mr. Lyman?

MR. LYMAN: Yes?

MEMBER POWERS: Could you explain this a little more to me? I am not aware of requirements in the regulations that say that I have to look at actions by potential terrorists beyond the design basis threat.

MR. LYMAN: Well, I'm not saying this is beyond the design basis threat. You're right. There is no regulation that requires, let's say, license amendments or modifications be made taking into account terrorist attacks.

But I think UCS; in particular, Dave Lochbaum has gone on record believing that that kind of process should be brought to bear in consideration of license amendments and other regulatory actions. In other words, the terrorist threat should be considered in addition to safety initiators.

MEMBER POWERS: I see. He is making some petition to the commission for rulemaking in this

effort so that I'll --

MR. LYMAN: Yes.

MEMBER POWERS: -- better know when I have to take this and look at it?

MR. LYMAN: Right. And here it's obvious that if you want to really mitigate the threat, you are not going to want to put your diesel generator in a position where a single terrorist explosive, for example, would create a common mode failure and take out all the protection at once. So when you consider diversity, you are going to want to consider some sort of diverse protection as well.

The final point here is that even if the calculated cost-benefit differentials are marginal -- and I don't believe that is the case for this example -- considerable weight should be given to defense-in-depth when determining whether regulatory action is needed. It should be their qualitative consideration, should push the scale and direction of regulatory action. I think that point was made by the staff over a year ago. And I think it is still true today.

Now, why don't I think the cost-benefit is marginal? Even without the additional external event on benefits that we saw today, the fact is -- and I

think everyone acknowledges -- that there are large uncertainties in the use of Level III PRA to try to come up with precise benefit quantification.

I don't think the technology is there yet to be able to do those. And in Duke's initial severe accident management alternatives analysis for the license renewal case, it had in some cases benefits or difference between cost and benefit.

There were less than a factor of two. And they argued that that means that some of these interactions and management alternatives were not cost-beneficial. And I don't think that the technology is there to be able to be precise enough to say that a factor of two is relevant or coming up with any firm conclusions.

And just to underscore that -- and this is a point that the staff has indicated before -- especially the level III calculations are very sensitive to inputs.

I took the liberty of running some MAAP calculations with the alternate source term and, for instance, release fractions when they were 40 percent for iodine and halogens and 30 percent for cesium and semi-volatiles. That would result in a nearly fivefold increase in the 15-mile population dose

compared to the MAAP source term, which has been used in the Catawba and McGuire PRA, where the halogen release is only on the order of six percent, cesium on the order of five.

So I believe that using the MAAP source terms led to a significant underestimate of the benefits of mitigation. And there are many other assumptions as well, which one might consider.

For instance, the limitation of population dose to a 15-mile region, although it's what's specified in the regulatory guidance, is not necessarily well-justified, especially for people who live 60 miles away and may be affected by the plume of this event. If you increase the radius, for instance, to 200 miles, I found you double again the population dose.

Again, these are arbitrary assumptions. And if you're going to try to use level III PRA in a more precise fashion, you are going to have to better justify these.

Finally, if you are going to apply cost-benefit analysis with such precision, you end up with some counterintuitive results. For instance, the effort of trying to prove that you don't have to power the air return fans but only the igniters just to keep

the cost down of the mitigation I think was misguided, although it turned out that it looks like all the technical evidence points to the fact that you don't need the air return fans. Even if you did and this was a factor of two increase in the cost, I don't think that should have been decisive to begin with.

So, finally, in conclusion, I think that the urgency of this issue requires a mandatory regulatory action, which is not inconsistent with saying it is performance-based. And you can still specify a performance-based rule for containment performance and have that mandatory.

For instance, why is this urgent? Well, the $MO_x$ program at Catawba-McGuire is soon going to increase the public health risks at the Catawba-McGuire plants. And we need to have mitigation of the containment failure risk in place before that program begins.

The research solution from last year, which was pre-staged, non-safety-grade diesels to power the igniters only is probably adequate to mitigate early containment failure if, as I pointed out before, the terrorist threat is considered and how that is designed and protected.

The issue that has been raised in the air

return fans may actually have a deleterious impact on hydrogen combustion. It has to be resolved now obviously because presumably the emergency operating procedures for non-SBO severe accidents involve using the air return fans. So it seems that this is an issue that has to be resolved if there is any potential safety issue there.

And, finally, the high probabilities of late containment failure. Duncan Brewer just pointed out that mitigating hydrogen is not going to save the day, but I think that doesn't bode very well for the future of the ice condensers because if we can't deal decisively with the fact that they are weaker and smaller than the large dry containments and have a higher overall risk of both early and late containment failure that can't be mitigated, I think that calls into question whether the safety basis of ice condensers is firm. And they should be operated safely under any circumstances.

Thank you.

MEMBER KRESS: Thank you.

Are there any questions of Mr. Lyman before we close this session? Do you have any comments you would like to make?

MR. CRANSTON: No. I think I have

discussed everything.

MEMBER KRESS: With that, then, I think I will turn it over to you, Mr. Vice-Chairman.

VICE-CHAIRMAN WALLIS: Thank you very much. We're going to take a break for 15 minutes or until 10:30 -- by then, the Chairman will probably be back -- unless anyone else had any points to raise at this time.

Personally I found it very interesting to have what we don't often have here, maybe we should have more often, a three-sided debate on this issue. It's refreshing.

MEMBER KRESS: Yes. I certainly appreciate the contributions from --

VICE-CHAIRMAN WALLIS: To have different views which are actually based on technical analysis was very helpful. So thank you all for your contributions.

We will now break until 10:30.

(Whereupon, the foregoing matter went off the record at 10:15 a.m. and went back on the record at 10:46 a.m.)

CHAIRMAN BONACA: Let's get back into session. The next item on the agenda is regarding regulatory effectiveness of the resolution of

unresolved safety issue USI-A45, "Shutdown decay heat removal requirements." I think Dr. Ransom is taking us through this presentation.

MEMBER SHACK: No. I think it's me.

CHAIRMAN BONACA: Oh, Shack. Sorry.

MEMBER SHACK: Yes. We keep changing the rules here.

CHAIRMAN BONACA: I apologize for that.

7) REGULATORY EFFECTIVENESS OF THE RESOLUTION OF UNRESOLVED SAFETY ISSUE (USI)-A45, "SHUTDOWN DECAY HEAT REMOVAL REQUIREMENTS"

7.1) REMARKS BY THE SUBCOMMITTEE CHAIRMAN

MEMBER SHACK: The NRC has a program of reviewing the regulatory effectiveness of some of its rules and regulations. We have been through this once to discuss the SBO rule, discussing today the regulatory effectiveness of the shutdown decay heat removal requirements.

This is a little different. Unlike the SBO, we didn't pass a specific rule. There were no generic hardware requirements to deal with this. Instead, it was treated as part of the IPE program. And there will be a discussion again of this. I think we can have some discussion of just how reliable the IPE program is for making these conclusions.

One of the interesting things that I thought -- perhaps you can be addressing it -- is that virtually all of the operational experience with decay heat removal problems it seems to me is focused on shutdown situations, which, of course, is the one thing that isn't discussed in either the IPE or the IPEEE. And, yet, we can learn something about the effectiveness of the rule from those exercises but it turns out to the staff.

7.2) BRIEFING BY AND DISCUSSIONS WITH REPRESENTATIVES OF THE NRC STAFF

MR. FLACK: Before we start, if I could just interrupt and introduce myself? My name is John Flack, the branch chief of the Regulatory Effectiveness and Human Factors Branch.

As Bill had mentioned, we had come down before the ACRS on two other studies: the station blackout and ATWS. Basically as an information briefing, we're not seeking a letter of any form, but we do like to get feedback from the committee as to what was down and how we went about doing it and your own thoughts in this very important area. In this case, it's decay heat removal, A45, which has a very long history.

John will walk you through it. John

Kauffman is the engineer who had done the work within a team within the branch, which is leaded by George Lanik, who has left.

This was unusual. As was mentioned, it was a generic issue. And it was subsumed into the IPE program. We know that the IPE program looked at events from full power through shutdown from full power. And it was used as the basis for closing the issue.

So from our perspective, we went back and looked at it from the closure process. Was it a defective way of closing this issue? And John is going to walk you through what we have done in light of that. And any feedback we can get on the process and how we went about looking at it certainly will be appreciated.

At this point, John?

MR. KAUFFMAN: Good morning. As John mentioned, I am John Kauffman, the Regulatory Effectiveness and Human Factors Branch in Research. My background is in operations at commercial BWR and at Navy PWRs.

I am here to give you a briefing on our recently completed contractor report performed for our branch on the regulatory effectiveness of the

resolution of USI-A45 shutdown decay heat removal requirements. ISL was the contractor for this report. Bob Youngblood was the principal investigator.

This report was recently issued as a NUREG CR, number 6832, and is available on the research Web page, on the NRC public Web site, and also in Atoms.

As John mentioned, there is a long history with USI-A45, and it's a very broad topic. We went back through the documents to try and understand the history and evolution of the industry and try and understand exactly what the agency was trying to accomplish.

Briefly, that history takes us back to 1975, the WASH 1400 report, where it was found that decay heat removal was a substantial contributor of risk for both BWRs and PWRs.

Of course, there was a 1979 Three Mile Island accident. In 1981, this issue was designated a USI. In 1984, there was a task action plan. And that document talks about the major focus from reactor trip to hot shutdown, excluding large break LOCA. And events from shutdown or refueling are not directly targeted by that tap.

Around this time, two important studies were being commissioned. One was some case studies.

And that was on six plants, two BWRs, four PWRs. That came out of this NUREG CR-5230 and NUREG 1289, which was a regulatory and backfit analysis for USI-A45.

What followed from those studies was that decay heat removal is a very plant-specific issue. It was dependent on the support systems. And an in-depth review was needed, really, before any other actions could be done.

In NUREG 1289, six approaches were investigated. The dedicated shutdown cooling system was rejected. It's not cost-beneficial. And the second option performed a detailed analysis. Plant-specific analysis was a recommendation that fell out.

About this time, generic letter 8820 for IPEs and IPEEEs to address severe accidents was about to be issued. And it was decided to incorporate A45 would be an efficient way to do it. And it was also resulting in more comprehensive reviews than a stand-alone DHR review.

Scope of A45 is one thing that seems to be people need to be clear to understand. As you mentioned, it involves small LOCA, LOOP, loss of power conversion system, and transcience initiated at power. It includes large break LOCA, medium break LOCA,

intersystem LOCAs, and ATWS.

VICE-CHAIRMAN WALLIS: Let's talk about this. There is another USI, A43, which deals with some blockage, which is also concerned with removing decay heat, whether or not you can recirculate water and so on.

There doesn't seem to be any mention of an overlap between these two USIs, although more recent developments in some blockages actually now are a subject of some interest.

I was rather surprised because in the Los Alamos report, it says it's very likely that in 25 plants out of 69, it was small break LOCA. There will be some blockage which affects the decay heat removal. And it never is mentioned at all in your review.

But your review, your discussion, looks very relevant to that issue because if there is some blockage, then all of the discussion in your review here about surface water, fire water, river water, all of these other sources of cooling are very relevant to the sump blockage problem because it is dealing with adequate cool core in the event of small break LOCA, where you have trouble removing the decay heat.

There doesn't seem to be any cross-reference at all to this other very related

problem. I was very surprised not to see any connection made at all. Am I under some misapprehension, misunderstanding here or something?

MR. FLACK: Yes. I think if I may just inject for a moment, the generic issue process has a number of issues in it. And there have been a number of resolutions to those issues. In fact, there are over 800 in the database.

When we look at A45, we're asking ourselves -- we're not really asking ourselves at this point what was captured. We're looking at what was the intent of the issue at that time and how it was being addressed and resolved and whether it was an effective process to do that, recognizing there were a number of other issues taking place at that time.

As the report points out, actually, the resolution of this issue should not be viewed as a stand-alone. There were many synergistic effects taking place at the time in resolving separate issues, like loss of off-site power, for example, where we had A44.

It all leads, really, back to decay heat removal. Everything seems to lead back to decay heat removal. except for the ATWS sequences, you know, reactivity.

So the question is, what were we trying to achieve by having one issue open just across the board on what is the reliability of the decay heat removal?

I think in the context -- and this is how my interpretation of this issue is, that when one looks across the plant in a holistic fashion, is there anything that one can do to improve decay heat removal reliability? And if so, should actions be taken to a prorated sense?

Now, recognizing there are other activities going on, many other activities were going on, parallel at this time, it wasn't in trying to capture everything in that sense. Maybe it started out that way. A lot of people were putting things into A45 in the very beginning. And it just became overwhelming in that sense.

Recognize there were these other activities going on in parallel and it wasn't trying to duplicate those activities.

VICE-CHAIRMAN WALLIS: I don't see how you can ignore them. And you're going to talk about feed and bleed and so on.

MR. FLACK: Yes, right.

VICE-CHAIRMAN WALLIS: There are certain cases where you are drawing from the sump presumably

in the feed and bleed situation.

MR. FLACK: In the context of feed and bleed and how much credit they have taken for it under the conditions aside from other issues going on, I guess it was where we drew the boundary, where the boundary was drawn, in fact, for A45 in improving its reliability.

VICE-CHAIRMAN WALLIS: I guess we will come back to this in the discussion.

MR. FLACK: Sure.

VICE-CHAIRMAN WALLIS: I think it is rather strange to say it's taboo to mention an effect which must be going on during some of these scenarios which you are going to discuss. But maybe we will see that. Maybe that will become clearer as you go forward?

MR. FLACK: Well, I think a point to keep in mind -- and I'm going to get to it on the future slides -- is that this is a very broad topic. We took a pretty much high-level review of trying to capture some of the information in the IPEs, extract it, and see if what was hoped to be achieved from A45 was.

For example, the detailed review of the IPEs was not done for this project. That was an effort that took several years and happened in

research. This was a much more limited effort than those types of reviews that happened when the IPEs came in.

This is I think pretty much a retrospective look again trying to see if the resolution made sense and whether the resolution on a high-level plane accomplished what it was trying to do.

MEMBER LEITCH: Just a process question. Is this effectiveness review a standard part of looking back at these unresolved safety issues to see how effective they were? Is this done in every case or just selectively?

MR. FLACK: Well, again, I don't know if George wants to speak to this, but we are in a mode of looking for things basically as a delta. In other words, as in a station blackout, a before and after was the vehicle that was put into place by this regulatory agency effective in achieving its goals that it had established itself. And so what we are really focusing on is a change in something due to some action on our part as an agency.

And so we have done this on a number of issues already, as has been mentioned, ATWS, station blackout, and appendix J, and now this resolution, to

see if we are really achieving the outcomes that were expected.

So it could end up being another generic issue in the future. We're constantly looking for other things. We are discussing now activities surrounding shutdown because this was not part of the resolution of A45. Shutdown states the trip were from full power.

So this actually may be a follow-on activity from this. They will go investigate and see exactly what experience has occurred from shutdown. We know there was a rule that was attempted to be in place. It never made it in the '90s.

And what is the experience since then? The initiative was really given to industry to try to address that issue. And now from an operating experience, we would go back and see if it, in fact, is being assessed or does it look like we need to do something else?

So we're constantly in a mode of looking for things like that, where we have put in place a certain regulatory vehicle, and then to see if it has achieved its goal, its outcome that we expected it to do.

VICE-CHAIRMAN WALLIS: You see, the

problem I have is you are going to tell us that you found a way to cool the core when you lose some of these systems by using fire water and so on. That seems to resolve the sump blockage issue as well.

MR. FLACK: Okay. Why don't we let John walk through it? Then we'll come back to these other issues. I'm sure it's just not only sump, probably other ones that will come up. Then we'll take that on.

VICE-CHAIRMAN WALLIS: But if you have done that, it would be nice to say so.

MR. FLACK: That we have had --

VICE-CHAIRMAN WALLIS: If you have also resolved the sump blockage problem by finding out other ways to cool the core, that would be very helpful to say.

MR. FLACK: Okay.

MEMBER SHACK: John, just to comment on it, that would be a very interesting study. You have things where you have actually passed rules, like SBO. You've got A45 now, where you have different kinds of regulatory action. To look at shutdown, where it was essentially left to industry action would be an interesting comparison.

MR. FLACK: Now it would, yes, at this

point in time. And that's exactly where we're headed. I think that we haven't laid out the plans. It was one of the ones we were considering to do following this one.

MEMBER LEITCH: I guess I still don't have a clear answer to my question. In other words, if you looked at the generic safety issue resolution process, is there a standard part in that process several years downstream that says after we have implemented this solution, we're going to come back and look at the effectiveness of it? Is that a standard part of the process?

MR. FLACK: No. What closes the issue is actually the implementation of whatever recommendations come out of the resolution process. Once they are implemented, then essentially the issue is closed. It would not be reopened again or looked at again unless there was need to later on downstream.

For example, we did recently revisit GI 80, generic issue 80, which had previously been closed. We could reopen it based on operating experience and reassess it at that point, but that was not the case here.

In this case, we were looking at a process that was used to close a generic issue. And we were

asking ourselves, was that process the right thing to do? Did we achieve our goal in doing that?

MEMBER LEITCH: Okay. I guess I am thinking about like licensees' corrective action programs, for example. Most of those really good corrective action programs not only implement the corrective actions, but at some period of time downstream, they take a look at the problem and see if those corrective actions have been effective at preventing a problem. I was just wondering, is that kind of a feedback loop filled into this process.

What I think I am hearing you say is not always but perhaps in some cases, you do that, but it's not necessarily a standard part.

MR. FLACK: Yes, right. It's not standard.

MR. KAUFFMAN: Okay. My next slide is on the assessment methodology we use. Typically in our reg effectiveness assessments, we compare expectations to outcomes.

Now, frequently when there is a rule involved, we can go to the statements of consideration, some of the questions and answers, going back and forth. And it will be very clear what safety benefit we expected to get, what we thought

that would cost licensees to do and what not.

In this case, this was not a rule. And when we went through the documents, what we find is that the expectation we had here was that a process would be established so that detailed looks in the form of IPEs would be performed.

As expected, if licensees followed this process, vulnerabilities would be identified and that modifications would be made to reduce risk and that the risk would be quantified.

In this case, the outcomes for our study we took from the actual IPE, IPEEE submittals, and the IPE database. And that's pretty much summarized in table 6 of our report.

And then recall that we are doing a process evaluation here. Two questions we asked ourselves, did the risk reduction happen and was the approach used reasonable? In this case, we said, is it possible there was a generic fix they could identified and a hard and fast rule made?

So we approached that question by looking at the changes and modifications that licensees made for DHR and submittal and looked to see if there were common fixes within classes of plants or whether they were different. If they were different, we were going

to conclude that this was a reasonable approach.

The detailed expectations for USI-A45. And these come from NUREG 1289, which was the regulatory and backfit analysis for this issue. It had three categories.

The first one was if the DHR CDF was less than $3E^{-05}$, that there would be little, if any, cost-beneficial modifications warranted. If it was greater than $3E^{-04}$, action would be needed. And if it was in between, it would be intermediate.

Recall here that when the submittals came in, if there were plans that came in in the second category as part of the review, the staff was going to be looking to identify plant-specific backfits and identify if any might be able to pass the backfit rule and be imposed.

CHAIRMAN BONACA: This material would be applicable, irrespective of the baseline CDF?

MR. KAUFFMAN: The backfit rule, 5109, is a regulation for the staff to --

CHAIRMAN BONACA: No. I understand.

MR. KAUFFMAN: -- make a rule or to impose a new position. It has to be cost-beneficial, compliance-related, et cetera. And it was expected that this program would reveal vulnerabilities if they

were there.

When we look at the BWR outcomes, all BWRs were in the category 1 of less than $3E^{-5}$ for DHR CDF. No vulnerabilities were identified. The third bullet is not meant to be all-inclusive. We would note that over 500 miles made during the IPE process.

Some of the enhancements made at boiling water reactors for decay heat removal are things such as cross-ties from surface water or fire water to RHR system, procedure changes on alignment of low-pressure ECCS pumps, alternate power to automatic depressurization system, and training changes.

MEMBER ROSEN: What does SPC stand for?

MR. KAUFFMAN: Surface control coolant. In the PWR outcomes, when we removed the blackout sequences which are addressed by the station blackout rule, on average, the PWRs are category 1 less than 3 times $10^{-5}$, although 11 were category 2.

The process did identify vulnerabilities. And they were addressed at Calvert Cliffs. Vulnerabilities there involved surveillance on auxiliary feedwater hand valves. They put surveillance so they could take more credit in the IPE. And there was training on inadvertent engineered safety features, actuations, and $O_x$ feedwater

actuations.

Again, many enhancements were made as part of this process. Examples were improving $O_x$ feedwater reliability by procedure changes, hardware for alternate water sources or alternate control power, changes in surveillance, changes in operating procedures for running the pumps.

Low-pressure injection systems. Changes were made, such as increased testing, increased surveillance, staggered testing, and procedure changes.

VICE-CHAIRMAN WALLIS: Nothing was done about high-pressure injection?

MR. KAUFFMAN: I have a detailed list of plant by plant changes that were done. I'm sure some changes were made. I was trying to capture the more dominant ones there. This is not meant to be an all-inclusive list.

Plants did make change to improve feed and bleed, such as modifying the --

VICE-CHAIRMAN WALLIS: Now, where do these injection systems include feed and bleed drawing from? What is the source of water?

MR. KAUFFMAN: Pardon me?

VICE-CHAIRMAN WALLIS: What is the source

of water from these injection systems and the feed and bleed? What is the source of water?

MR, KAUFFMAN: I imagine that depends on the sequence you're talking about. For a long term into a small break LOCA, that might be the containment sump. Early on it could be from the normal CST supply.

VICE-CHAIRMAN WALLIS: Where does it go? When it bleeds out, where does it go?

CHAIRMAN BONACA: It goes to the tank.

VICE-CHAIRMAN WALLIS: Well, it goes to the tank.

CHAIRMAN BONACA: Then it goes to the sump.

VICE-CHAIRMAN WALLIS: It goes right to the sump. Right. So we are talking about here going from a sump or an alternative source and returning to the sump.

CHAIRMAN BONACA: Well, I'm not sure, however, how long. I mean, you could go a long time with available --

VICE-CHAIRMAN WALLIS: That's why I wanted to know.

CHAIRMAN BONACA: Because you inject through charging or high-pressure injection.

VICE-CHAIRMAN WALLIS: Well, they are tanks.

CHAIRMAN BONACA: And you bleed. Now, in the bleeding, do they qualify the valve for bleeding? What does improvement? Does it means that valves are qualified for passing water?

MR. FLACK: Yes. I think there were a couple of questions there. One is the size of the refuel and water source tank. I think that some of the enhancements that were made also included refilling that refueling water source tank. So you could basically come out.

The question on qualifications -- and I think you will see at the end of this presentation that some of the questions that we have are the fact that some of these are not safety-related equipment that they're relying on. And some of it there is substantial credit taken for that. But John will get to that at some point.

CHAIRMAN BONACA: Yes, because, I mean --

MR. KAUFFMAN: Please recall we're talking about the IPEs for every power plant in the country --

VICE-CHAIRMAN WALLIS: I think I have --

MR. KAUFFMAN: -- which involves --

VICE-CHAIRMAN WALLIS: I think we have

established, though, that the water source could be the sump --

MR. KAUFFMAN: Sure.

VICE-CHAIRMAN WALLIS: -- and bleed goes to the sump. And, yet, there is no mention in your whole report about the possibility of blocking that path.

PARTICIPANT: Well, on the level of whatever was in the IPEs at that time and what was understood, that is the purpose of --

VICE-CHAIRMAN WALLIS: But you're saying everything is fine. And I'm not sure it is.

PARTICIPANT: We're not saying everything is fine. This is like any other one of the rate effectiveness studies we do. We look at what the intent was at the time that the thing was implemented. We don't try to catch every blip and every change that has been discovered, every new phenomenon that --

VICE-CHAIRMAN WALLIS: How can this issue be resolved in the wonderful way you describe it, as if it ignores something which is going to defeat the effectiveness of this method of cooling the coil?

MEMBER SIEBER: Well, they made another issue out of that.

VICE-CHAIRMAN WALLIS: You should say so.

You can't ignore it.

MR. KAUFFMAN: If I might try to answer the question? We have operating experience. New issues are always being identified and coming on the table.

There was a red finding at Point Beach involving the $O_x$ feedwater system. And you could say that the IPE missed that. The IPE was no good. You could also say deterministic engineering --

VICE-CHAIRMAN WALLIS: I think you ought to say that. You ought to say that.

CHAIRMAN BONACA: That's just a question. I mean, you don't go to feed and bleed if you have a LOCA. You don't need to do that. I mean, why would you go to feed and bleed? I mean, you do it --

MEMBER SIEBER: That's a last resort.

CHAIRMAN BONACA: Well, you go to feed and bleed only if you have to cool and you don't have secondary site cooling. So, therefore, you go to feed and bleed. I mean, if you have a hole in the system, gee, I mean, you don't need to feed already. You just need to circulate.

So I think it is a notation on that thing there. So that would be the answer to me.

VICE-CHAIRMAN WALLIS: Well, the feed and

bleed is a big actor in the --

CHAIRMAN BONACA: Yes. In fact, that is why I am saying that the bleed and feed has two fundamental elements to it. One is the qualification of the valves to pass water. I don't care if they are safety-grade or not. They qualify to pass water and stay open.

And the second issue is depending on the plant, they have a ranging window of acceptability. I mean, some plants you may have most at one and a half hours by which you have to bleed and feed. Otherwise you are not going to be successful. It doesn't matter how much you bleed and feed.

MEMBER SIEBER: That's right. You can't --

CHAIRMAN BONACA: And so those are issues in the qualification of the process. Others you work, I mean, some of the CE plants, if you don't bleed and feed we think two hours. And that's a hard decision to make if you don't have a break in the system to just go in and bleed and feed. Operators don't like to do that.

If you don't do that within two hours, it doesn't matter how much you do it. It will not be successful because you cannot pump enough water. You

don't have high pressure injection.

VICE-CHAIRMAN WALLIS: Because the pressure is too high. Is that right?

CHAIRMAN BONACA: Well, some of these plants have very small charging pumps at the pressure level, like 200 ppm, and the pressure is too high. So you have to wait until you come down to high pressure injection, which is about 1,400 psi. And it takes you a long time to get there, if ever you get there.

VICE-CHAIRMAN WALLIS: So you have to have an ADS valve?

CHAIRMAN BONACA: Well, yes, that would be desirable.

MEMBER SIEBER: Well, that was the AP1000 solution.

CHAIRMAN BONACA: So I'm saying and trying to understand what improvements to make. I mean, hopefully it was the thing that I mentioned.

MR. FLACK: When they did their IPEs, they looked at this. And this is very important to do. I think when one looks at the big picture, we recognize that there is a GDC 34 that talks about redundancy and decay heat removal. But what we are talking about now is diversity in decay heat removal. Redundancy is more. It's just the steam generator side of things

and what happens when you lose that side.

Is that good enough? And we have found by looking at the IPEs that many of them believed it was not. And they needed to go beyond just decay heat removal being removed from generators.

That puts us into a feed and bleed type of mode. And, in fact, we have seen that on most of the plants, which indicate that it was important for them to consider this, to do this, put it in their procedure, recognize the time.

But that also raises other issues, which you have just mentioned one of. I think John will get to that in the end. Then the question is, what else needs to be done here?

CHAIRMAN BONACA: The question I have is, will you go back and check that, in fact, the procedures reflect this mode of operation? For many plants, it does not have the feed and bleed in the procedures. Any time they got on the simulator and somebody tried to see that we get into that process, they wouldn't.

MR. FLACK: They couldn't do it.

CHAIRMAN BONACA: They couldn't do it or they even wouldn't do it because they were assistant to the process. They had to think about what the

consequences are, the weight, and if you only had one and a half hours to be successful, one and a half hours pass quickly. They try this, try that, and then.

So was that a verification of the procedures reflecting these changes?

MR. FLACK: And also whether the thermal hydraulic analysis has been performed to support the time frame in which one would have to enter into such a procedure and be successful there in that --

CHAIRMAN BONACA: Yes. I had a question on this. I mean, the question I have is, was there a verification that, indeed, they put in place a means of being successful in this?

MR. FLACK: Do you mean a validation as far as out in the field by inspectors?

CHAIRMAN BONACA: Yes.

MR. FLACK: I cannot speak to that. One of the things that we have raised is the amount of credit that had been taken for non-safety-related equipment and whether or not we would need to go follow up on that. That's a question in our minds, the same I am sure you have.

Well, John will get to this at the end. And maybe we can talk about this as a follow-on to the

work.

MEMBER SIEBER: One of the other issues is there is the capacity issue. It's how much can you inject and how much can you relieve and how many valves do you need, for example?

MR. KAUFFMAN: And that varies amongst plants. And there are even arguments amongst people.

MEMBER SIEBER: That's right. When you start a plant, you are building up an inventory of decay heat. So when you start, it really makes a difference.

CHAIRMAN BONACA: I mean, I have seen cases where the procedures finally were changed to bleed and feed. And then when we went to the simulators, the operators would not do it. And so there were consequences if you had to force this because the operator doesn't like that procedure.

So you get to frame them, make a belief that it is to be successful, and give them a time by which they had to do it. Otherwise they won't do it.

And so that is a significant issue. If you get a lot of credit for that but it is not going to work on the field --

MR. FLACK: The validation question. However, the IPEs did require in a sense that in order

to take credit for it, one must have procedures. So I think that was pretty explicit up front.

MR. KAUFFMAN: The NUREG on the IPE submittals. And there was also some NUMARC guidance. So the question, then, is the procedures are there. It's just a matter of if they met the --

MR. KAUFFMAN: Again, for this project, we pretty much extracted what was in the IPEs.

CHAIRMAN BONACA: I understand.

MR. KAUFFMAN: At 100 plants, every assumption and buried assumption and every reliability. We tried to take on a reasonable size task that we --

CHAIRMAN BONACA: They do that, but then if you use this to close an issue, there have to be assurance that those things, those elements that you put closure are, in fact, going to happen and implement it.

I don't want to interrupt any further the presentation.

VICE-CHAIRMAN WALLIS: Well, how about the operator reliability issue? If the operator doesn't go into feed and bleed properly and then can't get into feed and bleed because the pressure is too high, then you haven't really solved the problem.

MR. KAUFFMAN: Well, again, the IPEs were done. Hopefully the analysts that did that, the reviewers that looked at how it was done --

VICE-CHAIRMAN WALLIS: Did they bring in human reliability? Did they consider human reliability?

MR. FLACK: Well, human reliability was part of the analysis, which is the PRA that supports the IPE.

VICE-CHAIRMAN WALLIS: Isn't that a part of the PRA that my colleague who isn't here would say was least reliable?

MR. FLACK: I would tend to agree with that. By the way, there is someone from NRR, Warren Lyons. If we have questions specifically addressing those issues on inspection, he would be happy to respond.

MR. KAUFFMAN: The findings of our study. It's pretty much a rehash of the previous slide. BWRs were all found to be category one. No vulnerabilities were identified. And the modifications credited and made in the IPEs were generally dissimilar between plants and within plant classes.

And other activities contributed to the DHR CDF reduction that was seen, such as the station

blackout rule and the hard containment vent, generic letter 89-16.

MEMBER LEITCH: And were they all category ones as found or after they made these modifications?

MR. KAUFFMAN: I don't believe we really have necessarily before and after pictures for all of the plants on what they were before.

MEMBER LEITCH: But is the goal here to get them all in category C-1?

MR. KAUFFMAN: The C-1 was -- the literature there talks about it tieing to the NRC safety goals. And it also talks that it was thought that little, if anything, would be cost-beneficial if it was category one. So as a screening tool, if it was C-1, it was determined to be okay.

MEMBER LEITCH: But, yet, the BWRs and some of the PWRs were C-1. And they still made some modifications to further improve the situation. Is that correct?

MR. KAUFFMAN: Right.

MEMBER LEITCH: Is my understanding correct?

MR. KAUFFMAN: Certainly the PRAs, IPEs are a valuable tool for identifying in many cases relatively easy, cheap, inexpensive fixes that can

have a big impact on risk and can help reduce risk and drive the --

MEMBER SHACK: But you don't really have a before and after for the BWRs, right? The C-1 is the statement you get from the IPEs. You know that they made a bunch of mods, but there's no real comparison of what it was before or after, is there?

MR. KAUFFMAN: Right. In one of my earlier slides, I try and point out that perhaps we discovered this too late. So we talked about, did we get the risk reductions we're after? And, really, the idea here is that the risk was quantified and found to be acceptable.

VICE-CHAIRMAN WALLIS: This would help, though. I mean, you are going to convince us that this work and all of these modifications reduced the risk sufficiently. We have a before and after. That would be the conclusive evidence, wouldn't it? You could present that to us.

MR. KAUFFMAN: It would be nice if we had it, but we don't.

VICE-CHAIRMAN WALLIS: You don't? How do you know that you have been successful?

MR. FLACK: I think there is some evidence, though. We have like before and after in

certain cases on feed and bleed, for example, and how much credit they are taking for things like that.

So it's spotty. It's not across the board. In other words, there wasn't a predetermined delta that we were trying to achieve through the IPE process in decay heat removal, like it was with station blackouts.

In station blackout, we understood that before and after, we expected the rest to be changed by so much. And we could go back and see what the change was.

VICE-CHAIRMAN WALLIS: That's what I wonder about. You say the expectations were met and the outcomes met the expectations. And it's all in qualitative terms. It says it was found acceptable.

Well, if you have numbers or something, we can see what is actually being achieved.

MR. FLACK: Yes, right.

VICE-CHAIRMAN WALLIS: Without the numbers, we don't quite know what you are using to say it's acceptable.

MR. FLACK: Well, I think we can talk a little bit about that at the end and what we mean by that. We don't want to discuss that now. Do you want to talk about that, John? If we can just go through

the whole presentation, we will come back to that.

VICE-CHAIRMAN WALLIS: Okay.

MR. KAUFFMAN: On our conclusion slide, we decided that the program expectations were met, that the PRAs were performed on all plants, that staff reviewed the methods and results for each plant. The risk was quantified, understood, and found acceptable. And vulnerabilities were identified.

We concluded that this approach was reasonable. Credit taken in the IPEs on the topics was reasonable and in some cases challenged by the staff. And the staff would have interactions with the licensees used proven PRA techniques, which are good at identifying weaknesses in a plant design.

From our look at the changes that were made, we did not see where any specific generic enhancement could have been identified.

VICE-CHAIRMAN WALLIS: When you say "proven PRA techniques," what was the measure of the quality of this PRA? And was it appropriate to the decision that was being made?

MR. KAUFFMAN: Well, when we go back to the time of the IPEs, the generic letter, again, it's not a requirement. At that time, there were not PRA standards. And there still are not.

And that was a management policy decision at the time. And efforts are underway to go toward standards. But maybe John would like to --

MR. FLACK: Yes. The quality question always comes up in this context using PRAs or IPEs in the decision-making process.

Now, the IPEs were performed across the board by a number of different vendors, for example. And there is obviously a variation in what we might term as quality of those PRAs.

So it's difficult to assess exactly the role that is played in the plant's identifying vulnerabilities. What we really are basing it on here is the vast amount of information that was generated as part of the PRAs.

And they did do PRAs. I mean, that was not a requirement of the IPEs. They could have done something different. Only one plant chose to do something different. And eventually they came back and did a PRA because they felt that they could see the benefit of doing a PRA. These were not simple analyses. They're very sophisticated.

So having said that and being in a position to assess all of this information, we have to look for certain things. And whether or not the PRAs

were pulling forth the kinds of things that one would expect having done a reasonable PRA, these were reviewed in that context. As part of the IPE reviews, each plant was assessed based on what they had provided to us, the sequences they have identified, improvements that they have made.

I think the real benefit -- and I'm not here to sell the IPE other than I thought it was a very successful process -- was in the number of modifications that ere made.

John mentioned that these IPEs did generate 500 modification plant improvements. I think a lot of that comes from just doing the analysis, understanding the plant better from an integrated sense, and seeing how things could be improved at a reasonable cost. Many of these things did not cost the licensees much to do.

So you're right. We're judging success in that process from a broader sense and not getting down to the quality of the validation issues that certainly would remain. If we were to try to do each one independently would not be feasible for us to do it at that time.

So we are limited in what we can say and resolution of the issue, base it on what came out of

the process, looking for generic insights to see if there had been something that could have been done generically to improve decay heat removal across the board and that sort of thing.

We recognize the limitations in making those arguments that indeed are qualitative. There is no delta change of risk that we can really point to and say, "Yes, we have achieved what we have set out to do here." So yes.

MEMBER SHACK: Yes, but, to be fair, you did have the 1289 expectations, the C-1, C-2, C-3, which were done before the IPE. So I assume the guy did the IPE and when he got himself out of C-3, he kind of declared victory or if he was in C-2, he did what he needed to do to get to C-1 because he knew he wasn't going to get any grief when he got there.

MR. FLACK: That's true.

MEMBER SHACK: So to that extent, I mean, you did have a set of expectations that were, in fact, even quantitative.

MR. FLACK: Right. But, again, the question on quality about the numbers and that sort of thing --

MEMBER SHACK: Right. Validation of that is a different story.

MR. FLACK: Right.

MEMBER RANSOM: One thing, going back to Professor Wallis' question on was sump pump blockage considered in the IPE program? Was that a factor that came into play?

MR. FLACK: In that context, it wasn't something that we requested licensees to look at specifically. There were certain things we wanted them to do. One of them was to resolve this issue. But we did not specify how that was to be done. We left a lot of this up to the applicant.

At the time, from having seen a number of IPEs myself and having been in that review process way back then, it was not something that was what you might say on the forefront, where people were looking at it in a sense of having to resolve an issue that we see out there, that this is one way of looking at it and resolving it.

I think it grew since that. Of course, recently, more recently -- and 191. I think it's generic issue 191 which is again looking at some blockage and recirculation as being an issue with the insulation; for example, in the insulation plant.

I don't think at that time that people were sensitive to that issue, although, see, the IPEs

and PRAs don't rule out issues. It's the extent and the rigor by which the licensee applicant does the analysis. And a lot of it is based on what the state of the art was at that time, including 1150 and so on.

So they're using what was at that time the state of the art, since that, of course, time, state of the art has evolved. More issues have come to the forefront as being more important.

There were some times when they actually blew it where they shouldn't have, like this issue that was picked up at Point Beach. We felt that that should have been picked up through the IPE process, and it wasn't. So there are going to be oversights in that case. It's not a perfect process.

CHAIRMAN BONACA: When they do the IPEs, I think there availability of the recirculation system due to blockage was considered to be a small number, reasonably small number. So today we have a different perspective of that.

MEMBER RANSOM: Well, is the IPE program a one-time type thing or is it continuing?

CHAIRMAN BONACA: Yes, it was done once.

MEMBER ROSEN: It was a one-time thing, but what it did was start many licensees in the PRA world. That process of picking up the IPEs and

bringing them forward, improving them continuously, is what you see today in the licensees.

MEMBER RANSOM: Well, that's what I wondered because presumably the resolution of A45 is that it is being folded into the IPE program. And if that is not an ongoing program, it won't cover problems like Professor Wallis is mentioning, the sump pump blockage problem.

CHAIRMAN BONACA: Well, that resolution --

MEMBER RANSOM: It really uncovered things.

CHAIRMAN BONACA: The resolution of A43 was certainly required.

MR. FLACK: But the generic issue program is a living program. And right now we are in the process of resolving 12 issues in that program. So if, in fact, another issue came up, like some blockage, for example, we wouldn't go back and reopen A45, but we would raise it as a separate generic issue based on new information which we didn't have previously.

There's a certain process that we go through that would do some form of risk assessment. We go through a panel and decide whether or not it is a new issue and it needs to be addressed and then if

it warranted that, then if we go assign a task manager and an action plan.

So the process does pick up new issues as we identify them. So we usually don't go back and reopen an old issue once it --

VICE-CHAIRMAN WALLIS: John, I don't want to take a lot of time, but when you talk about regulatory effectiveness, which is the title of this whole study, you seem to be saying that knowing what they knew at the time, they did the right thing.

You could also say that, therefore, they were effective. But you could also say they were not effective because they resolved the issue, but it really didn't resolve it because new things have come up which are still an issue. So they didn't really resolve it. So they weren't effective. They missed --

MR. FLACK: Yes.

MEMBER SHACK: Well, they were solving certain kinds of problems, weaknesses in support systems. They didn't identify every weakness in the system, but every time you remove one weakness, you --

VICE-CHAIRMAN WALLIS: All right.

CHAIRMAN BONACA: It's still one of those things. Do you really wish that -- in the '60s, they

debated whether or not they had to have low pressure or high pressure at a charge? They had to make that decision to go high pressure.

MEMBER LEITCH: Well, you will have to educate me. I have some basic maybe understanding with the process. We have this issue regarding shutdown decay heat removal requirements.

We conclude someplace along the way that we are vulnerable in this regard. So how did we resolve A45? We asked the industry to do certain things to improve the reliability of this? What do we do?

MR. FLACK: Yes. Essentially A45 was a tough issue to resolve at the time. Primarily as John had mentioned, it came down to being very plant-specific.

There were some generic issues proposed, some generic resolutions to this issue proposed. And they were found to be not cost-beneficial. But everyone recognized the significance of the issue. Something still needed to be done, even though a generic solution was not apparent.

And so at that same time, we were in the process of doing the IPEs. So the decision was made that we'll let the industry take this issue. And that

was the big change I think as compared to the other issues that were resolved where we put the initiative. We said we will make this an industry initiative to resolve this issue as part of the IPE. And that was folded into the program at that time.

We also gave them the opportunity to address other generic issues as part of the IPE as well. But this one specifically requested them to look at, to report sequences that were associated with decay heat removal, and to identify vulnerabilities and define the vulnerabilities.

So what we are looking at is whether that process is really work because we have now changed something.

MEMBER LEITCH: There's nothing very prospective about it other than that the industry should identify those vulnerabilities and take steps to solve them or lessen them in some way.

MR. FLACK: That's right.

MEMBER LEITCH: A lot of things were done, all of which were in the right direction, but we can't really quantify how much reduction in risk was achieved.

I guess what you are saying is you are concluding that that process, family allowing the

industry to take the initiative and do some of that, was effective in that reduction was achieved.

Am I getting the sense of this? I am trying to understand the process, not the technical aspects of it.

MEMBER SIEBER: Well, a lot of the work was done by the owners' groups. Everything ended up as solutions and improvements per class of plant. You know, Westinghouse had an owners' group. And then they divided up the plants in two, three, and four plants.

And some plants have better capabilities than others. And that's why you end up with differences in risk.

MR. FLACK: That's right. It's very much plant-specific. I think the basis for coming to that conclusion was that we looked at it to see if there was, in fact, a generic fix to begin with, where we should have taken action to have plants do X.

And I think after having gone through all of this information and assessing it, I think the conclusion that we are hearing is that we did not see a generic fix being cost-beneficial. So the approach that was taken was justified.

I don't want to put words in John's mouth,

but he was the one who did the study.

MEMBER SHACK: How do you decide the 11 PWRs that are still category two are acceptable?

MEMBER SIEBER: You're not supposed to ask that.

MEMBER SHACK: Your quantitative design objective for A45 wasn't met.

MR. FLACK: You're right, and it's a very good question. This is exactly the question we talked about before we came down. It's in the gray area. It's not one where it's in above the C-3 or the C-1, where we are sure it looks like something needs to be done, like in Surry. Surry had a --

MEMBER SHACK: C-3 is the one where something has to be done.

MR. FLACK: Yes. Okay. So if it's C-3, it's not in that category. C-2 is a gray area. Now, when they did the IPE reviews, one of the objectives was to see if, in fact, there were cost-beneficial fixes on a plant-specific basis that looked justified. And it was, really, the burden was on the reviewers to bring those forward as part of the review process.

In this region, where you may say, well, there might be something there that is cost-justifiable, none of these issues had been

brought forward in saying, it does look like it would have met the backfit rule. If it had thought to have been able -- and they're all different. My understanding is the 11 plants, the reasons why they are there is for different reasons. So it's really a plant-specific issue.

And so we're basing it on the fact that a backfit issue had not been raised as part of the process and, therefore, would not have met this cost-benefit test. And we had left it at that.

MEMBER SHACK: So you believe the reviewers sort of look at those results and try to decide whether you would get a cost-benefit?

MR. FLACK: Yes. The answer is yes.

MEMBER SIEBER: Well, the fix for loss of heat synch turned out to be non-safety-related equipment in an attempt to make it cost-beneficial. In other words, you can use whatever it is you have to have feed and bleed. And you don't have to stall safety-related systems to do it.

And I think that's one of the things that helped us past that point because if you lose the heat removal capability from the secondary side, there isn't a lot you can do except feed and bleed. I don't know what else there would be.

CHAIRMAN BONACA: If you have a very small break LOCA where you cannot depressurize. Again, if you have the secondary side, you can stay cold if you don't have that.

VICE-CHAIRMAN WALLIS: Should we go on to the next page, where you actually do have some CDF values?

MR. KAUFFMAN: Okay. before I go there, I would just like to say that we don't want to oversell A45, as this discussion has made clear. There were a lot of other things ongoing around the same time. And I've listed some of those. That is not a complete list either.

MEMBER RANSOM: Can I ask a quick question? What is the hardened vent?

MR. KAUFFMAN: That's for BWRs.

MEMBER RANSOM: Right. What is meant by "hardened"?

MR. KAUFFMAN: They can withstand pressure.

MR. FLACK: Yes. I think earlier plants had used their ventilation systems, something less than hardened, to vent the containment. And putting in the hardened vent assured that that vent path would be available.

CHAIRMAN BONACA: Previously you would vent inside your reactor building because you would just reach the ducts. That was a good way of filtering. It was very good, even through your reactor building. If you just give up the plant, you could filter.

VICE-CHAIRMAN WALLIS: This picture tells me that feed and bleed really is an important actor for some plants. You really need it.

MR. KAUFFMAN: Well, for this study we point out in our report that feed and bleed is very important. And we raise the issue that in some cases, it's non-safety equipment. The analysis supporting it maybe hasn't undergone regulatory review.

And success criteria can be important. And sometimes feed and bleed may have to be done very quickly. Then you get into the appropriate amount of --

CHAIRMAN BONACA: I think it is very important. I wasn't assured by your report that it had been fixed so that the problem with getting feed and bleed to work had gone away.

You assure that it is important and they have done some things. But what is the assurance that the problem of getting it to work properly has gone

away or has been resolved properly, adequately, or whatever?

MR. KAUFFMAN: In our follow-up activities, we are going to recommend that do we consider doing further analysis to reduce uncertainty in this area involving the timing and the success criteria?

That work will probably go through and identify the plants where the credit is most important and where the credit is perhaps where we have the most uncertainty about whether we think it will work.

CHAIRMAN BONACA: I think it would be sufficient to send communication field inspectors out to the field to the region to just --

MR. FLACK: That's very important. In fact, we have members of my branch going to the counterparts meetings with our reports, including this one, to show the importance of these, for example, feed and bleed.

The other thing is, you know --

CHAIRMAN BONACA: Arkansas One. What is it? That's a feed plant, water?

MR. FLACK: ANO-1. I believe that is or is that B&W?

CHAIRMAN BONACA: ANO.

MR. KAUFFMAN: Again, this was before. we kind of zeroed it out in some of the models to see if it was still that important in the results. It turns out it still is.

PARTICIPANT: But the other point on this slide I think is that you see that there isn't a huge change in the credit in the IPE versus what's the current view with the SPAR models.

And, from what I understand, there are still some discussions going on right now, especially in the SPAR models, about whether they have to take credit for one PWR, BWR, too. So this is still. It's an active area. That uncertainty is still there. We weren't there to fix that.

MEMBER SHACK: That's an independent analysis. They went through and did the success criteria and that sort of thing.

PARTICIPANT: So you might say in some ways that that brought it up to date.

CHAIRMAN BONACA: Who calculated that CDF for Arkansas One? Is it IPE or is it --

MR. KAUFFMAN: That was taken out of that NUREG 5230. Off the top of my head, I don't.

CHAIRMAN BONACA: Because I remember.

MR. KAUFFMAN: I believe the contractor

probably calculated that.

VICE-CHAIRMAN WALLIS: What does ANO think its CDF is, as opposed to NUREG CRO? What is it now? Is it much lower than these numbers?

MR. KAUFFMAN: Well, for the IPEs on page 39 for ANO, it says 4.7 times $10^{-5}$ is -- I'm sorry. That's the IPE DHR CDF. From the IPE database, it's a very similar number.

VICE-CHAIRMAN WALLIS: That's assuming that the feed and bleed works?

CHAIRMAN BONACA: No. I was asking right now the current CDF.

MEMBER SHACK: With the credits that they give in their IPE for feed and bleed.

MR. KAUFFMAN: And the contractor presumably thinks it's somewhat higher.

MR. KAUFFMAN: Well, that was an earlier study.

MEMBER SHACK: That was an earlier study. Okay.

CHAIRMAN BONACA: That must be because --

VICE-CHAIRMAN WALLIS: You don't want a letter on this. Is that what we were told?

MR. FLACK: We'd like your feedback, as we're getting it here on the record. So we can go on

that, too. Again, we're concluding the study. And whatever we can get from the ACRS today certainly would be integrated into that.

VICE-CHAIRMAN WALLIS: I don't know. I would like some harder measures of effectiveness than we seem to be getting here.

MR. FLACK: Well, we would, too, I guess. We're sort of at the mercy of the process at this point.

So these were the last two bullets, I guess, that you --

MR. KAUFFMAN: Okay. Insights for follow-on activities. I've talked about the first bullet. The second bullet, the key point to remember is that decay heat removal function is sensitive to the use of non-safety-related equipment and the implicit assumptions regarding equipment availability and reliability in the various analyses.

We are going to be recommending that operating experience be assessed to look at the consistency between the IPE, IPEEE results, and the actual reliability and availability of DHR components, focusing on two main areas. One is areas where there is substantial credit in the analysis; or, two, where the analytical assumptions cause a big impact on the

ultimate CDF.

MEMBER SHACK: Just coming back to that first bullet, if you have already done this for the SPAR models, don't you have a sort of independent analysis of that already for these cases or are you saying that even for the SPAR models, you want to go back and look at the numbers again.

MR. KAUFFMAN: I'm not a PRA model person. I have heard some discussion of whether validating the SPAR models and updating those, that they are having some discussions about the success criteria and some arguments and that it impacts the results very much.

If we do do this sort of analysis, it will probably be another group in research that does that, the people that are more into doing the code runs and those sorts of things.

MEMBER LEITCH: I have a follow-up question to Bill's question of a few minutes ago. He asked, what about these 11 PWRs that are still in category two? Do we know that we have 11 PWRs in category two?

MEMBER SHACK: Yes.

MEMBER LEITCH: Is that the way they are now after all of these modifications or --

MEMBER SHACK: Yes, they are.

MR. FLACK: Well, I can't speak --

MEMBER LEITCH: Then the data we are looking at is as-left data, not as-found data?

MR. FLACK: Well, I think there we're looking at it from the IPEs now. They may have since then made improvements that have reduced those numbers, but we are not sure of that at this point, I don't think.

MR. KAUFFMAN: This exercise wasn't to redo the IPEs, and it certainly wasn't to go to the latest and greatest PRA that a licensee might have.

MEMBER LEITCH: So they may or may not still be in category two?

MR. FLACK: But they may be. That's probably something we should look at as follow-ons to this to see if, in fact, there have been things done there.

CHAIRMAN BONACA: What stage are we in this process? I understand this is an evaluation of USI-A45. And the ultimate step is to be that all that had to be done is done. And then we can close the issue.

MR. FLACK: From that perspective of the process that took place. And that was closure of A45. And I think the conclusions that were reached is that

it was an effective way of resolving this issue.

However, there are always insights from these studies as to where we are going to go from here. And that's some of the things that we're entertaining now that we are discussing around the table.

So it's not like a generic issue process where we're trying to reach closure. What we are doing is we are trying to continuously assess our regulatory process to see if there are ways we can improve it and whether it's a --

MEMBER SHACK: In the generic issue sense, A45 was closed when you handed it to the IPE.

MR. FLACK: That's right. That's exactly right. And the question is, do we want to reopen it at this point? That is always an option, but I think what we are saying is no, we don't think that it should be because we don't see the generic fix there that reopens it.

CHAIRMAN BONACA: But it seems to me that it was given to the IPE for resolution. Statements have been made from the IPE performers of the plants about improvements they have made. And these improvements, from what I understand, have not really been validated or whatever.

So that one is left with the question of how effective are these improvements. I mean, I am sure that nobody lied and just said, yes, we can prove something about feed and bleed. For example, we will build you a better bleed and feed.

Well, that's one way to do it, but it was not going to be effective. We need to see that there are procedures to bleed and feed, that their heart has been convinced that they had to do it urgently to get in the situation, that they have this sequence of a simulator where they are trained so that they will do it because it's a critical function.

I mean, I have seen it. It is a critical step. You get to train them. You get to bring them to the point where they will do it because at the beginning, they won't.

It's not something that you do nationally, bleeding and feeding, and putting everything in containment. You know you are giving up the plant. I mean, you know that it is the end of it. And there just is a system.

So I am saying that these steps are only credible once you do and there is a way to inspect for it. Would you have inspectors going to the plant? If an issue is significant enough, they can do comparable

checks, look at their plants for classes in the simulator? And you have to contend, you know.

I'm saying there are ways to confirm that these commitments are, in fact, in place. And, therefore, the issue is not any more or less significant as it was perceived to be before the IPE evaluation was performed.

I mean, it seems to me that probably research at some point has to go into NRR or something for the --

MR. FLACK: That's a good comment. I don't know.

CHAIRMAN BONACA: Particularly when I see something like Arkansas One here with these numbers, I mean, they are big numbers. There are three other little calculators. It is 1.23 and $10^{-3}$ is a heck of a number. And if it goes down to 8.8 and $10^{-5}$, it means that bleed and feed is very important as to be effective.

MEMBER SIEBER: There are other plants with similar numbers where feed and bleed didn't help a lot.

CHAIRMAN BONACA: That's right.

MEMBER SIEBER: Like the three LOOP.

CHAIRMAN BONACA: That's right.

MR. FLACK: Well, Warren Lyons is from NRR here. I don't know. He may want to make a statement where NRR is on that now.

MR. LYON: I can comment in a general sense of some of the background in that my comments are based on information that would be several years old.

When we were going into the generic emergency procedures reviews, for example, and the emergency procedures that resulted from those reviews, we did walk down a number of plants.

And we did go into quite a bit of detail in some of those walkdowns, including looking at such things as the operators working with procedures, including just as an example of the kind of detail, what would happen in such and such, I would close such and such a valve. Can you do that from the control room? Yes. Here's the control right here. Suppose it failed. What would you do? Well, I would close it locally. Show me the valve, where it is, and how you would do it kinds of things. These comments are helpful, great. If you would like me to amplify on anything, I could do so.

And let me add one more thing. In these process of these reviews, we would be looking at such

aspects as the feed and bleed. And we would be reviewing the analyses that backed up some of those processes.

MEMBER SHACK: Now, was that a sample program or was that a program that was meant to look at the emergency procedures at all plants?

MR. LYON: This was essentially aimed at the EOPs of all of the plants. Now, I will add one more thing. Occasionally in the process of doing inspections, the inspectors will identify additional aspects of EOPs. And those will be pursued as well.

CHAIRMAN BONACA: I guess the inspector if he were armed with this information about Arkansas One here, not saying the plant is this way but whatever is presented to us here, he would look at the procedures with a different eye. He would focus on this particular evolution while just verifying or validating the piece was a huge task.

I mean, there was such a huge task going from the old procedures to the EOPs to the new EOPs, system-based, that one maybe lost this activity. This action here may be lost, and it's the bulk of the review.

MR. LYON: I can't specifically to that Arkansas one. I just don't remember those things.

MR. FLACK: But we are getting the reports out to the regions. And we will be briefing them as we hit all of the regions over the next year or so. We'll bring it to their attention.

CHAIRMAN BONACA: Okay. And that will be very helpful, I think.

MEMBER LEITCH: Is there another issue related to loss of decay heat removal while shut down? This evidently did not address that.

MR. FLACK: Right. The IPEs did not do shutdown. It basically was for full-power operation. And we see that as a limitation a well in the A45 study. Recognizing that boundary, that's what we were working with.

As a follow-on activity, actually we met with NRR just recently to talk about this particular issue. And we are thinking of moving forward and looking at operating experience since at least the point of which rulemaking was considered at one point, which was in the late '90s, to date to see how does our operating experience reflect our regulatory process, against our regulatory process, to see if, in fact, we need to do more.

So we're entertaining that as a follow-on activity. If the committee wanted to make comments on

that, that's fine. I don't know if Warren wants to say anything else on that particular issue.

MR. LYON: No other than we have been discussing it. Just to amplify a little bit on the background there, the commission essentially when it decided not to go to a rulemaking activity looked at the assessment of the ongoing voluntary activities, which had a significant influence on the perceived risk and effectively said, well, as long as our perception of the voluntary activities is correct, we don't need a rule.

But they did ask that we continue to follow the situation and make sure that it didn't change. And so we and the Office of Research are discussing that as a potential follow-on from this program.

MEMBER LEITCH: Okay. Thanks.

MEMBER SHACK: It was interesting to me. I mean, A45 was before the NUMARC guidance for shutdown, before the improved guidance procedures. You had lots of experience with decay heat removal problems during shutdown, but A45 itself excluded shutdown.

MR. LYON: You are absolutely correct.

MEMBER SHACK: The decision is made at

that time. Now, that goes back umpty-dump years trying to figure out why that was, but it does seem real bright in hindsight.

MR. LYON: Much of the insight associated with shutdown activities occurred after a lot of the A45 work was initiated. A similar comment could be made with respect to some of the potential sump blockage issues.

MEMBER SHACK: It just seemed to me it was flying in the face of experience. I mean, it's one thing if you haven't experienced an event to say, "Okay. You should have foreseen this problem." But if I'm sitting there with a bunch of operating experience and I've written generic letters and then to go and exclude it just seemed curious.

MR. KAUFFMAN: I think it would have been very difficult to analyze. The way it was done is pretty much you look at the initiating event frequency. You look at the reliability of the equipment. Your capability of the equipment will pretty much show that you can handle that.

And then shutdown and refueling indeterministically or in PRA space, when you get into all kinds of strange initial conditions and you don't know what your initial conditions might be, it becomes

a very big problem.

I think for demonstrating adequacy, if the capability was there this approach did it. Now, when you get into midLOOP, when you start taking systems out of service, when you start manipulating systems and cross-tieing systems and getting drained-out events, but hopefully that is addressed by configuration control tagouts, work plan, those sorts of things.

MEMBER SHACK: No. This at least assures you have the systems. Now, the configuration control makes sure that, in fact, they're there when you need them sort of thing, perhaps a reasonable way to break it down.

MR. KAUFFMAN: I don't know if the committee remembers the 1994 Wolf Creek event, but Sandy Israel and I went and investigated that, trying to figure it out, and came and briefed the committee then.

MEMBER LEITCH: Two of us are here.

MR. KAUFFMAN: Certainly I share Warren's concern about events from shutdown and refueling.

VICE-CHAIRMAN WALLIS: I guess we ought to stop here. My concern is that this is a NUREG, right? This goes out in the world.

MR. KAUFFMAN: NUREGs go out, right.

VICE-CHAIRMAN WALLIS: It's an example of how an issue gets stated to be effective. If it ignores certain things or if it doesn't have proper measures and so on, it's perhaps not that good an example of what the NUREG should look like when it's sort of deciding that some resolution of some issue has been effective.

If you were just giving us a report, I think it would be okay. We could say we criticized you in the record and everything is fine. If this is an example of how this sort of work should be done, maybe we need to comment on it.

MR. FLACK: Well, the other thing is the NUREG report is a contractor report. We are preparing a transmittal memo which will --

VICE-CHAIRMAN WALLIS: So this statement that the agency doesn't endorse or is not responsible for? I thought once it became a NUREG, it sort of became an agency document.

MEMBER SHACK: This is a NUREG CR.

MR. FLACK: This is a CR.

VICE-CHAIRMAN WALLIS: So that means that you can get away with things or something?

MR. FLACK: Well, no. The difference

really is that the contractors can provide us with the technical information, but the judgment on the effectiveness of the regulations is NRC's responsibility.

VICE-CHAIRMAN WALLIS: So you're not endorsing that?

MR. FLACK: So we're not using this as --

VICE-CHAIRMAN WALLIS: I understand.

MR. FLACK: It could provide part of the basis of our decision, but it is not the decision.

VICE-CHAIRMAN WALLIS: So CR is the kind of report that Dr. Shack writes, then, isn't it?

MR. KAUFFMAN: Well, I think issuing these types of reports, these NUREGs or NUREG CR, is a new thing that research recently started doing to try and get broader dissemination, broader publicity for our reports.

I guess I will speak out of turn here and say as a person working on these reports, it's a fair amount of work to get it into a NUREG format and get it all out. I wasn't universally accepting of that because I didn't see any value added. So, anyway, it's --

MEMBER SHACK: I'll second the work it takes.

MEMBER SIEBER: There is a value to it, I think.

MR. FLACK: I think there is a value in getting the information out and having people read it.

MEMBER SHACK: If there are no further questions, I will turn it back to you, Mr. Chairman.

CHAIRMAN BONACA: Okay. If there are no further questions or comments, we will take a recess for lunch. Get back at 1:00 o'clock.

(Whereupon, at 12:04 p.m., the foregoing matter was recessed for lunch, to reconvene at 1:00 p.m. the same day.)

CHAIRMAN BONACA: The next item on the agenda is mixed oxide fuel fabrication facilities. Because of the interest in the Advisory Committee in looking at waste in the mixed oxide fuel fabrication facilities review, we have invited two members of the ACMW to participate with us in this review, and they are Dr. Ruth Weiner at this table and Dr. Michael Ryan.

Welcome.

PARTICIPANTS: Thank you.

CHAIRMAN BONACA: And Dr. Dana Powers is the responsible member. So I'll let you --

MEMBER APOSTOLAKIS: Is Dr. Powers a

responsible member?

MEMBER POWERS: It's the first time anybody has called me responsible.

MEMBER APOSTOLAKIS: Do we have members who are responsible.

MEMBER POWERS: I think this should be viewed as a formalism and not an assessment of my general character.

CHAIRMAN BONACA: It absolutely is a formalism.

MEMBER POWERS: We're going to discuss the Mox fuel fabrication facility. We've been at this a while. There's still some open issues. The staff is going to give uss an update on where they stand, where they're having differences of opinion and whatnot, and they're going to try to go through a bunch of stuff, and I am going to hold us to two hours on this.

So somewhere in that mix we'll do the best we can, I suppose.

VICE CHAIRMAN WALLIS: Would you allow us to have questions then? Because I have a bunch of --

MEMBER POWERS: They tell me that their skill and ability, their training has led them so that at sprinter's pace they can get through this in an hour, and they comply with our 50-50 rule.

Now, they did not put a Wallis factor on that.

(Laughter.)

MEMBER POWERS: Just asking one question could take an hour, but I would encourage you to ask questions when you think it's useful for your understanding and not for making some point about some cosmological significance of --

VICE CHAIRMAN WALLIS: No, I never do that.

MEMBER POWERS: -- of the universe.

VICE CHAIRMAN WALLIS: I'll ask the academic questions.

MEMBER POWERS: No, I would avoid asking the academic questions, but the they are going to travel through quite a few subjects, and like I say, we're going to do the best we can on this.

What I'd like to get at some point in the discussion, Drew, is kind of a road map on where we're going as best you can, and when I can go up to the Commission and say, "We're done," and get them off my back.

MR. GIITTER: Good afternoon. I'm Joe Giitter, Chief of the Special Projects and Inspection Branch at NMSS.

We last met with you on July 10th to discuss remaining open issues in the staff's review of the MOX fuel fabrication facility. At that time, there were a total of 12 open items, ten related to chemical safety, one related to nuclear criticality safety, and one related to fire protection.

Since that time, the staff has held five days of public meetings with the applicant. We've conducted two in-office reviews, and we've conducted four telephone conferences.

Only one issue, the remaining fire protection issue, has been closed. The staff is still reviewing information submitted by the applicant related to the remaining nuclear criticality safety issue and plans to make a final decision on that matter after a November 13th meeting with the applicant.

This recent information was submitted by DCS in September and took a substantially different approach towards validating the criticality codes in the previous approach under review by the staff. For the remaining ten open items related to chemical safety, the majority of the staff believes that the applicant has provided reasonable assurance that the design basis of the principal structures, systems, and

components are sufficient to allow construction of this facility.

However, there is not a complete consensus within the staff on whether the chemical safety issues should be closed at this point. Therefore, we have asked Mr. Murray, one of the senior chemical safety reviewers on the MOX project to present his separate views.

In addition to Mr. Brown, Mr. Troskoski and Mr. Wescott will be making presentations for the staff.

This is a change from the slides in your notebooks that were provided to you earlier which showed only Mr. Brown as the presenter.

We are not requesting the ACRS to suggest a solution or broker an acceptable position. We plan to meet with the ACRS again prior to issuing the final SER, and at that time, we will request a letter from the ACRS.

Before we begin, I would like to emphasize that the applicant is seeking NRC review and approval in two separate stages. The first stage is authorization to construct the facility and the second is authorization to operate the facility. We are only discussing approval for the start of construction

today.

DS-DCS plans to submit a separate safety evaluation report submission for NRC review for the possession and use license application. NRC will issue a separate safety evaluation report documenting its review of that application.

It is also important to remember that for construction, 10 CFR Part 70 only requires that NRC approve the design basis of the principal structure, systems, and components, not the design of the components. That review will occur during the staff's review of the possession and use application.

There have also been some changes in our schedule to issue the final SER since we last met with you. On August 22nd, the staff informed DCS that it planned to delay the issuance of the final SER by 60 days to coincide with the delay in the final environmental impact statement, which was necessitated by new information submitted by the applicant.

Up until yesterday afternoon, the staff intended to issue the final safety evaluation report in December. Late yesterday afternoon, we received word from the applicant that DOE has requested a significant change in the technical direction.

PARTICIPANTS: Oh, no.

MR. GIITTER: DOE has asked the applicant to change the controlled area boundary to coincide with the MOX fuel fabrication facility restricted boundary instead of the Savannah River site.

This change substantially reduces the control area boundary and will affect the current safety analysis. The staff is in the process of determining to what extent the schedule for issuing the final SER could be affected.

And with that, I'd ask staff to go ahead, Mr. Brown to go ahead and start with his presentation.

MEMBER POWERS: I appreciate it. You raise two points that I forgot to remind the committee. We are looking at design bases here and not the actual design, and now we've got an interesting change. Good.

MR. BROWN: Thank you.

My first slide basically just reiterates what was just said. This is the focus of the staff's review. We're not really reviewing final design, but just design bases.

Just to reiterate, again, what we're talking about today is one nuclear criticality safety open item at ten chem. safety items. And without delay I'll turn it over to Margaret Chatterton, our

crit. safety reviewer.

MS. CHATTERTON: As he said, there's one remaining nuclear criticality safety issue, and it has to do with the subcritical margin required for two of the five areas of applicability that the applicant is using. It's for the plutonium oxide powders and for the MOX powders.

The reason that this is a problem is basically that there are few critical benchmarks available to be used to validate the codes, and it's also difficult to justify the benchmarks that are selected.

This basically is a statistical problem. With fewer than the prescribed number of benchmarks for a given level of confidence, additional margin is required, and of course, the applicant would like to have as little additional margin as possible.

VICE CHAIRMAN WALLIS: Is this just a statistical problem or is it something to do with the density of the powder? If you tamp it down or it gets -- can its density change depending on how it's treated?

MS. CHATTERTON: No. From what we're --

VICE CHAIRMAN WALLIS: It's so hard that it doesn't change?

MS. CHATTERTON: For what we're doing as far as validation of the code, which is what this problem is about, it really is a statistical problem of having enough benchmarks that are applicable to the system.

VICE CHAIRMAN WALLIS: I presume the criticality does depend upon how well the powder is packed.

MS. CHATTERTON: Yes, yes.

VICE CHAIRMAN WALLIS: And that doesn't matter.

MS. CHATTERTON: Well, what this is trying to do is validate a code. The code will predict various benchmarks and then based on the difference between the predictions and the actual benchmark, which is essentially a K effective of one, a bias and uncertainty will be determined. That will be used then in connection with the actual calculations of the particular applications that are needed to be analyzed during the design and review of the plant.

Does that answer your question?

MEMBER POWERS: You're asking a question about?

VICE CHAIRMAN WALLIS: Well, I was wondering if there are uncertainties about just how

dense this stuff would be.

MEMBER POWERS: Oh, absolutely.

MS. CHATTERTON: Yes, and that's taken into account, yes.

VICE CHAIRMAN WALLIS: That's included. That's all I need to know.

MS. CHATTERTON: Oh, yes, that's taken into account.

VICE CHAIRMAN WALLIS: That's all I need to know.

MS. CHATTERTON: Okay.

MEMBER APOSTOLAKIS: Validating a code is a statistical issue?

MEMBER POWERS: Sure.

MS. CHATTERTON: Yes.

MEMBER POWERS: Criticality is a statistical problem, George.

MS. CHATTERTON: Yeah. The codes are Monte Carlo codes, and validating the code is running that code in your particular types of thing against benchmarks. If your code can predict the benchmarks well, then you have less uncertainty and less bias that you have to take account of, and that's what this problem is all about.

As I said, it's because there are few

really applicable benchmarks, particularly because the majority of the benchmarks in the international handbook have to do with uranium and uranium systems.

As far as where we are with this, the staff received a revised validation report in July of this year, and we've been reviewing that. It included all five of the areas of applicability, and there's only two of them that we have any questions with at this point. So we're not even going to discuss the rest of the other three.

MEMBER ROSEN: What puzzles me, Margaret, is why you still have this open nuclear item when other countries are using MOX fuel. Why were they able to do it and we're not able? What's different here?

MS. CHATTERTON: I think, well, for one thing, we have weapons grade plutonium that we're dealing with, as opposed to reactor grade.

I think the other thing is I'm not sure exactly how they do their validation. We've done some work on that. They use different codes than we do. They are proprietary codes that are developed in some cases based on the some of the experimental data that's not necessarily available. It's not necessarily --

MEMBER ROSEN: It's not in the open literature.

MS. CHATTERTON: That's right, yes.

There was discussions about that at a conference we were at just a couple of weeks ago, and some of that data may be available in the future.

MR. SHACK: I assume it would also depend on how conservative you were willing to be about the biases you were going to assign, the uncertainties you were going to assign to the code. I mean if you're willing to live with a large margin of conservatism, yeah, you'll get something you can use.

MS. CHATTERTON: Right, right. So anyway, we've reviewed the validation report that the applicant has sent in. As I said, for three of the areas of applicability, they used a traditional approach which is fairly consistent with the approach outlined in a NUREG that we had put out.

The other two areas, the plutonium oxide and the MOX powders, they used a SU method, which is sensitivity uncertainty method. This is a method that's being developed by Oak Ridge National Lab. It is scheduled for release toward the end of this year, but it is still somewhat under development.

MEMBER APOSTOLAKIS: So there's no

document that describes the method yet that we can read, or do we have it already?

MS. CHATTERTON: I think there are some preliminary papers out about the method. In fact, I know there is a paper coming out in Nuclear Science and Engineering in the October issue that talks about this particular method.

MEMBER APOSTOLAKIS: But do you have any papers?

MS. CHATTERTON: Do we have any papers? We've seen that article. We've seen some other articles for --

MEMBER APOSTOLAKIS: Can I have a copy of that article?

MS. CHATTERTON: I'm sorry?

MEMBER APOSTOLAKIS: Can I have a copy of this article?

MS. CHATTERTON: Certainly. Yes, I will get you a copy.

MEMBER APOSTOLAKIS: A sensitivity uncertainty method.

MS. CHATTERTON: Yes.

MEMBER APOSTOLAKIS: It's really a creative name, is it not?

MEMBER POWERS: Let's move right along on

this.

MS. CHATTERTON: Right, right. Basically what it is is just more of a quantitative method for benchmark selection. It identifies benchmarks based on sensitivity studies. Sensitivity studies are on the nuclear data, such as cross-sections, variations in crossings. How much effect would that have on the predictions?

As the staff went through this and reviewed this, we had two very major concerns. The end product from this sensitivity and uncertainty analysis is a correlation coefficient. If the correlation coefficient is above your threshold, you accept the benchmark and count it in your benchmarks that are applicable.

If you don't meet the threshold, then you don't count it. Well, we had several questions about that. The basis for the selection of the threshold was one of our major concerns. The other was the confirmation that the correlation coefficients were really adequate.

We met with the applicant in early September, and as a result of that meeting and as a result of our questions, the applicant decided to change their approach. Therefore, they submitted a

revised part to their validation report at the beginning of October, and we have been reviewing that since.

It now takes the traditional approach to benchmark selection for all five areas of applicability. Again, we only have questions with the two areas, and it basically uses an outline that follows our NUREG.

We have questions that we have developed on that, and we have a meeting set up with the applicant next week that we'll be discussing these questions.

We still have some concerns about some of the benchmarks that the applicant has selected to validate as far as if they're applicable or not. The impact of reducing the number of benchmarks means, as I said earlier, that there will be an additional margin needed, and that is based on statistics. It's by the confidence level.

So we'll be meeting with them next week. We hope to be able to make some final decisions after that meeting as to whether a penalty is needed or a penalty is not needed, and resolve this issue that way.

MR. BROWN: If there are no other

questions, I'll move on to the chem. safety item.

Thank you.

The first item we'll talk about is "devote oil" (phonetic) explosion hazards. Just by way of reminder, this is a chemical reaction involving tributyl phosphate and its degradation products and nitric acid, generating a large amount of gas, which can rupture, explode vessels and piping.

So what's important here is providing some means to vent those gases or otherwise prevent the over pressurization. These events have occurred so we can have some operational experience to go on.

The applicant here, as part of developing a strategy, has discerned open systems from closed systems. An open system is just that. It is capable of venting the gases that would be generated during a red oil reaction.

VICE CHAIRMAN WALLIS: It must depend on how big the vent is. That means the vent is big enough to prevent the run-away reaction.

MR. BROWN: In this case, the applicant's proposed design basis is actually a function of how much mass is present. So it's so many square meters or so of area per gram of solvent.

The focus of the staff's review at this

point is on closed systems where that vent isn't big enough basically. The term "closed" just refers to that one aspect. The fact is these vessels would have vents, specifically in off-gas treatment system, is provided to relieve gases that are generated. It's just that in a closed system that vent isn't big enough.

In this case, the acid recovery evaporator is an example.

The applicant has proposed two design bases for that off-gas treatment system. Even though the vent is not big enough, it would be capable of moving the energy that's being generated in the system, with a safety factor here of 1.2.

Also, if the temperature of the liquid in that vessel gets too high, certain actions would be taken, and here the limits are 125 degrees or an increase in temperature of more than two degrees C. per minute.

The steam that would be applied to the evaporator would be isolated, and more additional water would be added, if necessary.

MEMBER WEINER: Are you requiring back-up systems for these? If you're going to use a cooling system to control both the temperature and the gas

flow, aren't you going to need a back-up system?

MR. BROWN: The reliability of all of these strategies is something we will look more closely at as we review the integrated safety analysis. This is an artifact of the two step licensing process here.

We'll look at design bases now, and then we expect to see a demonstration that, in fact, that off gas system would be reliable and available, you know, if the event demands it. We'll do that review later during the license application review.

VICE CHAIRMAN WALLIS: This vent, is that a single phase gas vent?

MR. BROWN: It's a --

VICE CHAIRMAN WALLIS: It's venting single phase gas or is it venting a two phase mixture on some circumstances.

MR. BROWN: I think -- go ahead, Alex.

MR. MURRAY: I'm Alex Murray.

Let me just fill you in on that. It can be single phase gas, it can be a liquid, or it can be a two phase mixture. In some of the experiments which have been done at Savannah River, they just let the vent do whatever it did. They did not really look into the actual phenomena involved with the two phase

--

VICE CHAIRMAN WALLIS: Well, there's quite a bit of uncertainty about the capacity of a two phase vent.

MR. MURRAY: Correct, yes.

MR. BROWN: As I suggested, there were certain things we allowed the applicant to commit to doing later as part of development of their integrated safety analysis, and I've listed them here.

There is some refinement of the actual reaction kinetics that are going on; the effect of impurities; and certainly what the actual operational limits would be with the understanding that we'd have a design basis value for temperature, for example, but what would the set point be for isolating the steam? That's a question we'll review later.

MEMBER POWERS: Am I correct in my memory that the applicant has come in and said he is going to attempt to prevent red oil phenomena by controlling the temperature and cleaning or replacing his solvents on some sort of regular basis to avoid the build-up of impurities?

And should he have an event, despite all of that, he has this venting system to extract energy

out of the reacting mixture.

MR. TROSKOSKI: That's basically correct. What they want to do is have an energy removing capability through evaporative cooling and venting that's at least 20 percent of the capability of the energy being put in by both the steam and any ongoing chemical reaction.

MEMBER POWERS: And so it's a fairly defensive, in-depth strategy that has come up here.

MR. TROSKOSKI: Yes, and what's important about venting is that if you look at the chemistry of it, about 90 percent of the energy actually comes from a number of chemical intermediates that are very evolved or would be pulled off.

So if you do have venting going on that's continuing to pull off these intermediates, the reaction will not go anywhere or generate anywhere near as much energy as it would as if it was fully closed.

VICE CHAIRMAN WALLIS: Now, this criterion for run-away is not just removal capability. It's a stability criterion having to do with the rate at which things change on the temperature changes.

MR. TROSKOSKI: Yes.

VICE CHAIRMAN WALLIS: That should also be

considered. You have a D something, DT involved in it.

MR. BROWN: That's right. Two degrees C. per minute temperature change.

VICE CHAIRMAN WALLIS: Well, the energy release DT is temperature as well, but it begins to heat up and heats up more and so on. That's all presumably being considered. It's the stability of the temperature that's at issue here.

MR. BROWN: This is an issue.

VICE CHAIRMAN WALLIS: Is this your issue?

MR. BROWN: One of many.

VICE CHAIRMAN WALLIS: Okay. Thank you.

MR. MURRAY: Could I just charge in?

MR. BROWN: I think so.

MR. MURRAY: Good afternoon. My name is Alex Murray. I am the lead chemical safety reviewer for MOX. I have been working on this for approximately three years.

I've just returned from Moscow where I was supporting one of the DOE programs over there, and I was advised when I returned that there was an ACRS meeting planned where these issues were being essentially closed. I was of the understanding there would be more internal staff discussions.

I will have to see what other internal staff discussions I can accomplish. If necessary, I may pursue some of these some more using the management directive 10.159 process for differing professional views and differing professional opinions.

Now, let's get on to the issue here. This is red oil, as Dave was mentioning. We have looked extensively at the open system, and the open system is vented. It does have basically a chemical physical limit of a maximum temperature of 120 degrees centigrade. It also follows some venting parameters which come from independent testing by several groups associated with the Savannah River site of DOE.

Myself, and I think it's the staff consensus opinion as well, conclude that for the design basis stage, that approach is acceptable.

Most of the concerns basically accrue from the closed system, where I have come to the conclusion that at the present time we have inadequate assurances of safety. Now, I've put up some of the findings from the revised draft safety evaluation report, which was issued this past April 2003, and these are findings which are still valid at this time.

I want to point out the first sub-bullet

on the slide here about the applicant's approach is directly contradicting some safety approaches within the Department of Energy.

I'd like to mention in particular temperature. For a closed system the applicant is proposing a temperature which is the safety limit temperature, which is five degrees above the safety limit which DOE uses at their facilities. So it's 125 degrees C. proposed by the applicant. One hundred twenty degrees C. is the TSR, technical safety requirement, not to exceed temperature at DOE facilities.

In addition, with DOE facilities, they operate the evaporators with about a ten degree margin below that TSR limit. The applicant intends to operate the evaporator basically in the three to five degree Centigrade range just below their proposed limit of 125. Hence, their operations would still be -- the normal operations would be above the DOE TSR limited.

MEMBER POWERS: Let me ask you a question on that operational margin. They will use conventional thermocouples for monitoring temperature?

MR. MURRAY: That is more of a component issue which will be addressed at the operational

stage. I would speculate, and I emphasize speculate that they would probably use something more like an RTD, platinum type approach because no matter what, whether it's 125 C. or 120 C. or 117 C. or whatever, it's going to have to be pretty accurate, have a low drift, high reliability, and so forth.

Such systems can be designed and implemented.

MEMBER POWERS: Sure. It's just that thermocouples are typically plus or minus two degrees Centigrade devices.

MR. MURRAY: Right, right. Well, just to fill you in on that, at the DOE facilities at Savannah River with a TSR limit of 120 degrees Centigrade, they go with a safety set point of 117, and that is based upon about a 1.5 degrees Centigrade temperature margin on the thermocouple, one degree Centigrade margin on the controller, and about a half a degree or so margin or basically just plain margin for unknowns.

VICE CHAIRMAN WALLIS: And, of course, the reactor is homogeneous and all at the same temperature.

MR. MURRAY: I'm sorry.

VICE CHAIRMAN WALLIS: And, of course, the reactor is homogenous and all at the same temperature.

MR. MURRAY: Well, we all would like to think that.

VICE CHAIRMAN WALLIS: It never is, is it?

MR. MURRAY: It never is. I will get to that on the second slide. Okay? But that is a concern that I have. It is non-homogeneous.

I also want to mention just about some of the contradictions with respect to DOE practices. The proposed spent size, which while it is based upon evaporative heat transfer, essentially a thermal effect, we do not have that quantified right now in terms of BTU per hour or some other, say, minimum velocity or some other type of parameter or design basis parameter from the applicant.

All right, and that is a concern to me. If you compare the proposed spent sizes for the closed system, it is considerably to the right; actually it's even off the chart of the DOE safe value, and that's a concern I have. Okay? We need information to address that.

Also, I just want to mention another contradiction of DOE parameters is this proposed system will be running at a much higher nitric acid concentration, potentially up to 70 percent, where obviously red oil reaction rates are greater.

In contrast, the DOE systems typically don't go above about 50 weight percent.

And also, one last thing about the DOE systems. The DOE systems do make a very concerted effort to have controls to prevent solvent coming into the systems. Okay. Those approaches, which some may be present at the proposed facility, those means for removing or preventing solvent carryover have basically -- basically the applicant has informed us the solvent carryover will be an anticipated event.

MEMBER POWERS: Now, you indicate that these are variance with DOE's system.

MR. MURRAY: Right.

MEMBER POWERS: But are they at variance with the French system?

MR. MURRAY: We have limited information on the French system. Okay? One of the questions that we have asked in the past is since you are following a facility from France, namely, it would be the Le Havre facility, where there are waste evaporators that might have solvent and nitric acid in them. You know, what is their proposed -- their safety bases.

The applicant has elected not to provide that information. We know just from informal

discussions with the French regulators that some of the parameters they have overlap DOE parameters, but further details were not forthcoming, and I would assume if we were to obtain further details, they would have to be under some sort of proprietary agreement.

Okay, and I'd just like to mention one last thing. The staff did conduct fault tree analyses on both open and closed systems, and for the closed system was found to be at best borderline with frequency ranges typical of highly unlikely.

And if I could have the next slide, please.

And I'd just like to continue. I have noted on the slide here about in the deposed approach there's a potential for common failure effects. I mentioned temperature, heat transfer and venting of course.

I've also mentioned about the proposed venting capacity is way beyond what DOE would consider to be a safe limit. I want to emphasize that. It's not like it's closed. It's not like some clear rationale has been provided why this should be acceptable. It is what we like to say in the business, above and beyond. And fundamentally we need

some information on the docket to address this.

Now, I've also shown here a little bit of -- there was a question about homogeneity of the system. At the July public meeting the applicant put up a diagram of some of the proposed evaporators. It is a high aspect ratio evaporator. Such systems are prone to face separation, particularly if circulation --

VICE CHAIRMAN WALLIS: Which way do you mean by --

MR. MURRAY: A high aspect.

VICE CHAIRMAN WALLIS: It's tall?

MR. MURRAY: It's taller than it is wide.

VICE CHAIRMAN WALLIS: Thank you.

MR. MURRAY: Such systems are prone to face separation. It is known that with red oil phenomena with phased separation occurs, there is a high likelihood of both a red oil reaction occurring and also a more severe reaction occurring. So I have concerns about that.

I will also add I'm very concerned about looking for some assurance from the applicant to address, you know, these concerns, particularly on the docket, and I'll just add one last thing. As I just said, I returned recently from Russia. At one of the

workshops in Russia there was a presentation on the red oil phenomena or, as they like to call it sine they have experience in this area, the nitrated tributyl phosphate phenomena.

And they had some data with concentrated nitric acid systems, which showed initiation temperatures for reaction run-away as low as 123 degrees centigrade. And that would be below the safety envelope proposed by the applicant.

The bottom line, I think we need to have some more interactions with the applicant and get some assurances on the docket that what they're proposing can work and has the capability of meeting the regulations.

MEMBER WEINER: Wasn't there any applicable experience when Hanford used to use tributyl phosphate?

MR. MURRAY: Yes, yes, and that's factored into the DOE limits which essentially are all rolled up in the Savannah River site documents. That's correct.

Just for your own information, there were several incidents at Hanford, plus one event, okay, which lifted a large column off its support. Okay? At Savannah River there have also been incidents plus

two events. Both of the events were quite catastrophic, but fortunately personnel were not nearby.

Okay. Thank you.

MR. TROSKOSKI: My name is Bill Troskoski. The general consensus of the remainder of the staff was that the applicant's proposed design basis does, in fact, provide reasonable assurance of protection against the consequences of red oil reaction.

In specific, for the system that the licensee is proposing to use or the applicant is proposing to use, the literature indicates that the runaway reaction rate really initiates in the 134 to 137 degree C. range. Adjusting for uncertainties, DOE has chosen 130 as using the ultimate range for the initiation of the reaction.

Now, the applicant has committed to assure that the bulk fluid in the thermal siphon evaporator does not exceed 125 degrees, and that does not exceed under any and all conditions, and that will be modified with the appropriate set point methodology.

In addition, they will establish a rate of temperature rise to limit it to no more than two degrees C. per minute.

VICE CHAIRMAN WALLIS: That's presumably

when it's not running away. Well, most of the thermal analysis data is taken when you're ramping it up about one degrees C. to two degrees C. per minute and you're measuring when you have your large pressure increases. So bounding it by two degrees C. per minute is, indeed, pretty reasonable.

In addition, it's a lot likely to run away on you if you've got the additional 20 percent heat removal, energy removal capability, that's --

VICE CHAIRMAN WALLIS: As long as it's not giving 25 degrees energy removal because it's getting heated up. I mean you've got to have a balance here.

MR. TROSKOSKI: That's correct.

VICE CHAIRMAN WALLIS: You've got a stability criterion of some sort.

MR. TROSKOSKI: And they still have to do some of the kinetic experiments and to refine that as they have committed to do through --

VICE CHAIRMAN WALLIS: They still need to do some work?

MR. TROSKOSKI: Yes.

VICE CHAIRMAN WALLIS: Okay.

MR. TROSKOSKI: And they still need to find out whether or not there will be set point depression. So there is acknowledged some work still

to be done, but taking that into account, once they do that, they won't commit to a 20 percent safety factor for a heat removal over the heat being inputted from the steam and heat being generated from the reaction.

MEMBER WEINER: Do you have some documents that show how the experiences that Savannah River and Hanford correlate with these proposals, with these proposed temperature limits?

MR. TROSKOSKI: I mean, they must have done something to measure at what temperature they get excursion, how the big the vents have to be, and so on.

MR. TROSKOSKI: Well, the vent size, that's determined with the Fowsky (phonetic) correlation that has already been presented. It is in the literature, and it is understood.

Now, most of the events that have occurred have one common theme for a red oil reaction. They've all got tributyl phosphate in contact with nitric acid and a lot of heat unexpectedly. To be able to measure, you know, the exact conditions that set it off is often not possible, but it has all been through conduct of operations really that they've ended up in a situation with the process that they didn't want to be in.

VICE CHAIRMAN WALLIS: Which Fowsky method are you using? I mean, he had several methods, one of which was based on phase slip and one of which was conservative and was based on the homogeneous. Is he using the conservative method or the best estimate method?

MR. TROSKOSKI: Which one? Best estimate?

MR. MURRAY: I think you're referring to his --

VICE CHAIRMAN WALLIS: He did a lot of work with Dyer.

MR. MURRAY: Yeah, the Fowsky correlation which is being used here is empirically derived, and it's specific for red oil phenomenon.

VICE CHAIRMAN WALLIS: Okay. So it's related to the real stuff.

MR. TROSKOSKI: Yes, and there are, again, going to be experiments in that regard to confirm that relationship.

Now, further, should you approach the bulk temperature limit or the rate of rise limit, then of course what they'll do i they'll shut down steam and they'll initiate a quenching system. The idea behind the quenching system is that you make sure you've got an adequate aqueous inventory to be able to support

the evaporative cooling.

Your main cooling mechanism is going to be the evaporative cooling. It's not that you're going to be putting cold water into it. What you're doing is you're assuring as long as you've got a nitric acid aqueous phase in there and it's at a high temperature, it's going to be boiling off. It's going to be pulling off energy.

There are excursions that occur once you boil off all of the nitric acid and water. Then you run into the run away reaction very quickly.

VICE CHAIRMAN WALLIS: So does this vessel -- and there's a boiling mixture and then there's a vapor space above it?

MR. TROSKOSKI: Yes.

VICE CHAIRMAN WALLIS: But I'd be worried about the pool swell of it. I mean if it swells up like boiling milk, it will boil over into the vent. That's one of the classic things that happens with these things.

MR. TROSKOSKI: Right.

VICE CHAIRMAN WALLIS: And do you do about the tendency of this stuff to froth or foam or swell?

MR. TROSKOSKI: And to be able to relieve two-phase venting is one of the things they are

confirming.

VICE CHAIRMAN WALLIS: Yeah. It has to be done pretty carefully.

MR. TROSKOSKI: Agreed.

MEMBER POWERS: One question just to check my memory. The red oil events that I'm aware of all entail a substantial contribution from gamma radiation of fission products?

MR. TROSKOSKI: Okay. They are going to be limiting the amount of degraded products through a number of mechanisms. One, of course, is going to be the timing contact with high radiation. The other is going to be timing contact with the tributyl phosphate with nitric acid.

In addition, what they're not taking credit for are various washes and the change-outs that occur for the solvent.

MR. BROWN: The second event is the explosion involving hot hydroxylamine nitrate and then, again, nitric acid. This is not a catalytic reaction. It's very fast, ideally prevented, not just vented. And we've had several events of this type in the industry.

The applicant's approach here is providing really two distinct strategies depending on what's

going on in the process. In some areas, there is the presence of HAN and hydrazine without adding the NOx, and in other areas the NOx is added purposefully to destroy those materials, such that in this case it's the oxidation column. This is to make sure these chemicals are removed before going to the final steps of the process to recover nitric acid.

The controls that have been identified here are the process safety control system. This will help monitor temperature, which is one of the control parameters. Chemical safety controls to insure concentrations of chemicals are kept within their limits, and the off-gas treatment system does provide venting for gases that are generated.

The applicant has developed a fairly sophisticated kinetic model that describes the production and generation of various chemical species and systems with HAN and nitric acid. It does confirm observations that hydrazine when added to systems like this is an effective scavaging agent and scavenges the nitric acid before it can attach the HAN reading to the run-away.

And so the applicant has proposed a minimum concentration of hydrazine to keep the system safe.

Alex.

MR. MURRAY: Well, thank you.

I'm Alex Murray, the lead chem. safety reviewer again.

And just in the area of HAN and hydrazine I'm going to focus on those areas both with and both without and with Nox addition. As we go out of the HAN hydrazine without NOx addition, this is where the model is applied. I believe that some assurance is needed with regard to addressing some idiosyncracies within the model itself.

Some of these involve input parameters, such as the appropriate levels for hydrazoic acid, which is $HN_3$, which can be explosive under some conditions, and also nitrous acid. I want to note that if one puts in the design basis value for hydrazoic acid as an input parameter to the model, it turns out that using the model, the hydrazoic concentration goes up and the assumed yield, which is also part of the design basis, changes significantly.

I believe this is something that we need to address with more discussion with the applicant.

As regards the approach where HAN and hydrazine are destroyed by deliberate addition of the NOx or nitrous fumes, as the applicant likes to call

them, the revised construction authorization request in October or from October of 2002 had identified a flow type control.

Earlier this year, actually it was around June; the applicant removed this flow control, and the staff at that time had questions as to why this was done. Essentially a flow type or mass type of control is a control on total energy in the system, and so we're a little puzzled why this was removed or something comparable to address the concern was not added.

I think those discussions are still open, and we, the staff, need to interact some more with the applicant on it. And this information needs to be placed on the docket.

Thank you.

MR. TROSKOSKI: The other staff view is that the applicant has provided an adequate safety design basis for protection against a HAN reaction.

VICE CHAIRMAN WALLIS: There's no way we can evaluate who's right from these discussions.

MEMBER POWERS: And you're not being asked to either.

VICE CHAIRMAN WALLIS: You're not being asked to, but I mean, so what do we do?

MEMBER POWERS: Well, I think we need to be aware of what the issues are.

MR. TROSKOSKI: The staff is still internally working these issues out, and we just want to give you both sides.

MEMBER POWERS: And we've been provided the documentation that exists now. So since that documentation is massive, it tells you which sections to go read.

(Laughter.)

MR. TROSKOSKI: Well, the proposed safety margin we evaluated using a commercially available Polymath 5.1 program for the design basis safety limits provided by the applicant and the likely operating ranges.

This model is what, five partial differential equations that you have to solve simultaneously?

We did do a sensitivity analysis, and the staff found that the design basis values do provide adequate assurance of safety with appropriate margins.

MEMBER WEINER: I'm confused. I don't know how -- these reactions can go very quickly, and it's almost impossible to model every stage of one of these nitrous acid reactions. I mean, you're dealing

with explosive stuff.

MR. TROSKOSKI: Sure.

MEMBER WEINER: And I don't know on what basis your last statement there is made.

MR. TROSKOSKI: Well, when you compare the numbers, there is an alternate methodology that is used by DOE. The applicant has chosen not to use the instability correlation because the DOE instability correlation only takes account of an iron catalyst. It doesn't take into account plutonium. They think it's not completely applicable to their facility.

But if you do use the existing DOE correlation and you run the operating ranges that they're proposing, it does basically envelope it. So there is an independent alternate method that does give us confidence that, hey, this is not out in left field somewhere.

VICE CHAIRMAN WALLIS: Well, I think the question is appropriate margins which have to do with the uncertainty in these calculations.

MEMBER APOSTOLAKIS: And the uncertainties are not quantified, I understand, are they? It's just a deterministic conclusion that the models are insufficient after a sensitivity study.

MR. BROWN: But what we've looked at so

far is our margins between, for example, at what temperature does this reaction run away or go out at catalytic, and what is the temperature that's been proposed as a maximum temperature?

As I recall, the run-away temperature was 65 degrees. They proposed to keep the system less than 50 degrees. Based on that margin, we've drawn our conclusion. It's not consideration of uncertainty as yet.

MEMBER POWERS: That's part of IgMark (phonetic).

MR. TROSKOSKI: Yeah.

MEMBER POWERS: Fifteen degrees in these systems is what?

MR. BROWN: The next event we'd like to talk about is involving titanium fires. At the beginning of the head end of the MOX facility as proposed, they need to dissolve plutonium oxide. They're going to do this electrolytically with an electrolyzer using Silver II.

The structure of that electrolyzer includes titanium, and so the combination of potential electrical currents and titanium, the staff had a concern about the possibility of a fire.

To address that concern, the applicant has

proposed passive engineered features, namely, insulators and separators to make sure that, you know, the components don't come in contact with the titanium, and those are the silicon nitride barrier and a Teflon electrical insulating material.

In addition, the electrolyzer will be seismically designed. It could eventually involve either analysis or shake table testing, and the applicant has committed to design this so that it will withstand turbulent flow and not induce any vibration in these components.

MR. MURRAY: Thank you, Dave.

I'm Alex Murray, the lead chemical safety reviewer for MOX again.

I have the differing viewpoint right now. I want to emphasize that in this electrolyzer, titanium electrolyzer fire event, the applicant changed their strategy about one month ago. Prior to that they had proposed a safety strategy using electrical controls, and the only question the staff had at that time involved design basis.

Now, getting into the specifics here, since they have now gone with this new strategy, I want to emphasize that these materials which they are identifying for this passive engineer control are not

materials which you usually associate with the robustness, the reliability, other stout characteristics that usually go into passive engineering controls.

I want to note that silicon nitride itself is a ceramic. It is a good ceramic, but it is still a ceramic. In this application, it functions as the porous threat between the two electrolyte compartments. So it is not the sort of silicon nitride which you might see in some engine parts.

Of course, I could say with the car engines I have had to date I wouldn't say that silicon nitride is fairly reliable there either, but that's another comment.

MEMBER POWERS: It's pretty impressive stuff.

MR. MURRAY: Oh, it is impressive stuff. Don't get me wrong, but you know --

MEMBER POWERS: But the point is this is a fret (phonetic) and not --

MR. MURRAY: Yes, it is a fret.

MEMBER POWERS: -- not the compact.

MR. MURRAY: I also want to emphasize, you know, we have PTFE, which usually goes by the brand name of Teflon. Again, you know, that is an

elastomer. It undergoes creep. It changes properties quite well or can change its properties quite well, particularly when you don't expect them.

Again, these materials are not what you usually look for in passive engineered barriers. I want to emphasize there's a comparison on the chart here, you know, that properties are not comparable to metals, and I want to emphasize usually when you start looking at passive barrier, you start looking for something that starts approaching, oh, having the capabilities like a reactor pressure vessel or high pressure boundary or something like that.

And you know, fundamentally at this time the staff does not have information that the docket which gives us assurance that these two materials in their intended application and environment can fully function or have the ability of functioning as passive engineered controls and had the ability to meet a highly unlikely likelihood.

VICE CHAIRMAN WALLIS: What's the property of concern? Is it something to do with brittleness or what is the property that you're concerned about here?

MR. MURRAY: I would say all of the properties including brittleness, including maintaining spacing, maintaining dimensional

consistency, and so forth. I mean, understand that --

VICE CHAIRMAN WALLIS: So there's a thermocycling, all kinds of things happening.

MR. MURRAY: All sorts of things. Understand that in this electrolyzer it ranges between 30 and 50 volts of applied DC current and potentially several hundred amps, and the power going into these electrolyzers is comparable, you know, to 20, 25 kilowatts, easily exceeds welding supplies. I mean, strange things can happen with that type of electrical energy.

MEMBER POWERS: But what I have never, I have to admit, understood exactly on this issue was suppose I had a fire.

MR. MURRAY: Yeah.

MEMBER POWERS: Why am I concerned?

MR. MURRAY: Well, let me explain that for you, sir. Okay. Again, here we are for any breadth, any depth, to try and help you out here.

In the case of titanium, if it ignites, all right, and I want to emphasize that being situations with welding type current where titanium has ignited, okay, it turns out it burns with a very high temperature. It reacts with many things, particularly typical fire suppression agents, water.

It will dissociate water into hydrogen and the hydrogen will explode.

If you use carbon dioxide to extinguish it or attempt to extinguish it, it will react with that. It will react with nitrogen in the air. It turns out that the temperature and other bases, other parameters, shall we say, of a potential titanium event far exceed what the applicant has assumed as the design basis for a fire event.

Okay. Also, titanium events tend to be very unpredictable. Now, I think the applicant has chosen the right strategy. Let's prevent this. Okay? I think it's appropriate to prevent titanium type events, though as I've noted on the slide and in my discussion here, I have questions about the proposed control, if you will, and the parameters which they are saying it has.

VICE CHAIRMAN WALLIS: So you're concerned about a major spark or an arc setting off the titanium? Is that what you're --

MR. MURRAY: Yes, yes.

VICE CHAIRMAN WALLIS: There's something about these materials not being able to prevent this arcing because of some weakness in the floor or something?

MR. MURRAY: Right. To be capable of meeting a highly unlikely likelihood, you know, is putting quite a burden on materials like a ceramic and elastomer, which generally do not have properties capable of getting there, generally.

MEMBER POWERS: I guess, I mean, you portrayed a dismal view for metal fires, but all metal fires are pretty much like you say. You don't put them out with water. You don't put them out with $CO_2$. You have to smother them.

MR. MURRAY: Smother them somehow.

MEMBER POWERS: And smothering them with sand usually ends up with your burnt fingers because it reacts with sand and things like that.

MR. MURRAY: Right, right.

MEMBER POWERS: So carbon often gets used and things like that. What I'm still interested in is -- but it's a finite amount of metal, and suppose I go ahead and melt it or burn it. Am I going to burn a hold through the floor?

Well, I don't think so. Now, what is the consequence aside from the fact that I have a mess?

MR. BROWN: But the electrolyzer is in the glovebox. It's not in a process cell. So the immediate concern would be the nearby worker. the

electrolyzer -- correct me if I'm wrong -- holds up to 14 and a half kilograms of plutonium oxide.

MR. MURRAY: Thirteen, point, five, 13.5.

MR. BROWN: Okay. So it's certainly sufficient material there to be a hazard, which would not be boiling or atomizing. So the hazard is certainly there if the fire would have started.

MEMBER POWERS: It's basically a mess, is what it is. You can get a release.

MEMBER SIEBER:: There's a fire similar to a magnesium fire, right? Railroad rails were magnesium things.

MR. MURRAY: Yes.

MEMBER SIEBER:: So you could melt right through the HUM box (phonetic).

MR. MURRAY: Yes, yes, and that's why I think while there are a lot of interactions between the NRC staff and the applicant, I think, the applicant came to an appropriate conclusion to come up with controls to prevent the event.

MEMBER SIEBER:: How much titanium is in there? That determines how far you're going to melt.

MR. MURRAY: In terms of quantities, multiple kilograms. We have not quantified it.

MEMBER SIEBER:: A lot?

MR. MURRAY: But it's a lot.

MEMBER SIEBER:: Okay.

MR. MURRAY: You know, there's no question that there's a sufficient amount there.

MEMBER POWERS: Metal fires have unusual characters, and one of them is a tremendous ability to lose heat by radiation, and so they behave differently.

MR. MURRAY: Yeah, they are peculiar. I agree.

VICE CHAIRMAN WALLIS: It's in a glovebox? Does it become oxygen limited?

MR. MURRAY: Yes. You've got to understand that in the environment it has, it has oxides and other types that are readily available, including not only plutonium dioxide, you know. So there's a potential for thermite-like reaction. You also have nitric acid. Okay?

MEMBER POWERS: Well, the thermetic yield must be zip.

VICE CHAIRMAN WALLIS: Thermetic acid would be --

MEMBER POWERS: Take it glued to the dioxide. You won't go to the dioxide, just cannot be a very high yield. It takes more energetic oxides

than plute (phonetic) to take in the --

MR. MURRAY: And in qualitative terms, the oxygen source as reactive materials are there.

MEMBER POWERS: I mean, the truth of the matter is if you were to ignite it, it will suck the oxygen from wherever it can get it.

MR. MURRAY: Wherever it can get it, correct, correct.

Okay. John.

MR. BROWN: The next issue --

MR. TROSKOSKI: Well, sorry. The rest of the staff is of the view that the applicant's proposed use of passive engineered controls to prevent current leakage from the electrolyzer electrode to the titanium shell is an acceptable approach for the construction authorization phase.

We note that the electrolyzer will be seismically designed, as well as other equipment will be, and the seismic qualifications will be reviewed during the operations phase.

MEMBER POWERS: It seems to me that you guys are in outrageous agreement. You like the strategy. The only issue is the materials of choice here, and I have to admit I never thought about using silicon nitride as a fret, but I mean, Teflon is not

a bad material to use in some of these applications, especially if you're not any hotter than what I think they're going to be here.

Silicon nitride, I don't know. Your response doesn't address the question. I mean, your response says, "We like their approach, too." He says, "We like your approach. It's just a question of materials here."

MR. TROSKOSKI: And a failure mode that we can understand.

MR. MURRAY: Yeah, I want to emphasize I like the strategy of prevention. Okay? I have to say I think the approach of using a passive engineered control based upon silicon nitride and PTFE causes me some concerns because those materials do not have parameters which are normally associated with passive features.

VICE CHAIRMAN WALLIS: Well, have they been used for this purpose before? Is there experience with using these materials in this sort of situation?

MR. MURRAY: These types of materials are routinely used in the electrochemical industry. Okay? And there are frequent failure, and when I say "frequent failure," I want to emphasize you're

talking, you know, five to ten-year life per cell.

Okay. Now, keep in mind a highly unlikelihood while in this proposed application, that is, a qualitative measure. Usually we associate highly unlikely with the reliability of something like one failure in 100,000 years or more, you see. So --

MR. BROWN: I think it's worth pointing out though that one of the things we will also look at later on is any surveillance requirements for any safety strategies, such as HEPA filters, which are also notably fragile, passive engineered barriers, but they require a certain frequency of surveillance in order to maintain their integrity.

MR. TROSKOSKI: That's with any safety related component.

MR. BROWN: So if there are no other questions, I'll move on to the next issue.

The phenomenon of uranium burn-back is the oxidation of $UO_2$ to $U_3O_8$, especially if the cotter (phonetic) has been ground to a fine particle size and there's some ignition energy present.

There will be some ball milled, micronized, depleted uranium powder in this system, and so staff has identified a concern with how do we make sure that we prevent burn-back, which can release

energy in this case from affecting the ventilation system HEPA filters, if that reaction were to occur on those HEPA filters.

We've asked --

VICE CHAIRMAN WALLIS: Or if you somehow had it on the filter and then the filter got rapped, and it got sort of exposed. Presumably then it can have a lot of oxygen, a lot of area. It's ready to go.

MR. BROWN: You mean -- I'm sorry. If it gets deflected on the filter already --

VICE CHAIRMAN WALLIS: Yeah, if the filter gets rapped so this powder gets kicked off into the air --

MR. BROWN: Okay.

VICE CHAIRMAN WALLIS: -- then it's really ready to go presumably.

MR. BROWN: He's British. When he says "rapped," he means somebody hits.

VICE CHAIRMAN WALLIS: No W, just R.

MR. BROWN: I knew that. I knew that.

MEMBER POWERS: This is an interesting one.

MR. BROWN: Okay. Well, we looked at the spill occurring in the glovebox, not so much the

suspension of this powder once it hits the filter, but what if we spill a jar of this powder? And that cloud is now moving toward the filter.

These gloveboxes handling this powder are nitrogen inergic. That's a requirement the applicant has because they want to control the oxidation state of this powder. That's not a safety function at this time. So we didn't credit that in our analysis, and we assumed that this powder could, in fact, affect the final filters.

The applicant has since suggested or has since proposed that the second stage rough-in filter, which is a metal mesh type filter in the final HEPA filter assembly, which has an efficiency of 90 percent for one micron particles and above, would serve to collect any uranium that's spilled and suspended down to the ventilation system, and then that would protect the final HEPAs.

The staff then effectively applies the leak path factor in its analysis to reduce the source term by a factor of .1.

VICE CHAIRMAN WALLIS: Now, what's going through the filters is only nitrogen in terms of the gas? At no time when you're actually breathing air through the filter?

MR. BROWN: Gloveboxes are nitrogen inerted, but not all gloveboxes --

VICE CHAIRMAN WALLIS: As you breathe air through it, you've got the same things as breathing air into a vacuum cleaner with a spark in it or something. It's a beautiful initiator for a fire.

MR. BROWN: Right. The conditions aren't quite like that, but we do have dry air gloveboxes. So air could be at the final --

VICE CHAIRMAN WALLIS: Could be drawn through.

MR. BROWN: -- filters, not just nitrogen.

Al.

MR. MURRAY: Thank you, Dave.

Good afternoon, again. I'm Alex Murray, the lead chemical safety reviewer, and I have a differing opinion on this one. I have some concerns about the safety analysis and its adequacy a I've noted here. Some of these have to do with things like other combustible materials or lint which accumulate on HEPA filters over time. There are values for those amounts from the manufacturers.

I also want to note in the safety analysis, the calculated source term is about 100 grams or so. This is the source term which actually

impacts the HEPA filters. If we use values which have been confirmed by the applicant, they're five to eight times higher.

MEMBER ROSEN: Alex, where does the lint come from?

MR. MURRAY: I'm sorry?

MEMBER ROSEN: Where does the lint come from?

MR. MURRAY: This just comes from normal operation of the HEPA filters. This is based upon the experience of manufacturers such as Flanders and so forth.

MEMBER ROSEN: It comes from the HEPA filters themselves?

MR. MURRAY: Just what basically they suck in through the air from personal protective equipment, abrasion of materials, and so on and so forth.

MEMBER ROSEN: It comes from the process itself?

MR. MURRAY: Just the use of the filters. They trap whatever gets sucked in, and from Flanders they have indicated it's somewhere around after several months of operation, maybe a year of operation, it's somewhere around 500 to 1,000 grams. That's a number straight from the manufacturer.

That's an experiential based value.

Okay. That is not considered in the analysis.

MEMBER POWERS: Let me ask. I get puzzled over this.

I have never seen burn-back, by the way, after a career of working with uranium dioxide and oxidizing of $U_3O_8$, I've never seen it. I don't doubt that it can occur.

But your scenario goes something like this. You ball mill this stuff in a glovebox. It is suspended. It travels down a duct which no longer is inerted with nitrogen. It dodges the roughing filter, and we end up with a load on the HEPA filter.

MR. MURRAY: No, it does not dodge the roughing filter. It is captured by the roughing filter part and it goes through.

MEMBER POWERS: But part of it penetrates through, and then it suddenly decides it's going to react with oxygen. It avoided that the entire transport distance, but it did it on the HEPA filter.

Am I understanding the scenario correctly?

MR. BROWN: You are understanding the scenario correctly.

MR. MURRAY: To some degree, yes. One of

the things to keep in mind about the scenario and with dust type phenomena is that the actual concentration in cubic meters is a very important parameter. If it is too disbursed as it is traveling through the duct work and the plenums, then you essentially have a fuel limited condition. The particles do not interact with each other. The temperature does not rise. It does not become, if you will, autocatalytic, to use that term familiar.

Once you get into the plenums around the filters though, you're now bringing it back together, and you can potentially go through an optimal concentration.

If it is completely packed on the filter, however, all right, then you now have an oxidant limited situation where once again it cannot react and get a temperature rise.

Now, I want to emphasize that in commercial fuel fabrication facilities, burn-back reactions do happen and are observed to happen with some frequency. At one facility it's about once a month. At another facility it's about once a year.

One of the controls that's used is either inert or they deliberately partially oxidize it, and that addresses it.

VICE CHAIRMAN WALLIS: So your concern is that there's just too much of this stuff.

MR. MURRAY: Potentially there's too much of the stuff here, yes.

And I wanted to emphasize, you know, empirically, burn-back reactions occur in the commercial facilities. They are quite capable of getting equipment quite hot, paint peeling off, and so forth.

We have had, you know, verbal reports. I want to emphasize verbal reports that, you know, these particles can glow cherry red.

I also want to emphasize that in the early 1990s, there were two more serious events which did involve some damage to HEPA filters. In those events the depleted uranium dioxide appeared to have functioned more like an ignition source for other combustibles, and the mixture or reacting mixture was carried onto the HEPA filters, and we know that the two incidents which were reported, the primary bank of HEPAs were damaged, but the secondary bank of HEPAs was able to keep functioning.

Unfortunately, even though those events only occurred about 12 years ago, maybe 13 years ago, there's relatively little information to give us more

specific details. We've gone digging. Okay? So, you know, we have to go by what we have so far. It is a concern, but some specifics, kinetic data, for example, we have not been able to find at this time.

Okay. I just want to point out the last bullet on my slide here, that if you look at some of the quantities reaching the final HEPA filters and compare them to adiabatic type high rise calculations involving the filters themselves, which give you a threshold quantity of depleted uranium on the filters, you are getting around the amount or potentially getting around the amount needed to cause damage to the filters just on a straight thermal type analysis.

Next slide, please.

Now, I also wanted to point out some other concerns I have with the analyses. One has to do with reaction heat, yes. Like everything else in the real world, $UO_2$ doesn't just react to $U_3O_8$. You actually get to $UO_2$ plus X.

People argue what is the exact material. I have just given a range for the likely reactions here. As you can see, it's quite, quite a delta.

If you do what is called a calculated adiabatic rise in temperature calculation for uranium dioxide particles, which is one measure of potential

hazards of reacting species, these clearly show that we're looking at temperatures of 1,000 degrees Centigrade for point of contact, an ignition type concern.

And I think the bottom line is I think the safety factor, using values from the applicant, is not clear and that fundamentally we need to ask the applicant some more questions and get some more assurances or feedback on their system.

Thank you.

MR. TROSKOSKI: The other staff view of course, is that the applicant has proposed an adequate safety strategy, and they do have an appropriate margin to prevent a burn-back event from compromising the safety function of the HEPA filters.

Staff consequence analysis has determine that the HEPA filters would be able to survive a burn-back event by at least a safety factor of ten for the maximum powder spill or a safety factor of four for the maximum fire.

VICE CHAIRMAN WALLIS: This would seem to be a very simple energy balance calculation. How can you two differ so much. Is it just because you have so different amounts of stuff? Is that what it is or what's the reason for the difference?

MR. MURRAY: That's why I think we need to discuss it some more

MR. TROSKOSKI: Well, one of the calculations seems --

VICE CHAIRMAN WALLIS: If there's energy balance, you can't both be right presumably.

MR. TROSKOSKI: Well, one energy of balance assumes that the majority of the material goes to $U_3O_8$, the other one that it goes to just $UO_3$, and I don't think it's physically possible for the material to go to $UO_3$ in significant quantities.

MEMBER POWERS: Very difficult.

MR. TROSKOSKI: So really it's a matter of margin and realistic conservative assumptions that you make.

VICE CHAIRMAN WALLIS: Realistic chemistry, right.

MR. MURRAY: Obviously, I differ.

MR. BROWN: This next issue is a little different in that it doesn't really address a specific event or hazard, but something more general, which is regulations require that the applicant set a chemical concentration that corresponds to an intermediate consequence and one that corresponds to a high consequence.

In other words, we don't have a list of chemicals in the regulations and concentration limits. Those are proposed to us, and we review them.

In this case, we do provide some guidance in our standard review plan that the staff would accept, AEGLs and ERPGs, as I've shown here, or other values with justification.

The applicant may also use an alternative standard with justification, and we've looked at the applicant's proposal. They've proposed to use the AEGLs or ERPGs where they're available.

The trouble with this facility is that there are some chemicals where those types of limits aren't available. What to do then? And they've proposed to use the DOE's TEELs, which it uses, DOE uses in its nuclear safety analyses, but we do have two views on that.

Alex.

MR. MURRAY: Okay. Very good. Thank you. Thank you very much.

I'm Alex Murray again. I'm the lead chemical safety reviewer, and I'm giving the differing view on that.

First I'd like to just point out that the TEEL stands for temporary emergency exposure limit.

I want to emphasize "temporary." All right.

If you go and look at the various DOE documentation on TEELs, they're quite adamant that this is just an interim limit when other limits are not available.

Now, I want to emphasize that my concerns fall into three main areas as regards the use of TEELs. The first has to do with findings from the revised draft safety evaluation report. The second has to do with procedural issues in the staff policy on the use or acceptance of TEELs, and the third has to do with safety.

Okay. Now, if I go and look in the revised draft safety evaluation report, there are a number of concerns about TEELs. I've listed some of these here.

TEELs are not peer reviewed. They're not endorsed by regulator, such as the EPA or OSHA. EPA has other limits such as eagles and speegles (phonetic) and so forth. OSHA with NIOSH, they have short-term exposure limits and also ceiling limits which are not to be exceeded. Okay?

And you start looking at some of that. Those are very similar or would address some of the circumstances for which TEELs have been proposed.

I also want to point out that in the two-plus years in which the staff has been reviewing the application, certain TEEL values have changed dramatically. I want to note that several fees have increased by over 50 percent, particularly values that have been used for hydrazine, nitrogen tetroxide and nitric acid.

Nitric acid, for example, increased by a factor of over three in the proposed limits from the applicant during the course of our review.

Next slide, please.

MEMBER WEINER: What were the TEELs based on? I mean, how could they increase if they're based on some health effect threshold?

MR. MURRAY: Well, that is the question. TEELs tend to look at other limits proposed by other people, and they do have an algorithm which they apply. Part of that algorithm is a little more of a mathematical algorithm rather than a true consideration of toxicology or health impact, and that's all part of the concern that I have.

You know, clearly there is some, how shall we say, disconnect between TEEL limits which are temporary? I want to emphasize that part and the potential impacts to people.

I also should note that TEELs appear to be based upon a perfectly healthy worker sort of profile, someone age 18 to 55. All right? It does not necessarily represent a reasonable spectrum of calculation. Okay?

Thank you.

As regards procedural issues, I want to note a couple of concerns. The acceptance of TEELs basically is a management policy decision. All right? The staff really was not involved. There was on person primarily involved in the decision. The credentials of that person for making decisions regarding toxicological data are not the best. Let me just phrase it that way. They are health physicist background. They do not have a background in chemistry or toxicology.

Staff was not involved. Okay? The staff has looked at TEELs and the proposed use of TEELs for 12-plus years. For various reasons over those 12-plus years, different people, different members of the staff have decided that other limits were more appropriate than the use of TEELs. Okay?

These have not been included in the discussions regarding the use of TEELs. The public has not been involved. You know, generally if you're

going to make a decision about limits that impact multiple facilities, you have a public type process with public meetings. That has not occurred.

Other regulators, such as NIOSH/OSHA or the EPA, have not been involved.

Now, I also want to mention, you know, there are some real safety issues involved here. It's not just "oh, gee, I feel touchy-feely. You know, I wasn't involved in the process," or "staff member XYZ wasn't involved" or something like that.

When you have limits which are changing by in some cases factors of ten, you know, how can one say that, you know, these limits which are used to determine your acceptability of your accidents are appropriate? You know, why are significantly higher values acceptable --

MEMBER POWERS: I mean, even the sacrosanct limits that OSHA puts out evolve substantially from addition to addition.

MR. MURRAY: Yes, they do evolve. I want to emphasize they evolve.

MEMBER POWERS: Well, I mean, sometimes that evolution is punctuated equilibrium, to quote our Harvard friends.

MR. MURRAY: Oh, yeah.

MEMBER POWERS: I mean, it's a substantial change.

MR. MURRAY: But they usually involve --

MEMBER POWERS: The one that comes to mind is ammonia. Toluene recently went through a big change. People look at these things differently.

MR. MURRAY: It can happen. Don't get me wrong, but generally when you have NIOSH/OSHA limits or EPA limits, generally there's a much slower cycle, if you will, on the revision of those limits, and generally they involve additional data. Generally you have multiple people like the National Academy of Sciences involved, groups from industry, other parts of the government beyond the EPA an NIOSH/OSHA and so forth.

In fact, in the process that the EPA is following to determine AEGLs, they are basically involving the world, in simple terms.

VICE CHAIRMAN WALLIS: Well, it seems to me that any evolution is reasonable as long as the rationale is present and believable.

MR. MURRAY: Yes, yes.

VICE CHAIRMAN WALLIS: Are you claiming there's no rationale for these changes?

MR. MURRAY: For some of the changes which

we have seen in the past two years-plus, where we have been reviewing the application, I would say the rationale is not firm, and I've heard that from other people.

VICE CHAIRMAN WALLIS: Is it something like engineering judgment or something like that?

MR. MURRAY: I think some of that has occurred, yes, but in fact, that's me speaking.

I'll just note one other thing about this area involving chemical consequences. There have been two differing professional views filed in this area, and the panels formed by management did come to conclusions that those DPVs have merit and that actions have been identified by management for those DPVs, and that is ongoing at the present time.

Okay. John.

MR. TROSKOSKI: The consensus staff view is that use of TEELs where AEGLs and ERPGs are not available is an acceptable methodology. TEELs were developed using a structured derivation process. That involved a large group of experts from throughout the DOE complex, many of them experts in toxicology and having backgrounds that we in the NRC just don't have.

And, again, our consensus view is that once these values are agreed upon they would be fixed

in the license. That way you don't have the continuing, changing license basis.

MR. BROWN: I'll move on to the next issue. This has to do with the maintaining control room environments in the event of a chemical spill.

This applicant has told us that there are no specific actions required for these operators. Their role during this sort of event would be to monitor the facility.

Nonetheless, if there were a spill of some chemicals, there would be a high consequence to these workers, and the applicant has proposed the emergency control room air conditioning system as a PSSC to mitigate those effects.

The function of this system is that it does have two diverse intakes. If one intake detects concentrations above a given limit, it will isolate and the system will go into recirculation mode.

The filters on the inlet side will have chemical cartridges as determined during the integrated safety analysis. Once they've determined the details of where the spill could occur and exactly where the intakes are, they'll determine if those are necessary, but there are provisions for those now.

If both intakes should be affected by a

spill, then they do have this self-contained breathing apparatus available.

The question the staff had was: so at what concentration would you take these protective actions? And what they've committed to is at the IDLH, where those kinds of limits are available for the use of TEELs, where they are not available.

Some of you may be familiar with Reg. Guide 1.78 that was recently revised. There was a question regarding the two minute criteria described in that reg. guide. This is not something the applicant has committed to.

MEMBER POWERS: And I believe that we invited the author for that to experience for himself the joy of donning a scuba apparatus in an IDLH environment of ammonia.

MR. MURRAY: How did it go?

MEMBER POWERS: He didn't take us up on it, but you don't want to have to do that.

MR. MURRAY: Yes, I've been around chemicals.

MR. BROWN: The applicant will determine if there should be a time limit associated with donning an SCBA during the ISA.

Alex.

MR. MURRAY: Oh, thank you, Dave.

I'm Alex Murray, the lead chemical reviewer for MOX, again, with a differing viewpoint.

I want to point out that if you have chemical exposure concentration, it is inevitably linked to an exposure time. Okay? You cannot separate one from the other. All right?

Now, using both IDLH values and TEELs in the proposed approach basically means we have two different time intervals. Previously for IDLH values the NRC staff has identified a two minute time period. TEELs imply a one-hour time period. That's quite a difference. Okay?

So in addition to that, I also want to note that given such a time difference, which again linked to the chemical limit, you cannot separate the two; a time difference of 60 minutes versus two minutes also implies a potential for changes in the design of the facility.

MEMBER POWERS: Maybe we should spell out these things.

MR. MURRAY: Oh, I'm sorry.

MEMBER POWERS: IDLH stands for immediate dangers to life and health.

MR. MURRAY: Immediate dangers to life and

health. I apologize.

MEMBER POWERS: And I mean, this may be just emphasizing your point that clearly a very short time is required for that.

MR. MURRAY: Yes.

MEMBER POWERS: In fact, I believe that IDLH has a 30 minute exposure time --

PARTICIPANT: Thirty minutes to escape, yes.

MEMBER POWERS: -- associated with it.

MR. MURRAY: In NIOSH/OSHA space, it is nominally associated with a 30 minute period. NIOSH/OSHA space also recommends that it's an immediate exit. In the staff review for Reg. Guide 1.78, the conclusion was that two minute time is appropriate, and that would provide adequate margin and so forth.

MEMBER POWERS: And now TEEL, I'm not exactly sure what it stands for. It's an emergency evacuation --

MR. MURRAY: Temporary emergency exposure --

MEMBER POWERS: That's right. Limit.

MR. MURRAY: And it's associated with the normal exposure time of 60 minutes, one hour.

MEMBER POWERS: Okay. I mean, the difference is not between two and 60 for the same chemical with the same limit. It's between two and 60 for different limits.

MR. MURRAY: Potentially, yes, yes, yes. So you have a delta in time, and it applies to some -- the difference applies to some of the chemicals of more concern at the proposed facility, such as nitric acid.

You have an IDLN, $N_2O_4$. Using the applicant's approach, you would have a TEEL 2 limit for nitrogen dioxide. Using the applicant's approach, you would have TEEL 3 limit, you know. So there's some bouncing around.

I also want to point out I just mention $NO_2$, nitrogen dioxide, and nitrogen tetroxide, which are some chemicals of concern at the proposed facility, which can have significant health effects. The applicant has different values for them.

All right. If you go and look and consult with people in the chemical toxicological area, they'll say, oh, well, they really represent the same phenomena, the same chemical hazard even though they can be two different compounds.

All right, and I have some concerns about

that, about some of the values which the applicant has proposed, and I also have a question about clarification of this habitability approach. You know, does the control need to be identified for the work of protection, the donning at the SCBA's facility work action, FWA as I've identified it on the chart?

Should there be a limit or control identified with the cartridge, the chemical cartridge or removal cartridge which the applicant has mentioned?

You know, fundamentally I think we need to talk to the applicant some more and clarify these type of issues because they are significant for the control life.

You're on.

MEMBER POWERS: I had a personal interest. $N_2O_4$, one is just the dimer of the other one.

MR. MURRAY: That is correct.

MEMBER POWERS: But my understanding is that, indeed, $N_2O_4$ has a different health effect than $NO_2$.

MR. MURRAY: Generally if you look at $N_2O_4$, the health effect is primarily due to the $NO_2$ that it produces.

MEMBER POWERS: Okay. So it's just --

MR. MURRAY: It acts very much like a carrier.

MEMBER POWERS: There's just a dynamic equilibrium there, and it's the $NO_2$ that does the damage.

MR. TROSKOSKI: The staff notes that while it's not clear at this time as to whether the control room staffing will be required to meet 10 CFR 7061 performance requirements, it is nevertheless desirable to be able to maintain control room staffing through possible emergency events.

The consensus view of the staff is that the applicant's proposed safety strategy does provide adequate assurance that staffing can be maintained during a hazardous material release. We believe that appropriate consequence limits have been established for initiating actions.

The time criteria for donning scuba will be determined during the ISA phase when the exact facility and process configuration will have been developed.

And this last action would only be necessary if the hazardous chemical were detected after isolation of the two air intakes and placement of the control room on recirculation.

MEMBER ROSEN: Is there an alternate control room like reactors have, an alternate shutdown panel or any other control station that we can remove?

MR. TROSKOSKI: It doesn't really need that or shutdown panel.

MEMBER ROSEN: Is the answer no?

MR. TROSKOSKI: -- done and you can just walk away from it.

MEMBER ROSEN: Tell me the answer.

MEMBER SIEBER:: No.

MEMBER ROSEN: The answer is no.

MEMBER SIEBER:: Right.

VICE CHAIRMAN WALLIS: But the only concern is the health of the operators, isn't it?

MEMBER ROSEN: I don't hear answers. I just hear waving of arms and --

MR. BROWN: There are two control rooms, two emergency control rooms.

MEMBER ROSEN: So there are two emergency control rooms, one remote from the other presumably so that if you had a cloud of some chemical, the operators could move to another control room and resume control monitoring of the process?

MR. BROWN: No. If you had a control room intake, air intake affected, it would be isolated.

You do then have a redundant air intake. If it's not affected, then you've had a fresh air --

MEMBER ROSEN: Why is the English language failing me? Let's go back to the beginning.

I asked are there two control rooms. He told me they're not needed. I didn't ask that question. I asked are there two. You said there are.

I asked are they separate. I still don't know the answer.

MR. BROWN: I don't know.

MEMBER ROSEN: Okay.

MR. BROWN: I don't know how separate they are. That is a final design issue.

MEMBER ROSEN: I'm trying to draw an analogy between this situation and what we have in reactors where we have an alternate shutdown panel. Should the main control room become noninhabitable?

And I guess the answer, I'm still reaching for that, and I --

MEMBER SIEBER:: No answer.

MEMBER ROSEN: -- guess I don't know the answer to that.

MEMBER SIEBER:: Right. There you go.

MR. TROSKOSKI: The one thing we do know is that you can walk away from the control room.

Right now you don't have to staff the control room to meet the performance requirements of 7061.

MEMBER ROSEN: You know, I've operated reactors and chemical plants, and one of my least favorite things to do --

MR. TROSKOSKI: Is walk away from a control room.

MR. TROSKOSKI: -- is to walk away from a control room.

MR. TROSKOSKI: Absolutely, and that's why we've got these.

MEMBER ROSEN: We'll have operators who report to me walk away from the control room since it's their job to operate the plant in all modes. So I think a design in which you walk away from the control room is a design basis that leaves something to be desired, does it not?

MR. BROWN: No. What we're really saying is that the process is highly automated. If there are a need for safety controls, they're generally brought in in an automated way. The operator is there to monitor the conditions, to see that the plant is coming to a safe condition.

MEMBER ROSEN: And if not, to call up the President and say? What is the function of the

operator?

MR. BROWN: To monitor the plant to insure its --

MEMBER ROSEN: Can he do that from sitting in the parking lot?

MR. BROWN: No.

MEMBER ROSEN: Well, QED.

MR. BROWN: No. They have to propose that there is an emergency control room air conditioning system, and its purpose is to make sure that that control room remains habitable.

PARTICIPANT: The same control.

MEMBER ROSEN: That is the design basis.

MR. BROWN: The set point is what we talked about. It's going to be the IDLH concentration at the intake. Where those aren't available they'll use TEEL 2 or TEEL 3 values.

MEMBER RANSOM: You just mentioned most of the processes are automated. As I've been listening to this, it seemed like these are hazardous materials and hazardous processes.

MR. BROWN: They are.

MEMBER ROSEN: And it would be remote.

MR. BROWN: Yes.

MEMBER ROSEN: But yet I hear gloveboxes

or personnel are around these during the process?

MR. BROWN: There could be from time to time, yes.

MEMBER ROSEN: And yet they meet OSHA safety requirements?

MR. BROWN: Yes.

MR. TROSKOSKI: Well, you took the tour of the French facility. Again, it was highly automated. How many operators were throughout out the facility near gloveboxes doing work on a routine matter

MR. MURRAY: Just on that subject, easily 100, easily.

MR. TROSKOSKI: Throughout the whole facility?

MR. MURRAY: Yeah, easily.

MR. TROSKOSKI: And if something would have happened, they'd leave, right?

MR. MURRAY: That would be my assumption. Fortunately, when I was visiting there, there wasn't an event. So I was happy.

(Laughter.)

VICE CHAIRMAN WALLIS: occasionally there are ACRS members in the vicinity.

MR. MURRAY: That's right. That's right.

MEMBER POWERS: In which case, they leave

them there.

MEMBER WEINER: Yeah, that's so they can monitor.

MEMBER POWERS: Let's go ahead.

MR. BROWN: The last issue we'd like to talk about today is the limits the applicant has proposed to maintain flammable gas concentrations below explosive limits. This was initially four open items, but really as we looked at these, it really became one issue, which is: what is the limit above which you're going to do something if there are flammable gases present?

And so this is four open items for really one issue.

The applicant has proposed to implement the guidance if NFPA 69, which allows combustible concentrations at or below 25 percent of the lower flammability limit, up to 60 percent if the system is provided with automatic instrumentation and interlocks.

Whether it's 25 percent for a given process vessel or 60 percent depends on where we are in the plant, and the applicant has laid all of that out with basically six different areas of applicability. So it's 25 percent in some areas and

60 percent in others.

VICE CHAIRMAN WALLIS: This guidance is for this specific staff or is it generic guidance for any plant?

MR. BROWN: Generally what we're talking about is hydrogen gas.

VICE CHAIRMAN WALLIS: Hydrogen?

MR. BROWN: And flammable vapors from the solvent used in there, basically the Purex type process.

MR. MURRAY: I'm on?

MR. BROWN: Yeah.

MR. MURRAY: Thank you.

I'm Alex Murray again, the lead chemical safety reviewer for MOX, and I have a differing opinion to some degree.

First, I want to point out that for hydrogen and flammable gases, all right, the applicant has identified the design basis as being 25 percent of the lower flammability limit. I want to emphasize that's acceptable. It's acceptable to me, and I think it's acceptable to the staff as well.

The concern has to do with solvents and mixtures of solvents, the dilu. and the tributyl phosphate, and perhaps some of the degradation

products that might occur, and this is where we have 25 percent and 60 percent of the LFL limits proposed.

And if you look at some of the specific strategies which have been proposed by the applicant, it's not clear that there's adequate margin, particularly since in some areas where a higher limit of 60 percent of the LFL is being proposed, heat is involved.

All right. And I want to emphasize if we go and look at some of the guidance which is available, both NRC guidance and National Fire Protection Association guidance on the matter, it's not terribly specific on this specific case.

The SRP, standard review plan, for MOX does mention several places 25 percent of the LFL as primarily associated with hydrogen and flammable gas.

If you look at NFPA 30, which applies to flammable and combustible liquids, it mentions the vapor space should not exceed 25 percent of the LFL when you're above the flash point. It doesn't say anything about being below the flash point.

MEMBER POWERS: Let me see if I understand exactly. If I have 100 percent of LFL and an ignition source, I can presumably get a combustion front someplace.

MR. MURRAY: That's correct, yes.

MEMBER POWERS: It probably won't be complete combustion.

MR. MURRAY: May or may not, yeah.

MEMBER POWERS: So the reason that somebody would put limits at, say, 25 percent or 60 percent of the flammability limit must surely be because if you're building up to 25 percent, you'd want to take some action before you got to this lower flammability limit.

MEMBER SIEBER:: Right.

MR. MURRAY: The 20 --

MEMBER POWERS: It's to give you some margin to act. It's not because there's any probability of getting a combustion front to travel through 25 percent or 60 percent.

MR. MURRAY: That's correct, but in actual practice if you use design basis for, say, a general room or general area of, say, either 25 percent or 60 percent, you're looking at, for something that would guarantee, say, where the material, where the flammable gas or vapor is being generated, that that is not above --

MEMBER POWERS: Okay. So you're saying wherever you're detecting, it might be 25 percent, but

someplace else, it might actually be 200 percent of LFL.

MR. MURRAY: That is correct. You know, classic cases around batteries.

MEMBER POWERS: I understand. I understand.

MR. MURRAY: Okay.

VICE CHAIRMAN WALLIS: That's a solvent. Is it always in the vapor phase or are there aerosol particles or something as well?

MR. MURRAY: Well, that's the point. Usually when you're dealing with liquids and solvents, you do use an approach based upon flashpoint temperature, and up until about a month or so ago, that had been how the discussions with the applicant have been proceeding.

The staff had actually discussed a 15 degree Centigrade margin from the flashpoint with the applicant, and that seemed to be how things were going, and as I said, about a month or so ago, that's when this different strategy came in.

At face value, the 60 percent of the LFL does not seem to be consistent with a 15 degree margin to the solvent flash point, and ultimately I think the staff needs to have some more discussions with the

applicant in this area to make sure that adequate safety is addressed.

MR. WESCOTT: Could I add something else on this point?

MR. MURRAY: I'm done.

VICE CHAIRMAN WALLIS: Well, I have one question. Do these limits apply to the worker area or the glovebox area or the control room or all?

MR. MURRAY: In the case -- okay. Let me start with the hydrogen limits, the easy ones for staff. Okay?

Those apply to occupied rooms. Those apply to vesselolic (phonetic) spaces whether the hydrogen is generated by radiolysis or by electrolysis. Okay?

Now, as regards the limits for solvents, these are generally associated with vesselolic spaces, the free space in the tanks and piping, and ultimately the duct work going to the off-gas system.

VICE CHAIRMAN WALLIS: The free space in the tanks?

MR. MURRAY: Yes.

VICE CHAIRMAN WALLIS: Could well have very small droplets in it.

MR. MURRAY: Yes. It's possible, but

these free spaces include the free space above the car columns. The car columns are agitated, and yes, in the disengaging area there, they can be dropless, yes.

I'm sorry?

VICE CHAIRMAN WALLIS: Do they have an estimate of that? Do they take this into account in their 60 percent? And do they do it right? That's the --

MR. MURRAY: I have questions.

MEMBER POWERS: No. It would affect the completeness of the combustion, but it would not affect the combustibility.

VICE CHAIRMAN WALLIS: Unless the temperature changes or something happens to evaporate that, yeah.

MEMBER POWERS: You need a concentration limit to get a propagating flame.

VICE CHAIRMAN WALLIS: Yeah, it would have to be there and then evaporate, yes.

MEMBER SIEBER:: Actually the limit applies everyplace. This is just where you expect to find those limits being approached, right?

MR. MURRAY: I'm sorry. I didn't quite understand.

MEMBER SIEBER:: The limits that you're

discussing here apply everyplace, except these are the only locations where you expect the limits to be approached.

MR. MURRAY: Yes. That's correct, yes.

MEMBER SIEBER:: It's a philosophy question.

MR. MURRAY: Yes, yes. And for solvents and combustible liquids there does seem to be some variation, and there's some question or at least from my perspective there's some question about the proposed controls.

I'm sorry.

MR. WESCOTT: No problem.

I'm Rex Wescott. I'm the ISA reviewer and I'm also Senior Fire Protection Engineer, and I'll present the staff review and conclusions in regard to the LFL issue.

First, we believe that NFPA Code 69 provides an acceptable means for limiting the concentration of flammable vapors and preventing explosions in the process area from being considered. And this is where you're going to have 25 percent LFL or 60 percent LFL if you have adequate instrumentations and interlock.

We also believe that NFPA 30, flammable

and combustible liquids code, provides adequate guidance for solvent mixtures. Now, that allows 25 percent LFL in enclosed process areas. This is not the tank itself, but this is areas like in a building or something. The NFPA 30 really doesn't even address spaces inside of tanks.

But I think what's significant is it only pertains to temperatures above the flash point. It does not address -- there's no margin involved and no other requirements.

Now, what's significant about flashpoint temperature? And where it is a little bit different, say, than LFL is you don't really get to LFL at flashpoint temperature until your vapor becomes saturated. When you first get to LFL or first get to flashpoint, you're probably going to have LFL be at LFL just above the level of the liquid, but it will take some time before you actually get to saturation, which would actually be the lower flammability limit inside the tank at the flashpoint temperature.

So there's some margin in there. You're starting out or they're proposing the 60 percent to LFL margin, and then when they get up to flash point, they're going to reduce -- well, they could reduce this, but I guess the whole idea here is to never

reach the flashpoint temperature.

VICE CHAIRMAN WALLIS: Wait a minute. You're confusing me.

MR. WESCOTT: Yeah, I did --

VICE CHAIRMAN WALLIS: This is supposed to be an average in the whole tank or at the place of the highest concentration or what?

MR. WESCOTT: When you get to flashpoint temperature, let's say you haven't got to saturation yet. I mean, if you look at it like it's a water favor rather than --

VICE CHAIRMAN WALLIS: Diffuses out into the space.

MR. WESCOTT: That's right. You've got to reach an equilibrium condition before you're at saturation, and when you're at saturation, then you'll be at LFL within the whole space. So there's a bit of a time delay in there.

So there is a margin. The 60 percent LFL, where that is temperature-wise depends on the -- that the applicant is proposing -- depends on the vapor temperature curve. So that's something that has to be calculated in the temperature, and they're proposing to limit the temperature so that they don't get above 60 percent.

That is our understanding of the applicant's proposal.

And I think the last point for me to make -- go to the last slide -- is that in the ISA review is when we're actually going to look at the margins involved and determine that, you know, this really does meet the performance requirements of the regulation.

I think at this point what we're all concerned with, Alex and ourselves, although we're accepting this, is that we don't want to be in a situation where we approve something right now based on proposed temperature limits and then get to a point at the ISA review where we find that this just is not acceptable from a performance standpoint.

And we believe that by meeting these limits that they can meet the performance objective.

And that's our.

MR. BROWN: I realize we're -- thanks, Rex -- we're right up at the end of our time here.

MEMBER POWERS: Has to be the bravest slide I have ever seen presented to the ACRW in my life.

MR. WESCOTT: And it was only up there one second.

MEMBER POWERS: I am flabbergasted by that one.

VICE CHAIRMAN WALLIS: You mean the answer to it is always yes?

(Laughter.)

MR. GIITTER: The next step is for the staff to prepare a memorandum for each of these issues, and the memorandum is going to go to management, and management will view the staff position and along with Mr. Murray's position. Hopefully there will be some consensus building in the process.

And we will issue the FSER at some point in the future. As I said earlier, it doesn't look like December because of this latest change in direction, and we do plan to come back to the committee and provide you with an advanced copy of the final safety evaluation report and at that time ask you for a letter.

MEMBER POWERS: Yes. I mean, without knowing the details, it sounds like you have gotten a significant change in direction from the DOE. I mean changes in my thinking about the facility dramatically.

I don't know whether it changes the

specifics, but it changes your thinking about it a little bit.

So let me ask that as your memoranda on these issues get generated and go up to the management and they make a decision, that at that point if you'd be good enough to send us some indication of the memorandum and the decision that this made just to keep us appraised on these issues.

MR. GIITTER: Yes, we could do that.

MEMBER POWERS: I'm asking that simply in the name of efficiency. Okay?

And when you think you're in a position to put your SER out, let's think in terms of having a subcommittee meeting to go through the details probably contiguous with the full committee meeting because I see such a diversity of topics that arise with this facility that trying to do it within the committee, within a time constraint that's necessary for full committee meetings might not give you an adequate opportunity to explain what you've done if there are questions coming up. I don't think it will add any more time, and it won't add any more preparation work on your part, but it will give us a little more chance for just elucidating the many different variety of issues that come on here.

You know, you've heard from the questioning here that there are different points of view, different ways of looking at these things so that it will probably take a little longer, but I don't think it will take more than a day subcommittee meeting to go through that because I know that the members are so dedicated that they will review in great detail this massive pile of documents, and so they will be thoroughly familiar with the material at that subcommittee meeting, just as a matter of strategy.

And as far as the scheduling on that, I leave it totally to you guys.

MR. GIITTER: Okay.

MEMBER SIEBER:: I would appreciate some information just so I can learn some more about criticality safety if you have something that's --

MEMBER POWERS: Actually the very best thing to do is to go look at the reg. guides. They have some excellent references in them.

MEMBER SIEBER:: Okay.

MEMBER POWERS: I mean, that's where I would start learning about criticality safety, is just the reg. guides.

Are there any other questions, members?

Ask away.

MEMBER WEINER: I have two questions that you might not want to answer right now. We've been looking at the question of risk informed regulation, and I would be interested to know how your analyses especially of the chemical problems are risk informed, what you would do differently if they are; what you would do differently if they were not risk informed.

It sounded pretty deterministic to me. That's one question. And you might want to get back to me, to us, in writing on that.

The other question is what considerations have been given to the chemical processing of the waste. You've got a whole lot of mixed waste from these processes, and they're dealing with it now in a number of situations from other reprocessing, and maybe this is in literature that I just don't have or haven't read.

MR. BROWN: I'd like to at least partially answer your question right away.

MR. GIITTER: We'll get back to you on that question.

MEMBER WEINER: Thank you. That's fine.

VICE CHAIRMAN WALLIS: But the waste goes to DOE, doesn't it? The waste is shipped over to DOE.

MR. BROWN: Yes, that's right.

VICE CHAIRMAN WALLIS: It's pumped to DOE.

MEMBER POWERS: If there are no more questions to present to these gentlemen, I think you've got some discussions to do. I appreciate your taking the time to come talk to us.

I compliment you on excellent presentations, very clear visual aids, and I appreciate it.

And I will turn it to you, Mr. Vice Chairman.

VICE CHAIRMAN WALLIS: And I will compliment both Dr. Powers and the presenters for staying exactly within the two hour limit, which we should do always when we set out to meet our objectives in a certain time. Congratulations on that.

We are 15 minutes late, but we do have to take a break, I think. So we will take a break until 3:15.

(Whereupon, the foregoing matter went off the record at 3:02 p.m. and went back on the record at 3:18 p.m.)

VICE CHAIRMAN WALLIS: Okay. We'll come back into session.

We've had a very interesting day so far, and of course we always keep the best till the last. So please keep up the interest of this committee, and I'm sure you will.

Dr. Kress, would you please lead us through this one?

MEMBER KRESS: Are you kidding? This will be the most interesting session we've had.

VICE CHAIRMAN WALLIS: I think it will be.

MEMBER KRESS: Yeah, this is an important and interesting subject, and it's another briefing, yet another briefing on the subject of the technology neutral regulatory structure or framework for that.

And since the last briefing we've had, I think it appears to me after reading the documents that they've made considerable progress, and I think this will prove to be extremely interesting.

And so with that as sort of a non-introduction, I'll turn it over to you, Mary.

MS. DROUIN: Thank you.

My name is Mary Drouin with the Office of Research. At the table with me is just part of the team. I want to acknowledge that right away because there are many people who are involved in this work.

But sitting at the table with me is Trevor

Pratt from Brookhaven National Labs; John Lehner from Brookhaven National Labs; Tom King from the NRC; Vinod Mubayi, also from Brookhaven National Labs.

And hopefully between all five of us we can walk through this and not overly confuse you with where we're trying to go in our vision for this technology neutral, risk informed regulatory structure for advanced reactors.

MEMBER KRESS: You're not asking for a letter or anything from us this time. This is just another briefing?

MS. DROUIN: Let's just jump right next to the next slide.

MEMBER KRESS: I should keep my mouth shut.

MS. DROUIN: And get right into it.

We're here today just to present information. I want to emphasize that we're very early in the process. As you'll notice on every slide, it's a work in progress. These are very preliminary thoughts. So we are not at this time requesting a letter.

Down the road when we have more of a final draft prepared, I'm sure at that point we will be requesting a letter, but that's, you know, a good six

months at least down the road. We're here, again, to share information and to give you our preliminary thoughts.

If you feel that we're going down a wrong road or we're coming up with some ideas that are just really not going to, you think, pan out or there's issues we haven't thought about, you know, we want to start having that dialogue with the ACRS as we move forward.

So one of the things is also when and what frequency would you like to hear from us as we move forward on this program.

I won't spend a whole lot of time here on the background and why we feel it's important to develop this framework document and to ultimately then develop these technology neutral set of regulations.

You know, as we go back in history over the last 40 years and you look at the current Part 50, much of that was developed without the benefit of insights from PRAs. It was developed in what I would call a very unstructured, non --

MEMBER KRESS: Ad hoc manner?

MS. DROUIN: That, too.

MEMBER APOSTOLAKIS: It was a non-structured, structureless approach, wasn't it?

MEMBER SIEBER:: Hey, that's the best comment.

MEMBER APOSTOLAKIS: It had no framework. You can't prove this.

MS. DROUIN: It had no framework.

MEMBER APOSTOLAKIS: You just can't lose.

MS. DROUIN: And you know, when you look at the Part 50, you have a compilation, but it's really hard to get your hands around. We particularly learned that under Option 3 in risk informing, trying to understand what that structure was and how all of the regulations are organized and how you meet your mission. So --

MEMBER APOSTOLAKIS: But we are still now confident that there is no undue risk to the public health and safety --

MS. DROUIN: Absolutely.

MEMBER APOSTOLAKIS: -- for the operating reactors.

MS. DROUIN: Yes.

MEMBER APOSTOLAKIS: Okay.

MS. DROUIN: That goes without saying

MEMBER APOSTOLAKIS: You are not questioning that.

MS. DROUIN: We are not questioning that;

we are not questioning that.

We're trying to provide here something that will now address all technologies and not be biased towards just your LWR technology.

MEMBER APOSTOLAKIS: Very good.

MS. DROUIN: But also try and provide this framework in a structured, systematic way so that you can see the road map of how we get there, and I'll talk a little bit about that as we move forward.

We have four primary phases to the program. We're going to talk today primarily about Phase 1 because that's the one we're dealing with right now, and that's the development of this technology neutral framework, a development of guidelines and criteria that when we execute them would give us the output for -- not the output -- it would give us the second one, which is the technology neutral regulations.

So we want to build this framework that will give us the process that when we apply it, the product out of that process are these regulations, and again, they're at a technology neutral level.

The next phase then is to go back to the process part of the program and develop guidelines and criteria that would show us how to take this

technology neutral framework with these technology neutral regulations and how we would then apply them on a technology-specific level, and the product coming out of that then would be technology specific regulatory guides.

VICE CHAIRMAN WALLIS: I would hope that you don't wait too long; that once you have a vision you believe in, you actually try to draft out in some form all of this stuff. You don't just wait to do two until you have done one absolutely perfectly, and you don't wait until there's three and --

MS. DROUIN: We agree.

VICE CHAIRMAN WALLIS: Yeah.

MS. DROUIN: And if you go to the next on the schedule, that's where you -- it doesn't look apparent, but we are talking about overlapping dates. Like, for example, we don't plan to have a draft final of this framework to the end of 2004, but we plan to start drafting, you know, a recommended set of technology neutral regulations early in 2004 because we see this as an iterative process.

You know, once we feel confident that at least we were pretty confident of the technical basis that's in the framework, then to start applying it and lessons learned as we draft the regulations to see

where there are problems or whatever, then that would feed back into the framework and refine it so that, you know, they converge together.

VICE CHAIRMAN WALLIS: It might be one year of doing the job and three years of convincing everybody else.

(Laughter.)

MS. DROUIN: I hope not; I hope not.

You see there on the schedule that in two weeks from now we're planning a public workshop. This will be our second public workshop, and we're going to continue to have workshops and public meetings throughout this entire process.

MEMBER KRESS: Who are you inviting to that particular -- who are you inviting to that particular meeting? In particular, are you inviting the people associated with the potential advance reactor certification, people, you know --

MS. DROUIN: Everyone is invited.

MEMBER KRESS: Yes, I hope, but are you targeting particular people? I know anybody can come.

MS. DROUIN: Yes, we are. Yes, we are.

MEMBER SIEBER:: -- in the Federal Register.

MS. DROUIN: So, I mean --

MEMBER KRESS: Anybody in particular?

MS. DROUIN: Well, NEI, of course, has been targeted. Westinghouse has been targeted. The IRAs, PBMR because I understand they might be coming back.

MEMBER KRESS: The Gen-4 people, are they?

MS. DROUIN: The Gen-4 people have been targeted.

MEMBER APOSTOLAKIS: Gen-4, do you mean DOE?

MEMBER KRESS: Yeah. Well, it may be --

MS. DROUIN: And Idaho.

MEMBER KRESS: -- the DOE people associated with --

MEMBER APOSTOLAKIS: I don't think they think that way. But anyway --

MEMBER KRESS: But anyway that's -- and the idea is to see what their input is and what they think about what you've done so far?

MS. DROUIN: Absolutely. I mean the purpose of this workshop is, again, basically to start sharing preliminary information and to start receiving feedback.

MEMBER LEITCH: Mary, if I walk in in 2004 and want to build an ES-BWR, do I have the option of

building it in accordance with the current regulations?

MS. DROUIN: I have an answer for that on another slide.

MEMBER LEITCH: Okay.

MS. DROUIN: So if you hold off I will direct the answer to that.

MEMBER APOSTOLAKIS: When do you want to build it, Graham?

MEMBER LEITCH: 2004.

MEMBER APOSTOLAKIS: I think you don't have an option. You have to go with the present regulations.

MEMBER LEITCH: Yeah, well, we'll talk about it when we get there. I guess what I'm concerned about is might this schedule put the brakes on development of a new vintage of light-water reactor.

MS. DROUIN: I'm going to address that very presently.

MEMBER LEITCH: Okay, sure.

MS. DROUIN: Okay. I think I've already talked about this one.

MEMBER APOSTOLAKIS: Yes.

MS. DROUIN: We just can't emphasize

enough the very preliminary stages here.

MEMBER APOSTOLAKIS: So that means we shouldn't comment?

MS. DROUIN: No, we do want your comments. I don't want people to read something and get hung up on a particular word or, you know, these are very initial thoughts that we're brainstorming and --

MEMBER APOSTOLAKIS: I don't know if we got hung up, but what's the difference between an idea and a thought?

No, keep going. I'm sorry.

MS. DROUIN: Thank you, George. Okay.

MEMBER APOSTOLAKIS: Is there a difference? You can explain to me later.

MS. DROUIN: Okay. Dr. Leitch, getting to your question, right now it is envisioned that this document, this framework, this program is to be applied to non-LWRs, for example, your HTGRs, your liquid metal reactors. They applied to advance LWRs, such as IRIS. IRIS has even expressed an interest in coming underneath here.

It's not intended to be applied for things that are currently in the process. So for designs such as the AP-1000, the ACR-700, the SBWR, those that are already in house, they are being licensed under

the current process.

MEMBER APOSTOLAKIS: So this is --

MEMBER LEITCH: May I ask the other questions though? If ten years from now I want to build an ES-BWR, it would be under this process though?

MS. DROUIN: It potentially could be. That's one of the questions that you will see later on. Is this to be voluntary when it's all said and done or mandatory? And that will be a policy question that will go up to the Commission to decide.

MEMBER APOSTOLAKIS: So this is essentially Generation 4.

MS. DROUIN: Yes.

MEMBER APOSTOLAKIS: I mean, if you look at the time scale, you're really addressing Gen-4.

MS. DROUIN: Un-huh. It is to cover all aspects, looking at both design construction and operation.

MEMBER APOSTOLAKIS: Speaking of whom to invite, are you inviting or targeting any international organizations? I mean, there is an effort, as you know, at the IAEA to do something about it. Are they coming?

They certainly have been notified and are

aware of it. I am attending an IAEA workshop on this topic.

MEMBER APOSTOLAKIS: In December?

MS. DROUIN: In December.

MEMBER APOSTOLAKIS: Oh, very good. Okay, yeah.

MS. DROUIN: Also, it's to, you know, address -- in the past a lot of the things that we've been hearing from the committee have been strictly on public, but this is to look at not just the public but also worker risk and land contamination. So it's going across all three areas. Okay.

MEMBER KRESS: George, I really didn't write this.

(Laughter.)

MEMBER KRESS: It's probably what you might think. I didn't write this.

MS. DROUIN: Okay. Some of the ground rules under which we've laid out for ourselves is that we do envision this to be a new, for example, Part 53. We are trying to start with a clean piece of paper. We talked about whether or not this is going to be voluntary. That, again, will be in a policy issue that once this is said and done and we have this framework and these new set of regulations, whether

they will be voluntary or mandatory.

VICE CHAIRMAN WALLIS: Well, if the old regulations don't apply or can't be applied, there isn't much choice, is there?

MS. DROUIN: No, you can still be licensed through that, and that's where you go through an exemption, and I mean, Jerry, if you want to speak a few minutes to that.

MEMBER APOSTOLAKIS: Well, you remember what the bad guys were doing at Exelon some time ago. They came in here and said, "We'll go with the current system, except we would like these changes."

MS. DROUIN: Right.

MEMBER APOSTOLAKIS: So it's conceivable that they would do that.

VICE CHAIRMAN WALLIS: You could adapt the present system. You couldn't use it as it is.

MEMBER APOSTOLAKIS: No.

MS. DROUIN: No, no. You have to adapt, and you exempt some and you add other things as appropriate.

MEMBER SIEBER:: That's probably what the process will turn out to be.

MEMBER KRESS: No.

MEMBER SIEBER:: Adapting and building on

what you have.

MEMBER APOSTOLAKIS: Not this one.

MEMBER KRESS: Not necessarily.

VICE CHAIRMAN WALLIS: Well, you're hoping not.

MEMBER APOSTOLAKIS: Well, I mean, there will be a strong influence of existing regulations.

MEMBER KRESS: Yeah, because some of them are still pretty good things to have.

MEMBER APOSTOLAKIS: Yeah, I mean, the thinking behind the regulations is really still of value.

MS. DROUIN: I mean, you can't totally turn your brain off in terms of what you know from what you have, but we truly are trying to start with a fresh piece of paper in the building of this.

MEMBER APOSTOLAKIS: I think it's more accurate to say the fundamental approach to safety is probably the same as, you know, 20 years ago and now. It's the implementation that will be different. That's where you started with a clean piece of paper.

MS. DROUIN: Yes, and I think as you go through you'll see some similarities there.

MEMBER APOSTOLAKIS: Yeah, yeah. Okay.

MS. DROUIN: I know Tom has been here

several times to talk about the policy and technical issues on the advanced reactors. A lot of them correlate, very much impact our work on framework, and so you'll see that tie-in. When you look at, for example, expectations for safety, defense in depth, containment versus confinement, these are all -- probabilistic approach -- these are all issues that we're going to have to deal with under the framework.

Just some more of the ground rules that we've laid out, and a lot of these ground rules have issues associated with them in the framework, and we will be getting into those as we get more into our presentation today.

But we are currently using the Commission safety goal policy as the desired level of safety that we want to achieve for protection of public health and safety. We're looking to develop goals and criteria also for workers and environmental protection, not just look at reactor safety in the public.

MEMBER APOSTOLAKIS: Speaking of the Commission's goal, the Commission has also expressed a wish that the new generation reactors will be safer.

MS. DROUIN: That's correct.

MEMBER APOSTOLAKIS: Are you taking that into account anywhere?

MS. DROUIN: We're taking that into account, and we've got several viewgraphs on how we plan to deal with that.

MEMBER APOSTOLAKIS: Okay, okay.

MS. DROUIN: I'll tell you what. Why don't we just jump right into --

MEMBER APOSTOLAKIS: Well, you say initial focuses on reactor safety. Oh, you mean safeguards will be something else.

MS. DROUIN: Yes. Safeguards and security we plan to deal with after, down the road and not try and address that right now as part of the framework. Since this is supposed to be risk informed, we're going to have both probabilistic and deterministic requirements.

And in terms of the design basis, accident concept, we do plan on retaining the concept, and we'll get more into what we mean by that because we don't propose defining, pre-defining specific design basis accidents. We don't see how you can do that when you're technology neutral.

VICE CHAIRMAN WALLIS: It will come out of the probabilistic analysis?

MS. DROUIN: Yes.

VICE CHAIRMAN WALLIS: Okay, good.

MS. DROUIN: And we're going to get more into details on that as we go through today.

MEMBER APOSTOLAKIS: Very good.

MS. DROUIN: Okay. So now, getting right into the framework, before we get into a discussion of the actual technical issues, as what I would call them, how we plan to meet the safety expectations, our risk guidelines, those things, I think it's important that we try and explain this road map of how do we go from, you know, our mission of the Atomic Energy Act, of protecting the public health and safety which we do through a set of regulations. How do we get there? What is the process that we're going to follow?

Yes, we're going to have guidelines on all of these different issues, but how do you bring them all together, and when does this magic occur? When you sit down to write them, how do you know what to write?

So right now, this is our first draft at what we would call this approach or this road map, and so first what we do is we propose, you know, establishing our safety and risk objectives, and that would support the mission, you know, of the Atomic Energy Act, which is to protect the public health and safety.

And then second, looking at these objectives, we want them to address -- sorry?

MEMBER ROSEN: It's to provide reasonable assurance of adequate protection of the public's health and safety, right?

MS. DROUIN: Those are not the words that are in the Atomic Energy Act.

MEMBER ROSEN: Where do those words come from?

MEMBER APOSTOLAKIS: NRC.

MS. DROUIN: Yeah, I can't remember exactly what policy statement or if it's even a policy statement, but those are not the words that are actually in the Atomic Energy Act.

MEMBER ROSEN: So are you going to even bridge to those words, or are you going to say those are no good for this new generation?

MS. DROUIN: No, I mean, I'm not going to say they're no good. I just hadn't thought, to be quite honest, about those particular words.

MEMBER APOSTOLAKIS: But if you are accepting the Commission's safety goals, you are essentially telling the world what you --

MEMBER ROSEN: I don't think you can do what you're about to do without providing reasonable

assurance of adequate protection because a probabilistic approach lends itself to provide reasonable assurance. It's not positive, 100 percent assurance. It's reasonable assurance.

MS. DROUIN: Right. I don't disagree.

MEMBER ROSEN: And what's reasonable is a quantified, you know, within limits and uncertainty of some sort of --

MS. DROUIN: And in that regard, we will have answered your question when we get into what our view is on how to address safety expectations and risk expectations. But all I'm trying to say here is that as we go from this goal set by the Atomic Energy Act to protecting the public health and safety, we're saying we're going to establish safety and risk objectives. Those are going to be applied to worker risk, public, and land contamination.

And then for each of those, the next thing is we're going to define cornerstones such that when you, reading my exact words here, they're going to provide the high level criteria for insuring safe nuclear power design and construction and operation.

And once we have agreed that these are the cornerstones to insure that, then look and identify what are the challenges that could prevent you from

achieving those cornerstones, and then articulate those challenges through your regulations, and that's kind of the flow path or the flow chart of how we get from protecting the public health and safety to what actually should be written in these regulations, what they should encompass.

MEMBER APOSTOLAKIS: But I think it's important though to remember that the Commission has resisted defining adequate protection in terms of frequencies.

MS. DROUIN: That is correct.

MEMBER APOSTOLAKIS: We don't have that. Informally, the staff is using something like ten to the minus three per reactor year, core damage frequency. Once you exceeded that, there's a lot of interest, and the higher you go, the more immediate the reaction as the Quad Cities fire demonstrated.

What Mary is using is goals, a very different concept, right? We are not using adequate protection measures.

MEMBER KRESS: Don't be too sure, George.

MEMBER APOSTOLAKIS: She's using goals as far as I can tell.

VICE CHAIRMAN WALLIS: Well, I think they're becoming the same thing.

MEMBER APOSTOLAKIS: No. You can be above the goal.

MS. DROUIN: If you'll bear with us, we are going to get into this in the discussion. All I'm trying to show you is at a very high level. I'm not trying to answer any technical issues at this point.

MEMBER APOSTOLAKIS: Okay.

MS. DROUIN: All I'm trying to show you is a road map, and I'm going to jump over to Figure 12 that says, you know, we're starting at the Atomic Energy Act. We're going to establish safety expectations and risk expectations, and we're going to get into details of this in the next set of slides. Those are going to be applied to on site, off site, and land. We're going to develop cornerstones, and we've taken a first cut at the cornerstones for our off site public population.

We're going to identify challenges. Those are the challenges that could defeat your cornerstones, and then articulate those through regulations and organize them under design construction and operation.

VICE CHAIRMAN WALLIS: How much are you going to review? I mean, it seems to me that safety and risk objectives are a societal thing. They depend

very much on the views of people in the society, which change year to year and shouldn't just be fossilized in some decision made 20 years ago by some group of people.

It may be the acceptance of nuclear power and the acceptance of risk has changed in society over the years. How do you get to measure what society is willing to tolerate in order to have nuclear power?

MEMBER APOSTOLAKIS: Small fraction.

VICE CHAIRMAN WALLIS: I think there ought to be some relook at the outside measure of risk, not just the internal idea of what the agency has about it.

MEMBER APOSTOLAKIS: If society changes its views, then society should put pressure on the Commission. As far as Mary and her colleagues are concerned, society is what the Commission says, and that should be very clear. I mean the Commission says these are the goals.

MEMBER KRESS: It represents society in a sense. They're the societal representatives in this.

MEMBER APOSTOLAKIS: Yeah, they are representatives of society.

MEMBER KRESS: And they have come up with what they believe are the society's -- what they're

willing to risk for nuclear power, and that's the safety goals.

MEMBER APOSTOLAKIS: That's exactly right.

MEMBER KRESS: And so that's what we have right now, is a societal goal, and if you want to change those, you've got a real problem.

VICE CHAIRMAN WALLIS: No, I don't want to change them. I just wonder where the society input comes from.

MEMBER APOSTOLAKIS: The issue is that there will be a very small fraction, and it is interpreted that way, and I don't see that the general risk with the population who is exposed is going to change that much.

MEMBER KRESS: You can't go out and poll the whole world.

MEMBER APOSTOLAKIS: If society changes its views, there are mechanisms for bringing pressure on the Commission to do something about it.

MEMBER KRESS: Sure, of course, and we start with what we've got.

MEMBER APOSTOLAKIS: And right now we have the objectives as stated by the Commission. That's the society's view, as far as the staff is concerned.

MEMBER SIEBER:: And there's multiple

paths to accomplish that.

MEMBER APOSTOLAKIS: Sure.

MEMBER SIEBER:: Congress can do it through the Atomic Anergy Act. All of this will be rulemaking. So that is a public process where there's lots of input.

VICE CHAIRMAN WALLIS: So it's conceivable there might be some public input then.

MEMBER SIEBER:: Yeah, and if there isn't, to me it means the public is satisfied with the proposal.

MEMBER APOSTOLAKIS: And it's not just the society's views that may change. What if, you know, something happens, and then all of a sudden we start building 1,000 reactors. I don't think the objectives we have now should stay as they are. I mean, you change one or two orders of magnitude.

MEMBER KRESS: Yeah.

MEMBER APOSTOLAKIS: One is reminded of the existing fleet, right? See, that's a problem that --

CHAIRMAN BONACA: Well, the set of risk objectives --

MEMBER APOSTOLAKIS: Huh?

CHAIRMAN BONACA: Accepting risk will be

the same. All you need is to make more stringent requirements, and --

MEMBER APOSTOLAKIS: Yeah, but I think what Mary is developing here and her colleagues is independent of numerical values.

CHAIRMAN BONACA: Yes, that's true.

MEMBER APOSTOLAKIS: If the Commission decides tomorrow to change the objectives, the numbers, but if the change the dimensions of risk, then you might want to reconsider, but you are considering something broader.

VICE CHAIRMAN WALLIS: But the present regulations don't change when the Commission decides to change some goals, but this is a road map which would allow you to do that?

MEMBER APOSTOLAKIS: No, but what I'm saying is --

VICE CHAIRMAN WALLIS: So if the Commission changed its goals, safety objectives, and the system would adjust immediately?

MS. DROUIN: Well, if the Commission came in and changed, you know, the safety goals, which are numeric, and if your framework is based on that, your framework would have to --

VICE CHAIRMAN WALLIS: It would change.

It would adapt.

MEMBER SIEBER:: But they've already done that. They've sent an expectation for advanced reactors.

MEMBER KRESS: Mary, just a question of detail on that particular thing. Why did you choose to separate out barriers from mitigation as a separate cornerstone?

MEMBER APOSTOLAKIS: Yeah, I was wondering about that myself.

MEMBER KRESS: I mean, I can see putting it in with mitigation or separating it out if you wanted to focus on it for some reason.

MS. DROUIN: To me a barrier is something physical and is not the same as mitigation. I think they're two distinct things.

VICE CHAIRMAN WALLIS: The injecting the ECCS isn't a barrier.

MS. DROUIN: That's right. It's not a barrier.

CHAIRMAN BONACA: Yeah, and it has always been viewed as something physical, a clouding or --

MEMBER ROSEN: Well, it's a reflection of the RFP also. You know, if payment is a barrier, mitigation is the ECCS. You've got to have both to

have defense in depth.

CHAIRMAN BONACA: Even the protected area is being considered, the size of it.

MEMBER ROSEN: I mean, there's initiating events, mitigation, barriers. You know, it's the --

CHAIRMAN BONACA: Sure.

MS. DROUIN: And I will say, you know, we've borrowed heavily in our initial thinking here from the ROP. Now, we are thinking also on site, you know, worker risk and land contamination. Now, one of the challenges we're facing, and we may come back next time with a different set of cornerstones because the question we have asked ourselves which we haven't answered yet: is there a set of cornerstones that could be common across all three?

And that's what we're looking into right now. So these --

MEMBER KRESS: It certainly could be for the land then and environment, but you know, for the on-site worker it may not be.

MS. DROUIN: See, that's interesting because I would have said the opposite personally. I would have said, you know, when you look at on site you're going to worry about events. You still want mitigation. You want barriers, and you need to deal

with emergency preparedness for your worker.

VICE CHAIRMAN WALLIS: You're not going to evacuate the land.

MS. DROUIN: You're not going to evacuate the land, right.

MEMBER KRESS: But the emergency preparedness is not necessarily evacuation.

MS. DROUIN: So they're still thinking that we need to do here, you know, what actually we're going to end up with what cornerstones, but we felt that having the corner stones was the right place to start and that that would tell you the challenges, and then that would lead you to then what regulations.

And since you also inspect against your regulations to match them up from the very beginning with your cornerstones so that you are having this uniform entity at the end we thought was very important.

MEMBER KRESS: Would you consider changing the evacuation cornerstone and calling it emergency preparedness?

MS. DROUIN: Yes. I did need to do that. It is supposed to be called that.

MEMBER APOSTOLAKIS: Yeah, and I have a couple of comments on that.

MS. DROUIN: I thought I had made that change, but I had not.

MEMBER APOSTOLAKIS: The terminology. I agree that should be emergency preparedness, and I would say in the box "develop emergency preparedness . . . as appropriate."

MS. DROUIN: Yes.

MEMBER APOSTOLAKIS: But these are key words, "appropriate." As you know, one of the goals of Gen-4 is not to need emergency preparedness. So if they can prove to you that there is no need for it, you can say, "Okay. So it's not appropriate to have it."

The way it is now you have to have it. So I think "as appropriate" would give you a way out.

MEMBER SIEBER:: Yeah. On the other hand, emergency preparedness started out as a political issue, and regardless of the enhanced safety features of Gen-4, I think it will rémain a political issue. It gives people confidence that in the unforeseen event that something goes wrong, there is something the state and local people --

MEMBER APOSTOLAKIS: Right, but if you say "as appropriate" --

MEMBER KRESS: But that may what you mean

by "as appropriate."

MEMBER APOSTOLAKIS: But as needed. The words "as appropriate" include what you just said, Jack.

MEMBER SIEBER:: Oh, I agree with that.

MEMBER ROSEN: You see, that's the current reactor fleet, but the Gen-4 concept was to make these machines so robust that as part of the selling process for it, you can say these are such robust machines that you really don't need an evacuation program or an emergency preparedness program for off site populations. You do need it for on site.

MEMBER KRESS: I thought even then you might want --

MEMBER SIEBER:: That would be a difficult sell.

MEMBER ROSEN: Well, it may very well be, but the point of -- I guess I'm not getting my message across. If you could do that, then you would have a different class of reactors. That could be cited in --

MEMBER APOSTOLAKIS: I guess Jack is saying even if you did that public confidence would require the public --

MEMBER SIEBER:: There would be --

MEMBER APOSTOLAKIS: -- but we don't know that.

MEMBER SIEBER:: -- public demand.

MEMBER APOSTOLAKIS: I would also call these events on the left, which are obviously the initiating events; I would call them challenging events, the way you called them in the mitigation box, but not just events because when I saw "events," I thought of event sequences that lead all the way to bad things, and that's not what you mean.

Now, you say "insure adequate protection from routine operation and limit events that can challenge the plant and result in undesirable. . . ."

I think you shouldn't make this distinction between adequate protection from routine operation and limit events. I think the adequate protection issue applies to all events. So we need a better phraseology here. Maybe you started to say limit events that can challenge the plant and resulted in desirable consequences, thus insuring adequate protection.

I think that protection is much broader than just routine operation, I think. Now, what I just said needs wordsmithing itself, but it seems to me that you need to put the adequate protection at the

end or make sure that it applies to all of the events, and I am still a little confused.

CHAIRMAN BONACA: You are still deal with the issue of anticipated transience versus --

MEMBER APOSTOLAKIS: Yeah. And it's still not clear to me why mitigation and various are two different boxes. I understand what you're saying, but --

CHAIRMAN BONACA: I think the terminology here reflects the early thinking when you were thinking about events and the mitigating events, you know, like, you know, an ECCS system mitigates an event. Okay?

And when you talk about including burial (phonetic) with mitigation, you're thinking more of core damage or severe accidents and releases.

MEMBER APOSTOLAKIS: But we said that this thinking still applies.

CHAIRMAN BONACA: Huh?

MEMBER APOSTOLAKIS: We said earlier that this thinking still applies. You still want to have mitigation capability.

CHAIRMAN BONACA: Sure.

MEMBER APOSTOLAKIS: Anyway, I think this is similar to what was happening when we were

developing Regulatory Guide 1174, where we were arguing about the words because the words are very important.

MS. DROUIN: The words are very important. I agree.

MEMBER APOSTOLAKIS: And this is an input for today, I guess.

VICE CHAIRMAN WALLIS: Also it's very important that you fill out the boxes so that you really understand what's implied. I'd like to see more than just this structure. I guess you're going to get to it.

MS. DROUIN: We will get to that. I mean through this whole framework, I mean, there's a lot of writing that still needs to occur so that better explains, you know, what our thinking process is here.

MEMBER APOSTOLAKIS: Let's look at the last box.

MS. DROUIN: Okay. You're not going to let me move on?

MEMBER APOSTOLAKIS: No, Mary, no.

MS. DROUIN: I tried.

MEMBER APOSTOLAKIS: Well, you're here to get some input, right?

MS. DROUIN: Absolutely, but I want to get

input on everything.

MEMBER APOSTOLAKIS: There is a goad.

Why are you distinguishing between administrative and technical? You mean regulations, administrative regulations and technical regulations? Is that what you mean?

MS. DROUIN: Yes. We have both administrative and technical regulations.

MEMBER KRESS: I think that's perfectly reasonable because that's what we have now.

MEMBER SIEBER:: That's what the regulations is in there for.

MEMBER APOSTOLAKIS: You see, another way I was looking at this, the box above says challenges that could defeat the cornerstones, and then you have an arrow, and I thought you were implying that there are administrative challenges and technical challenges.

MEMBER KRESS: No, no.

MS. DROUIN: No.

MEMBER KRESS: It's all of the above leads to these rules.

MS. DROUIN: That's right.

MEMBER KRESS: The box is called regulations.

MEMBER APOSTOLAKIS: But shouldn't there be a recognition somewhere that these challenges are not purely technical? I mean, are we learning anything from Davis Besse or not? The challenges are not just technical. You cannot fix them by design criteria, construction criteria or by issuing rules.

MS. DROUIN: That's right. That's why you have "administrative" there.

MEMBER KRESS: Yeah, that's to take care of the other things, George.

MS. DROUIN: We're saying that we're going to end up with both administrative and technical regulations.

MEMBER APOSTOLAKIS: So administrative will cover safety culture issues?

MS. DROUIN: I don't know what it's going to cover age this point.

MEMBER APOSTOLAKIS: But it would. It should.

MS. DROUIN: I'm saying that we will end up with both administrative and technical regulations, and we're proposing that for the technical set of regulations, we would organize them under design construction and operation.

Now, whether or not there would be an

organization for the administrative regulations, I don't know. We haven't thought that far yet.

MEMBER APOSTOLAKIS: Give me an example of an administrative regulation.

MS. DROUIN: Fifty, fifty-nine is administrative. That to me is not a technical regulation. Fifty, forty-six is a technical regulation. Fifty, thirty-four, that's a technical operational to me regulation. Fifty, forty-four, technical.

MEMBER SIEBER:: All of the reporting requirements, petitions for rulemaking, all of those are administrative.

MS. DROUIN: Seventy-two, administrative.

MR. KING: Yeah, in the draft we sent you to look at, there's like a dozen examples of administrative regulations.

MEMBER APOSTOLAKIS: Okay.

MEMBER SIEBER:: Part 19.

MS. DROUIN: Yes.

MEMBER KRESS: Now you can go to the next slide.

MEMBER SIEBER:: Part 21.

MS. DROUIN: Thank you.

Okay. Now, we want to start kind of going

back through this thing, but starting at the top and getting into some detail on each of these.

VICE CHAIRMAN WALLIS: How does this tell you what the purpose of the regulations is and how you measure when a regulation is a good one?

MS. DROUIN: What do you mean? How do you measure whether it's a good one?

VICE CHAIRMAN WALLIS: Well, presumably you want a good regulation. How do you measure that it's doing its job? You have to somehow specify the job of the regulation, and then have a structure that makes sure that it's carried out.

MEMBER KRESS: The job is to get safety and risk objectives met with defense in depth. They had a list of things here.

VICE CHAIRMAN WALLIS: But I think that's the key thing, is whether all of this structure to see how the regulations fit into what you're trying to achieve in terms of safety.

MEMBER FORD: Surely what they're trying to do, against the events, to give you some barriers, there's going to be some criteria. Rather than say challenges, it should be tools. These are the tools, the regulation tools.

MEMBER APOSTOLAKIS: See, that's what

confused me, the word "challenges." If you say "tools," then I agree.

MEMBER SIEBER:: Actually this is not the approach and road map. What it is is the structure --

MEMBER KRESS: It's a framework.

MEMBER SIEBER:: -- that they intend to -- it's the framework, the structure.

MEMBER APOSTOLAKIS: That's good. I think a change in the word would go a long way toward making it clear because I interpreted what's in the green box, the bottom box, as a challenge.

MS. DROUIN: Well, I'm hoping that we can get --

MEMBER APOSTOLAKIS: These are the tools.

MS. DROUIN: -- more discussion on each of these. We can explain it better. I mean we just didn't have the time, to be honest.

MEMBER APOSTOLAKIS: That's okay. I'm just saying the word "tools" will be better. That's all.

MEMBER KRESS: I think once she gets into the details of those --

MS. DROUIN: But I don't know if I agree that the word "tools" is going to convey really what we're trying to say.

MEMBER KRESS: I don't think so either.

MS. DROUIN: So I don't want to just say we're going to change that word to tools. I don't know that that would fix the problem.

MEMBER KRESS: Tools has to do with things like computer codes and stuff like that.

MS. DROUIN: Yeah.

MEMBER KRESS: I don't think you want to do that.

MR. LEHNER: I think that challenge box probably needs to be elaborated on, but I think the question was what's a good regulation, and I think a good regulation would be one that adequately meets the challenges that you're trying to address.

VICE CHAIRMAN WALLIS: But is a good regulation one that makes sure that the events are under proper control and that the mitigation in some way happens and that the barriers are there, and that the emergency procedures function in some way?

MEMBER KRESS: That's right.

MR. LEHNER: I think it would be to enumerate the challenges to these cornerstones, and once you've done that, then you write regulations to address the challenges.

MEMBER KRESS: You have criteria for when

you successfully met the challenge.

CHAIRMAN BONACA: For your mitigation assistance, for your barriers, for your evacuation, you have construction criteria to assure that they are capable.

VICE CHAIRMAN WALLIS: It's based on what could go wrong rather than what ought to go right?

MR. KING: I think it's both. I mean it really defines those things that need to be in place to insure that the high level risk goals are met, and what Mary is trying to illustrate here is a systematic way to march through and make sure that we've covered all of those things, included all of those things in the regulations.

VICE CHAIRMAN WALLIS: So you need to have the measures of things going right first before you really know when things go wrong.

MR. KING: That includes prevention as well as mitigation, yeah.

MS. DROUIN: Too many things that go right, that's what your barriers are. These are the things you want in place. Now, what regulations do you want such that you can insure these things are being met?

And to me that is you're going to have to

figure out what are the challenges that could defeat that, and then you put regulations in place that would neutralize those things from occurring so that you do have mitigation; you do have barriers; and you do have emergency preparedness.

VICE CHAIRMAN WALLIS: I don't know that you need to look at the challenges at all. All you need to do is state, "Thou shalt have a certain level of quality in your event control, in your mitigation, barriers, and evacuation."

It's up to you to show that the challenges don't defeat these.

CHAIRMAN BONACA: But I think if they identify an event which requires a certain level of mitigation, such as pumping X gallons of water under certain conditions, then you have a design criteria out there that's specifying that.

MEMBER KRESS: The events you come up with are going to be design and plant specific. They don't intend to specify a set of events.

MS. DROUIN: That's right.

MEMBER KRESS: This is a framework which you would develop a set of regulations. Now, what they may come up with is criteria for maybe the frequency of events and maybe how good the mitigation

is and --

MS. DROUIN: Exactly.

MEMBER KRESS: -- things of that nature. So it's a framework which is what they're developing.

MS. DROUIN: I mean if you wanted to, you could write your set of regulations. You have four regulations, and they're your four cornerstones.

MEMBER KRESS: Oh, yeah, yeah.

MS. DROUIN: But I don't think we'd ever be allowed to get away with that.

MEMBER KRESS: I wouldn't do it.

VICE CHAIRMAN WALLIS: Well, try the minimum set of regulations and see what it looks like.

MEMBER KRESS: Excuse me. You had a comment that you wanted to make?.

MR. MUBAYI: Yeah, I just want to say that on viewgraph number ten, the last bullet says that the means to neutralize the challenges, whether that's the right word to use is a different issue, are identified and articulated by the regulations, and the concept here is that we are developing technology neutral, and so the regulations must address those expectations that we have of safety or conversely of risk, and those are the things that must be met. Each specific design will have its own set of challenges which will

be distributed across these various boxes at a fairly high level.

MEMBER KRESS: And part of the regulations would be you, your particular design. Tell me what these challenges are.

MR. MUBAYI: That is correct. That's absolutely correct.

MEMBER KRESS: Identify them.

MR. MUBAYI: The designer has to come and --

MEMBER KRESS: And tell me what the frequencies are.

MR. MUBAYI: Great, and tell you what the frequencies are and the regulations are then meant to address all of them in a systematic way.

PARTICIPANTS: Right.

MEMBER KRESS: I think that's the only way you can do it for an unknown design, an unknown thing.

VICE CHAIRMAN WALLIS: But if the regulations are a high enough level, a lot of the detail of meeting the challenges and so on is up to the applicant.

MS. DROUIN: Yes.

VICE CHAIRMAN WALLIS: The regulation is not a lot of detail about how you are to meet the

challenges, which plainly isn't necessary.

VICE CHAIRMAN WALLIS: Yeah, but the review of the NRC reviewer will need some guidance.

MEMBER KRESS: Oh, yeah. They'll need guidance for each one. I think they intend to develop some sort of guidance for each reactor type.

MS. DROUIN: Yes.

VICE CHAIRMAN WALLIS: But what I'm getting at is if you have a high level regulation which says, "Thou shall prevent" -- that you should maintain the integrity of the fuel or something, that's very different from saying 2,200 degrees and all of these other details.

MEMBER KRESS: Well, that's the intent, I think.

VICE CHAIRMAN WALLIS: That's okay.

MEMBER APOSTOLAKIS: I think that the technology neutral part will be like that.

VICE CHAIRMAN WALLIS: Exactly.

MEMBER KRESS: But you can't just say you will maintain the integrity of the fuel without saying what that means.

VICE CHAIRMAN WALLIS: Say what you mean. That's right.

MEMBER KRESS: Yeah, and there has to be

some criteria.

VICE CHAIRMAN WALLIS: That's right.

MEMBER KRESS: And they intend to develop that.

VICE CHAIRMAN WALLIS: That's right, but it has to be the general way.

MEMBER KRESS: No, no.

VICE CHAIRMAN WALLIS: No?

MEMBER KRESS: It has to be related to this top bracket up there, safety and risk. It has got to be very specific.

VICE CHAIRMAN WALLIS: General there, but not 2,200 degrees and things like that.

MEMBER KRESS: No, no. It could be something like that, but it doesn't --

MEMBER SIEBER:: It's just one type of fuel, not necessarily advanced reactor fuel.

MEMBER KRESS: That's right.

MR. MUBAYI: but it would be for oxide fuel or for nitride fuel or for other types.

MEMBER KRESS: That's right.

MR. MUBAYI: They will have to be addressed in very specific ways, but this regulation is not intended to go down to that level of detail.

MEMBER KRESS: But what it does say is in

order to meet risk and safety goals, you kind of have to deal with fission products. So a lot of these regulations down there will deal with fission products as opposed to the temperatures and the things of that nature.

MEMBER ROSEN: What does maintain the integrity of the fuel mean for a molten salt reactor?

PARTICIPANT: That's Phase 4, isn't it? That's when you get down to --

MS. DROUIN: That is the next phase. I think when we come back at our next meeting where we have a lot more discussion and explanation of this. Again, I don't want to get too hung up on any one of these things because they could change over the next couple of months.

You know, as we start exploring this and getting into the details of it, we may not even end up with these same cornerstones. I mean, this is our first thinking.

MEMBER ROSEN: My remark was intended to suggest that maybe maintain the integrity of the fuel is not a high enough level criteria.

MS. DROUIN: That might be so.

MEMBER ROSEN: For a full range of reactors.

MEMBER KRESS: I'm not so sure that's a criteria in there.

MEMBER APOSTOLAKIS: Where do they say that?

MEMBER ROSEN: Well, someone suggested it.

MEMBER KRESS: Well, I don't think it's one of the criteria.

MEMBER APOSTOLAKIS: Because right now we don't say it.

MS. DROUIN: But all I wanted to show here is that we are trying; it's not complete. It might end up changing drastically, but we're trying to show the process of how we start with this Atomic Energy Act to a set of regulations, and somewhere some magic has to occur. What is that magic?

MEMBER KRESS: I think it's a good way to organize your approach and thinking.

VICE CHAIRMAN WALLIS: Have you done it yet?

MEMBER SIEBER:: I'd like to suggest this one thought. All of the regulations and the framework, as you have it and as the current regulations exist seem these days to focus on public health and safety as opposed to what the insurance companies do, which is to protect the property of the

plant.

Now, if you don't release any radiation, but take a $2 billion plant out of service and create a big mess in the plant, the regulations ought to speak to that issue, too, even though under the current philosophy it only hits it from the side.

MEMBER KRESS: I think they're going beyond their mission then if they do that.

MEMBER APOSTOLAKIS: Why would the NRC care about the investment?

MEMBER SIEBER:: I think that there's more than the investment. First of all, if you have a plant that melts down even though the containment holds the residue, the public confidence in the NRC's ability to regulate these plant sis probably shaken.

Secondly, you create an environmental issue that goes on forever.

MEMBER KRESS: Yeah, but that's all an issue of prevention versus mitigation.

MEMBER APOSTOLAKIS: And that's 1,000 to one.

VICE CHAIRMAN WALLIS: Yeah, but the philosophy doesn't get to that as directly as it might.

MEMBER KRESS: I think it does when they

get to the details.

MS. DROUIN: Okay.

VICE CHAIRMAN WALLIS: Shall we move on?

MS. DROUIN: Let's move on and get into some real detailed technical discussions more than we have. At this point I'm going to turn it over to John Lehner who is going to walk us through what we're trying to do or what we are proposing right now on meeting the safety expectations and our risk expectations with our risk guidelines.

MR. LEHNER: So here we're trying to become a little bit more concrete about this idea that there's an expectation for future reactors to be safer. This was stated for the advanced light water reactors. It's one of the basic attributes for Generator 4 reactors, and we feel that the framework should address this in some more concrete manner.

Now, we start off with the current QHOs, the qualitative and quantitative safety goals that the Commission already put into place, but we also would like to express some additional regulatory aims in terms of worker health and in terms of environmental impact to go along with those safety goals.

MEMBER KRESS: And I see how you could have a different set of goals for each of these, and

let the one that controls be the controlling one, for example, but have you thought about having one set of goals that captures all of these at the same time?

MR. LEHNER: Well, up to this point we've thought mainly in terms of the public and in terms of the worker, and --

MEMBER KRESS: Now, the workers are different.

MR. LEHNER: Yeah.

MEMBER KRESS: I have to admit you can't have the --

MR. LEHNER: Okay.

MEMBER KRESS: But in terms of land contamination, I think you could incorporate it along with the latent cancer fatalities into a single goal somehow.

MR. LEHNER: That's certainly a possibility. I mean, we're -- as you'll see, we've floated some strawmen, I guess, for the worker goal and for the public goal, but we're still wrestling with the environmental impact.

MEMBER APOSTOLAKIS: Now, remind me. Has the Commission agreed to this? That you should consider environmental impact, or are you preparing options?

MR. LEHNER: No, we're preparing options at this point.

MR. KING: These are clearly policy issues.

MEMBER APOSTOLAKIS: I understand that, but you made the presentation a year ago or so. Has there been any decision on this particular issue?

MR. KING: No, we made a -- had a discussion when we were talking about revising the safety code policy a couple of years ago, and the Commission basically said, "Don't make any changes to it," even though one of the issues we had talked about was land contamination, but at the time -- well, environmental -- at the time the staff did not propose to add a land contamination goal because we felt that our tools weren't up to the point where we were actually measuring whether we meet that goal or not.

MEMBER KRESS: And the Commissioners were reacting to a different proposal then. We're now in the risk informed regulation and neutral and they may have a different viewpoint with respect to this.

MR. LEHNER: Yeah, and in effect, the Commission came back and said, "Don't make any changes at this time," even the ones that were, I thought, pretty straightforward and had nothing to do with land

contamination. They said, "Let's get some more experience under our belt with risk informed regulation and then we'll reconsider all of this."

We're reconsidering it as part of this.

MR. LEHNER: So for all of the goals that eventually are agreed on, and as we just pointed out, we don't know yet whether there will be agreement on some of these goals, the idea would be to approach this in what we call a three-region approach, which has been used in other venues where you basically have an unacceptable region where risk is clearly greater than some upper safety limit.

Then you have a region of tolerable, but not very desirable risk, and then finally you have a region that's considered acceptable where you would not impose any additional regulation.

MEMBER APOSTOLAKIS: So we're catching up with --

MEMBER KRESS: Does that sound familiar, George?

MEMBER APOSTOLAKIS: Yes. This is a major step towards harmonization of safe standards.

VICE CHAIRMAN WALLIS: I have always had problems with this. It seems to me that if you articulate to society a safety goal, you're saying

that is what we're aiming at. Our reactors should meet this goal, and then you go and weasel this thing by saying, "We're not going to really do that. We're going to have adequate protection. We're going to allow the lowest common denominator to keep operating, although they're way below what we have articulated to society as a safety goal."

I don't think that's right.

MR. LEHNER: Well --

VICE CHAIRMAN WALLIS: If you're just telling them that this is a safety goal that's acceptable to society, that should be the same as adequate protection, and acceptable and nonacceptable should meet without having something in the middle.

MR. LEHNER: Well, our aim for the advanced reactors is that the -- if we look at this three region figure, currently I think it's fair to say that the current regulations are aimed at providing adequate protection.

VICE CHAIRMAN WALLIS: Which has never been described properly.

MR. LEHNER: Which has never been, and we realize that drawing the line here, that sort of implies that there's a definite border is not --

VICE CHAIRMAN WALLIS: That's because

there's a history. It's political. You had to do it because there were existing reactors and all of that. Now you are starting with a new sheet.

MR. LEHNER: Yes.

VICE CHAIRMAN WALLIS: You don't have to have three reasons. You can have two.

MR. LEHNER: Right, and, well, our aim is to focus these new regulations on having the risk at or below the safety goal.

VICE CHAIRMAN WALLIS: Well, let me ask this question.

MS. DROUIN: Let me just jump in real quick. What we're talking about here is at the current set, when you look at this figure, you have regulations that are at -- you know, if you meet your regulations, you have adequate protection, but you can be above the safety goal.

Now, what we're trying to say now is we want to write the regulations such that you're always below the safety goal. So this would collapse down to two regions.

VICE CHAIRMAN WALLIS: You are asking that.

MS. DROUIN: That is what we're saying, yes.

VICE CHAIRMAN WALLIS: Oh, I thought you were not. That's good. That's what the arrow means? This strange arrow in the middle means you're going to collapse the middle region?

MR. LEHNER: No, no, no, no, no.

MS. DROUIN: Our intent is to have the regulations such that you're below the safety goal.

MR. KING: Which gives you margin to adequate protection.

MEMBER APOSTOLAKIS: And where would be the goal in this picture? Over there between undesirable and --

MR. MUBAYI: Acceptable region.

Sorry. One comment, there's going to be a lot of uncertainty when you come to the actual risk assessments of designs that are being proposed for the first time. And I think you will need some -- where Tom just referred to margin. We'll need some leeway, if you will, there in which some of these issues will need to be discussed.

I think a hard and fast line that this is where we are and we are below this will be somewhat difficult.

VICE CHAIRMAN WALLIS: You have a goal and then you say you've got to meet it with 95 percent

confidence or something like that. You bring in the uncertainty, but you don't try to weasel and let people do something for vague reasons which you call adequate protection, which is undefined. You can't do that.

CHAIRMAN BONACA: I think that after you design in the acceptable region, events will take some issues or things into the yellow region. That's life. So at some point you'll have to define what you tolerate that moves into the undesirable region because of circumstances or new discoveries, new events.

But otherwise I think you should stay within the acceptable region with the criteria that, you know, he's talking about, high level confidence.

MEMBER APOSTOLAKIS: I think no matter how you do it, you probably can find ways to attack it. Right now what Mary said is true. I mean we have the safety goals, and yet we tolerate a number of plants operating above the goal. That's not very good either.

I think the problem with this -- well, leave alone the terminology. Maybe we could call that tolerable region and so on. I think this is going to ask of the Commission to define this blue line there

of adequate protection, would it not?

MR. LEHNER: Well, no.

MR. KING: No, I think the idea is not to have to define.

MR. LEHNER: Not to have to define it.

MEMBER APOSTOLAKIS: Which is what we do today.

MR. RICH: The idea of the safety goal level is that you don't have to define adequate.

MEMBER APOSTOLAKIS: Right, which is what we do today.

MR. RICH: Which is what we do today.

MEMBER APOSTOLAKIS: But we have informal guidance as to where that line is for core damage frequencies, ten to the minus three.

MS. DROUIN: Right, but we don't write our regulations to the safety goal today. We write them to adequate protection.

MR. LEHNER: The reactors may operate closer to the safety goal line, but not necessarily because of just the regulations.

MEMBER APOSTOLAKIS: So this is conceptual.

MR. LEHNER: It is conceptual. Well, I think you can think of this as we talked earlier. You

know, if the goals change, this would allow you the flexibility of your goal changes. This would move along with your goal change.

Now, later on we proposed certain risk guidelines that are actual numerical guidelines that --

MEMBER APOSTOLAKIS: But this is a recognition that this is how we operate today, and you are all going to say, well, now all of the regulations will be written having the safety goal in mind. So presumably they're pushing us down to the acceptable region.

MR. LEHNER: Exactly, yeah.

MEMBER APOSTOLAKIS: But we recognize that there will be some tolerable region there where cost-benefit analysis will be done. So we may be above the goal even though that is undesirable, and there will be another boundary above which it's unacceptable, and that boundary we cannot define, and you can invoke the Commission's and the staff's arguments to date.

We have been told many times that the issue of adequate protection is not just a number. It's a general conclusion that comes from the totality of the regulations, and you can say the same thing here.

VICE CHAIRMAN WALLIS: It's a tautology. It's a self-justifying thing, that whatever the regulations say is adequate protection is adequate.

MEMBER APOSTOLAKIS: It sounds that way, but it's also true. It's also true that there is a total judgment, a conclusion that you reach by looking at a lot of things.

VICE CHAIRMAN WALLIS: Well, that's not a top-down framework of the type that Mary is describing based on the safety goals.

MEMBER APOSTOLAKIS: But you do that also in your professional life when you decide to promote an assistant professor, Graham. You look at the totality of the evidence. You don't have the number, right? The number of publications is relevant? There is no goal.

(Simultaneous conversation.)

MEMBER APOSTOLAKIS: I think we do that all the time. So it is not surprising that we do it here as well.

Boy, dead silence.

(Laughter.)

MEMBER ROSEN: I don't know much about promoting assistant professors.

MEMBER POWERS: But what you know is that

it's usually a very incorrect decision most of the time.

MEMBER APOSTOLAKIS: Any time you promote anybody it's a very subjective decision.

VICE CHAIRMAN WALLIS: But it's a yes/no. It's not an undesirable or unacceptable.

MEMBER APOSTOLAKIS: It's not based on criteria.

MEMBER KRESS: But when they get around to the details of saying, "When I have this reactor design come forth for certification or whatever, we're going to say he must meet a certain frequency consequence, if you'll allow me, criteria. If we say he must meet it, then there's a bright line there.

And if you put that confidence level on it, it's not necessarily bright. It varies depending on how he calculates it and what he knows about his reactor, but in essence you will have a line, and then you could apply -- below that, you could apply some cost-benefit safety enhancement concepts below there, but I think the three regions will go away with what they're talking about.

MR. PRATT: And if you look later on, we'll get to that eventually. That's exactly what we --

MEMBER KRESS: So I think we're discussing a non-problem really.

MEMBER APOSTOLAKIS: The issues is this. Other countries are using the regions with numbers.

MEMBER KRESS: Yeah, but I don't think --

MEMBER APOSTOLAKIS: And the message they're sending us is we're not going to put numbers on all of the lines here. There is a difference.

MR. LEHNER: We're willing to put a number on the safety goal line, not on the --

MEMBER APOSTOLAKIS: I said the border lines.

MEMBER SIEBER:: Really what you're trying to do is go back through the two region --

MS. DROUIN: We're trying to write the regulations now to that line. We aren't trying to write the regulation for the adequate protection line, but to the safety goal line.

MEMBER APOSTOLAKIS: Okay, great. Let's go on.

MS. DROUIN: And that's how we're trying to answer that issue for the Commission's expectations for the advanced reactors to be more safe.

And we're saying the way we're going to address that expectation is to have the regulations

written to the safety goal line and not the adequate protection line, and now we're prepared to define what we mean by that safety goal line.

MEMBER APOSTOLAKIS: Well, that's an interesting --

VICE CHAIRMAN WALLIS: That's very clear because I thought you put this up to say this is what you're going to do. You put this up to say what you're not going to do.

MEMBER KRESS: Well, I think I would eliminate the --

MS. DROUIN: We will change the figure.

MEMBER SIEBER:: A way that I'd look at it to understand it is that prior to risk informed regulations and safety goals, you had a two region system. You either obeyed the regulations or you didn't.

If you go to the ultimate thing where it's risk that governs whether a plant is acceptable or not, you're going to have a two region thing still because adequate protection and the safety goal will become the same one.

MEMBER KRESS: Maybe not because they're going to have additional regulations that are not necessarily -- and that would be part of your adequate

protection.

MEMBER SIEBER:: Adequate protection may be --

MEMBER KRESS: May be lower than safety goal.

MEMBER SIEBER:: -- lower than the safety goal.

VICE CHAIRMAN WALLIS: Okay. Can we move on?

MEMBER APOSTOLAKIS: I think it's important though to come back to what Mary just said. You're interpreting the Commission's expectation that the future plants will be safer as meaning that the regulation should be written to the safety goal.

MS. DROUIN: Yes.

MR. LEHNER: That's the idea.

MS. DROUIN: That's the idea.

MEMBER APOSTOLAKIS: And that presumably all of these units that are above the road now, that you will not have such units in the advanced reactor.

There is a significant group of people out there though that interpret this expectation as meaning that the core damage frequency will be lower than ten to the minus four, that the goal will change. You're interpreting it one way that is not necessarily

the universal way.

MR. SHACK: Well, wait, George.

VICE CHAIRMAN WALLIS: Let's go ahead.

MR. SHACK: Wait.

MEMBER APOSTOLAKIS: Okay.

VICE CHAIRMAN WALLIS: Let's go ahead.

MEMBER APOSTOLAKIS: I'm commenting only on what I've heard so far.

MS. DROUIN: Okay. We're going to jump to Slide 18.

MEMBER APOSTOLAKIS: You're really master and mistress at these things. You jump ahead, and that's very good.

MEMBER SIEBER:: I like that.

MEMBER APOSTOLAKIS: I like that, too.

VICE CHAIRMAN WALLIS: But we're moving ahead. We're moving ahead anyway.

MEMBER APOSTOLAKIS: One more word and she will go to 19.

MR. LEHNER: All right. So now that we've articulated this philosophy, we want to put some actual quantitative objectives out there in terms of what we call risk expectations, and on 5/18 we just discussed the fact that we want to have a more uniform approach that includes not just the public but worker

environment and that this may actually, aside from being a more uniform approach, may actually also be more appropriate for some of these advanced designs where something like LRF may not be an appropriate metric for risk measures.

So the question then is what quantitative guideline should be used, and at one point we were thinking in terms of a few accident scenarios only, but then after some discussion, internal/external discussion, it was felt that it would be useful to have a risk consequence curve that would span the frequency and dose range, in other words, not just talk about the severe accident range, but also talk about normal operations all the way to severe accidents.

So what you'll see in the next few slides is a proposal that starts off with some of the ideas developed by the international commission on radiation protection, ICRP-64. That's the table that's now being shown, where they associated frequency ranges with certain qualitative statements about exposures, and we've taken this a step further, and we have to acknowledge that the node (phonetic) was very instrumental in developing this, where we've put in some doses associated with these frequencies that

eventually -- maybe we should just go right to the figure, Mary, on --

MEMBER APOSTOLAKIS: So this is now a staircase version of the code?

MR. LEHNER: Yes.

MEMBER KRESS: Now, the question I have is why did you decide to staircase it. You could make this a continuous curve without the discontinuities.

MR. LEHNER: We had that version, but in some ways it seemed harder to justify that because then here are these levels, and the staircase have certain anchor points that --

MEMBER KRESS: Well, let me throw out another concept here. My intuition is that down here at the low doses and the high frequency rate that the associated uncertainties are much smaller, and they get bigger as you go towards the right of this curve.

Now, my feeling is if you said I want to meet these requirements at, say, some confidence level -- pick a number -- you might feel comfortable at this end with a 90 percentile at the left hand, but you might not feel comfortable with that at the high end. You might want 99 percent.

If you did that, you would get a curve that curved downward like this, but it would flower in

from one confidence level to another, and --

VICE CHAIRMAN WALLIS: It's also a risk averse approach.

MEMBER KRESS: It is risk averse type thinking, and there's no reason why it has to be stairstepped that I could see. It could just be a continuous curve.

MEMBER APOSTOLAKIS: Actually, this is neutral, the one that you have there, isn't it? Every time you go down one order of magnitude, you go one order of magnitude to the right.

MR. LEHNER: Pretty much.

MEMBER APOSTOLAKIS: I mean, the product is constant, right?

MR. LEHNER: Right.

MR. MUBAYI: It's almost constant, quasi-constant, not quite, but --

MEMBER KRESS: This thing really is a straight line on this curve.

MEMBER APOSTOLAKIS: Pretty well.

MEMBER KRESS: Except for the big part, it's a straight line, and my curve wouldn't be. It would be a curve.

MEMBER APOSTOLAKIS: Well, you can make this also risk averse.

MEMBER KRESS: That's the way to make it risk averse.

MR. LEHNER: You're right. We had a straight line here at first, but you're talking about having a --

MEMBER APOSTOLAKIS: You know, I think it would be an interesting exercise -- maybe you've done it already -- to go back to, say, NUREG 1150 studies or others and see if you can produce assessed curves in this form.

MR. LEHNER: Well, we haven't done that, but if --

MEMBER APOSTOLAKIS: You will get a lot of insight. I tried it once, and you get some funny things.

VICE CHAIRMAN WALLIS: Also once you've got 100,000 REM, it doesn't really matter if you've got a million.

MEMBER APOSTOLAKIS: If you've got what?

VICE CHAIRMAN WALLIS: Once you're dead, you're dead.

MEMBER KRESS: There's a certain level you can't get more dead.

MR. LEHNER: Well, you've got flight after 100.

MEMBER APOSTOLAKIS: There are no gradations of death?

MEMBER SIEBER:: Well, the strange thing though is that Part 20 doesn't bear very much resemblance to the real risk as it exists right now. It's very, very conservative.

MEMBER APOSTOLAKIS: Actually this nearly risk neutral I don't think would be acceptable. You really have to do something about the fact on sequence.

MEMBER KRESS: Yeah.

MR. LEHNER: I'm sorry?

MEMBER APOSTOLAKIS: You have to, like Dr. Kress said, you have to do something about the high confidence events and be risk averse. This is quasi-risk neutral. I don't think anyone will accept this.

We were lending straight lines. I think if the slope in log-log scale is greater than minus 1.2, we would have to shut down all of the industries around the world. Nobody passes that.

If it's minus one, it's risk neutral. So you have to find an exponent between those two.

MEMBER KRESS: You know, if you even specified that you wanted this at, say, the 99 to 95 percent confidence level, just that statement itself

gives you a curve because the uncertainties on one end are different than on the other.

MEMBER APOSTOLAKIS: Or you can have a different slope or stick with the mean value everywhere.

MR. MUBAYI: I think, you know, one of the drivers is that the Commission interprets the 5E minus seven, which cuts off us at the fatal dose levels or, you know, at the high dose, which is not 100,000, by the way, as somebody said. That's --

VICE CHAIRMAN WALLIS: Well, whatever it is, once you've killed, you've killed. So --

MR. MUBAYI: Yeah.

VICE CHAIRMAN WALLIS: -- this should be--

MR. MUBAYI: But the Commission, you know, asked it to be interpreted as mean value --

MEMBER KRESS: I know that.

MR. MUBAYI: -- of a distribution. So in some sense one can choose. The continuous approach, that's what we started with, and then we were asked that at the lower end, you know, you want the designers to have some anchor points. So the staircase is somewhat easier for the designer to have anchor points and, you know, like a seismic risk or

something here, some anchor point to choose from.

But I think that's really very easy, straightforward, in fact, to convert this.

MEMBER APOSTOLAKIS: Actually you are risk averse at the high level

VICE CHAIRMAN WALLIS: Yeah, you don't go all the way. You are slightly risk averse.

MEMBER APOSTOLAKIS: Now, one last comment here. The ACRS published a report 20 years ago or so when they were discussing the original safety goals that had some very nice reviews of curves like this and industrial stuff. You guys should get a copy of that. Do you know which one it is?

Yeah. It's an orange cover. I can find out, I mean, the number if you want, but it's way back, from way back.

And second, I presume you're aware of what the Dutch have done in this context and the British.

MEMBER KRESS: Yeah, I want to make another point about my using variable confidence levels along these things because I have a feeling down at this end you don't care that much. You don't care as much.

MR. MUBAYI: Yeah.

MEMBER KRESS: So you can say, "I don't

need the higher confidence level."

Down here you really start to care because you're a serious thing. So having a varying confidence level in this curve as you go along might be something worth thinking about.

MEMBER APOSTOLAKIS: You go with the standard practice of -- well, typically the limit for a worker is one order of magnitude, right? But in the low levels you go two orders of magnitude. Do you see what you're doing there?

MR. LEHNER: Yes, yes.

MR. MUBAYI: Mostly two, and at the higher levels we wanted to --

MEMBER APOSTOLAKIS: At the high levels I think they both go.

MR. MUBAYI: -- at the high dose level in order to cut it off at ten to the minus six.

MEMBER APOSTOLAKIS: But you do have a story why the curve should be this way and not another way.

MR. MUBAYI: There is a quasi-story that accompanies a slightly different report that was done and has something about voluntary versus involuntary risk.

MR. LEHNER: Oh, you mean between the

public and workers.

MR. MUBAYI: Yes, between the public and worker.

MR. LEHNER: But I thought you were asking about the anchor points for the curve.

MEMBER APOSTOLAKIS: I was asking --

VICE CHAIRMAN WALLIS: This is individual risk. It makes sense for a worker. The worker is going to work and take a certain risk, but the public is more diverse. It depends on population density and all of that stuff, and it seems to me there is this problem of how you deal with individual risk when you've got obviously the risk. Obviously the societal risk is different.

MEMBER APOSTOLAKIS: Now, the question here is what is the degree of consistency between this and the Commission's safety goals. The Commission's safety goals are point values. Here you're considering a spectrum of releases.

VICE CHAIRMAN WALLIS: They're integrals of this curve.

MEMBER APOSTOLAKIS: So an integral of this presumably is the Commission's goal?

MR. LEHNER: Right.

MEMBER APOSTOLAKIS: And you have verified

that?

MR. MUBAYI: Pretty much so.

MR. RICH: You can integrate. Well, if you take the public curve and try to integrate underneath of it and compare it to the fatality QHO, which is really the only one you can compare it to, they're very close.

VICE CHAIRMAN WALLIS: Actually you haven't got much choice because if you integrate you are fixed in at one end, at the low frequency. What's tolerable is something that's going to happen every day, and the other one is like you're dead. So you haven't got much flexibility in what you're doing.

MEMBER APOSTOLAKIS: The low end should be what Mario keeps saying, that, you know, the Part 100 and those guys. There are two distinct regions.

MR. MUBAYI: Sure.

MR. LEHNER: Yeah, that's right. Part 20 is the lower.

MEMBER APOSTOLAKIS: Part 20, yeah.

MR. MUBAYI: There are actually three regions here if you consider the anchor points. One is for deterministic effects which arise somewhere in the range of 50 REM total body, ED. So that's where that notion.

So anything below in the stochastic range, which is anything to above roughly 50, maybe 25; some people have, you know, preferences for what you would consider as anchor points, but if you do that, you'll get the latent cancer goal approximately, and at the end it's the early fatality goal.

MEMBER APOSTOLAKIS: And this does is not just from reactor accidents. It's from the plant.

MR. LEHNER: Yes. Certainly at the --

VICE CHAIRMAN WALLIS: Remind me the background radiation dose.

MR. LEHNER: The background radiation dose is?

MR. MUBAYI: Three hundred-odd milliREM per year.

VICE CHAIRMAN WALLIS: Yeah, that's right. A fraction of a REM.

MR. MUBAYI: But this is all about background.

VICE CHAIRMAN WALLIS: I know, but it does give you a measure to compare it with.

MEMBER KRESS: Now, a question I have. The process is envision the plant would have some sort of good PRA to calculate whether or not it meets these given its design. I see how the PRA can be applied

down at this level down here, but can it actually be applied to the worker dose? I mean normally you don't get that out of a PRA. So you've got to have some other mechanism for showing that you meet the worker dose.

MR. KING: To me the difference is you're modeling the accident with a PRA and you're getting some releases.

MEMBER KRESS: But that doesn't apply to workers.

MR. KING: The only missing step is assuming where the workers are and what the doses to the workers are during those releases. You've got everything else.

MEMBER KRESS: I guess when there's not any releases, which is not dealt with with a PRA, he's still getting some exposure when he does maintenance and when he does -- that's not counted in this somehow?

MR. KING: Routine exposure?

MEMBER KRESS: Yeah.

MR. KING: Yeah, I don't think we've considered including that.

MEMBER KRESS: You deal with that some other way.

MR. KING: You would deal with that some other way.

MEMBER KRESS: Okay.

MR. MUBAYI: That would be dealt with --

MEMBER KRESS: This has to do with challenges.

MR. MUBAYI: Right, because Part 20 presumably would still remain on the books. The average exposure is published every year by the NRC, and they also publish separately. For workers they publish exposures that are above one REM, for example, and of course, anything above the limit of five REM they also will highlight and publish and do something about.

MEMBER APOSTOLAKIS: What kind of level PRA do I need to do this, Level 2 or 3? Three. The dose is part of three, isn't it?

MR. MUBAYI: Yeah.

MR. LEHNER: Yeah.

MEMBER APOSTOLAKIS: Wouldn't there be resistance to that?

MR. LEHNER: Well, I mean, for a particular technology hopefully you could develop some surrogates.

MEMBER APOSTOLAKIS: So you think that

this is the lowest practical metric that is technology neutral.

MR. KING: Yes.

MEMBER APOSTOLAKIS: Why isn't the release the lowest practical?

MEMBER KRESS: Well, because you can't separate your risk considerations from the site. I mean, you have to know what happens at the site.

MEMBER APOSTOLAKIS: Well, we now have LRF.

MEMBER KRESS: Yeah, but it's really -- in my mind it's a pretty gross substitute for the safety goal.

MR. LEHNER: I mean, the LRF we use is based upon today's LWRs, their source term characteristics, the emergency evacuation characteristics and so forth.

MEMBER APOSTOLAKIS: So this, again, would include the number of people in some indirect way living the neighborhood.

MEMBER KRESS: Oh, yeah. It would have to do that. You know, it goes against the concept of separating siding characteristics from this, but I don't know how else to do it.

MEMBER APOSTOLAKIS: Then remember now for

the core damage frequency, we become more stringent in current generation reactors.

MR. RICH: One of the questions, George, that doesn't show up on the slide is: do these frequency consequence curves need to go in the regulations or are there surrogates that would be more, from an engineering standpoint, more practical to put in that would insure these things were met, like CDF, like large release frequency?

I don't have an answer to it, but it's a question that we're wrestling with.

MEMBER APOSTOLAKIS: So my point is if we follow current practice and become more stringent on the CDF side, then automatically this goes down, too, doesn't it? I mean, if you make the CDF lower --

MR. KING: It makes it easier to meet these.

MEMBER APOSTOLAKIS: Yeah, much easier.

MR. KING: And at some point you can see if I'm my CDF and I can come up with a technology neutral LRF or low enough, then I'm guaranteed of meeting these if I meet those.

MEMBER APOSTOLAKIS: And you still stand by your statement of a year or so ago that core damage can be defined for all of these reactors.

MR. KING: Yes. You're going to see a proposed definition when we get to Slide 25, I think.

MS. DROUIN: That's a perfect transition to our next presentation.

VICE CHAIRMAN WALLIS: While you're on this, maybe you've done this --

MS. DROUIN: Perfect timing.

VICE CHAIRMAN WALLIS: -- but that top line cannot be flat all the way down to zero dose. It makes no sense.

MR. LEHNER: It's not zero dose.

VICE CHAIRMAN WALLIS: No, but it looks as if it's going to stay zero percent there forever.

PARTICIPANT: It's a one milliREM dose.

VICE CHAIRMAN WALLIS: Yeah, but it goes off scale. What happens at .001 and so on? The indication is that it's flat. It has got to go up. It makes no sense to have it. The minuscule dose, which is not measurable, is going to still have a frequency to it?

Do you stop there? You just stop?

MR. SHACK: Yes, below regulatory concern.

(Laughter.)

MEMBER APOSTOLAKIS: BRC.

VICE CHAIRMAN WALLIS: So which one is the

next?

MS. DROUIN: Twenty-five.

VICE CHAIRMAN WALLIS: Wonderful.

MS. DROUIN: So Tom is going to take over this part of the presentation.

MR. RICH: Twenty-five through the rest of the presentation, we talk about several fundamental aspects of this framework that we think need to be defined in order to develop a decent set of technology neutral regulations.

The first one is should we have some surrogate risk goals that would be directed toward implementing the frequency consequence curves. What we have listed here is a strawman proposal for core damage frequency and a large release frequency, not a large early release frequency, but a large release frequency.

MEMBER APOSTOLAKIS: How do you pronounce that?

MR. RICH: Large release frequency.

MEMBER APOSTOLAKIS: I see a potential problem here though because, based on what you said earlier or Mary said and you're showing here now, you're actually doing two things. You're interpreting the Commission's expectation of safer plants in two

ways, and I don't know how conservative it is.

Not only are you reducing the goal, but you are writing the regulations to the goal. So I don't know what that means, a combination of the two. I mean are these goals anymore?

MR. RICH: Well, in a risk informed set of regulations, it would be conceivable to me that these would actually be in the regulation as part of the regulation, CDF and large release frequency.

PARTICIPANT: Is that CDF in all modes or just in general modes?

MEMBER APOSTOLAKIS: All modes.

MS. DROUIN: All modes.

MR. RICH: Now, what these numbers represent are what I call a generic or fall-back value. I would envision a set of regulations that said you can meet these numbers, but if you want to make the case for your plant specific design that a different number applies and take credit for some design features or emergency planning or whatever, you have the option to do that.

But if you don't want to do that, here are some numbers that, you know, from a generic standpoint would be acceptable.

Now, these numbers are based upon trying

to eliminate emergency planning and eliminate reactor technology from consideration. They're strictly based upon if you look at the meteorological dispersion. What kind of numbers would you have to have so that you still meet the safety goals independent of, you know, source term characteristics, timing, chemical form, emergency evacuation, the assumptions and all of that other stuff.

And these are, you know, rounded off numbers that we feel would meet such a generic criteria.

MEMBER APOSTOLAKIS: And these are at mean values, right?

MR. RICH: These are mean values, yes.

VICE CHAIRMAN WALLIS: I don't quite understand this normal coolant activity because you could have a system which actually tolerates quite high coolant activity, but still is safe.

MR. RICH: Well, the different technologies are going to have different coolant activities. Sodium plants have a high coolant activity. If you've got plants that are licensed to run beyond cladding breach, in other words, they can allow some fuel failures without having to remove them, you're going to have high coolant activity. The

idea --

VICE CHAIRMAN WALLIS: With molten salt reactor, you have very high coolant rate.

MR. RICH: Very high coolant activity. The idea would be whatever it is designed for as normal coolant activity and licensed for, whether it's molten salt or, you know, running with some clad failures, that's what I call normal coolant activity.

When it starts to go beyond that, then you get into something is happening that you don't want to happen, that you don't expect to happen. That's what I call core damage.

MEMBER KRESS: When you say "release," that means to the outside atmosphere?

MEMBER APOSTOLAKIS: I think that's what it means, LRF.

MEMBER KRESS: So even though a molten salt reactor has a very high coolant inventory, there's very few ways it can get released outside of some sort of containment. So you know, that might apply there.

MR. RICH: Well, release in the terms of core damage frequency is release to the coolant. Release in terms of large release frequency would be release to the atmosphere.

MEMBER KRESS: Oh, you are talking about release to the coolant.

MR. RICH: Yeah, for core damage frequency, for core damage frequency.

MEMBER APOSTOLAKIS: I wonder whether you need an adverb there, "that significantly exceeds" or, I mean, just "exceeds," I wonder whether one fuel pin failure.

MR. SHACK: One more fuel pin? Yeah. You don't want --

MR. RICH: Again, this is a concept at this point.

MEMBER APOSTOLAKIS: I understand that, but I'm just thinking out loud. It would qualify?

MR. RICH: It probably will.

CHAIRMAN BONACA: Well, by normal coolant activity, you mean what you have in tech. specs.

MR. RICH: Yeah, whatever the tech. spec. limit would be.

CHAIRMAN BONACA: Well, I'm saying what you have in tech. spec. is a limit. It's not one pin. It's 100 pins.

MR. RICH: Yeah, for example, on Clinch River with a sodium cooled plant, what they had was they had a high coolant activity, but where they

started to worry is when they started to get delayed neutrons show up in the activity. That indicated fuel was somehow getting out into the coolant.

So that kind of thing is what I had in mind.

MEMBER APOSTOLAKIS: And these are, again, consistent with a staircase you showed us earlier?

MR. RICH: Yeah.

MEMBER APOSTOLAKIS: Everything seems to be consistent here.

MEMBER KRESS: Isn't it wonderful?

MEMBER APOSTOLAKIS: What's the purpose then of the staircase? I mean, finally I end up again with point values for core damage and LRF. I mean, what is the point of showing that?

MR. RICH: Again, remember these numbers are based upon protection of public health and safety. These numbers are probably good for the worker. If we get into land contamination, I'm not sure what --

MEMBER APOSTOLAKIS: Well, you might also say that these are reactor specific. The other one includes everything at the plant, like the spent fuel pool and so on.

MR. LEHNER: And these are ways to avoid a Level 3.

MEMBER APOSTOLAKIS: I understand the value of it. It's just that if we're going to end up with these again, why do you present the other one and bother to defend it?

The only thing is the plant, that you're dealing with the plant, and that includes now the spend fuel pool, if there is any, and so on. But this is reactor specific, right?

MR. RICH: These are technology neutral numbers that would apply to any technology.

MEMBER APOSTOLAKIS: I don't mean reactor technology. I mean the reactor because you have other sources of potential radiation.

MR. RICH: That's true.

MEMBER APOSTOLAKIS: So the dose applies to the whole plant.

MR. RICH: Yes, yes.

MEMBER APOSTOLAKIS: But you have to make sure. You have to give some evidence that these things are consistent with the ultimate goals, with the staircase and this.

MEMBER ROSEN: I'd like to say something. Core damage frequency, defining it as it exceeds normal coolant activity, that would mean every time you go above your tech. spec. you would have core

damage by definition.

MEMBER APOSTOLAKIS: That's a qualifier.

MR. RICH: When you're doing your PRA, your definition of core damage in your PRA would be whatever event would take you above your tech. spec. limit. That would be your success criteria. Let me put it that way.

MEMBER ROSEN: So nowadays, tech. specs. are miles below core damage obviously. What you're saying is in this future system they'll be collapsed. Tech. specs. and core damage are the same thing.

VICE CHAIRMAN WALLIS: Unless you want to go on to a more complicated analysis of dose and so on.

MR. RICH: That's one way to do it. Let me put it that way.

PARTICIPANT: It's a deviation from our current practice.

MR. RICH: Yes.

MEMBER APOSTOLAKIS: Well, if you put the word that "significantly exceeds," then --

VICE CHAIRMAN WALLIS: Then you quibble forever about what "significant" means.

CHAIRMAN BONACA: You have got to do something else. You have to come back to coolant

reactors. I mean, there have been reactors where you had two, 300 pins fail by Friday, okay, debris. I mean, that's not core damage.

MEMBER APOSTOLAKIS: No. The current definition is you are releasing at least ten percent of the nobel gases into the coolant. Is that not the current definition?

MEMBER ROSEN: No, it's one percent iodine.

MR. RICH: It can be water level. It can be clad temperature. It can be a release of a certain amount of radioactivity.

MEMBER ROSEN: Are you talking about the tech. spec. limit?

MEMBER APOSTOLAKIS: No, no, no, no. Core damage definition.

MEMBER KRESS: I think you guys are mixing up some normal operation with challenges. I think if you're going to define core damage frequency, it has to be a challenge results in a fission product release, not when you just have failed fuel pins for whatever reason.

CHAIRMAN BONACA: Because if you had debris, you would cause 500 pins to fail.

MEMBER KRESS: It doesn't have anything to

do with what really happens in a reactor. This is a calculation using a PRA or something.

MR. RICH: You don't really model pins failing by some debris in your PRA.

MEMBER KRESS: No.

MR. RICH: Remember this is to test your PRA analysis.

CHAIRMAN BONACA: I understand that. I'm only saying that you want to relate to a challenge. That's right, yeah.

MEMBER APOSTOLAKIS: I'm telling you if you put that word "significantly" there, you're sold.

MR. SHACK: It's a quantitative design objective.

MR. RICH: Okay. I agree with George. I think we need some qualifier.

All right. We move on to Slide 26, the next issue. This has to do with how do we select events to be considered in the design, and we're proposing some probabilistic criteria to do that. It would be technology neutral and then any design would use them, apply them, and come up with their design basis or events for their design.

VICE CHAIRMAN WALLIS: So you would look at the "contribute to the PRA."

MR. RICH: You would need a PRA to do this.

VICE CHAIRMAN WALLIS: Right, of course.

MR. RICH: And on Slide --

VICE CHAIRMAN WALLIS: Hey, you've come a long way on this one.

MEMBER ROSEN: So when the boss says, "We're not going to have any PRAs," he's --

VICE CHAIRMAN WALLIS: Well, we're trade DBA for PRA.

MR. RICH: The price of admission, to use this scheme, is you've got to have a full scope PRA.

VICE CHAIRMAN WALLIS: You've got a complete PRA for this?

MEMBER APOSTOLAKIS: Right. We've had that before.

MR. RICH: Right.

VICE CHAIRMAN WALLIS: We have to have a complete PRA for this?

MEMBER KRESS: Right on, yes, sir.

MR. RICH: Well, you certainly need external event shut-down and full power. Whether you need a Level 3 or not, you need certainty analysis, yes.

So we're proposing a scheme, a binning

scheme for events that are analyzed in the PRA where you categorize frequent, infrequent, rare, extremely rare, using the probabilistic values shown here. These are consistent with what has been used in the Part 50 framework.

MEMBER APOSTOLAKIS: When you say in the previous slide -- you don't have to go there -- to provide the criteria used to select those events that have to be considered in the design, what do you care? That have to be considered in the review or in the licensing process; is that what you mean?

MR. RICH: I think they're one and the same thing to me. But there is some point --

CHAIRMAN BONACA: Let me them worry about it.

MR. RICH: No, no, but there is some --

MEMBER APOSTOLAKIS: But this is the licensing process.

MR. RICH: Yes, this is the licensing process

MEMBER APOSTOLAKIS: So you should say that, I think. They may decide to do some other things.

MR. RICH: They may. That's true. They may.

MEMBER APOSTOLAKIS: So you are really determining the licensing basis. You're saying, "Look. When you come to me, this is what I'm going to look at."

MR. RICH: Yeah.

MEMBER APOSTOLAKIS: And the reason, I think one of the arguments why you do need things like that is to avoid having to argue about the PRA sequences all the time, it seems to me.

In other words, the way I see this there will be some what we call negotiation, and people didn't like it, between the advocates of a new design and the NRC, and then they will settle on a set of design basis accidents that will be used then in routine reviews.

But in the initial interaction it has to be a give and take, right, to define them for each technology?

CHAIRMAN BONACA: Could you explain to me this slide? I don't understand that.

MEMBER APOSTOLAKIS: Yeah, but we're talking about something else.

CHAIRMAN BONACA: Okay. I mean at some point to have this --

VICE CHAIRMAN WALLIS: Let's move on.

MS. DROUIN: I wanted to comment on something you said, George, and maybe I misunderstood. But to me there's another aspect to this, which gets us away from some of the problems that we have in the current. This means also that your design basis events, if that's what we end up calling this, are not static. They can change over time. So your initial ones may not be ten years from now the same ones. Because as you learn more and you get more history, you know, they will change.

As you look at your PRA, that's what is significant. It's not always the same thing over time. So you're going to always be designing against those events.

MEMBER APOSTOLAKIS: Because your PRA may change. That's what you're saying. The PRA may change.

MS. DROUIN: That's correct.

MEMBER APOSTOLAKIS: But my point is this, that the design basis events for each technology now will be the result of some sort of interaction between the NRC and the vendor that says, "Look at the PRA. We did this PRA."

You review the PRA. If we look at events in the future, A, B, C, D, and you design against

those, then we have a warm feeling that you have really met all of the goals, and that makes the review process easier.

MS. DROUIN: Yes.

MR. RICH: Yes.

MEMBER APOSTOLAKIS: That's really the intent here.

MR. RICH: Yes, yes.

MEMBER APOSTOLAKIS: Now, if you're getting information that changes your PRA ten years from now, then you change that, too. I agree with that.

MS. DROUIN: Well, to me the second one is equally important so you don't end up in a situation now what we're looking at at 5046, where you're having to carry this old, unrealistic, over-conservatism.

MEMBER APOSTOLAKIS: But another way to do it would be to say --

MS. DROUIN: No, you could start with a 5046.

MEMBER APOSTOLAKIS: -- we will always use the PRA, but that's very ineffective. We will not have design basis events. We will always look at the PRA. It's extremely ineffective.

VICE CHAIRMAN WALLIS: No, well, maybe the

design basis things are only reviewed once every two years or five years or something.

CHAIRMAN BONACA: I'm trying to understand this figure up there. I don't understand it.

VICE CHAIRMAN WALLIS: It's another staircase.

MEMBER ROSEN: I have two columns for design. Is it the worst? Do you take the worst of the two or do you take them both or average them? What? How do you do --

MR. RICH: How do you select out of here a design basis event?

MEMBER ROSEN: How do you pick whether you have a probabilistic criteria or a deterministic criteria for rare events?

I mean, I'm the designer. You need to tell me. Should I design to 25 REM TEDE or ten to the minus four, five per year? Which? They're not always the same.

MR. RICH: No, but risk informed is a combination of the two. Now, the things that are listed here under the deterministic criteria column are just examples. Don't take those as anything hard and fast. These are initiating event frequencies, the frequencies shown.

VICE CHAIRMAN WALLIS: I think you would have problems when you have a continuous -- everything is continuous in the real world, probabilities and so on. Now you've got this staircase which is going to give you some sudden changes. There will be slight changes in the operation of something, and it jumps from one of these categories to the other. That's very unrealistic.

Why don't you just have a continuous curve? You always have staircases with these things. It makes it difficult for computers and so on, you know. You leap from one step to another when there's nothing really has changed.

MEMBER APOSTOLAKIS: I think the question is: why do you need the last column?

VICE CHAIRMAN WALLIS: Why do you need steps? Why don't you have --

CHAIRMAN BONACA: I mean, why do you say that an infrequent event -- I'm trying to, you know, see -- an infrequent event is one that is between one and 25 REM?

MR. RICH: An infrequent event is one that is between ten to the minus two per year and ten to the minus fifth per year. That defines it as an infrequent event. Now --

MEMBER SIEBER:: It results in a TEDE does of 50 milliREM.

MR. RICH: Now, given that category of events and that frequency range --

CHAIRMAN BONACA: Oh, you're putting a limit there.

MR. RICH: -- the thought was let's select some of those and call them design basis events. Whether we selected the highest risk events or the highest consequence events remains to be seen, but pick some that we call design basis events.

CHAIRMAN BONACA: And they're putting a limit to those insofar as the REMs?

MR. RICH: And for those events, you have some deterministic criteria they have to meet.

CHAIRMAN BONACA: All right. I understand.

MR. RICH: Maybe not these, but some --

MEMBER APOSTOLAKIS: And what you just said is very different from this. I suggest that you drop the last column and put a text that explains that.

MR. RICH: Okay.

MEMBER APOSTOLAKIS: In other words, in the name of structuralism, I want to impose a limit on

the frequency of these challenging events, but then I need something more because I have to go back now to my staircase or something else, and how I select them is a matter of negotiation, decision, and so on.

MR. RICH: That's one way to do it.

MEMBER SIEBER:: Well, in the alternative though you're saying -- you're defining which are the challenging events by looking at the dose. So there's a whole series of events that you need not declare design basis events out of this set.

MR. RICH: The extremely rare ones you're talking about.

MEMBER SIEBER:: That's right.

MR. RICH: Yeah. The idea is at some point, you know, things are infrequent enough we're not going to design for them.

MEMBER SIEBER:: That or they don't have enough consequence for them to be design basis, which is to me what the last column tells you. So I think you need both, at least by my way of thinking.

MR. RICH: Okay.

MEMBER APOSTOLAKIS: But do you need to define them in advance? That's the question.

MR. RICH: I think there's two reasons --

MEMBER SIEBER:: I think so because you

have to design for them. You have to design to get under these numbers.

MR. RICH: When we talked to our structural people and said, "Do you need design basis events anymore? Can we just do away with these things?" and they said, "No, from a practical standpoint I think we need them."

MEMBER APOSTOLAKIS: I do agree, yeah.

MR. RICH: So that's why we left the concept in.

MEMBER APOSTOLAKIS: No, but my question is: are these deterministic criteria that you're imposing or are these deterministic guidelines resulting from the PRA? That's where we differ, I think, and I was always thinking in terms of the latter, but the designer will have deterministic criteria, but how you derive them will be from the PRA meeting your goals and so on, and you will say, "Now, look. If you design it again so that you get a 100 milliREM maximum, then you're admitting the goals don't tell this guy, but tell him to design against 100 milliREM."

CHAIRMAN BONACA: Well, I understood the difference. I understood that an event is one that is down to ten to the minus five per year, and for those

the designer will have to implement whatever to stay below 25 REMs.

MEMBER APOSTOLAKIS: Well, actually it's not that far from what I'm saying because if you look at the PRA, you may decide that if he designs against this, then all of the objectives have been met of the PRA, but the designer does need to know that. You don't get a designer involved in the risk calculations because, you know, he needs deterministic rules how to design.

CHAIRMAN BONACA: But he may need to, right? I mean, assume that the activity gets 50 REM and you still want to consider. So you're doing something to your plant that will reduce --

(Simultaneous conversation.)

VICE CHAIRMAN WALLIS: Risks are an inherent problem with design.

MEMBER ROSEN: We must be much smarter designers now than we used to be. We actually understand PRA.

MEMBER KRESS: See, I envision the designer of a reactor type. First he's going to have his concepts and his fuel and coolant. that's basically judgment and stuff.

And then he's going to try to develop a

PRA based on some sort of preliminary design where he identifies the challenges, the initiating events that you're going to have.

Then he's going to run through a PRA with his preliminary design and see where he meets this FC curve or not, and he has got to have a lot of basic information to do that. If he doesn't meet it, he's going to change his design, and maybe I don't meet it here. Well, he's going to put some other things.

And we'll eventually meet this curve, and then the question is: now, what do we hold him to in terms of the design of the reactor? It's fixed there. It seems to me like the question is: where does the design basis events some in at?

MEMBER APOSTOLAKIS: See, that's the negotiation process I had mentioned earlier. When you're doing that, trying to meet the goals, you're negotiating with these guys. The moment you do that, then presumably you freeze a set of events, deterministic and so on, and you say, "Now, in the future if you design against these, the objectives of the PRA have been met."

MEMBER KRESS: Yeah, but what's the purpose of cutting them off somewhere?

MEMBER APOSTOLAKIS: What do you mean,

cutting them off?

MEMBER KRESS: I mean we're talking about selecting only some of those, not all of them.

MEMBER APOSTOLAKIS: Because those would form and envelope that will guarantee that the goals of the PRA are met. Otherwise you have to every time review the PRA.

MEMBER KRESS: How do you know where that envelope is?

MEMBER APOSTOLAKIS: But that's the negotiation.

MEMBER KRESS: Is every event in the PRA?

MEMBER APOSTOLAKIS: No, no. You can always define.

MEMBER KRESS: Okay. You go back and say if I just design for this range of frequency events here?

MEMBER APOSTOLAKIS: Yeah.

MEMBER KRESS: How do I k now if I just design for those that I'm going to meet the goals?

MEMBER APOSTOLAKIS: Well, this is not a negotiation with the NRC. You look at the PRA and you have reasonable assurance that that would happen.

MR. RICH: That's where the last column is important. What criteria would you apply to those?

I mean one of the things that this could be is another deterministic approach to try and eliminate putting those frequency consequent curves in the regulations. This would be another surrogate that would help insure the --

MEMBER KRESS: This is a surrogate after you meet them, but the way you get there is by meeting them in the first place.

MR. RICH: Right, right.

MEMBER KRESS: By then you select these and from then on you look at these surrogates to see if they're in compliance and things like that.

MEMBER APOSTOLAKIS: For example, with the current generation of reactors, the units that are above the goal, we know why. We know the contributors. It's just too expensive to do something about it. We do know why they're higher than the goal.

MEMBER KRESS: You see the thing that was bothering me, George, was this negotiation and this process of using the PRA interactive with the design until you end up meeting the theme ends up with a design, and part of the purpose of the design basis accidents before was to allow the designer a set of things he can design to. You've already got the

design. So now what's the purpose of the design basis here?

Is it just to continue to see if they're in compliance and to go back and give the inspector something to look at? You know, it has a different purpose?

MR. RICH: Yeah, test the design and maybe serve as a surrogate so you don't have to have the frequency consequence curve in the regulations.

MEMBER APOSTOLAKIS: And when you say that you have a design, do you really have a design for every site, including the spatial distributions and all of that? I mean, that's certainly something that practice will -- but I see what you mean. If you have the design, why bother?

But do you really have it?

MS. DROUIN: We clearly --

MEMBER APOSTOLAKIS: -- generic design that has to be adopted, like the certification process we do now.

MR. RICH: The other thing this does is makes it a risk informed process, not a totally risk based process.

MEMBER APOSTOLAKIS: The thing that's missing in my mind from all of this is how well these

different transparencies relate to each other.

MS. DROUIN: It is clear, George, that we are going to have to give a lot more discussion. We had no discussion on this in the report.

MEMBER APOSTOLAKIS: That's fine.

MS. DROUIN: We don't have any discussion here. We need to provide a lot more.

I'm a little bit worried about the time because we've got our whole defense in depth, and I'd like to --

MEMBER KRESS: Yeah, let's go into the defense in depth because that's impressive.

MS. DROUIN: Can we? Yes, thank you.

MEMBER APOSTOLAKIS: Defense in depth, what is that?

VICE CHAIRMAN WALLIS: They're telling you, George.

MEMBER APOSTOLAKIS: Huh?

VICE CHAIRMAN WALLIS: They're telling you on the next slide.

PARTICIPANT: Why don't you let them say?

MEMBER APOSTOLAKIS: There is such a thing as defense in depth?

VICE CHAIRMAN WALLIS: They're telling you.

MEMBER APOSTOLAKIS: Let's move on. You are waiting for me to stop? Geez.

MR. RICH: All right. This is the last issue, defense in depth. If you recall, we proposed to the Commission back in our policy paper to define defense in depth and incorporate it in a policy statement. They agreed with that. So we've been wrestling with what is defense in depth.

Part of the problem is or one of the main considerations is we've been challenged in the past that we tend to hide behind defense in depth, that we throw anything we want and put the label of "defense in depth" on it to justify any decision we want to make.

So we're trying a different approach where defense in depth is really directed toward treatment of uncertainties. It's not, you know, basic good engineering practices and so forth. It's a process and some deterministic requirements that would be imbedded in the regulations. It's not some separate regulation that would deal with the three classes of uncertainties.

We call those the completeness uncertainties, the modeling uncertainties, and the parameter uncertainties.

MEMBER POWERS: Is the inclusion of completeness uncertainties so that you can throw anything you want under the rubric of the defense in depth? I mean, after all, completeness uncertainties means treating the things I don't know about, isn't it?

And it's only in the eyes of the regulator that these things -- you might dream up something like the ignition of titanium metal under water and say, "Well, you don't treat that, and therefore, you've got to do these the things that I want you to do in the name of defense in depth."

Is that what's going on here?

MR. RICH: No.

MEMBER KRESS: Oh.

(Laughter.)

MR. RICH: The idea would be in the regulations you would put in those things that you feel are necessary because of your completeness concerns. To me, for example, maybe you want to take the main functions, safety functions, the reactor design needs to accomplish. You know, it needs to shut down. It needs to remove decay heat. It needs to retain fission products.

Maybe you want some deterministic

requirement that would say I want two ways to shut down the reactor, maybe two diverse ways, because that's such an important function, and there are uncertainties out there that I can't really model in my PRA. So I'm just going to right up front specify that as a deterministic requirement.

In going through that process, I'm sure there will be a lot of discussion and, you know, there could be some push to put some unreasonable type deterministic requirement in, but that would all be part of writing the regulation, and hopefully when the regulation is done, then that cuts off coming back later, the staff coming back later and say, "Oh, defense in depth. I need to add this or that."

There will be some negotiations, some discussion. It's part of writing the regulations, but it's not intended to put a process in that would allow at any point in the future the staff to jump in and put the defense in depth label on anything they want.

MEMBER POWERS: Maybe I understand this better by example. Suppose that I come into you and I have a design of reactor and I say, well, you know, it's got these pebbles and it's passively cooled because it conducts heat into the ground. I can't imagine anybody coming up with such a horse's ass

idea, but just what if.

And you say, "Gee, conduction with a ground is a complicated thing because there are all kinds of contact resistances that nobody knows what they are or what to measure."

You can't impose any additional cooling mechanism on this guy?

MR. RICH: I think you could if you didn't meet your reliability goals. I mean, you have a CDF goal.

MEMBER POWERS: Yeah, but I have a hard time doing that with, you know, all of the things that are going on in this strange, new reactor.

MR. RICH: No, I think those kinds of things you need to deal with up front in terms of putting in some deterministic requirements. If it's decay heat removal, maybe I want true diverse waste remove decay heat. Conduction to the ground could be one, but you'd better have something else in there.

Again, I think part of this process would be trying to sort out what are those key safety functions where I want that redundancy or that diversity and state it right in the regulations in a neutral way.

And I think when actually a designer comes

in and he has his two ways, then you've got the issue are they reliable. Do they meet the --

MEMBER POWERS: Then it's just a matter of evaluating them.

MEMBER APOSTOLAKIS: But you have already imbedded them in your middle box there or the challenging events, mitigating functions and so on. So now you're going to have additional structuralist ideas.

The fact that you're looking at challenges --

MEMBER POWERS: You're not supposed to say structural with such disdain.

MEMBER APOSTOLAKIS: This beautiful approach.

(Laughter.)

MR. RICH: This would be a combination of structuralist and rationalist requirements.

MEMBER APOSTOLAKIS: When you set it, yeah, you're right. But the thing is don't forget you have already imbedded in the framework this approach. You know, you say, "No, I want you to look at the initiating event. I'm challenging the mitigation barriers and emergency planning as appropriate."

MS. DROUIN: Right . I mean, the

framework right now is saying, okay, we've got these cornerstones. We want you to design to each of the cornerstones.

MEMBER APOSTOLAKIS: Which is a defense in depth statement.

MS. DROUIN: That's absolutely defense in depth.

Now what we're coming back and saying is okay --

MEMBER APOSTOLAKIS: Within each one.

MS. DROUIN: Now within each one of those we want you to apply our defense in depth principles now.

We have shown here on Slide 29 our first cut at what these principles are. Now it's up to the designer to come back and say, "Okay. When we say that we require you to have a balance between accident prevention and mitigation, we want to insure the accomplishment of key safety functions. We want to insure there's a high confidence of reliability.

Those are the principles.

MEMBER APOSTOLAKIS: So this is a single failure criterion again, single element of design or operation?

MS. DROUIN: No, that doesn't to me read

the same thing as a single failure criterion.

MEMBER APOSTOLAKIS: Well, it's a broader view, but it is a single failure when you say it does not depend on a single element.

MS. DROUIN: Now, the depth to which you're going to have to meet these principles --

MEMBER APOSTOLAKIS: Will have to be determined.

MS. DROUIN: -- comes in from the rationalist part, and then that's when you start looking at your risk guidelines.

MEMBER APOSTOLAKIS: I think you will need some pilot. I mean, I see what the problems are here. You need to try to implement these. Really, I think it's not obvious what you should do, but as candidate principles that make sense.

MEMBER SIEBER:: Help me understand this a little bit. The principle of defense in depth is to cover the uncertainty that you don't know all the things that can happen. So let's say that you have one of these gas reactors and you say, you know, there's a lot of uncertainty because I'm uneasy because I haven't defined all of the accident modes.

And so for defense in depth, let's put a containment on it which some folks don't really want

to do, and so the argument becomes I'm requiring the containment because of uncertainty that I don't know what all of the accidents are.

And so how do you prove that? How do you evaluate what that uncertainty is worth in order to make you put a containment on that plant? How do you do that?

I'm not sure how you do it.

MEMBER APOSTOLAKIS: There is no mathematical proof. I mean, the proof of the matter is that if you look at the history of reactor safety the last 30, 40 years, you can definitely identify events that were a surprise.

MEMBER SIEBER:: On the other hand, we have defense in depth because somebody back in the deterministic world said, "I think we ought to have containments."

But now you go to justify the decision to have the containment, and if you can evaluate the completeness uncertainty, then it seems to me that we get back into the deterministic world and say that you have it because I said so.

CHAIRMAN BONACA: And then you identify just a number from the metal elements where you may have to do that. That's part of that intelligent

rationalism, okay?

MEMBER KRESS: That's right. How does it work?

CHAIRMAN BONACA: That's intelligent rationalism.

MR. RICH: It looks at things both ways. It says right up front maybe there are some features we want in the plant. I don't care what kind of plant it is, and maybe containment will end up being one of those. That's going to be a policy decision from the Commission.

MEMBER SIEBER:: Yeah, could be.

MR. RICH: And whatever those are, they'll be written in this technology set at neutral --

MEMBER APOSTOLAKIS: Emergency planning.

MR. RICH: Yeah, emergency planning.

MEMBER APOSTOLAKIS: It's a matter of confidence, public confidence.

MR. RICH: But then on top of that, there are risk goals and reliability goals that come out of the, you know, risk informed part of this that have to be met, and there will be some confidence levels by which you want to assure yourself that they're met.

And if you can't meet those with your design, then you need to add an additional feature

which is the other element, a defense in depth.

That's sort of the way we've set this up. So you've got the risk reliability goals that are looking at it one way, and then you've got just the straight deterministic.

MEMBER SIEBER:: Yeah, I can see how that would work, but it still has some element of subjectivity in it.

MEMBER APOSTOLAKIS: It's a policy.

MEMBER KRESS: It's a policy.

MS. DROUIN: I think it does have some subjectivity into it.

MEMBER SIEBER:: Well, as long as that's the way it's supposed to work, then that's fine with me. I feel comfortable with that.

MS. DROUIN: But if you go to Slide 31 where we've tried to show this pictorially, when you look across the top, we're saying, okay, there are thing we don't know about, and so because we don't know about these things, we're saying that you have to address all four cornerstones. You need to have some type of mitigation. You need to have some type of barrier, and you're going to have to have some type of emergency preparedness.

Now, to what level you're going to have

them is that we want you now to go back and look at those defense in depth principles and you're going to have to show that you've met those principles on each of those cornerstones.

Now, you come into the risk problem and say, "How far do I need to go to show that I've met that?"

That's where we're trying to bring in the risk criteria and saying in looking at the frequency of the event, then balancing that with your reliability of your mitigation and your barrier and the effectiveness of your emergency, if you've shown that you've met the risk guidelines we're trying to establish, then we've said you're done.

And that has tried to get away from the very critical point that Tom made of we just say everything is defense in depth. We're trying to make this more --

MEMBER APOSTOLAKIS: So in the green box, you're a pragmatist. If you can justify the reliability numbers in a convincing way then you're a rationalist. If there are serious questions about uncertainties, you become structurists at the lower level. You invoke the principles you just listed.

MS. DROUIN: That's right.

MEMBER APOSTOLAKIS: Which is really the pragmatic approach.

MS. DROUIN: And the only time that we don't allow you to do anything is if what we're proposing is that if you can show with a 95 percent level of confidence that you're below this 5E minus seven --

MEMBER APOSTOLAKIS: Yeah, yeah. That's okay.

MEMBER SIEBER:: Now that makes sense to me.

MR. RICH: Yeah. I think the main message is a lot of these details have to be thought out and developed yet. The main message is we're considering defense in depth as a way to treat uncertainties, and it's going to have some structuralist and rationalist elements.

PARTICIPANTS: Right.

MR. RICH: That's the main message for today.

MEMBER APOSTOLAKIS: That's correct.

MS. DROUIN: Yes.

MEMBER SIEBER:: But I think to get acceptance of that concept you have to lay it out something like this. It has to be well written.

MEMBER APOSTOLAKIS: Yeah, I think, for example, it shouldn't be called the principle, what you had earlier on the single element.

MR. RICH: Objectives or something.

MEMBER APOSTOLAKIS: Yeah, something like that because if it's a principle, you never know what people are going to say. But there must be some story as to what kinds of uncertainties are you dealing with and then you invoke that principle.

For example, is there a serious question about incompleteness somewhere? Then it seems to me it's more likely that you will have to have diverse ways of doing certain things because you don't know. You are already uncomfortable.

If it's an issue of parameter uncertainty, it's not such a big deal, I mean.

I think this is very good.

MEMBER KRESS: I think this is a --

MS. DROUIN: My personal view is whether or not we call these principles or criteria, to have them sufficiently laid out such that we aren't hiding behind this thing called defense in depth, and it then leads -- the designer, it should leave him in a very logical way that he will either come to the conclusion that, yes, I need two diverse ways without us having

to specify it.

The process should lead him there in looking at his uncertainties and looking at the risk of the guidelines.

MEMBER KRESS: I'm not going to go around the table and see what comments you might get, but if anybody wants to speak up they can do it. But I'll say first I think this is a monumental step forward. You're on the right track. You're asking the right questions, and you're going down a track I think will get you there.

You know, there are some questions and some fleshing out and kneading, but you really have the right idea in my mind.

So if there are any other opinions that want to be expressed, George?

MEMBER APOSTOLAKIS: Yes, I second that. The only point that has not been made very clear, I really think you ought to try a little harder to show the connection among the various goals that you have shown. You have staircases and you have CDF and LRF. Then you have something else somewhere else. Show in a logical way how they are consistent with each other. I think it would be useful.

MS. DROUIN: Okay.

CHAIRMAN BONACA: You're not expecting a report from us at this stage, right?

MS. DROUIN: No, no, no.

CHAIRMAN BONACA: This is for information.

MEMBER KRESS: We've given you all of that.

CHAIRMAN BONACA: Even if it's a work in progress?

MS. DROUIN: Well, I always will accept your letters.

(Laughter.)

MEMBER APOSTOLAKIS: You miss your chance.

MR. RICH: But, Mario, we do need at some point to talk about future interactions. Do you want a subcommittee on this? When do we get together?

MEMBER APOSTOLAKIS: At some point we probably need to have a subcommittee meeting, do we not?

MEMBER KRESS: Yeah, I think a good, whole day subcommittee one of these days when you flesh this out just a little more.

MS. DROUIN: I mean, would you want it at this stage or would you want it --

MEMBER APOSTOLAKIS: No, later.

MS. DROUIN: -- when we have this more

worked out and described better?

MEMBER KRESS: I think more worked out and described better.

CHAIRMAN BONACA: Yeah, I think we should have some progress maybe from this.

MEMBER APOSTOLAKIS: Also, when you feel that you would like to have comments from the subcommittee on a more detailed level. You see, you can only get up to two hours at a full committee meeting, and if you judge that --

MEMBER KRESS: And we can take a whole day or two days or three, whatever it takes.

MEMBER APOSTOLAKIS: -- there are a lot of issues and we'd really like to have a free-wheeling discussion, that justifies a subcommittee meeting.

MS. DROUIN: But in our thinking, in the back of our mind, we were thinking about the end of was it January or February we were talking about?

MEMBER APOSTOLAKIS: January is out of the question.

MEMBER KRESS: January is no good.

MR. RICH: And January for our internal off-site --

MS. DROUIN: That's right, and then after that coming to the ACRS. So we're thinking the end of

February, first of March.

MEMBER KRESS: That would work. That wouldn't be bad.

MEMBER APOSTOLAKIS: That's the earliest, I think.

MEMBER KRESS: Yeah, that's about the earliest we could, I think.

But I've already seen a lot of progress since your last briefing, and --

MEMBER APOSTOLAKIS: Well, the point of view is the right one.

MEMBER KRESS: Pardon?

MEMBER APOSTOLAKIS: The point of view they're taking is the right one.

MEMBER KRESS: Oh, yeah. I think absolutely you've got the right point of view.

MEMBER APOSTOLAKIS: I mean, there will be a lot of debate, as you anticipate, about here and there, but I think the basic approach is very good.

MS. DROUIN: Well, we appreciate your --

MEMBER APOSTOLAKIS: Can we stop this mutual admiration society?

(Laughter.)

MEMBER KRESS: Go ahead if you want to comment.

VICE CHAIRMAN WALLIS: Well, I'd like to hear from all of my colleagues, but I'd like to say something now.

MEMBER KRESS: All right, all right.

VICE CHAIRMAN WALLIS: My reaction is this is good. My reaction is it's pretty obvious. It could have been done -- I mean I'm just -- maybe I'm being extreme here, but I think that an intelligent person with some vision could have done this very quickly.

I think the difficulty is to put together now a system which is actually going to work. Turning this into reality is going to be the task, and that's much bigger than this vision.

MS. DROUIN: We agree.

VICE CHAIRMAN WALLIS: But that's what you've got to do. You've got to work on the real nuts and bolts of things you have to do to make it actually happen.

MS. DROUIN: Yes.

VICE CHAIRMAN WALLIS: And I'd like to see some of that next time.

MEMBER KRESS: We'll just go on. Dana, do you want to comment? You don't have to, I mean.

MEMBER POWERS: Well, --

MEMBER KRESS: I didn't want to put anybody on the spot.

MEMBER POWERS: -- I have to admit I've been off doing a research report.

MEMBER KRESS: Yeah, you were here for the whole meeting.

MEMBER POWERS: But I am extremely suspicious of the idea of using defense in depth as a measure to compensate for uncertainties. I say that recognizing that those people espouse that view include in their definition of uncertainties this incompleteness uncertainty, and they say, "Oh, well, if I just know how big my incompleteness uncertainty, I know how much defense in depth to apply."

And I said yes, and if wishes were horses, then beggars would ride because you'll never know that. I believe defense in depth, the primary function is to take account of the fact that our hubris and our computational and analytic abilities sometimes get quashed by the realities of systems and that you want to have some protection against that, and that the route I am much more comfortable with taking on looking for defense in depth is the question that George makes so much fun of, is what if I'm wrong.

So I will look with interest on how they --

MEMBER KRESS: I personally think they accommodate that view with what they have --

MEMBER APOSTOLAKIS: I don't think we're that far apart.

MEMBER KRESS: No, I don't think so.

Do you want to comment?

PARTICIPANT: No, I don't have anything to add.

MEMBER KRESS: Jack, you've done enough commenting. Mario?

Okay. We're through, I think.

MEMBER RANSOM: I only have one comment. I never heard the words "engineered safety features" in this, which I guess is implicit in --

MEMBER KRESS: Mitigation, we're part of the mitigation.

MEMBER RANSOM: -- always been used in the past.

MEMBER KRESS: That falls under the mitigation box.

VICE CHAIRMAN WALLIS: I'm a big concerned that we have half the members have no comments. I mean, does that mean that they don't understand this

or they don't want to endorse it or they're suspicious of it or what?

PARTICIPANT: I share actually some of the comments that have been given already.

MEMBER KRESS: Some of them have already been made.

CHAIRMAN BONACA: And I think I personally, first of all, think this is a very good step forward. I believe also that we need to see now the more difficult task of moving into the more specifics, and that's going to be the challenge.

You know, the issue of defense in depth, again, I have misgivings, again, the way that takes and what voices, but I'm willing to see where you're going with this and, you know, in general my main comment is that I'm encouraged by what I see. There is progress. So. . . .

MEMBER KRESS: Thank you, people.

MS. DROUIN: Thank you very much.

MEMBER KRESS: Thank all of you people for coming down from New York to visit us. We look forward to seeing you again.

MEMBER POWERS: Is that a way of saying, "Y'll come back now"?

MEMBER KRESS: You all come back. We'll

bake a cake.

CHAIRMAN BONACA: Before we take a break, let me just say that I know you guys are absolutely anxious to hear my subcommittee report on the Ginna and array, but you'll have to wait until tomorrow because we need time for other things tonight.

So that's going to be delayed to tomorrow at 2:15 p.m. before we get into the reports.

So we'll take a break now for 15 minutes. Then we'll go through the next item on the agenda, which is the research report, and then after that, hopefully we'll have a bit of time left to discuss three reports, whether or not we should have them or not. Okay? We'll do that at that time.

(Whereupon, at 5:25 p.m., the meeting in the above-entitled matter was adjourned.)

## CERTIFICATE

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

Name of Proceeding: Advisory Committee on Reactor Safeguards

Docket Number: n/a

Location: 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.

Jennifer Rosario
Official Reporter
Neal R. Gross & Co., Inc.

Duke Energy

# Generic Safety Issue 189

*Presentation to:*

*Advisory Committee on Reactor Safeguards*

*Duncan Brewer, Duke Energy*
*November 6, 2003*

Duke Energy

# June 2003 NRC Public Meeting

- Industry indicated the need for a Task Action Plan for resolution of GSI-189. NRC indicated agreement during the meeting.
- Industry indicated the need for a more clearly-defined acceptable approach with clear scope and criteria, such as:

| | | |
|---|---|---|
| Timing Requirements | Tornado Protection | Testing Requirements |
| EOPs vs. SAMGs | Fire Protection | Technical Specifications |
| Remote Indication | Environmental Impacts | Maintenance Rule |
| Operator Response Time | Fuel Storage Quantity and Quality | 50.59 Requirements |
| Power Requirements | SDP | Security Requirements |
| Operator Training/JPM | Safety/Nonsafety Interface | |

## Duke Position

- Much work to date has focused on the front-end of the process, the averted cost benefit. The back-end of the process needs attention in order to define an acceptable physical modification and the criteria it must meet.
- Duke continues to see the need for a Task Action Plan to outline resolution for GSI-189.



## Conclusion

If the NRC proceeds to require a plant modification to address GSI-189, an approach preferred by Duke would be:

- Define the required design criteria
- Issue a Draft Regulatory Guide for comment outlining the requirements
- Issue a Final Regulatory Guide after comment resolution
- Implement plant modifications in accordance with the design criteria contained in the Regulatory Guide

# BWROG
# GSI-189 Committee

Presentation
ACRS MEETING
11/06/2003

Ken Meade, FENOC
440-280-5122
kcmeade@firstenergycorp.com

## BWROG GSI-189 COMMITTEE
### Background

- Committee was formed to address GSI -189 impact on BWR Mark III containment owners.
- Focus on PWR-BWR differences which impact benefits and cost
- Reviewed NRC benefits and cost analysis
- Results of review documented in letter dated October 23, 2003 (BWROG – 03053).

## Committee Review Results

- Present worth calculated benefits for mean NUREG 1150 case for MARK III containment is $10k
- External Events should not skew the calculated cost benefit.
- Total benefits do not support proceeding with plant modifications for BWR owners

## Committee Review Results

- BWR Emergency Operating Procedures (EOP) restrict use of hydrogen igniters
  - Hydrogen analyzers are required to assure hydrogen concentration is below deflagration limit
  - Hydrogen analyzers require support equipment
- Scope of backup power modification needs to include hydrogen analyzers for BWR's.
- Will need a much larger, most expensive, generator to power support equipment.

## Committee Review Results

- Plant emergency response to SBO events must focus on power restoration and core cooling.
- Increase in defense in depth from backup power to igniters is not supported by the cost.
- Power restoration for hydrogen igniters will be assessed as part of emergency response.

## Committee Review Results

- Request a review of the need for GSI-189 rule-making for Mark III owners.
- Benefits identified for Mark III containments do not justify modifications.
- GSI-189 concerns can be addressed by Emergency Response Organization.

# Framework for a Risk-Informed Regulatory Structure for Advanced Reactors

Presentation to
Advisory Committee on Reactor Safeguards
Full Committee

Presented by
Mary Drouin, Amarjit Singh, Tom King, US Nuclear Regulatory Commission
John Lehner, Trevor Pratt, Vinod Mubayi, Brookhaven National Laboratory
Dennis Bley, Buttonwood Consulting, Inc.

November 6, 2003

# OUTLINE

- Purpose
- Background
- Plan, schedule, status
- Scope
- Groundrules
- Framework
  - Approach/roadmap
  - Safety expectations
  - Risk expectations
  - Design expectations
  - Treatment of uncertainties

# PURPOSE

- Presentation today is for information and discussion only, to show the work in progress
- No letter requested at this time
- Should discuss need for and timing of future interactions with ACRS (Subcommittee and Full Committee)

# BACKGROUND

- Current regulations developed over 40 years
- Review and licensing of non-LWRs has been done case-by-case.
- SECY-03-59, dated 4/18/03, described the staff's plan to develop a technology neutral, risk-informed structure for future plant licensing

# PLAN AND SCHEDULE

- Four phases of project:
  1. Development of technology neutral framework
  2. Development of technology neutral regulations
  3. Define scope and approach for technology specific Regulatory Guide
  4. Development of technology specific Regulatory Guides
- Schedule:
  1. 2003-2004 (public workshop – 11/19/03)
  2. 2004-2005
  3. 2005-2006
  4. 2006-2007

# CURRENT STATUS

- Work, to date, has focused on development of technology neutral framework
- Is a work in progress
  - Indicates preliminary ideas and thoughts
  - Incomplete (even as a draft)

# PROGRAM SCOPE

- Non-LWRs (e.g., HTGRs, liquid metal reactors, etc.)
- Advanced LWRs (e.g., IRIS)
- Not intended for application to currently operating plants or designs currently certified or under design certification review
- Design, construction and operation (shutdown, refueling, power operation)
- Public, worker, environmental protection

# BASES/GROUNDRULES FOR FRAMEWORK

- New self contained part to 10 CFR envisioned
- Voluntary use?
- Build upon and implement Commission's policy decisions on SECY-03-0047:
  - Expectations for safety
  - Defense-in-depth
  - Use of international codes and standards
  - Probabilistic approach for the design basis
  - Scenario specific licensing source terms
  - Containment vs. confinement
  - Emergency preparedness

# BASES/GROUNDRULES FOR FRAMEWORK (cont'd)

- Use Commission's Safety Goal Policy Quantitative Health Objectives as desired level of safety to be achieved for protection of public health and safety
- Development of goals/criteria for workers and environmental protection (policy issues)
- Top down hierarchal structure
- Initial focus is on reactor safety
  - Safeguards and security to be addressed later building upon ongoing work
- Use technology-neutral, risk-informed approach:
  - Probabilistic requirements
  - Deterministic requirements
- Retain concept of design basis accidents for deterministic aspects of licensing

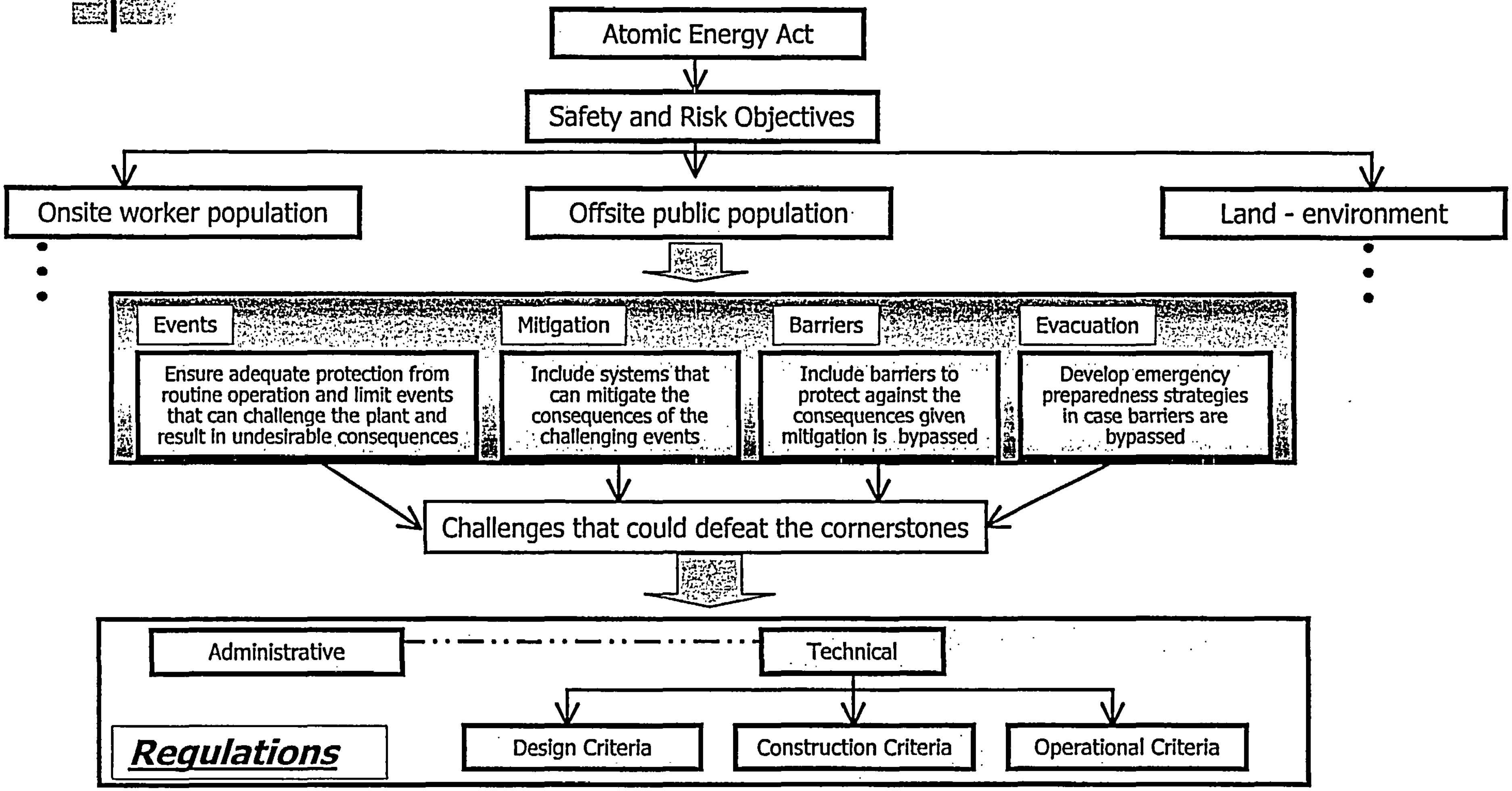
# APPROACH/ROADMAP

- *Objective: to provide the process/roadmap for derivation of the technology-neutral regulations*
- Top Down Approach
- Ultimate goal of regulations to meet the mission of the atomic energy act
- Safety and risk objectives are established that support the mission of the atomic energy act
- The scope addresses public, worker risk and land contamination
- Cornerstones are defined which provide the high level criteria for ensuring safe nuclear power design, construction and operation
- Challenges that could prevent the cornerstones from being achieved are identified
- The means to neutralize the challenges are identified and articulated via regulations

# APPROACH/ROADMAP (cont'd)

- Identify good "engineering" (i.e., design, construction and operation) practices to be used to neutralize the challenges
- Develop guidance and criteria on the technical considerations that need to be addressed in developing the regulations
  - Safety expectations
  - Risk expectations
  - Design expectations
  - Treatment of uncertainties

# APPROACH/ROADMAP (cont'd)




WORK IN PROGRESS

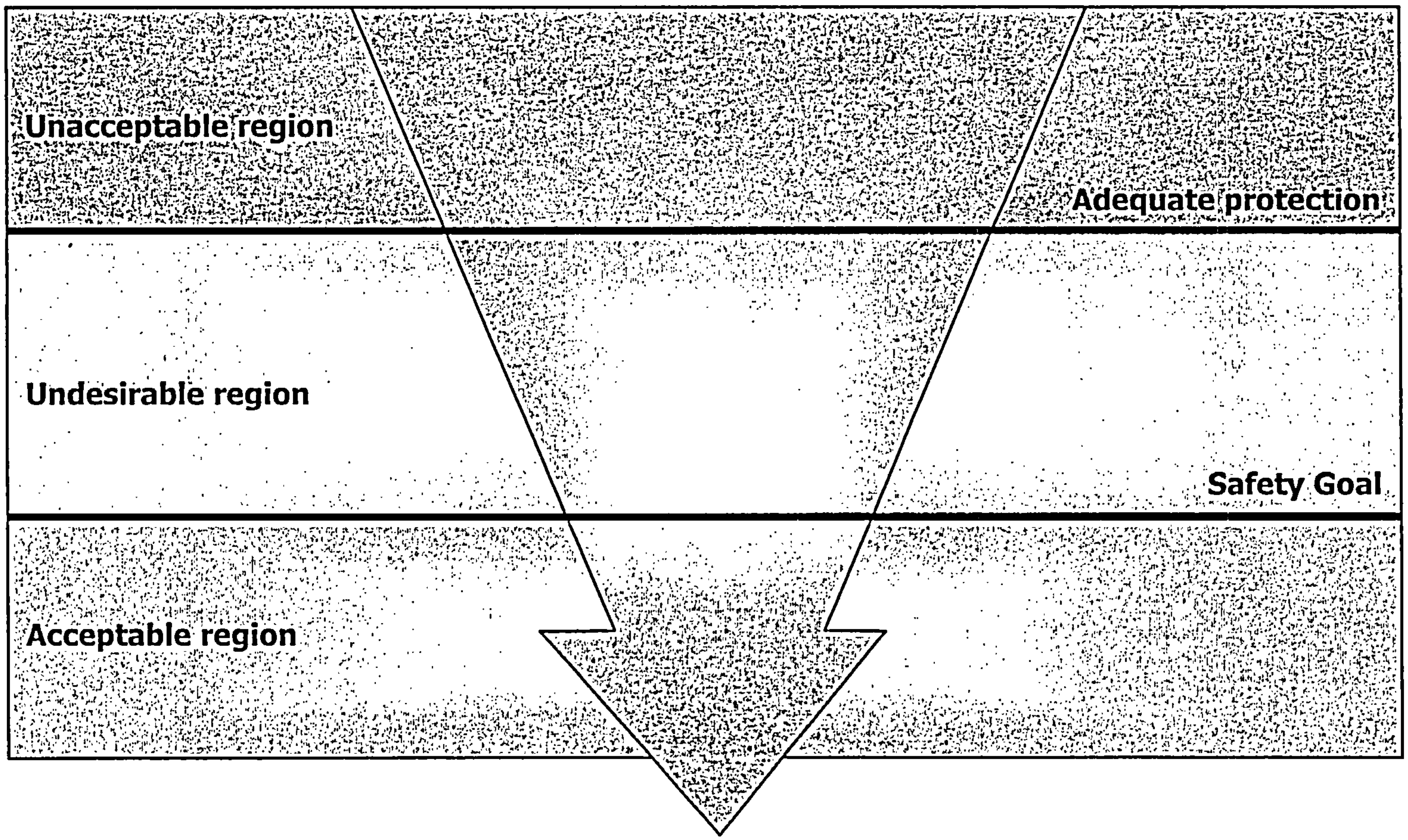
# SAFETY EXPECTATIONS

- *<u>Objective</u>: to provide the safety expectations for future reactors in keeping with expectations for ALWRs*
- A basic attribute expected of future reactors is enhanced safety
- The Regulatory Framework should articulate this expectation
- The current qualitative and quantitative safety goals for public health and safety will remain as the foundation that supports the NRC mission
- Additional regulatory aims could be expressed in terms of additional goals that address:
  - Worker health risk
  - Environmental impact

# SAFETY EXPECTATIONS (cont'd)

- For all of the goals eventually agreed on (i.e., public health and safety, and potentially worker health and safety, environmental impact), an approach involving three regions of risk is proposed:
  - An unacceptable region where the risk is greater than some upper safety limit (adequate protection)
  - An undesirable (but tolerable) region where the risk is below the upper safety limit, but above the goal in question
  - An acceptable region where the risk is at or below the safety goal

# Three Region Approach




WORK IN PROGRESS

# SAFETY EXPECTATIONS (cont'd)

- Issues related to 3 region approach:
  - Adequate Protection (boundary of undesirable/unacceptable) is not expressed as a single risk level in practice
  - Demonstrating the safety of a specific reactor is subject to considerable uncertainty
  - The greater uncertainty attached to a novel design is one reason to seek enhanced safety for such a design

# SAFETY EXPECTATIONS (cont'd)

- The target risk level of each individual advanced reactor should be at, or below, the safety goal(s)
  - As a technology improves it is reasonable (and common practice) to establish more stringent safety levels or benchmarks
  - Additional safety enhancement that may not be practical for an already built reactor may be reasonably practical for a new design
  - Future reactors should meet standards at least equivalent to those of the ALWRs

# RISK EXPECTATIONS

- *Objective: to provide the risk expectations in terms of specific quantitative objectives for future reactors*
- It would be desirable to have a more uniform approach to requirements in all three arenas
  - Public, worker, environment
- Also desirable to have an integrated approach for setting aims/goals for public, worker and environmental risk.
- May be needed to properly account for characteristics of future plants (e.g., long response times)

# RISK EXPECTATIONS (cont'd)

- What quantitative guidelines should be associated with the various goals?
- Should quantitative goals only be used for low frequency- high consequence accident scenarios, or is a frequency vs. consequence approach appropriate which encompasses the spectrum from normal exposures to severe accidents?
- The following are one set of proposals that are based, in part, on 10 CFR Part 20, the International Commission on Radiation Protection (ICRP-64), and the current safety goals.

# RISK EXPECTATIONS (cont'd)

- ICRP-64 developed a range of recommended annual probabilities of accident sequences leading to different severities of radiation exposure. Sequences of events leading to:

| | |
|---|---|
| Doses treated as part of normal exposures | 1E-1 - 1E-2 per year |
| Stochastic effects only but above dose limits | 1E-2 - 1E-5 per year |
| Doses where some radiation effects are deterministic | 1E-5 - 1E-6 per year |
| Doses where death is the likely result | < 1E-6 per year |

# RISK EXPECTATIONS (cont'd)

- Proposed frequency vs. consequences of various ***public*** dose ranges

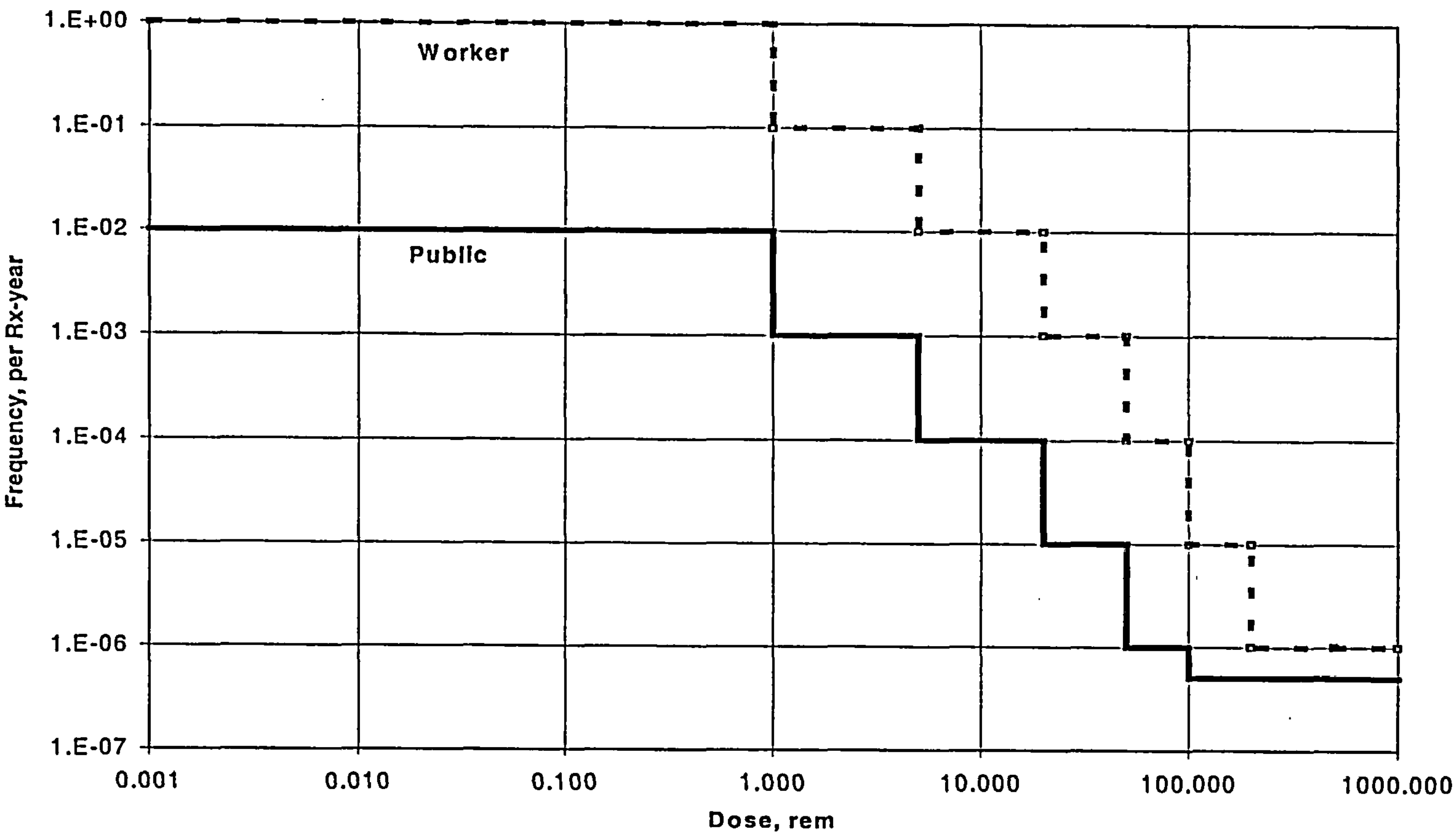
| *Dose Range* | *Frequ/yr* | *Comment* |
|---|---|---|
| < 1 rem | 1E-2 | Below normal exposure limits. Frequency recommended in ICRP-64 |
| 1 rem – 5 rem | 1E-3 | 1 rem offsite triggers EPA PAGs |
| 5 rem – 25 rem | 1E-4 | 25 rem triggers Part 100 limits |
| 25 rem – 50 rem | 1E-5 | 50 rem is a trigger for deterministic effects |
| 50 rem – 100 rem | 1E-6 | >100rem deterministic effects are very likely, 200 rem early fatality threshold |
| > 100 rem | ≤ 5E-7 | Based on early fatality QHO |

# RISK EXPECTATIONS (cont'd)

- Proposed frequency vs. consequences of various ***worker*** dose ranges

| *Dose Range* | *Frequ/yr* | *Comment* |
|---|---|---|
| < 1 rem | 1E+0 | Average worker exposure 400mrem/yr |
| 1 rem – 5 rem | 1E-1 | Doses above 1rem separately recorded, 5 rem is annual limit for workers in Part 20 |
| 5 rem – 25 rem | 1E-2 | 25 rem triggers EPA limit for life saving actions |
| 25 rem – 50 rem | 1E-3 | 50 rem is a trigger for deterministic effects |
| 50 rem – 100 rem | 1E-4 | Some injury, significant risk for latent cancer |
| 100 rem – 200 rem | 1E-5 | Serious injury, frequency same as suggested for NMSS goal |
| > 200 rem | 1E-6 | 2 times early fatality QHO for public |

# RISK EXPECTATIONS (cont'd)




WORK IN PROGRESS

# RISK EXPECTATIONS (cont'd)

- ***Environmental --***
- Proposal on guideline is still in progress.

# RISK EXPECTATIONS (cont'd)

- Surrogates risk goals are proposed
  - core damage frequency (CDF) goal of 10-5/ry
  - large release frequency (LRF) goal of 10-6/ry
- CDF is defined as sufficient fuel damage to result in a release of radionuclides that exceeds normal coolant activity
- LRF is defined as release of radionuclides sufficient to cause prompt fatalities at the site boundary (or exceed land contamination limits)
- Values ensure reactor safety goals are met independent of reactor technology

# DESIGN EXPECTATIONS

- *<u>Objective</u>: to provide the criteria used to select those events that have to be considered in the design of future reactors*
- No pre-defined set of "design basis accidents"
- Propose criteria for selection of events that must be considered in the design
  - Probabilistic
  - Deterministic

# DESIGN EXPECTATIONS (cont'd)

| Frequency of Events | Probabilistic Criteria Initiating Events | Deterministic Criteria |
|---|---|---|
| Frequent | ≥ 10-2/yr (mean) | 100 mrem/yr (TEDE) |
| Infrequent | < 10-2/yr (mean) | 1-25 rem (TEDE) |
| Rare | < 10-5/yr (mean) | 25 rem (TEDE) |
| Extremely rare | < 5x10-7/yr (95%) | NA |

# TREATMENT OF UNCERTAINTIES

- *<u>Objective</u>: to provide the process for addressing uncertainties associated with the design, construction and operation of future reactors*
- Treatment must address
  - Completeness uncertainties
  - Modelling uncertainties
  - Parameter uncertainties
- Treatment of uncertainties is addressed via ***defense-in-depth***
- Defense-in-depth will be embedded in the regulations

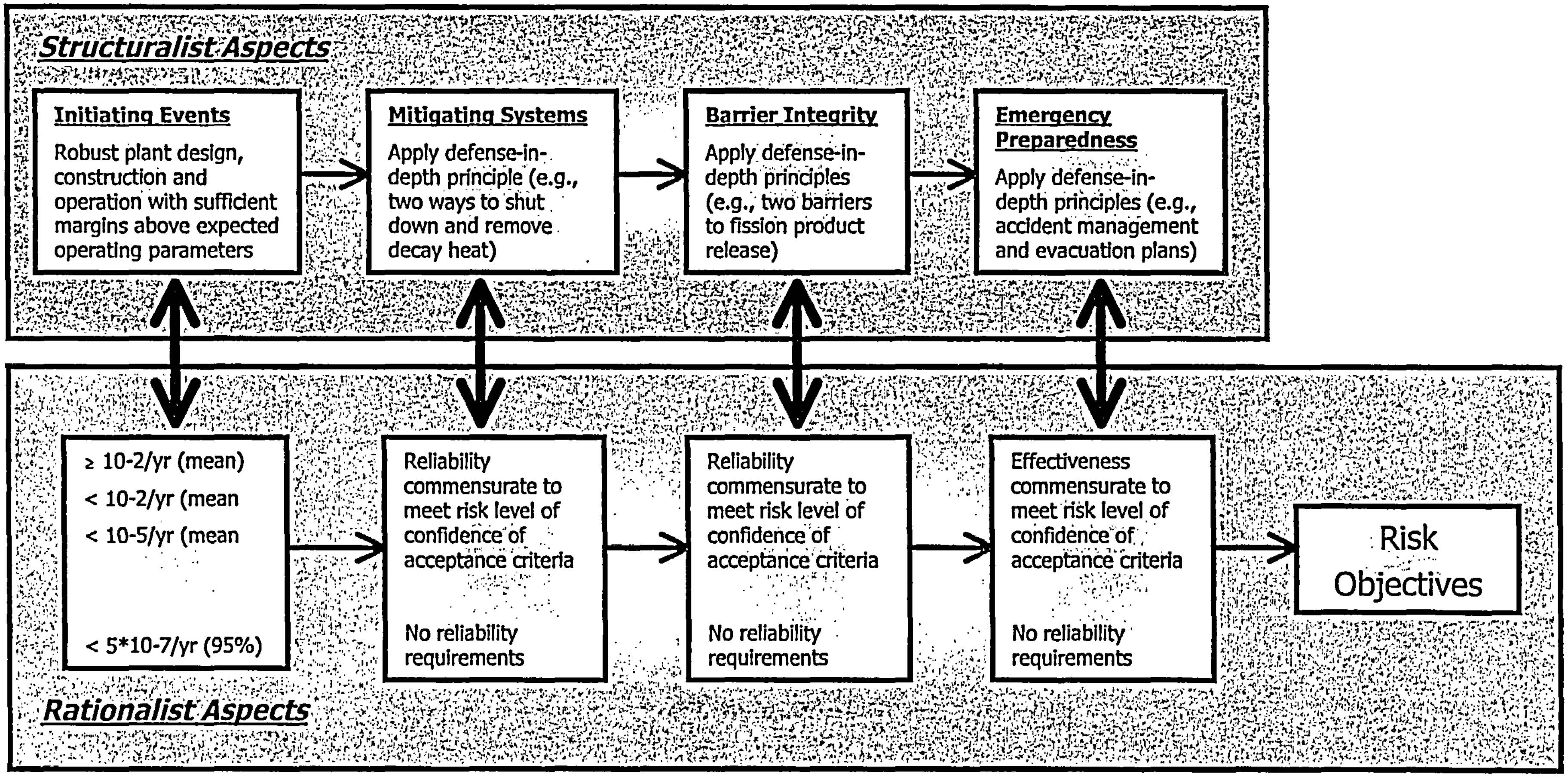
# TREATMENT OF UNCERTAINTIES (cont'd)

- ***Defense-in-depth Principles:***
- Provide a balance between accident prevention and accident mitigation
- Ensure the accomplishment of key safety functions are not dependent upon a single element of design or operation
- Ensure there is high confidence that reliability (e.g., equipment and human performance) and risk goals can be met

# TREATMENT OF UNCERTAINTIES (cont'd)

- ***Defense-in-depth model:***
- Structuralist elements to address completeness uncertainties:
  - E.g., key safety functions should not be dependent upon a single element of plant design (would cover items such as containment. EP)
- Rationalist elements to address modelling and parameter uncertainties
  - E.g., CDF/LRF goals, equipment reliability goals, level of confidence (safety margin), monitoring and feedback

# TREATMENT OF UNCERTAINTIES (cont'd)



# TREATMENT OF UNCERTAINTIES (cont'd)

- ***Application of defense-in-depth:***
- Elements of defense-in-depth are applied by the designer and operator as required to meet design and operational goals
- Analysis is done on a realistic basis with conservatism and a level of confidence applied in the acceptance criteria
- Monitoring and feedback will be required to ensure key assumptions remain valid

# 507th ACRS Meeting

Mixed Oxide Fuel Fabrication Facility
Construction Safety Evaluation Report

November 6, 2003

# 507th ACRS Meeting

Mixed Oxide Fuel Fabrication Facility
Construction Safety Evaluation Report

- NRC Regulations for MOX Construction Authorization
  - Staff evaluating design bases of principal structures, systems and components - NOT FINAL DESIGN
  - If construction authorization request is granted, the applicant would later file a LICENSE APPLICATION for possession and use of special nuclear material
    - Including an Integrated Safety Analysis Summary
    - More detail on safety-related Programs (Rad Safety, Surveillance)
    - More detailed descriptions of Items Relied On For Safety (IROFS)

# 507th ACRS Meeting

Mixed Oxide Fuel Fabrication Facility
Construction Safety Evaluation Report

- Remaining Open Items, November 6, 2003
  - 1 Nuclear Criticality Safety
  - 10 Chemical Safety

# Criticality Safety Open Item Update

NCS-4 Criticality Code Validation for Pu & MOX Powders

- K-eff limits for $PuO_2$ and MOX powders
  - Few critical benchmarks
  - Justification of critical benchmark experiments
- NRC Actions:
  - Validation Report July 2003
  - September 2003 meeting discussed S/U method

# Criticality Safety Open Item Update

NCS-4 Criticality Code Validation for Pu & MOX Powders

- S/U Method
  - quantitative method
  - correlated nuclear data dependencies

- Main concerns
  - Confirmation of correlation coefficients
  - Basis for numerical "threshold" for MOX/Pu systems

# Criticality Safety Open Item Update

NCS-4 Criticality Code Validation for Pu & MOX Powders

- Revised Validation Report October 2003
- "Traditional" approach to benchmark selection
- Staff questions on October 2003 Validation Report
- November 13, 2003 Meeting

# Criticality Safety Open Item Update

NCS-4 Criticality Code Validation for Pu & MOX Powders

- Current Status
  - Concerns with benchmarks to validate Pu & MOX powder AOAs
  - Impact of reducing number of benchmarks
  - Final decision to be made after November 13 meeting

# Chemical Safety Open Items Update

## CS-01 Red-Oil - Introduction

- Runaway tributyl phosphate (TBP) & nitric acid exothermic reaction
- Venting and pressure control are important considerations
- Red oil events have occurred in U.S. and Russia

# Chemical Safety Open Items Update

## CS-01 Red Oil - Applicant's Approach

- "Open Systems" can vent a full red-oil runaway reaction -"Closed Systems" cannot vent a runaway reaction.

- Safety strategy for open systems is acceptable - open item focuses on CLOSED systems

# Chemical Safety Open Items Update

## CS-01 Red Oil - Applicant's Approach (*Cont.*)

- CLOSED systems are provided with evaporative cooling (off-gas treatment system) to prevent initiation of the red-oil reaction

- Energy removal capability =
  1.2 x [Energy input from steam at 133°C +
  energy input from the chemical reaction]

- Bulk solution temperature not-to-exceed 125°C and/or rate of temp. rise not to exceed 2°C / minute

# Chemical Safety Open Items Update

## CS-01 Red Oil - Remaining Applicant ISA and Experiments

- Define Reaction Kinetics (Venting)
- Determine Effects of Impurities (Venting)
- Establish Operational Control Limits

# Chemical Safety Open Items Update

## CS-01 Red Oil - Lead Chemical Safety Reviewer

- Open System - assurances of safety - accepted
- Closed System - inadequate assurances of safety:
  - Applicant's approach contradicts some DOE practices
  - Inadequate margin
  - Uncertainties not adequately considered
  - No assurance of strategy being able to meet regulations (i.e., likelihood meeting highly unlikely)

# Chemical Safety Open Items Update

## CS-01 Red Oil - Lead Chemical Safety Reviewer (*Cont.*)

- Closed System (*continued*):
  - Common mode failure potential for heat transfer control and venting has to be considered for determining "Highly Unlikely"
  - Venting capacity can not accommodate a full red-oil reaction
  - Evaporator design may be more susceptible to phase separation and thermal isolation -potentially unsafe configuration
  - No assurance that the quench system and 125°C limit will prevent red-oil events
- Staff needs information on the docket to address these concerns

# Chemical Safety Open Items Update

## CS-01 Red Oil - Staff Review and Conclusion

- Staff has determined that the applicant's approach provides adequate safety
  - Runaway red-oil reactions initiate at ~134-137°C for closed systems with high nitric acid concentrations
  - Bulk fluid not-to-exceed 125°C
  - Rate of temperature rise limited to 2°C / min.
  - 20% energy removal margin
  - Quenching to assure adequate aqueous phase

# Chemical Safety Open Items Update

**CS-02, Hydroxylamine Nitrate (HAN)** - Introduction

- Spontaneous autocatalytic reaction in HAN-nitric acid solutions

- Multiple operating events in industry - most due to inadvertent concentration of process chemicals

# Chemical Safety Open Items Update

## CS-02 HAN - Applicant's Approach

- Safety strategy focuses on prevention for two distinct areas:
  - Vessels with HAN and hydrazine nitrate without $NO_x$ Addition
  - Vessels containing HAN and hydrazine nitrate with $NO_x$ addition (e.g., oxidization column)
- PSSCs are:
  - Process Safety Control Subsystem
  - Chemical Safety Controls
  - Offgas Treatment System

# Chemical Safety Open Items Update

## CS-02 HAN - Applicant's Approach (*Cont.*)

- Design basis safety limits developed using a kinetic model

- Model confirms observations that hydrazine scavenges nitrous acid intermediate, prevents HAN event

# Chemical Safety Open Items Update

## CS-02 HAN - Lead Chemical Safety Reviewer

- HAN/hydrazine - without NOx addition
  - Assurance needed vis-a-vis hydrazoic acid and nitrous acid concentrations
- HAN/hydrazine - with NOx addition
  - RCAR had a flow control -subsequently removed
  - Not clear that flow control not needed
- Staff needs information on the docket to address these concerns

# Chemical Safety Open Items Update

## CS-02 HAN - Staff Review and Conclusion

- Margin evaluated with Polymath 5.1 for the design basis safety limits and likely operating ranges
- Staff performed a sensitivity analysis to determine stability
- The design basis values provide adequate assurance of safety with appropriate margins

# Chemical Safety Open Items Update

## AP-3 Electrolyzer Titanium Fire - Introduction

- $PuO_2$ feedstock containing impurities is dissolved by electrolytic dissolution in 6N nitric acid at 86°F with Ag(II)
- Electrolyzers have a titanium shell
- Potential titanium fire initiated by an electrical fault could not be suppressed with planned fire suppression system

# Chemical Safety Open Items Update

## AP-3 Electrolyzer Titanium Fire - Applicant's Approach

- Passive preventive strategy - does not rely on active electrical protection

- Sintered silicon nitride barrier between anode and cathode compartments

- Polytetrafluoroethylene (PTFE, Teflon) insulator between anode and cathode structures and between anode and ground

# Chemical Safety Open Items Update

## AP-3 Electrolyzer Titanium Fire
## Applicant's Approach (*Cont.*)

- Electrolyzer structure seismically designed

- Electrolyzer designed to withstand turbulent flow, and not induce vibration

# Chemical Safety Open Items Update

**AP-3 Electrolyzer Titanium Fire**
**- Lead Chemical Safety Reviewer**

- These materials are not normally considered passive engineered controls
  - Silicon nitride ($Si_3N_4$) is a ceramic
  - PTFE is an elastomer
- Properties not comparable to metals
- Unlikely to meet "passive" like RPV/boundary
- Staff needs information on the docket to address these concerns, assurance of meeting "highly unlikely"

# Chemical Safety Open Items Update

**AP-3 Electrolyzer Titanium Fire**
**Staff Review and Conclusion**

- Staff found strategy to use passive engineered controls to prevent current leakage from electrolyzer electrode (cathode) to titanium shell (anode) acceptable

- Electrolyzer will be seismically designed as other equipment; seismic qualifications will be reviewed at the operations phase

# Chemical Safety Open Items Update

## MP-1 Uranium Burnback - Introduction

- $DUO_2$ powder ball milled to micron size range prior to blending with $PuO_2$
- Finely divided $DUO_2$ powder (1 micron) can "burnback" to $U_3O_8$ in an exothermic reaction with $O_2$ at room temperature
- Reaction is a function of particle size

# Chemical Safety Open Items Update

## MP-1 Uranium Burnback - Introduction (*Cont.*)

- Staff postulated that a glovebox spill or fire could disperse powder into ventilation system
- Located in nitrogen-inerted gloveboxes not designated as PSSCs
- Loss of material confinement could impact C3 and C4 HEPA filters

# Chemical Safety Open Items Update

## MP-1 Uranium Burnback - Applicant's Approach

- PSSC: High strength 2nd stage roughing filters with removal efficiency >90% for particles >1 micron

- Prefilter leak path factor (LPF) ≤ 0.1

# Chemical Safety Open Items Update

**MP-1 Uranium Burnback - Lead Chemical Safety Reviewer**

- Safety analysis is not adequate because:
  - Analysis did not consider effects of lint in HEPA filter heat loading
  - The calculated source term using applicant's values may be 500-800 grams vs. 100 grams
  - Quantities could exceed threshold quantity of one HEPA and are 50-80% of threshold if uniformly distributed over 4 HEPA filters

# Chemical Safety Open Items Update

**MP-1 Uranium Burnback**
**- Lead Chemical Safety Reviewer (*Cont.*)**

- Range of reaction heats not considered (440 - 620 joules/gram)
- Ignition phenomena (possible "hot spots") not addressed
- Safety factor not clear
- Staff needs information on the docket to address these concerns

# Chemical Safety Open Items Update

## MP-1 Uranium Burnback - Staff Review and Conclusion

- Prior to ball milling, not a concern due to 100 micron particle size
- Post ball milling consequence analysis demonstrates HEPA filter would survive burnback after maximum credible spill
  - Safety Factor of at Least 10 for spills
  - Safety Factor of at Least 4 for fires
- Margin is sufficient given conservative assumptions in staff's evaluation

# Chemical Safety Open Items Update

## CS-05b Chemical Consequence Calculations -Introduction

- Performance requirements in 10 CFR 70.61 requires protection from credible high and intermediate consequence events involving acute chemical exposures

# Chemical Safety Open Items Update

## CS-05b Chemical Consequence Calculations -Introduction

- NUREG-1718 Examples Include
  - Acute Exposure Guideline Level (AEGLs)
  - Emergency Response Planning Guidelines (ERPGs)
  - Or other cited values such as OSHA or National Institute for Occupational Health
- Applicant may use an alternative standard

# Chemical Safety Open Items Update

## CS-05b Chemical Consequence Calculations
## Applicant's Approach

- The Applicant proposed the use of AEGLs or ERPGs, where available

- For those chemicals without AEGLs or ERPGs, the Applicant has proposed the use of Temporary Emergency Exposure Limits (TEELs)

- The TEEL methodology is used by DOE

# Chemical Safety Open Items Update

## CS-05b Chemical Consequence Calculations
## Lead Chemical Safety Reviewer

- Findings from RDSER not addressed:
  - TEELs are not independently peer and public reviewed
  - TEELs are not endorsed by a regulator
  - Certain TEEL values have increased substantially between recent revisions

# Chemical Safety Open Items Update

## CS-05b Chemical Consequence Calculations
## Lead Chemical Safety Reviewer

- Procedural Issues
  - Policy Decision - staff not really involved
  - Prior staff evaluations of TEELs not considered
  - Public not involved
  - Other regulators not consulted
- Safety Issues
  - Why are significantly higher values acceptable?
  - Why are frequently changing values acceptable?
- NRC needs more internal discussions

# Chemical Safety Open Items Update

## CS-05b Chemical Consequence Calculations
## Staff Review and Conclusion

- The use of TEELs where AEGLs or ERPGs are not available is an acceptable methodology

- Structured formulaic derivation process involving a large group of DOE experts

# Chemical Safety Open Items Update

## CS-10 Emerg. Control Room Habitability - Introduction

- Control Room Operators perform monitoring roles - no actions for facility safety are identified
- Certain chemical release sequences are high consequence events for Control Room Operators
- Emergency Control Room Air Conditioning System is a designated PSSC

# Chemical Safety Open Items Update

## CS-10 ECR Habitability - Applicant's Approach

- ECR Air Conditioning intakes monitored
  - One intake above limit, intake auto isolation and switch to recirculation mode
  - Filters include acid gas or organic chemical removal
  - Both above limit, operators don SCBA
- Concentration Limits
  - IDLH, where available
  - Otherwise DOE Temporary Emergency Exposure Limits (TEEL)-2s or TEEL-3s

# Chemical Safety Open Items Update

## CS-10 ECR Habitability - Applicant's Approach (*Cont.*)

- Applicant is not Committing to Regulatory Guide 1.78
  - Reg Guide 1.78 accepts the use of IDLH Limits for 2-minutes to don SCBA
- Applicant will Determine Time Limit Criteria During ISA Phase

# Chemical Safety Open Items Update

## CS-10 ECR Habitability - Lead Chemical Safety Reviewer

- Exposure time part of chemical limit
  - Applicant using 2 and 60 minute times
  - Likely impact on design/CAR
- Different values for $NO_2$ and $N_2O_4$
  - Hazards the same - mass limits should be the same
  - Precedence is to use same values
- Habitability status not clarified
  - Control for worker protection/SCBAs/cartridge not identified
  - Top-level PSSC needed (e.g., FWA)
- Staff needs information on the docket to address these concerns

# Chemical Safety Open Items Update

## CS-10 CR Habitability - Staff Review and Conclusion

- Appropriate consequence limits are established
- Time criteria determined during ISA evaluation
- Control room staffing is desirable during emergencies
- Applicant's safety strategy provides adequate assurance that control room staffing can be maintained during a hazardous material release

# Chemical Safety Open Items Update

## CS-09, AP-02, AP-08, and AP-09 Lower Flammability Limits (LFL) - Introduction

- These items address establishment of appropriate safety margins
  - CS-09 Solvent Temperature Design Basis
  - AP-02 Electrolyzer Flammable Gas Generation
  - AP-08 Offgas Unit Flammable Gases and Vapors
  - AP-09 Solvent Flashpoint Temperatures

# Chemical Safety Open Items Update

## CS-09, AP-02, AP-08, and AP-09 Lower Flammability Limits (LFL) - Applicant's Proposal

- Guidance in NFPA 69-1997
  - Combustible concentration at or below 25% of the LFL
  - Combustible concentration at or below 60% of the LFL when provided with automatic instrumentation and safety interlocks
- PSSCs/safety functions were identified for each process area

# Chemical Safety Open Items Update

**CS-09, AP-02, AP-08 and AP-09 Lower Flammability Limits (LFL) - Lead Chemical Safety Reviewer**

- 25% of LFL identified for hydrogen and flammable gases -acceptable
- Concern is the solvent/mixtures:
  - 25% and 60% of LFL proposed
  - Adequate margin not clear from proposed strategies and the phenomena (heating)
  - Guidance not specific
  - 60% of LFL not congruent with 15 C margin from flashpoint (55 C)
- Staff needs information on the docket to address these concerns

# Chemical Safety Open Items Update

## CS-09, AP-02, AP-08, and AP-09 Lower Flammability Limits (LFL) - Staff Review and Conclusion

- Use of 25% LFL or 60% LFL with instrumentation and identified interlocks provides an adequate safety margin, as per NFPA 69.
- For combustible solvents, NFPA 30 (cited by SRP) limits vapor concentration to 25% LFL in enclosed process areas when the temperature of the liquid is above its flashpoint temperature. No required temperature margin nor vapor concentration for fluids below flashpoint temperature is specified.

# Chemical Safety Open Items Update

## CS-09, AP-02, AP-08, and AP-09 Lower Flammability Limits (LFL) - Staff Review and Conclusion

- The ISA review for the license application to possess and use SNM will assure that the performance requirements of 10 CFR 70.61 will be met by the detailed design proposed. The adequacy of the margins proposed in accordance with the NFPA codes, SRP, or other standards will be determined.

# 507th ACRS Meeting

Mixed Oxide Fuel Fabrication Facility
Construction Safety Evaluation Report

## Additional Questions ?

# GSI-189:
# IT'S TIME TO ACT

Edwin S. Lyman
Senior Staff Scientist
Union of Concerned Scientists

Remarks at the 507th Meeting of the ACRS, November 6, 2003

# OVERVIEW

- GSI-189: Action is long overdue
- The use and misuse of Level III PRA in backfit analysis
- Defense-in-depth is not optional
- Conclusions

# GSI-189:
# ACTION IS LONG OVERDUE

- GSI-189 chronology:
  - 1998: First public mention that Sandia is having trouble "resolving" DCH issues for ice-condensers (CCFP > 0.1)
  - April 2000: Publication of NUREG/CR-6427 after long delay
  - Sept. 2000: Staff proposes establishing GSI to assess costs and benefits of additional hydrogen control
  - May 2001: GSI-189 established
  - Dec. 2001: Commission requests that staff resolve GSI-189 "expeditiously"
  - Nov. 7, 2002: Jack Rosenthal (at ACRS meeting): "I personally believe that we have done enough number-crunching over 20 years, that it is time to make a decision."

# ACTION (cont.)

- GSI-189 chronology (cont.)
  - Nov. 13, 2002: ACRS recommends that GSI-189 be resolved by voluntary industry initiative (SAMG) and not by order or rule
  - Dec. 2002: RES recommends to NRR that further regulatory action is warranted
  - Aug. 2003: Commissioner McGaffigan approves revision of 10 CFR 50.44 but "hope[s] that GSI-189 will soon be resolved with appropriate additional measures being *required* (emphasis added)…"
  - Sept. 2003: "Risk-informed" 10 CFR 50.44 is published; only contains provisions that reduce regulatory burden
  - Nov. 2003: ????? (Can it really take NRR over a year merely to request a voluntary industry initiative?)

# DEFENSE-IN-DEPTH IS NOT OPTIONAL

- Continued acceptance of nuclear power in the United States post-Chernobyl is largely predicated on the belief that US reactors have pressure-resisting containments
  - For SBO sequences, ice-condensers essentially have no containment at all
  - A functioning containment is not a safety "enhancement" but a requirement for adequate protection
- Focus on prevention only does not fully address common-mode vulnerabilities that can be exploited by terrorists
- Even if calculated cost-benefit differentials are marginal, NRC should give considerable weight to defense-in-depth when determining whether regulatory action is needed

# USE AND MISUSE OF LEVEL III PRA

- In Duke's initial SAMA analysis for Catawba/McGuire license renewal, it claimed that no hydrogen mitigation strategy was cost beneficial, even if cost exceeded benefit by less than a factor of two
- But to imply that the result of a Level III calculation could be specified to within a factor of two is absurd
- MACCS calculations are very sensitive to input assumptions
  - use of Alternate Source Term (RFs for I ~ 0.4 and Cs ~ 0.3) results in a nearly five-fold increase in 50-mile population dose compared to MAAP source term for Catawba (I ~ 0.06, Cs ~ 0.05)
  - Other assumptions (50-mile limit, timely evacuation) have major effect
- Application of cost-benefit analysis with inappropriate precision can lead to counterintuitive results, i.e. a needed upgrade must be cut in half to satisfy the backfit rule
  - Even if air return fans had turned out to be essential, the extra cost (a doubling) should not have been a decisive factor

# CONCLUSIONS

- Urgency of this issue requires mandatory regulatory action (not inconsistent with a performance-based approach)
  - MOX program at Catawba and McGuire will soon increase public health risks
- Proposed RES solution (pre-staged, non-safety-grade DG to power igniters only) is probably adequate to mitigate early CF, if terrorist threats are properly accounted for
  - but possible deleterious impact of air return fans needs to be resolved for non-SBO severe accidents
- High probabilities of late CF in SBO (0.71 and 0.56 for Catawba and McGuire, respectively) are of great concern and call into question whether ice condensers can be operated safely under any circumstances

# IN OTHER WORDS

- “For Heaven’s sakes, put those things in!” (Thermal-Hydraulic Subcommittee Chairman T. Kress, Nov. 7, 2002).

# Regulatory Effectiveness of Unresolved Safety Issue (USI) A-45, "Shutdown Decay Heat Removal Requirements"

# ACRS Presentation – November 6, 2003

NRC Office of Nuclear Regulatory Research

John V. Kauffman (jvk@nrc.gov)
Senior Reactor Systems Engineer
301-415-6830

# Background

- **Brief History of USI A-45**
- **Rationale for Approach**
  - Plant-Specific
  - Support Systems
  - In-depth Review Needed
- **Resolution Approach**
  - Incorporate as part of GL-88-20 IPE/IPEEE
  - Efficient
  - More Comprehensive than Stand Alone DHR Review
- **Final Scope of USI A-45**
  - SBLOCA, LOOP, Loss of PCS, Transients
  - Excluded LBLOCA, MBLOCA, ISLOCA, and ATWS

# Assessment Methodology

- Compare Expectations to Outcomes

- Expectations
  - Process Estabilished so that IPEs Would Be Performed
  - Vulnerabilities Identified
  - Risk Quantified

- Outcomes
  - Actual Outcomes From IPEs/IPEEEs and IPE Database
  - Summarized in Table 6 of the Report

- Was Risk Reduction Achieved?

- Was the Approach Used Reasonable?

# Detailed USI A-45 Expectations

- DHR Risk Categorization
  - C1–DHR CDF Less Than 3E-05
  - C2–Between 3E-05 and 3E-04
  - C3–Greater Than 3E-04
- DHR Vulnerabilities Would Be Identified If Present

# BWR Outcomes

- All BWRs in DHR Category C1 (Less Than 3E-05)
- No BWR Vulnerabilities Identified
- Many Enhancements Made
  - Cross Ties From Service Water or Fire Water to RHR
  - Procedure Change to Align LP ECCS Pumps to CST when SPC Can Not be Established
  - Allowed Use of Aux. Diesel Generator to Power ADS
  - Training Changes to Emphasize Timely ADS

# PWR Outcomes

- PWR Average non-SBO DHR CDF Less Than 3E-05 (Category C1), 11 PWRs Are DHR Category 2
- DHR Vulnerabilities Identified and Addressed At Calvert Cliffs
- Many Enhancements Made
  - Improve AFW Reliability
  - Improve Low Pressure Injection Systems
  - Improve Feed and Bleed

# Findings

- **BWR DHR Findings**
  - All BWRs are DHR Category C1 (Less than 3E-05)
  - No Vulnerabilities Identified
  - Mods Dissimilar Between Plants and Within Plant Classes
  - Other Activities Contributed to DHR CDF Reduction

- **PWR DHR Findings**
  - PWRs Average non-SBO DHR DHR Category C1
  - DHR Vulnerabilities Identified and Addressed at Calvert Cliffs
  - Mods Dissimilar Between Plants and Within Plant Classes
  - Other Activities Contributed to DHR CDF Reduction
  - Feed and Bleed Important

# Conclusions

- USI A45 Program Expectations Met
  - PRAs Performed for All Plants. NRC Staff Reviewed the IPE Methods and Results for Each Plant. DHR Risk Quantified, Understood, and Found Acceptable.
  - DHR Vulnerabilities Identified

- USI A-45 Program Approach Reasonable
  - Credit Taken Was Reasonable
  - Used Proven PRA Techniques
  - No Specific Generic Enhancement Identified
  - Over 500 IPE Enhancements Made

- Other Activities Contributed to DHR Risk Reduction
  - Station Blackout (USI A-44)
  - BWR Hardened Containment Vent (GL 89-16)
  - Seismic Qualification (USI A-46)
  - PORV and Block Valve Reliability (GI 70)

# Impact of Feed and Bleed

## Effect of Feed and Bleed on the Total Plant CDF from NUREG/CR-5230

| Plant | CDF/RY w/o F&B | CDF/RY w/F&B | ΔCDF/RY |
|---|---|---|---|
| Point Beach | 1.87E-04 | 1.39E-04 | 4.8E-05 |
| Turkey Point | 1E-04 | 7.1E-05 | 2.9E-05 |
| St. Lucie | 4.8E-05 | 1.4E-05 | 3.4E-05 |
| ANO-1 | 1.23E-03 | 8.8E-05 | 1.15E-03 |

## Impact of Feed and Bleed Capability on CDF

| SPAR Model | SPAR Model Baseline CDF* | SPAR Model CDF without Bleed Capability* | Delta CDF due to Bleed Capability* |
|---|---|---|---|
| Braidwood 1 & 2 | 6.7E-05 | 1.5E-04 | 8.6E-05 |
| Fort Calhoun | 1.8E-05 | 7.1E-05 | 5.3E-05 |
| Millstone 2 | 2.8E-05 | 8.6E-05 | 5.8E-05 |
| Sequoyah 1 & 2 | 3.3E-05 | 5.5E-05 | 2.20E-05 |

* CDF is calculated in terms of a per year basis. A year is defined as 7000 critical hours.

# Insights for Follow-on Activities

- T/H Analysis to Support Success Criteria
- Equipment and Procedures Credited in IPEs

# Generic Safety Issue 189

# Susceptibility of Ice Condenser and Mark III Containments to Early Failure from Hydrogen Combustion During a Severe Accident

Suzanne Black, Director
Division of Systems Safety and Analysis

Sunil Weerakkody, Section Chief
Division of Systems Safety and Analysis

Gregory Cranston
Lead Technical Reviewer, DSSA

Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission

November 6, 2003

# Purpose

- Provide ACRS the NRR Technical Staff position and basis to resolve GSI–189 for review and comment prior to presenting recommended resolution to the Commission

- Provide ACRS the opportunity to receive comments from applicable licensees, the general public, and other stakeholders regarding need to add backup power for combustible gas igniters installed in Ice Condenser and Mark III containments

# Background

- 1985 – Rulemaking retrofitted 13 plants with AC-powered igniters (9 PWR ice condenser and 4 BWR Mark III)
  - Controlled H2 burn to prevent deflagration/detonation
  - Beyond design-basis accident scenario
- Controlled H2 burn not available during station blackout (SBO)
- GSI-189 in response to SECY 00-198 (Risk-Informing 10CFR50.44, Standards for Combustible Gas Control System)

# Background (cont'd)

- RES conducted technical assessment with cost benefit analyses
  - Enveloping data (NUREGs) for generic application

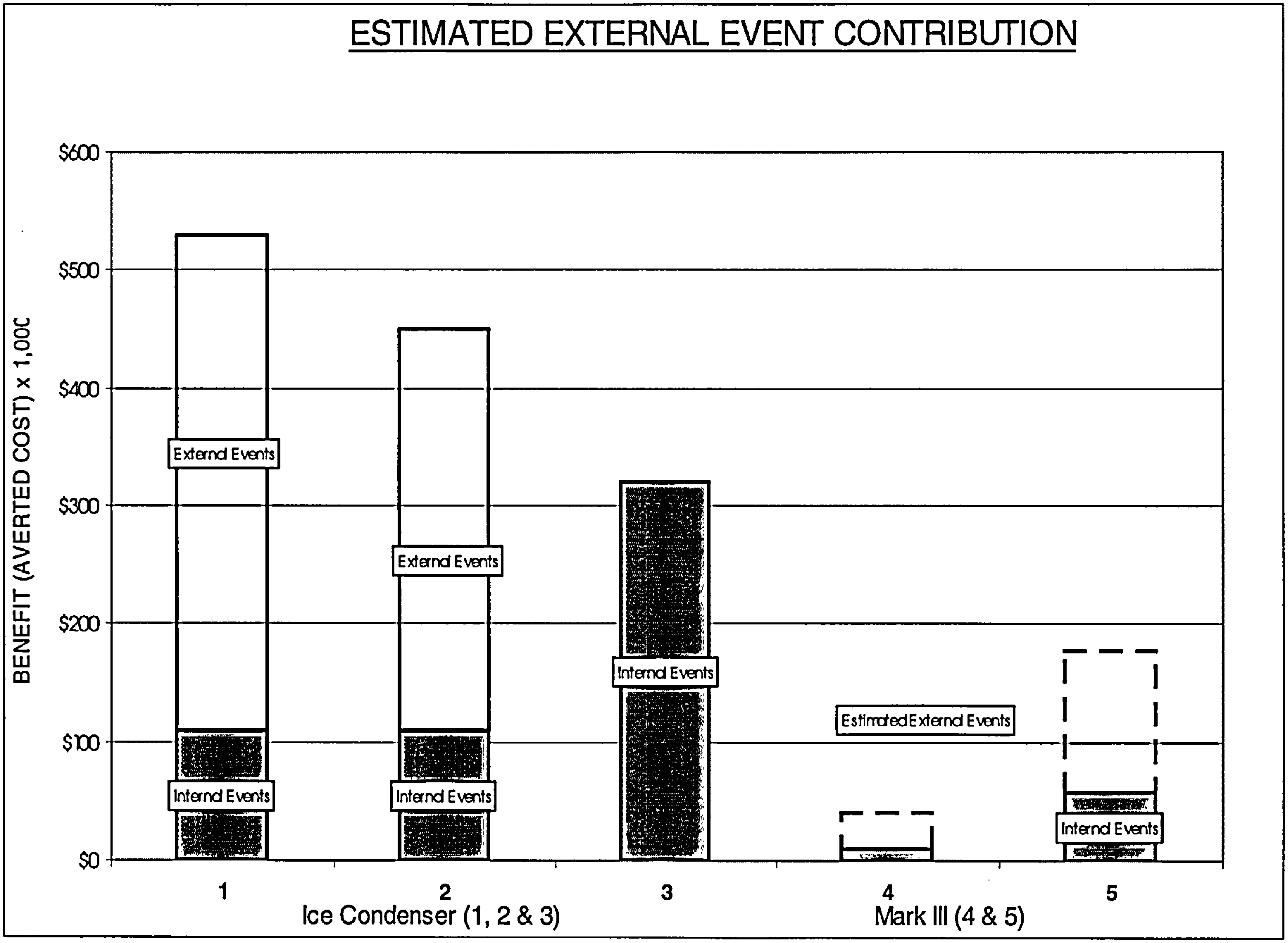
- Based on RES analyses ACRS concluded:
  - Regulatory Action warranted for GSI-189
  - Consider Defense-in-Depth (uncertainties)
  - Consider Public Confidence
  - Severe Accident Management Guidelines versus Order or Rulemaking

# Overview

- New Policy Issue
- Defense-in-Depth
  - Reg Guide 1.174 - Using Probabilistic Risk Assessment In Risk-Informed Decisions On Plant Specific Changes to Licensing Basis
  - ACRS Paper to Commissioners
  - Uncertainties
- 10CFR50.109(a)(3), Backfit Rule
  - Substantial increase in overall protection of public health and safety
  - Implementation costs justified
- Mitigation versus Prevention
  - NUREG/BR-0058, Regulatory Analysis Guidelines

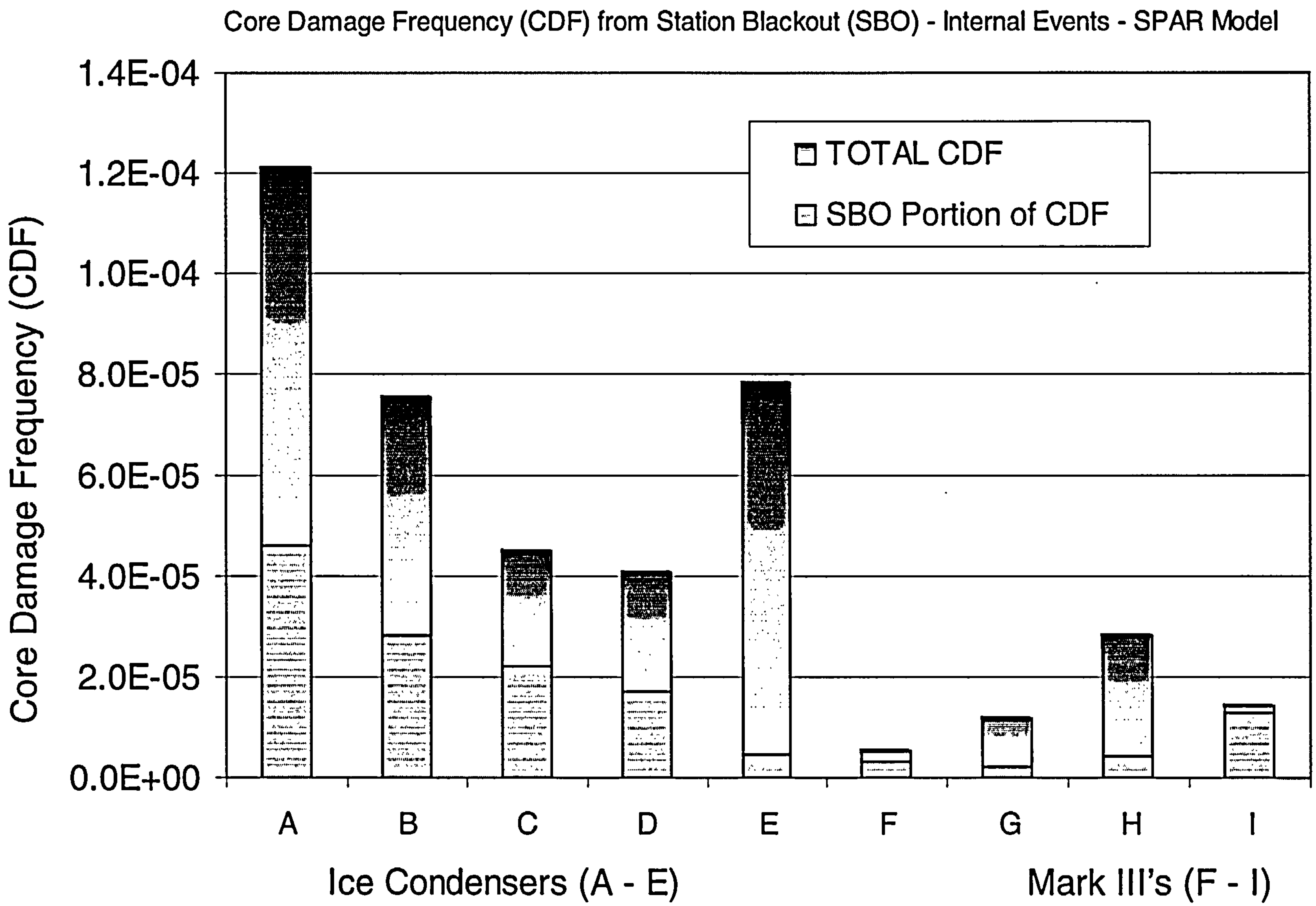
# Background (cont'd)

- NRR review
  - Regulatory significance
  - Regulatory basis
  - Regulatory options
- Defense in Depth - vital role
  - Limitation/uncertainties in cost-benefit
- Cost benefit analysis not decisive
  - Dependent on assumptions and uncertainties
  - All benefits not included (external events, avoiding late containment failure)
  - External events can be significant regarding averted costs (benefits)


ESTIMATED EXTERNAL EVENT CONTRIBUTION
BENEFIT (AVERTED COST) x 1,00C
$600
$500
$400
$300
$200
$100
$0
External Events
Internal Events
External Events
Internal Events
Internal Events
Estimated External Events
Internal Events
1
2
3
4
5
Ice Condenser (1, 2 & 3)
Mark III (4 & 5)

# Regulatory Significance

- Loss of Offsite Power, Common Cause Failure of Emergency Diesel Generators, and SBOs have occurred
- Core damage sequences resulting from station blackouts are credible
  - Depending upon plant, the SBO contribution may constitute a significant fraction of the core-damage frequency (CDF)


Core Damage Frequency (CDF) from Station Blackout (SBO) - Internal Events - SPAR Model
Core Damage Frequency (CDF)
1.4E-04
1.2E-04
1.0E-04
8.0E-05
6.0E-05
4.0E-05
2.0E-05
0.0E+00
TOTAL CDF
SBO Portion of CDF
A
B
C
D
E
F
G
H
I
Ice Condensers (A - E)
Mark III's (F - I)

# Regulatory Significance (cont'd)

- High containment conditional failure probability (CCFP) w/o igniters (typical values)
  - Ice condensers - from > 0.2 to ~ 0.9
  - Mark III (loss of containment) ~ 0.5
  - Mark III (drywell & containment) ~ 0.2
- Exceed containment performance Safety Goal (NUREG\BR-0058)
  - Higher CCFPs ($\geq$ 0.1) require greater staff action
  - Mitigative initiatives assessed on case-by-case basis

# Regulatory Significance (cont'd)

- Large Early Release Frequency (LERF)
  - Regulatory Guide 1.174 provides the Acceptance Guidelines for making a change
    - No Change Allowed if Delta LERF > 1E-6
    - Small Change OK if Delta LERF 1E-7 to 1E-6 and total LERF <1E-5

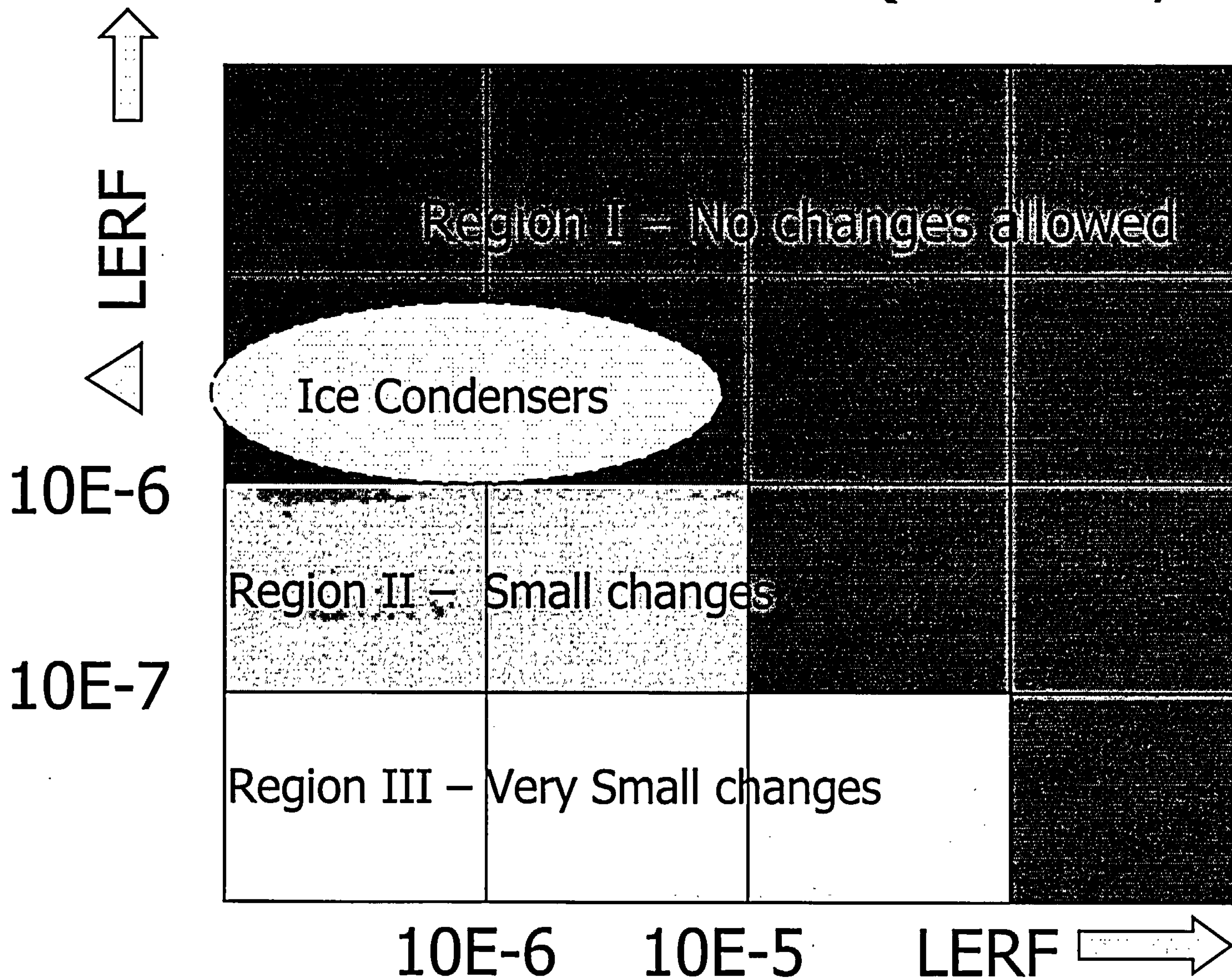
# Regulatory Significance (cont'd)

- Ice Condensers Delta LERF > 1E-6
  - Internal events

- Mark III Delta LERF between 1E-6 & 1E-7
  - Internal events
  - Considering external events could increase Delta LERF to > 1E-6.

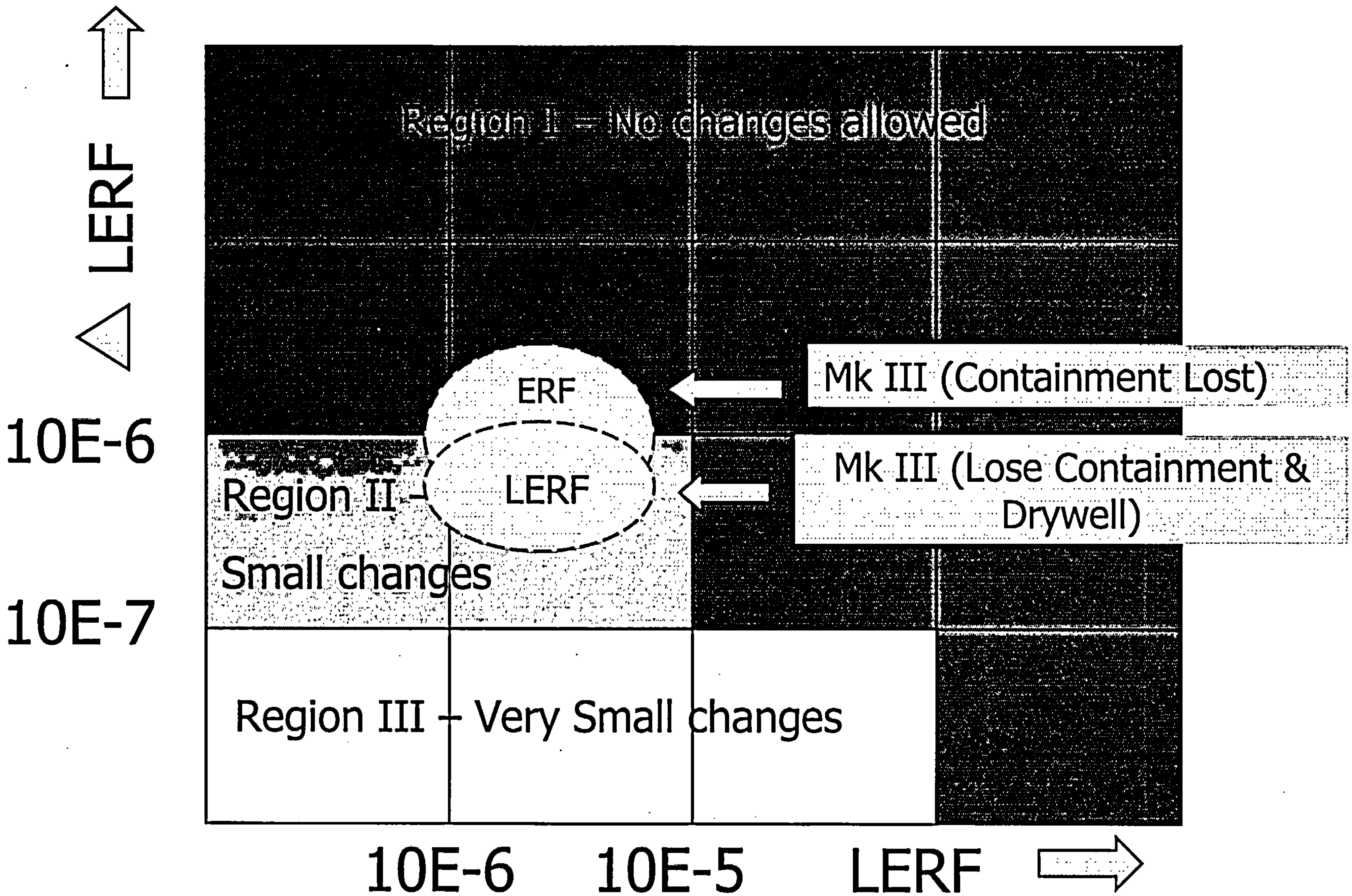
# LERF and Delta LERF Acceptance Guidelines

## Ice Condenser Containments (RG 1.174, Figure 4)



# LERF and Delta LERF Acceptance Guidelines

## Mark III Containments (RG 1.174, Figure 4)



# Regulatory Basis

- Defense-in-Depth
- Meeting Containment Performance Goal
- Change in Large Early Release Frequency (LERF)
- Cost-Benefit (Backfit)

# Defense in Depth

- Provide multiple means to:
  - accomplish safety functions
  - prevent the release of radioactive material
- Balance to ensure protection of public health and safety among:
  - core damage prevention
  - containment failure, and
  - consequence mitigation.

# Defense in Depth (cont'd)

- Accounts for uncertainties (RG 1.174)
  - Human performance
  - Equipment
  - PRA
  - External events
- To preserve:
  - Containment capabilities
  - System redundancy, independence, & diversity
- ACRS position on GSI-189: Defense-in-Depth considerations warrant further action

# Meeting Containment Performance Goal

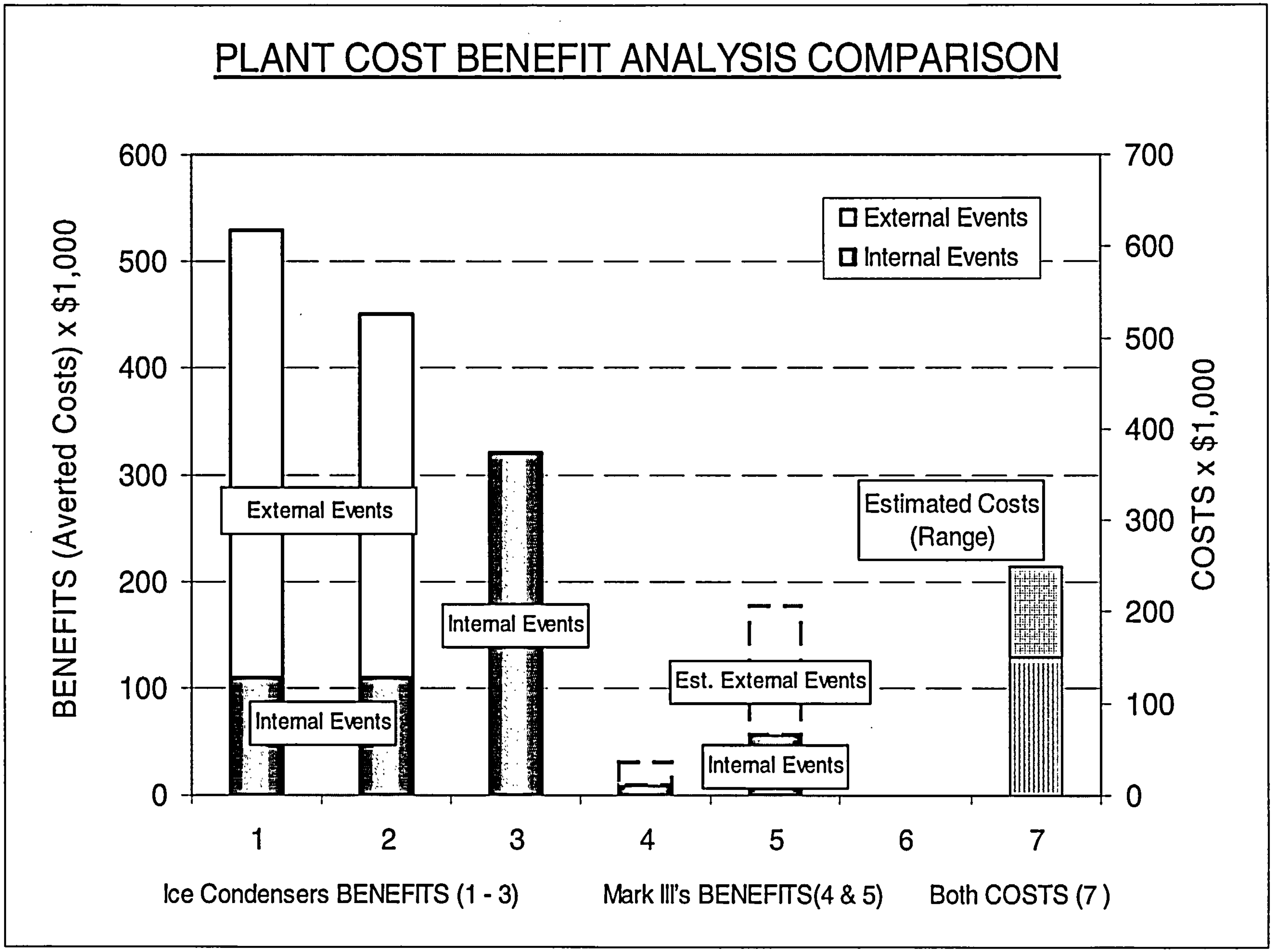
- Significantly reduce containment conditional failure probability (CCFP) to meet NUREG-0058 safety goal guidance
  - Ice condenser: from ~ 20 to 90% to <10%
  - Mark III (containment): from ~ 50% to <10%
  - Mark III (containment/drywell): from ~ 20% to <10%
- Prevent possible loss of containment with associated large release of radioactivity

# Change in Large Early Release Frequency (LERF)

- Change in Large Early Release Frequency (LERF) with Igniters
  - Ice condensers – delta LERF > 1E-6/yr
  - Mark III – delta LERF 1E-6/yr to 1E-7/yr (not considering external events)
  - Mark III - delta LERF (lose containment only, release scrubbed) can be > 1E-6

# Cost Benefit Considerations

- Per 10CFR50.109(a)(3), Backfit Rule applies if:
  - Substantial increase in overall protection of the public health and safety – reduced CCFP
  - Costs to implement are justified
- External events
- Costs are relatively low


PLANT COST BENEFIT ANALYSIS COMPARISON
BENEFITS (Averted Costs) x $1,000
COSTS x $1,000
600
500
400
300
200
100
0
700
600
500
400
300
200
100
0
External Events
Internal Events
External Events
Internal Events
Internal Events
Est. External Events
Internal Events
Estimated Costs (Range)
1
2
3
4
5
6
7
Ice Condensers BENEFITS (1 - 3)
Mark III's BENEFITS(4 & 5)
Both COSTS (7 )

# Regulatory Options

- Generic Communications
  - Generic Letters
    - Transmit information
    - Request information
    - Request action
    - Require action if a compliance issue
  - Information Notice
    - Transmit information

# Regulatory Options (cont'd)

- Generic Communications
  - Regulatory Issue Summary
    - Transmit information
    - Solicit voluntary licensee participation
  - Bulletin
    - Significant
    - Urgent
    - Compliance issue
    - Waives public comments

# Regulatory Options (cont'd)

- Order
  - Plant modification
  - Backfit Rule
  - Usually for urgent, compliance issues
  - Small number of plants
  - Little public involvement

- Severe Accident Management Guideline
  - Voluntary initiative
  - Implemented late in accident

# Regulatory Options (cont'd)

- Rulemaking
  - Plant modification
  - Backfit rule
  - Non-urgent issues
  - Large number of plants
  - Provides for public and stakeholder involvement
- Take no action

# Public Meeting and Feedback

- Public Meeting conducted June 2003
  - Discussed Rulemaking

- Licensee feedback from Public Meeting
  - Felt resources better spent on prevention versus mitigation
  - SAMGs may not be viable due to timing
  - Portable generators may create operator burden
  - Requested additional design guidelines

# Regulatory Action

- Advisory Committee on Reactor Safeguards – Regulatory Action Warranted
- Rulemaking – Position Taken by Technical Staff

# Summary

- No immediate safety concern – low probability
- Consistent with Defense-in-Depth philosophy
- Substantial safety enhancement
  - Significant reduction in containment conditional failure probability
  - Meet NRC risk acceptance & safety goal guidance
  - Consistent with NRC goal of maintaining safety
- Justifiable cost
- Rulemaking - Position Taken by Technical Staff

# Remaining Agenda Items

- Industry Presentation
- NRC Response
- ACRS Discussion