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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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599TH MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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THURSDAY

NOVEMBER 1, 2012

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ROCKVILLE, MARYLAND

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The Advisory Committee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., J. Sam Armijo, Chairman, presiding.

COMMITTEE MEMBERS:

J. SAM ARMIJO, Chairman

JOHN W. STETKAR, Vice Chairman

HAROLD B. RAY, Member-at-Large

DENNIS C. BLEY, Member

CHARLES H. BROWN, JR. Member

MICHAEL L. CORRADINI, Member

DANA A. POWERS, Member

JOY REMPE, Member

MICHAEL T. RYAN, Member

STEPHEN P. SCHULTZ, Member

WILLIAM J. SHACK, Member

JOHN D. SIEBER, Member

GORDON R. SKILLMAN, Member

NRC STAFF PRESENT:

DEREK WIDMAYER, Designated Federal Official

MAITRI BANERJEE, Designated Federal Official

EDWIN M. HACKETT, Executive Director

ANTONIO F. DIAS, Technical Advisor

JERRY BETTLE

DOUG COE

RICHARD CORREIA

KEVIN COYNE

BOB DENNIG

NRC STAFF PRESENT (CONTINUED):

BOB FRETZ

JIM GILMER

MICHELLE HART

TUAN LE

GREG MAKAR

JOHN MCKIRGAN

JOHN MONNINGER

ANDY PESSIN

BILL RULAND

MARTY STUTZKE

AARON SZABO

TOM TAI

HANRY WAGAGE

ALSO PRESENT:

TIM ANDREYCHEK*

PAUL GUNTER

SCOTT HEAD

STEVE KRAFT

MARY LAMPERT*

BOB LEYSE*

ROBERT QUINN

JIM RICCIO

CAROLINE SCHLASEMAN

ALSO PRESENT (CONTINUED):

JIM TOMKINS*

MARIN VAN HALTERN

*Present via telephone

C-O-N-T-E-N-T-S

C-O-N-T-E-N-T-S (CONTINUED)

P R O C E E D I N G S

8:31 a.m.

CHAIRMAN ARMIJO: [presiding] Good morning. The meeting will now come to order.

This is the first day of the 599th meeting of the Advisory Committee on Reactor Safeguards. During today's meeting the Committee will consider the following:

One, consideration of the economic consequences of land contamination within the NRC regulatory framework.

Two, role of filtered venting systems when installed in BWR Mark I and Mark II containments.

Three, long-term core cooling approach for the Advanced Boiling Water Reactor design for South Texas Project Units 3 and 4.

And four, preparation of ACRS reports.

The meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Mr. Derek Widmayer is the Designated Federal Official for the initial portion of the meeting.

Mrs. Mary Lampert from Pilgrim Watch has requested time to make oral statements regarding the economic consequences, land contamination briefing, and also on the role of filtered venting systems. We have also received written comments from Mrs. Lampert on these items.

There will be a phone bridge line. To preclude interruption of the meeting, the phone will be placed on a listen-in mode during the presentations and Committee discussion.

A transcript of portions of the meeting is being kept, and it is requested that the speakers use one of the microphones to identify themselves and speak with sufficient clarity and volume, so that they can be readily heard.

The first briefing will be chaired by John Stetkar.

John?

VICE CHAIRMAN STETKAR: Thank you, Mr. Chairman.

This morning we are going to hear a presentation from the staff on their summary of Commission Paper SECY-12-0110, Consideration of Economic Consequences within the U.S. Nuclear Regulatory Commission's Regulatory Framework.

Our Subcommittee on Regulatory Policies and Practices and our Subcommittee on Reliability and PRA reviewed this material during a joint meeting that was held on October 2nd.

For the Committee's benefit, the SECY Paper has already been submitted to the Commission. We are going to write our letter report on the material at this meeting. I understand the Commission is awaiting our opinions.

CHAIRMAN ARMIJO: With baited breath?

VICE CHAIRMAN STETKAR: With baited breath.

(Laughter.)

As Dr. Armijo mentioned, we have received two sets of written comments on the material from Pilgrim Watch. That material has been distributed to all of the members, and it will be entered into the record of this meeting. As Dr. Armijo mentioned, I understand that Pilgrim Watch has also requested time to make an oral statement regarding this matter. We will allocate time for that purpose and for any other public comments that might be forthcoming at the end of the staff's presentation.

With that, I will turn the meeting over to Kevin Coyne from Research.

MR. COYNE: Yes. Thank you, gentlemen.

My name is Kevin Coyne. I am the Branch Chief of the Probabilistic Risk Assessment Branch in the Office of Research and, also, a poor stand-in for Alicia Bone, who actually was the lead for the SECY Paper and had briefed the Subcommittee earlier in October. Alicia is on travel this week and, unfortunately, couldn't be here. So, I will do my best.

VICE CHAIRMAN STETKAR: She's the one who scheduled the hurricane?

(Laughter.)

MR. COYNE: Very good with that.

Just a couple of things. On the title, I want to point out the word "Framework". That is a word that is used a lot. In this context, it was in our tasking regulatory framework. Here we are referring to the body of regulations, policies, and past practices that define how the staff has historically considered economic consequences in the regulatory process.

Going into the purpose and agenda quickly, we wanted to provide a briefing on SECY-12-0110. As Dr. Stetkar mentioned, this is a little unusual in that the paper has already been submitted to the Commission. Due to timing considerations, we were unable to get to the ACRS Subcommittee and Full Committee prior to the paper being submitted to the

Commission. But the Commission has not made a decision on the paper yet, and my understanding is they are awaiting ACRS feedback. And in fact, their meeting SRM had indicated that they desired ACRS's feedback on the paper.

A couple of high-level topics I wanted to cover. We had a very detailed tasking for the SECY Paper. We will talk about that briefly.

We wanted to give a background on the NRC's legal authority to consider property damage, some background on how the NRC currently considers economic consequences arising from property damage, and various regulatory programs, provide an overview of the SECY options and the staff recommendation. And I also want to briefly provide some feedback on public meetings and Commission feedback.

It is probably just as good to do that right now. So, we had two public meetings on this topic, one in May and one in August. The May meeting was held very shortly after we received the initial tasking. It was more of a meeting to inform the external stakeholders that we did have the tasking, we were preparing a paper, but we really didn't have too many details to share with the external stakeholders at that time.

What we did come away with is there was strong public interest in the topic, external stakeholder interest in the topic, and, also, a desire to see the detailed tasking that the staff was working towards. So, we did make that tasking into a one-pager that is included in the SECY Paper, available to the public. So, external folks could see what the staff was working toward.

We had a much more substantial meeting in August, late August. The paper had actually already gone up to the Commission and been made public. So, we were able to provide a better overview of what was in the paper and the staff recommendations.

The main feedback we got from August is, again, there was strong interest from external stakeholders. There was an expressed desire for more transparency in how the staff considered economic analyses, particularly the innerworkings of the MACCS code that is used to support some of our economic analyses.

The external stakeholders who voiced an opinion also expressed an interest in Option 3 as a preferred approached. Although we didn't have a formal comment period, we did offer the opportunity for external stakeholders to submit written comments to support the Commission meeting. Those comments were provided to the Commission through SECY. We also provided all the comments that we received to the ACRS lead member after the Subcommittee meeting.

The Commission meeting we held on September 11th, two months ago. The main feedback we got from the Commission meeting was concern about the complexity of the issue and the relationship of this issue to other ongoing initiatives, such as NTTF Recommendation 1 and Risk Management Task Force followup.

That led to more concern that there has to be more of a holistic view on how this issue is approached and, also, a desire for more alternative benchmarking data, more information on how other federal agencies and other countries consider economic consequences in their regulatory process.

And the staff, since our last meeting, the briefing for the Subcommittee, has actually received a tasking from the Commission via meeting SRM to provide them additional information on benchmarking of other federal agencies and other countries.

I don't want to go into too much detail on this, but this is a snapshot in time. I believe it is April 29th, 2011. It is ground-level dose rates in the vicinity of the Fukushima-Daiichi plant.

I don't speak microsieverts, but the red color you see there is on the range of 1.9 to 9.1 millirems per hour, just to give you a perspective on the dose rates.

Not to make too much of an eye chart, the rings there are 20 kilometers, 30 kilometers, 60 and 80 kilometers from the site.

What the Fukushima accident had done is it had raised questions among the staff pertaining to a main issue that our understanding is the evacuation of the public in the vicinity of the site was largely successful. So, questions were raised as to, if such an accident would meet the agency's safety goals, in other words, health and safety were maintained, but there was still large economic disruption and large economic impacts. Is that where we want to be? Are we adequately considering economic impacts in our regulatory process? So, that was strong motivation to the tasking that the staff received.

A theme that will emerge over the next couple of slides is distinction between health and safety and economic impacts. The motivation for the paper isn't to go into how the agency handles health and safety issues. It is focused on how the agency handles the economic impacts that are decoupled from health and safety.

MEMBER CORRADINI: You are probably aware of this, but July 17th of this year, as part of the Parliament, the Diet Report, there is a mapping that I can provide, if you are interested, from their Japanese long report that actually shows these areas and how they are dealing with return to populations and how people are allowed in under various timeframes. I think that is probably more to your point.

MR. COYNE: Yes, that would be very valuable to us.

So, the status of where we are at right now. The staff received the tasking in early April with a due date of early August for the SECY Paper to go to the EDO. That was a fairly tight schedule for a paper of this complexity.

To address the issues -- and I should point out the tasking came from the EDO's office. It wasn't a Commission-directed action. It was an EDO-directed action to the staff. To address the tasking, an agencywide working group was formed. It included representatives from the Office of General Counsel, Research, and the major rulemaking offices, including

NRR, NRO, NMSS, FSME, and NSIR.

As I said, we held public meetings in May and August. We completed the SECY Paper in early August, and it was submitted to the Commission on August 14th. We held a Commission briefing on September 11th and a Subcommittee meeting was held on October 2nd.

There were a couple of followup questions we had from the Subcommittee meeting, and I believe we responded to all the information requests. There was a desire for the presentations from the Commission meeting, the public comments that we had received to date, and those were provided, and, also, some additional background information, such as NUREG/BR-0184 and another supporting technical report.

Just a quick comment on the schedule. Because of the essentially four months to write the paper, the staff had to focus on higher-level issues. One of the comments we got from external stakeholders, that it would have been beneficial to have more detail, more specifics, more examples of cost/benefit analysis in the paper. I don't disagree with that comment, but it just wasn't possible, given the timeframe and the constraints we had on the paper. So, the paper focuses on the higher-level issues rather than more in the details.

So, the tasking itself, and this was Enclosure 1 in the SECY Paper, is to provide a notation vote paper to the Commission with options to address the policy question. This following policy question, I have it reproduced verbatim here. It is, "To what extent, if any, should the NRC's regulatory framework modify consideration of economic consequences of the unintended release of licensed nuclear materials to the environment?"

So, "unintended" meaning it excluded issues such as radiation exposure devices and radiation dispersal devices. Those issues are being handled under a separate program that is run by NSIR. There is a short section in the SECY Paper that describes what is going on with those issues, but it is essentially out of the scope of this particular effort.

The tasking also included 10 relatively-detailed questions and subtopics the staff was to address. Those included description of the current process and guidance for use for addressing economic consequences, an overview of how the staff does severe accident mitigation, alternative and severe accident mitigation, design alternatives, SAMA and SAMDA evaluations, a description of any ongoing initiatives the staff has in progress related to the regulatory analysis, a legal analysis section.

And because of the motivation, how to tie to the safety goal and how the safety goal is applied in our regulatory process. There is also a description in the paper about a short history of the safety goal policy and some information pertaining to that.

I also want to talk about licensed nuclear materials. This is more than just reactors. The working group included representatives from the materials offices. The intend here is to cover the spectrum of licensed nuclear materials that could pose an adverse impact to the public.

So, with much trepidation, I plunge into the legal authority description. I see we have a representative from the General Counsel that I think you know very well from the Subcommittee meeting. So, I will give it my best shot, but we do have someone here who can give you the accurate and correct answer.

As I said earlier, there is a key distinction that this paper deals with, and it is the distinction between health and safety and economic impacts. Related to that are the NRC's requirements related to adequate protection.

In essence, adequate protection is a safety and common defense and security concern. In essence, the NRC is compelled to take action to achieve adequate protection of public health and safety. Regardless of cost, regardless of the economics of doing so, the agency is compelled to address adequate protection issues.

Adequate protection is a safety standard. It is not an economic standard. So, the economics of a particular decision can't be factored into the decision of whether adequate protection is met or not met. It is solely a safety standard.

I do want to make a side note that there are certain economic assumptions that affect safety, such as the consequence analysis and decontamination, cleanup costs, things like that as far as repopulation of areas that have been contaminated. Those economic decisions influence the safety aspects of the consequence analysis, but the economics themselves aren't factored into whether there is a safety benefit or not.

I am getting a nod. So, I am on good ground so far.

(Laughter.)

We will go to the second bullet, beyond adequate protection, the NRC also has the authority under the Atomic Energy Act to minimize danger to life and property. This is a discretionary authority where the agency can act to minimize danger to property, and we have used the term "offsite property damage" in the paper. It is a term of convenience to the staff. That term doesn't actually appear in the Atomic Energy Act, but it is a term that is more consistent with our staff guidance and the past staff practices.

There was some early concern in the paper that that offsite property damage term somehow limited the broader consideration of economic consequences, and it is not meant to do that. Offsite property damage includes the cost of damaged property or property that must be abandoned and relocation of the public from areas that have been contaminated. Loss of business revenues and agricultural impacts are all covered by that umbrella of offsite property damage.

MEMBER POWERS: When you talk about minimums, I mean you have selected that term because you are balancing two competing things. What are the two competing things?

MR. COYNE: The two competing things in reference to --

MEMBER POWERS: Yes, you have got a minimum. You have got to have something you desire, something you want to avoid, or something how to get to a minimum. Otherwise, the minimum is zero.

MR. COYNE: In reference to a cost/benefit analysis or --

MEMBER POWERS: Minimized danger.

MR. COYNE: Oh, minimized danger.

MEMBER POWERS: Yes.

MR. COYNE: Yes, I will defer how that is interpreted to Andy Pessin from the Office of General Counsel.

MR. PESSIN: The statutory authority says to minimize danger to property. That is what is in the Atomic Energy Act. So, it would be any action the NRC would take to regulate its licensees to minimize danger to property, and how that is applied would be on a case-by-case basis.

I am not sure if I understand the question. Minimized danger could be minimized all the way to zero, theoretically. Is that --

MEMBER POWERS: Well, I am familiar enough with the Atomic Energy Act that I know, I suspect that what they are balancing is the promotion of nuclear, use of nuclear energy versus potential damage to the property.

MR. PESSIN: Right. There is no requirement that -- yes, that is throughout the AEA -- there is no requirement that we regulate. This is a risk. So, I mean, it sets the standard. It is simply just independent discretionary authority the NRC has. When we are taking into account whether we are going to regulate or license an entity, we can also take into account that they minimize danger to property.

MEMBER POWERS: I mean, here is what ultimately comes down to my problem. That when you are seeking to minimize damage, and at the same time you do not want to preclude the use of nuclear power, you have got to have two things, one going up and coming down, so that you can get to a minimum. But nothing in your list there has the one that is going up. These are all costs.

MR. PESSIN: Right.

MEMBER POWERS: It didn't have anything -- if I minimize those, they are all at zero. Okay. I have got to have something resisting that to get to an actual minimum.

MR. COYNE: Would it be fair to say how the staff implements that part of the Atomic Energy Act is what does that balancing through the backfit rule and regulatory analyses? And that is for the analyses. It is implemented from the staff perspective.

MR. PESSIN: The balancing is a policy question. It is really not a legal question. There is no legal formula in the Atomic Energy Act or anything that we have teased out as far as I can tell over the last several decades where you have this failure of balancing it out, as you posed it.

So, that comes down to more of a policy issue as to, when we regulate or license an activity, do we want to take minimizing danger into account? And if so, how do we do it and how far do we go? And that is really a policy call. There is not a legal formula to do that.

MEMBER RYAN: Has there been any licensing action or other kind of action that the agency has taken to clearly define it at all?

MR. PESSIN: Not that I am aware of. It is an authority that really has not been used extensively.

MEMBER RYAN: Okay. Thanks.

MR. PESSIN: You are welcome.

MEMBER CORRADINI: Just to make sure I understand your answer to Mike, so there is no practical example historically?

MR. PESSIN: Not that I am aware of.

CHAIRMAN ARMIJO: And it is discretionary? It is not a mandated activity?

MR. PESSIN: Yes, sir. The authority on minimized danger to property is discretionary.

MR. COYNE: Perhaps as we go on, how the staff considers it will help address that question, if there is still a remaining question on that.

The working group that was formed went through a regulatory framework and identified three main areas where the staff considers economic consequences arising from offsite property damage:

Regulatory analysis, which is a structured analysis of proposed requirements of the many benefits and costs. It is done for information to provide to the decisionmaker.

Backfit analyses, when determining if a change in the requirements to a licensed facility represents a substantial increase in safety and is cost-justified. There are backfit regulations not only in Part 50, but also Part 70, 72, and 76. There are some ordering differences between them, but they generally follow the same framework. When we talk about backfit, we also usually include the finality provisions in Part 52, which are similar in nature to the backfit requirements of Part 50.

And finally, the National Environmental Policy Act analyses, which generally refers to the SAMA and SAMDA reviews that are done for operating reactors, and we will go through each one of these in a little more detail in a subsequent slide.

So, regulatory analysis is the broadest type of analysis that is done. It is identify and evaluate the likely consequences of regulatory action. It is a decision tool for policymakers. It provides the rationale for the action that the agency is considering, and it is intended to provide more transparent agency decisionmaking.

The NRC has been conducting regulatory analyses since the late seventies. There is an OMB Circular A-4 that provides guidance on regulatory analyses. Due to the nature of the NRC, that is not a mandate on us to follow that, but the NRC does voluntarily comply with Circular A-4.

The key thing with regulatory analysis is that it is an information tool. Senior managers in the NRC can exempt out of doing the regulatory analysis if it is warranted, but it is intended to increase transparency and provide information to decisionmakers.

Guidance documents. The staff uses -- and these will come up in subsequent discussions, too -- the staff uses two main guidance documents to support regulatory analyses. It is NUREG/BR-0058, which is a regulatory analysis document, and then a technical analysis handbook, NUREG/BR-0184, which provides parameters and more detailed information on how to conduct a cost/benefit analysis. We will see those guidance documents again because they are used in all three of these areas to some extent or another.

Backfitting and issue finality. So, the purpose of backfitting from a high level is to provide regulatory stability, ensure reasons, and inform agency decisionmaking and transparency in agency decisionmaking. We have looked at the main backfit provisions that exist in the reactor materials areas.

VICE CHAIRMAN STETKAR: Kevin, I didn't see it. You said you were going to mention the NUREGs. I didn't see a separate slide on them. Just for the Committee's benefit, when was the last time 0184 was updated?

MR. COYNE: Unless somebody in the audience knows, it was the mid-nineties when 0184 was updated. It was based on NUREG-1150 information. And so, it is dated and doesn't include advances in staff knowledge since that time period. So, additional severe accident experiments, the CERCLA project, things like that.

VICE CHAIRMAN STETKAR: Okay. Thank you.

MR. COYNE: Addressing that next bullet is best handled on the next slide.

So, backfitting is generally a four-step process. The rules differ between reactors and materials, but they generally follow a very similar format.

The first and second steps in the backfitting process, there are distinct steps, but there are essentially screening questions to determine is the action, first of all, subject to the backfit rule. So, voluntary initiatives, staff positions that can be implemented on a voluntary basis. Probably an example closest to my normal area is risk-informed regulatory license changes aren't subject to backfit provisions because they are voluntary provisions that a licensee could choose to follow if they so desire.

The second step is if there is, indeed, a backfit. A backfit covers a number of things, but a modification or addition to system structure or component design or procedures, new or amended rules or staff positions interpreting Commission rules, a new or different position from a previously applicable rule or staff position. So, there is an analysis that is done to determine whether the proposed staff action constitutes a backfit.

The third step is if one of the exceptions to performing a backfit analysis applies, and there are three exceptions that are listed in the rule. If the proposed change is needed for compliance, then no backfit analysis is needed and the action can be implemented. If the proposed is necessary for adequate protection or it is a defining or redefining what constitutes adequate protection, then, in that case no backfit analysis is required, and the agency can move forward with implementing the proposed action.

Under Option 3 of the paper -- and we will talk about the options in a moment -- but we have outlined a few areas where the working group felt that the regulatory framework could potentially be modified as an alternative to explore. This is one of the areas under these exemptions where you could envision a potential modification to the backfit rule, where you could have some exemption built on economic consequences, for example

I do want to say that it is a very preliminary proposal from the staff, then, that hasn't been fully investigated and would need to be explored if the Commission chooses to pursue Option 3. But I did want to highlight this particular paragraph as one of the areas where you could envision a change to the regulatory framework.

The fourth step in backfitting has two parts, and these parts are melded together in one sentence in the backfit rule, but they truly are distinct and the staff handles them as two separate questions.

The first is that the proposed backfit provides a substantial increase and protection to public health and safety or common defense and security. So, this is safety-based standard that the staff is judging against. It does not include economic consideration when the staff makes this decision. It is solely a safety decision from a benefit standpoint for public health and safety and, of course, common defense and security.

Probably the easiest example of how the staff applies this is in NUREG/BR-0058, where we have a safety goal screening criteria that looks at the Delta core damage frequency or the change in conditional containment failure probability, although I think the terminology is a little different in NUREG/BR-0058, where the staff looks at the Delta for, say, CDF or the proposed change, and there is a table that you would enter that tells you how to handle that action.

For those issues that can be easily screened by CDF, there is more of a LERF-based criteria. That screening criteria works great. If it is an issue that doesn't lend itself to using those metrics, then it is a little more difficult for the staff to make that substantial increase in protection decision.

Then, the fourth step, part two, is where we see the economic consequence analysis come in, and this is where we look if the cost of the backfit is justified in light of the increase in protection. Dr. Powers, this may be one area where, from an implementation standpoint, where the staff tries to achieve that balance of the cost/benefit of, say, protecting property versus what the cost to the industry would have to be borne to achieve that level of protection.

When the staff does that analysis, the backfit rule has specific questions that need to be answered, but they are very similar in nature to the kinds of questions that are answered by regulatory analysis. So, the staff used similar guidance documents to do the backfit analysis.

There is one additional NUREG that is used to support the backfit analysis. That is NUREG/BR-1409, which provides guidance specific to backfit. But the staff also uses NUREG/BR-0058 and 0184 to support that analysis.

VICE CHAIRMAN STETKAR: Before you go to the NEPA, we had a little bit of discussion about this in the Subcommittee meeting. I was, quite honestly, writing some notes here.

I want to make sure that the full Committee members understood these two steps. That if a proposed backfit satisfies the criteria -- you called the safety goal screening criteria that you have characterized as part one here -- if, and only if, it satisfies the criteria that it could result in a substantial increase in protection of the public health and safety, then, and only then, is the economic analysis performed. Is that correct?

MR. COYNE: Correct. Correct. It is a screening step. You have got to get through that to get to the cost/benefit.

MEMBER CORRADINI: And that an order-of-magnitude judgment.

VICE CHAIRMAN STETKAR: That is an order-of-magnitude judgment. The only time economic costs are considered, consequences are considered, is if you pass that first screening?

MR. COYNE: Correct, as far as the backfit analysis.

VICE CHAIRMAN STETKAR: As far as the backfit analysis.

MEMBER CORRADINI: So, can I just say it practically, because I remember you trying to tell that to us. So, you are saying if you see a factor of two there, that may not be sufficient to proceed to the next step?

VICE CHAIRMAN STETKAR: A small change, a small potential change, I believe -- and I want to make sure that I understand this also -- a small potential change, reduction in dose to the public, for example, might not satisfy that first criterion, even though there could be a large change in economic consequences?

MR. COYNE: Correct.

VICE CHAIRMAN STETKAR: So, therefore, the next step of the process would never be invoked to evaluate what that change in economic consequences might be? Is that correct?

MR. COYNE: Correct.

VICE CHAIRMAN STETKAR: Okay.

MR. COYNE: I also want to point out that the examples that can be done quantitatively are sometimes easier for engineers like me to understand. The staff can also do a qualitative evaluation to make that case.

VICE CHAIRMAN STETKAR: Sure. But however the decision is made, whether it is quantitative, qualitative, or a mix of the two --

MR. COYNE: Right.

VICE CHAIRMAN STETKAR: -- if it does not pass that first screen, then the economic consequences are never factored into a decision?

MR. COYNE: Right.

VICE CHAIRMAN STETKAR: Okay.

MR. COYNE: And thank you for stopping me there because I had an important note on my page that I failed to mention, which is, under Option 3, this is another point that could be addressed by the staff. You could envision an addition to that part one that looks at a substantial increase in protection of public health and safety or substantial reduction in economic consequences of a severe accident would be another framework change that you could potentially envision.

MEMBER SIEBER: I presume that in terms of risk metrics, the guidance in Reg Guide 1.174 is a controlling regulatory document. In other words, if you have a plant that represents a very small risk to the public, can you ask for a backfit that maybe even doubles that risk, but the risk is so small to begin with, that would not qualify?

MR. COYNE: The metrics in NUREG/BR-0058 -- and there is a table that I am having a hard time pulling up the exact axes on the table -- but they are not dissimilar to Reg Guide 1.174, though I think the interpretation is just a little bit different. I think that is a question I have to get back to the Committee on.

MEMBER SIEBER: Okay.

MR. COYNE: Unless somebody knows it in the audience.

MEMBER SIEBER: Anther part to that question is not in terms of the risk of an accident, but in the dose the public might receive. For example, if you would backfit a plant in such a way that the dose, which is already de minimis to the public, is cut in half, cut by a factor of 10, is there some kind of qualifying issue that says, even if the action has occurred without the backfit, the dose to the public would be de minimis and, therefore, the need to backfit the plant to cut that by a factor of two or a factor of ten is of small consequence? What I am trying to do is draw the connection or distinction between the risk factor and the dose factor.

MR. COYNE: In other words, is it a relative-risk measure or is it a more absolute risk measure?

MEMBER SIEBER: Yes, and is it in terms of dose to the public? For example, the public may not be too thrilled receiving over the course of a year or a lifetime an addition 500 millirems of committed dose by staying where they are. On the other hand, you know, that is generally considered under radiation protection standards to be relatively de minimis.

MR. COYNE: We have most of the key members from the working group here that routinely do this type of analysis. So, I will make a statement, and then I will see if any of them object to it.

I think the answer is, the staff practice for assessing that has been looking at the absolute case of what the actual change in public health and safety is rather than looking at more relative to the facility. So, it is an absolute criteria rather than a relative criteria.

Aaron, is that -- thumbs up.

MEMBER SIEBER: Okay. I will need to ponder that a little bit, but thank you for your position.

MR. COYNE: Okay.

MEMBER BLEY: I hadn't thought much about this until you brought it up. What it says here is something like the issue of land contamination alone isn't sufficient to require an analysis. On the other hand, if you get substantial land contamination, it certainly is a safety issue, unless you say, we evacuate it, nobody gets a dose. I don't know how that plays out in implementing this thing.

And the other piece of it is the kind of severe economic damage issues that you pointed out for overseeing this area to the country. I am not sure how you argue that is, in effect, common defense and security if it is really strong. So, these things are highly interrelated.

Certainly, these two steps aren't clear to be, how they would actually be applied in application.

I think you could go almost either way, depending on how you weigh those different pieces of it.

VICE CHAIRMAN STETKAR: And I am not familiar enough with it, either, personally. I haven't had enough time to dig into the examples, as Kevin mentioned.

But this notion of using CDF and LERF, and saying, well, we will take benefit from SOARCA insights, seems to imply credit for evacuation, shielding, timing of things which could --

MEMBER BLEY: And if you do all those, maybe you take things off the table --

VICE CHAIRMAN STETKAR: That's right.

MEMBER BLEY: -- through those efforts.

VICE CHAIRMAN STETKAR: That's right. Maybe. I don't know.

MEMBER BLEY: Yes, it seems a real maybe.

MEMBER SIEBER: And built into all this is the assumption that the public will do whatever the recommendation is, as opposed to recent and past examples of public behavior during emergency situations.

MEMBER BLEY: You are thinking of the last three days.

(Laughter.)

MEMBER SIEBER: That is one example, but the other example was TMI. There were people where there was no recommendation to go on --

MEMBER BLEY: Yes.

MEMBER SIEBER: So, a few people went as far as a thousand miles away out of fear, whether it is rational or not. So, I presume built into this is that the public does what they are advised to do.

VICE CHAIRMAN STETKAR: By the time this is done, you will have your law degree.

(Laughter.)

MR. COYNE: The next area where economic consequences are considered by the staff is are evaluations or reviews done pursuant to the National Environmental Policy Act, or NEPA? And the key thing here is that NEPA requires federal agencies to analyze potential environmental impacts of proposed actions and any reasonable alternatives to that action.

The other key thing with NEPA is that it is a procedural statute. It doesn't mandate a particular outcome. So, the agency must take a hard look at the potential environmental impact, but the alternatives that are evaluated, even if there are cost-beneficial alternatives that are evaluated, the agency isn't required to put those into place. In fact, NEPA would not give the agency the authority to mandate that a particular action be put into place. We would have to go through another analysis, like a backfit analysis, if we wanted to put something that is identified for NEPA in place. So, NEPA, in and of itself, doesn't give the agency additional authority. It just provides information to decisionmakers, similar to a reg analysis, and then also looks at these alternatives.

The last bullet is probably the most pertinent for NEPA relative to economic consequences. The place where this comes up is in the reactor arena, when the staff evaluates severe accident mitigation alternatives and severe accident mitigation design alternatives. So, I still struggle with the distinction between these terms. SAMA is the broader term. Design alternatives are generally, although not always, associated with plants that are still in the design phase where you could make significant design changes to the plant. Whereas, things that are within SAMDA, but are not considered design alternatives, would be things like procedure changes or simple modifications a facility could make. For better or worse, I think maybe the vernacular, SAMAs are most license-renewal type of issues, and SAMDAs are more new reactor licensing type of issues.

So, the purpose, as I said, is to look at identify and evaluate various alternatives and see if there are alternatives that are beneficial from an environmental standpoint and a cost standpoint. These types of reviews apply to reactor facilities. They are not done for materials facilities.

Generally, they are done for Part 52 licensing, Part 50 licensing, although I think that is a fairly limited use, limited work authorizations under Part 50, license renewal, as I said, and design certification.

And the same analysis uses -- again, the same guidance documents come into play to some extent in NUREG/BR-0184 and those types of things. There is also more of, I guess -- I haven't vetted this term with the rest of the people that do this -- but a pseudo-Level 3 PRA analysis. There is some form of a consequence analysis that is done. It is not a full Level 3 PRA, but there is some analysis that is done using the best available information to go through those reviews.

VICE CHAIRMAN STETKAR: Kevin, the second sub-bullet under the second bullet, if an applicant came in today for licensing a new plant under Part 50, would they be required to do a SAMDA analysis, with a "D", as part of that licensing process?

MR. COYNE: I will look to the expert here.

Michelle?

VICE CHAIRMAN STETKAR: I understand how it works under Part 52. I have seen that, but --

MS. HART: I am Michelle Hart. I work in the Office of New Reactors.

Obviously, we haven't had that situation yet. I think that we would do that. I think the difference is there is not a safety requirement to look at design alternatives like there is in Part 52. But I think that we would look at SAMA and SAMDA as part of the EIS that we would do for NEPA.

CHAIRMAN ARMIJO: But was it done in the past?

MS. HART: In the past, my understand is no.

CHAIRMAN ARMIJO: No, I didn't think so.

MEMBER SHACK: But the NEPA requirement came after most of those.

MS. HART: Post-Limerick.

MEMBER SHACK: Yes.

MR. COYNE: Okay. So, the key staff

conclusions from going through all this information is that the staff does have sufficient flexibility to consider economic impacts arising from offsite property damage through the various programs I just outlined, the reg analysis, the backfit, and the environmental reviews that deal with SAMA and SAMDA.

However, in going through it, the staff did note that there would be benefit to increased coordination, and that would help increase staff efficiency in this area. That probably needs a little more explanation than maybe what is contained in the SECY Paper.

Historically, the rulemaking function for the agency came out of the Office of Research. So, it was a centralized location to handle rulemaking issues.

Sometime in the not-too-distant past, on the order of 10 years ago or so, the rulemaking functions moved from the Office of Research down into the program offices. So, NRR, NRO, FSME, all have their own rulemaking groups that does these analyses and implements these programs.

That had a great benefit to the agency. The rulemaking group can be much more aligned with the mission of the particular offices and much more knowledgeable about the rulemaking issues that each office is facing.

The downside to that decentralization is there is no longer a central group -- that historically had been the Office of Research -- that is coordinating the more programmatic aspects of guidance document development and policy issues across the agency.

So, this paper was actually a good opportunity to recognize that there is at least that potential with the decentralization, to potentially lose coordination and an overall agency prioritization over these types of activities. So, you will see this when I go through the recommendations, that even for the status-quo recommendation, we do note the need for an increased attention to consistency across the program offices and how these programs are implemented, and then Option 2 tries to take it even a step further.

In addition, the staff identified a few areas where the regulatory framework could potentially be changed. The option that deals with framework changes is Option 3. That is written right now not to recommend any particular alternative, but to recommend that, if that option were selected by the Commission, that the staff would explore alternatives to changing the framework and better define what those alternatives and potential changes would look like.

So, three options in the SECY Paper, and I guess there is an unwritten law that Option 1 has to be the status quo. But, in the case, the status-quo-plus, which is essentially maintaining what the staff has been doing historically plus addressing this need for increased consistency, or at least address the potential for lost consistency across the program offices.

So, we recognize the need that having this working group together, and having all the offices that do rulemaking talking to each other on some periodic basis, is a good thing. So, Option 1 would include continuing that forward to make sure we --

CHAIRMAN ARMIJO: But that is an option you don't need Commission direction to do that.

MR. COYNE: Correct.

CHAIRMAN ARMIJO: The EDO can say, "Let's do a better job of managing this issue."

MR. COYNE: Absolutely.

CHAIRMAN ARMIJO: Okay.

MR. COYNE: Absolutely. And in fact, I should point out, Options 1 and 2 the staff does not believe would constitute any framework change, meaning Commission direction to do that. There may be some budget implications, particularly for Option 2, that would have to be handled by separate budget processes. But the key feedback we got from the Commission meeting on September 11th is the Commission seemed in agreement that the staff could also implement either Option 1 or Option without further Commission direction. Option 3 would need a Commission decision to pursue that.

MEMBER BROWN: Can I ask a question? If you go back to the previous slide, the first bullet says staff, after your previous discussions, "has flexibility to consider offsite property damage," but you really haven't. I mean, that has really not been done in the past relative to the licensing process. That is the flavor I got out of your previous part.

Then, I look at the next page, and it says, if we wanted to do, we have kind of got the blessing under the status quo in Option 2 to say, yes, we could expand our horizon a little bit. Is that relative to property damage?

MR. COYNE: Right. The staff --

MEMBER BROWN: Or contamination, however you frame it?

MR. COYNE: The staff does consider economic consequences today and has historically considered it within those various programs, the reg analysis, the backfit rules, and under the SAMA and SAMDA reviews. So, it is done today and has been done historically.

MEMBER BROWN: Yes, but I only got the economic part is if you met the health and safety part before you got into any type of economic analysis, which is part of John's and Dennis' comments earlier.

MR. COYNE: Right. For backfit analyses, that is true. You have to through the substantial safety increase before you got to the economic piece. That is a true statement.

MEMBER BROWN: For new design licensing? Where does it come about? Did I miss something? I thought we did.

MR. COYNE: Well, for new reactor licensing, the SAMA/SAMDA process could be used to identify potential alternatives if the agency was going to require that a particular alternative be done based on the results from the SAMA or SAMDA analysis --

MEMBER BROWN: Something not proposed by the licensee?

MR. COYNE: Right.

MEMBER BROWN: You would have to tell the license, "Hey, you really need to do more," and you can put that on the table, and then have to do the economic analysis on that basis?

MR. COYNE: And then, we would have to use another -- we couldn't use NEPA to enforce that. We would have to use some other regulatory authority to have an applicant put that into place.

MEMBER CORRADINI: But you would have the authority. I think what Charlie is asking, unless I misinterpreted, you do have the authority from the second part of your framework to minimize?

MR. COYNE: I will defer to the NRO folks on this. You know, finality comes in when the license is done.

MEMBER BROWN: Where does that line fit as you go back and forth with the considerations here? How far do you go?

MR. COYNE: Andy?

MR. PESSIN: Andy Pessin, OGC.

We do have the authority under the statute to minimize danger to property. The question, then, becomes, does that action or regulatory step, does that constitute a backfit? If it doesn't constitute a backfit, then we can go ahead and apply it. If it does constitute a backfit, then we have to follow the backfit rule. Of course, if it doesn't have a substantial increase in public health and safety or common defense and security, it is going to get kicked out unless it meets one of the exceptions.

One thing that I don't think was mentioned is there is an administrative exemption under the backfit rule which basically allows the Commission to, in a sense, ignore the backfit rule for policy reasons and go ahead and implement the measure, but that doesn't happen very often.

But I guess the key point is, again, if the measure doesn't constitute a backfit, you don't even look at the backfit rule.

MEMBER SHACK: I think Charlie's question was more in the context of the SAMDA. You know, when you come to the SAMDA, the guy can look at the result, but he is unlikely to meet the safety requirements because he is already well below those. But what does he do with the SAMDA? Is it something that he is just required to do, and sort of like the SAMA, you have no way to really enforce it?

MR. COYNE: Right. I think it is a nuanced question because it is applicant, not a licensee or a certificate-holder. So, I am not sure how -- I am sure NRO has ways of dealing with that particular situation to achieve a commonly-agreed-upon focus. But I am not sure that if a backfit necessarily would be what would apply to an applicant. Is that correct, Andy?

MR. PESSIN: No, a backfit is going to apply to a licensee.

MR. COYNE: Right. So, I think it is a little more nuanced, how that particular situation would be dealt with by NRO.

Shaking heads yes.

MEMBER SHACK: They are not going to volunteer any more data.

(Laughter.)

MR. COYNE: Apparently, they are not going to volunteer.

MEMBER CORRADINI: Can I ask a slightly different question, but it is something that Charlie raised? You don't have to go back to the slide, but it is the slide where you are in the backfit, it essentially was like an "if, then" instead of an "and".

So, I don't have a problem with that personally.

MR. COYNE: Right.

MEMBER CORRADINI: I think I understand the logic and I guess I would personally support this approach. But if you are to take the "and" approach, is there something that, if you considered only economic analysis, something would rise to the fore that wouldn't be safety-related? I can't see anything, but John asked it much more elegantly maybe in the Subcommittee.

But the same sort of thing, that if I looked at it in parallel, I would come to a different set of things to concern myself about it versus safety first and then economic consequences or non-safety --

MR. COYNE: I am not sure that we have an example where that has been the case in the past backfit considerations. Rather, Aaron, are you aware of anytime where we screened something out where you think that the economics would have -- no?

MEMBER CORRADINI: That is kind of a loaded question, though, because --

MR. COYNE: It is.

(Laughter.)

VICE CHAIRMAN STETKAR: I suspect nobody is going to admit that they really thought about the economics after something was screened out.

MR. COYNE: And that is something that we didn't have. You know we really didn't have a chance to go into that level of detail in the paper.

MEMBER CORRADINI: Okay.

MR. COYNE: But what you said is true; it is an "if, then," that you have to get through the substantial safety increase before you get to the cost/benefit, the way the process works.

MEMBER CORRADINI: I guess the only reason I am bringing this up is because I think Dana has brought up probably the key point to relative to, if you are going to use the word "minimize," it has got to be minimize something. So, if would have to almost define, then, in some manner if you were going to go through this sort of analysis. I am actually happy that it is secondary because I don't understand, if it were equally primary, what you would do.

MEMBER POWERS: It seems to me that when I come back to the minimize danger to the property, that in addition to the cost that they have listed on the slide, they need to somehow incorporate the benefit of the activity. The value of getting electricity from a nuclear power plant has to be incorporated in that, or you cannot arrive at a minimum. And I don't know have expansive that definition of the value of the electricity is.

Do you incorporate in the assessing the that value, such as the reduction in greenhouse gases, which becomes a very difficult analysis to do, challenging to a practical man in the NRO, for instance, because it depends on speculative and controversial subjects.

But it seems to me that it is unavoidable because of the word "minimum" in that language. It means that you are balancing something in one direction against something in the other direction. The solid thing in one direction is clearly cost, but the other direction it is not so clear to me what that is.

I suffer, whenever I have looked at the guidance on doing cost/benefit analyses, I am working in the adequate protection and increased benefit, and I don't think about that other codicil in the Atomic Energy Act about minimizing property damage.

But I know from the Act itself that the agency is precluded from simply terminating the use of nuclear energy. Or they are not asked to facilitate it, but they can't stop it. I mean, clearly, nuclear energy provides no threat to the public health and safety if there isn't nuclear energy, and that is a precluded option in the Atomic Energy Act.

So, it has to be those two things we are looking at to seek that minimum, but I just don't know how you would do the analyses.

MR. COE: This is Doug Coe with the Office of Research.

I think you have asked a very broad question and a very good. I think, for the purposes of this discussion, we need to be very clear that, when we say cost benefit, the benefit is the averted cost -- the averted cost -- of damage.

MEMBER POWERS: I think I understand that.

MR. COE: The cost of that, or the cost of the cost/benefit part is the cost of implementing a change that averts that subsequent cos. So, when we use the word "cost," you have to be very careful.

MEMBER POWERS: And I understand that. That is kind of how we always do backfit analyses and things like that. But when we switch over to this property damage, we are looking at a different paradigm here, I am pretty sure, just because we have to comply with this "minimum" language, which was probably used loosely when it was formulated, I will admit. But, nevertheless, we are stuck.

MR. PESSIN: Sir, the authority to

minimize stage for property is discretionary.

MEMBER POWERS: Yes, I understand that, yes.

MEMBER SCHULTZ: Kevin, before you go on to the details of evaluating the options, how do you see these options fitting in with the Near-Term Task Force Recommendation 1 that is ongoing and potentially about to burgeon soon with regard to its own program and process?

I thought, from what you presented so far, and what I see you presenting in the slides upcoming, that Option 2 is building a base perhaps for the work that is ongoing in Recommendation 1, where Option 3 would be perhaps merging with what is ongoing in the work for Recommendation 1.

MR. COYNE: Yes, I would agree with that, I think. Option 1 here, this Option 1, the status quo, probably has little tie with given the level of effort that the staff has been historically pursing as far as guidance updates --

MEMBER SCHULTZ: Right.

MR. COYNE: -- and the relatively-focused we have been doing.

MEMBER SCHULTZ: But between Options 2 and 3, how do you do that?

MR. COYNE: I think Option 2 probably starts running into that a little more, and then Option 3, the paper even, I think, has an attachment later in the paper that talks about the need that this has to be fully integrated with whatever we do with the NTTF Recommendation 1 and the RMTF. I think it is almost a rhythmic increase between Option 1, 2, and 3 as far as the coordination that is needed with that other initiative.

MEMBER SCHULTZ: Okay. Thank you.

MR. COYNE: Option 1, so this is the enhanced status quo; I will term it that way. The pros described in the paper maintains this perception of regulatory stability requires minimal additional resources on the part of the staff.

We have been doing updates, not necessarily directly related to offsite economic consequences, but we have been looking at how the staff values replacement power, the inverted cost of replacement power for regulatory analysis. We also have an ongoing project to update the dollar-per-person-rem conversion factor that we use to put a dollar value on radiation exposure.

MEMBER POWERS: An easy little tool.

(Laughter.)

MR. COYNE: More nuanced than we thought at first.

(Laughter.)

Option 1, although the staff would enhance the consistency we have right now across the various program offices that are doing rulemaking, it may not fully realize a fully consistent and comprehensive approach to at least maintaining the guidance documents that are used for these three programs.

There have been some stakeholder concerns raised that the staff should do more evaluate more comprehensive framework changes that came out during the public meetings and some other information that has been provided to the agency. Again, because we are not necessarily fully realizing a more coherent way of updating our guidance documents, there may be some continued inefficiencies if the staff were to pursue Option 1.

Option 2 -- and it is hard to see this in the paper -- but Option 2 is envisioned to be a bigger version of Option 1, that the staff would be more aggressive in updating guidance documents. What that would mean is that we would have higher budget propriety for getting documents updated. Right not, I think you would be hard-pressed to find a significant budget line item right now that addresses regulatory guidance document updates. It tends to be part-time work for a few members of the staff to update these guidance documents. Under Option 2, I think you would see in the fully-envision, in the budget you would see actual line items that are addressing regulatory guidance document updates.

We would also strive to be more comprehensive and harmonized across the program offices, to be more consistent in the approach, and make sure we continue that going forward. That, obviously, requires more resources to have that level of control over the program.

The cons, if you view resources as a con, it is true that it would require more resources than Option 1 and, again, may not be fully responsive to stakeholder concerns about the need to change the framework. So, again, Options 1 and 2 are dealing with staff guidance on how we do things and parameters that are updated.

Just like mentioned, NUREG/BR-0184 hasn't been updated since, basically, the NUREG-1150 data. So the data in that NUREG/BR could be updated. Based on knowledge we have today, you could envision doing more studies to get a better handle on some of the parameters that are in that document.

CHAIRMAN ARMIJO: Within this option, would you feel that you could change the dollars-per-person-rem parameter?

MR. COYNE: Yes. That would continue under all the options.

CHAIRMAN ARMIJO: Okay. So, you could still do that?

MR. COYNE: Right. And that is actually a good example because I did want to point out one nuance here. Although we don't believe we need Commission direction to do Option 1 or 2, there may be certain specific policy issues that come up that we may want a Commission decision to implement. So, we are still evaluating whether the dollar-per-person-rem would fall under that. But that is one that you could envision, that very specific issue. Once the staff is ready to recommend a particular value, we may want to go to the Commission for a policy decision on that before it is implemented. That has been done in the past. So, based on that precedent, it is reasonable to think we would do it in the future. But those would be very specific, isolated issues rather than a more comprehensive framework change.

MEMBER SIEBER: Would it be fair to

characterize these two options pessimistically as achieving the same output that the amount of time and resources that it takes to get there differs?

MR. COYNE: That is probably a fair characterization. And some among the staff have viewed the options that way, too. You could envision getting to the same place over the long-term, but the status quo hasn't been very active in updated guidance documents. So, sitting here, I tell you that that certainly is the intent, to get all these documents up-to-date over time, but without the resources to do, it could take a very long time. Some things may never rise to the priority to actually get them done. Whereas, Option 2 would give us more leverage to prioritize those updates.

VICE CHAIRMAN STETKAR: And I think in my experience what I have seen with some of the regulatory guidance, in Option 1 you might think that you get to the same point at sometime out in infinity. But when individual guidance documents get updated sporadically over time, they tend to diverge to some extent because each document is updated to our current state of knowledge at the time that it is updated.

MEMBER RYAN: Really? I am stunned that you would say this.

VICE CHAIRMAN STETKAR: I have been shocked also to see that.

(Laughter.)

So, in some sense, it is not just resources; it is coordination, some of the things you mentioned. Option 2 gives you an opportunity, at least at this snapshot in time, to hopefully coordinate things a little bit better, if, indeed, they do need that coordination, rather than kind of the time-sequenced process.

MR. COYNE: One example to illustrate is Research is currently working with NRR on a new user need to do a more comprehensive update to NUREG/BR-0058 and 0184. So, that is more of an Option 2 kind of thing where we are looking at that document more comprehensively and figuring out all the areas that need to be updated rather than targeting one section or two sections of that report.

MEMBER POWERS: Mr. Chairman, it seems to me this is very interesting information. It is one of those things that we might want to have some of our members following that on a more systematic basis. Because, as Mr. Coyne points out, this tends to be a bit more nuanced than one might think on the face of it.

CHAIRMAN ARMIJO: Yes, well, I think it is something we can address in our P&P related to our Subcommittee structure.

Okay. Go ahead.

MR. COYNE: Okay. Option 3 is the option that addresses actual potential changes to the regulatory framework for considering economic impacts. The way this option is worded is that, if selected, the staff would explore potential changes we could make to the framework. We aren't in a position where we could concretely recommend any specific change, but we do have a number of ideas that could potentially be pursued.

I mentioned a few of them. Some others that are in the paper are you could envision a policy statement that the Commission may want to promulgate addressing economic impacts. The rulemaking changes that I mentioned for backfitting; there are also some staff practices and how we consider generic versus plant-specific application of the backfill rule, that we tend to do backfits on a generic basis, not on an individual site basis, largely due to resource consideration. So, that is another item that was mentioned in the paper.

So, the pros of Option 3, it would

provide, basically, a Commission statement on the importance of economic consequences arising from offsite property damage due to land contamination. A key aspect of Option 3 would be stakeholder engagement. So, clearly, any of these options we would pursue through holding public meetings, workshops, opportunities for external stakeholder feedback and those kinds of things.

The cons, it could potentially increase the perception of regulatory uncertainty. Whenever you are changing a regulatory framework, I guess that would accompany that.

There would be increased complexity, I would almost say dramatically increased complexity. Some of that is brought in the paper, of the interaction with some of these other initiatives going on, the Near-Term Task Force Recommendation 1 and whatever the staff pursues with the Risk Management Task Force.

And substantial staff resources to pursue it; there are estimates in the paper, but, again, from a budget perspective and the importance of the policy direction, that is an option that the Commission would have to direct the staff to pursue.

MEMBER RAY: I have been trying to sort

out something here. Let me see if you can help me.

Options 1 and 2 don't specifically isolate on the issue of economic consequences of land contamination. No, they don't.

MR. COYNE: No, that is true.

MEMBER RAY: Option 3 does.

VICE CHAIRMAN STETKAR: Could.

MEMBER RAY: Well, I read it as it is on the screen up there, though, as it does. Now, if I am reading it wrong, tell me.

So, the question I have -- and I have been trying to see if I could figure out the answer myself, and I haven't, so I will ask you -- this doesn't seem like a continuum at all. It is like Option 3 is damage economic consequences of land contamination, or if you don't choose it, don't do it. The other two have to do with programmatic questions: stay the course. Do what we are now doing across the board. Or Option 2 is that same thing, except with more resources, do it more quickly.

Is that all correct?

MR. COYNE: That is correct, and there is a sense in the paper -- and we struggled with how to write it -- but Options 1, 2, and 3 aren't mutually-exclusive. So, you could envision pursuing Option 1 or 2. I hate to make more logical "if, then's," but Option 1 or 2 and Option 3.

MEMBER RAY: Right. That was going to be my next question then.

MR. COYNE: Right.

MEMBER RAY: Option 3 seems like it is a standalone issue almost --

MR. COYNE: Yes.

MEMBER RAY: -- and it can go either with Option 1 or Option 2. You either go fast or slow. But doesn't it also turn out that Option 3 -- well, I guess, by default, Option 1, if you don't do anything, other things will happen in parallel, but just really, really slowly.

No, I think you have answered my question. I have it.

CHAIRMAN ARMIJO: Well, is Option 3 a step change in regulatory view of the land contamination issue? Really a big change in policy could come out of this.

MR. COYNE: It could, although I think it is too soon to tell. Under Option 3, the staff would engage more on what could be changed, but it wouldn't be impossible that we could through that exploration and find that we didn't change the framework at all.

CHAIRMAN ARMIJO: But you get involved in this thing, the importance of land contamination. It opens up a whole lot of things that really are the foundation of the land contamination issue. It gets into health and safety, which it is founded on some theory of dose and health. So, with the issues of thresholds and then your no-threshold philosophy, does all that come on the table? One of our consultants has raised that issue in his report to us.

So, it seems to me like this is a big, big deal if the staff is going to get into it enough. I am just wondering, does the staff see it the same way, that it is a big effort with potentially a big change in our regulations?

MR. COYNE: Absolutely. Just to do the exploration required or envisioned under Option 3, it would require substantial staff resources to better formulate and flesh out what some of these alternatives under Option 3 and framework changes could look like. And then, a key to that is going to be the external stakeholder interaction on communicating and better refining those options based on feedback.

CHAIRMAN ARMIJO: But would everything be on the table, including things like LNT and thresholds? Or are those kind of like sacred things that can't be questioned? If you are going to enter into this thing, are you going to do it with a really open-minded approach or is it constrained in some way?

VICE CHAIRMAN STETKAR: I think, Sam, in my mind, you need to be careful about differentiating between metrics and mechanics for implementing regulations and policy about how you treat issues within the regulatory framework.

Whether or not you use the LNT model to evaluate health effects from small releases is a way that you evaluate the cost of those releases, the same way as the dollar-per-person-rem, the same way as how you assign how much money from having to relocate an automobile manufacturing plant from Point X to Point Y. Those are decisions that you make in terms of implementing that process.

CHAIRMAN ARMIJO: But you don't have to make that. If the contamination is below a certain level which you deem safe, then you don't have --

MEMBER SHACK: No, but what John is saying is, first, you consider whether you want to consider whether you want land --

VICE CHAIRMAN STETKAR: That's right.

MEMBER SHACK: -- contamination to be an

issue. Then, how you determine whether it is contaminated or not is a technical issue.

VICE CHAIRMAN STETKAR: It is an accounting issue. It is an accounting issue.

CHAIRMAN ARMIJO: No, but we are already taking it into consideration. The question is, how important is it and to what extent --

MEMBER CORRADINI: But I think we are only taking consideration now from an "if, then" process. I mean that is the reason I was asking the question earlier about it versus being in parallel versus "if, then". I am comfortable, personally, with "if, then," because if you made it of equal consideration, there is a whole bunch of things, starting with Dana's, that makes it quite complicated.

And an additional one would be what --

CHAIRMAN ARMIJO: Yes, if we are going to change the whole framework, let's make sure that the foundational things that govern how safe is safe enough --

MEMBER RAY: I hate to take the time here, but could you explain "if, then," please?

MEMBER CORRADINI: Well, his point, I thought, was in the backfit -- I am just simply repeating what John was explaining or was clarifying on some slide. Slide 13, 12?

MEMBER RAY: So, what do you mean when you say "if, then"? That is all I am asking.

MEMBER CORRADINI: Step four would have to be looked at first from a safety perspective, and only if that was large enough would you go to the next step of the economic consideration. That is what I thought --

VICE CHAIRMAN STETKAR: However you do the math for the economics.

MEMBER CORRADINI: Yes, however you do the math for the economics, it is a two-step process.

MEMBER RAY: Okay. You have clarified that there is --

MEMBER REMPE: It is on slide 11.

MEMBER RAY: -- there is a threshold which has to do with the likelihood of the event. And then, if it says that you have made or could make a significant change in the likelihood, then you address whether the effect of that change has economic benefit.

MEMBER CORRADINI: Likelihood or consequence.

CHAIRMAN ARMIJO: Consequence, yes.

MEMBER SHACK: Not likely, but

consequence.

MEMBER CORRADINI: Consequence.

Can I change the question a bit? Because Harold's observation, and you agreeing with it, strikes me as a bit different than when Steve made the observation, and you agreed with it, about Options 1, 2, and 3. Because the way I look at Options 1, 2, and 3 was that 3 -- and again, I will try to say it as Steve said it -- 1 is status quo; 2 is get prepared to make it, I'll use the word, risk-informed, but let's just say within a new framework. And 3 was, okay, let's launch into it.

And so, I view Option 2 is that you are going to get everything on a common framework, whether it be from a language standpoint, from a measuring standpoint, but the anticipation, in my mind, would be, eventually, you are going to have to go to Option 3 because the Commission -- or let me back up. The Near-Term Task Force in its proposal, that was No. 1 out of the gate. And it seems to me this ought to be part of No. 1 out of the gate, if we are going to do all this.

MR. COYNE: Yes, I am sorry if I might have confused it.

MEMBER CORRADINI: I am sure you don't

want that, but --

MEMBER RAY: No, but, I mean, I don't think that what you just recited was restating what occurred. But let's let Kevin talk.

VICE CHAIRMAN STETKAR: I was going to say, can I reel it back in? We are running up against some time constraints here because we have allocated some time for public comment. And I am sure, internally, in our deliberations over the letter report we are going to flesh out a lot of this information. So, I will, hopefully, let Kevin finish here.

MR. COYNE: Okay, and I think in a minute we can be done.

The recommendation in the paper is the staff-recommended Option 2. We believe it would enhance the currency and consistency in the existing framework. Many of our guidance documents are long out-of-date. The staff can work around that issue on a case-by-case basis. They aren't compelled to follow outdated numbers or parameters in those guidance documents, but, of course, each time you face that, if you don't have the guidance up-to-date, it is more effort on the part of the staff to do it.

So, we think that would increase our

efficiency if we got all those documents up-to-date. We could do the work more systematically. As I mentioned, we are currently engaged with NRR on looking on a more holistic update to NUREG/BR-0058 and 0184. And we think it would provide more comprehensive guidance across program areas.

And again, Option 2 would be, we wouldn't envision a change to the regulatory framework we currently have, though I will note, and maybe to resolve this issue, we certainly would pursue that with knowledge of what is going on with NTTF Recommendation 1 and the RMTF followup, and take that into account as these updates are made.

So, from that perspective, there would be increased coordination with those other initiatives, just to make sure the guidance meshes well with these other programs. But it wouldn't be a fundamental change in the regulatory framework we use for economic consequences.

And last -- and I already mentioned this -- but near-term actions: we are going to continue to update our regulatory analysis guidelines. As I said, we are pursuing fleshing out a user need with NRR right now. We have ongoing initiatives on replacement power and the dollar-per-person-rem conversion. We also have an action to address the SRM on the September 11th Commission meeting, where the Commission desired more information on how other countries factor economic consequences into their regulatory processes and how federal regulatory agencies handle the issue.

The paper went into this in a little detail, but I have got to say this is a very difficult and challenging question to answer. For better or worse, it took us almost two months to fully understand what the NRC did in this area, to bridge the communication gaps and to be able to explain it.

(Laughter.)

The people who do that knew what they were doing, but to be able to explain it and get it into a SECY Paper that can be widely read and understood by a variety of people. So, I fear going into other federal agencies we will face the same thing of getting the language correct, understanding the regulatory authority other agencies have, and making the comparison really meaningful to the NRC's experience. I think that effort is even heightened when we look at other countries.

But we will pursue that as best we can to get that information to the Commission. They did ask for a CA note, which lowered the threshold a little bit for us, but that doesn't change the accuracy and the context that the information has to be provided in. So, that is a challenging issue, but I can see that it would be very useful for the ultimate decision.

And that concludes the presentation.

VICE CHAIRMAN STETKAR: Thank you.

Do members have any other questions or comments for the staff

MEMBER POWERS: Well, let me just reiterate a little bit what Mr. Coyne has said. On those couple of times that we have looked at trying to understand what other regulatory agencies impose within the context of the regulations that the NRC applies, we found a wide range of figures of merit on that.

In the end, I mean, the last time I looked at this was in connection with the dollars-per-man-rem inverted. I think what the agency ultimately did was kind of taking a logarithmic average of those, and comparing the number that they used to that was probably as good as you could do.

But I think all we found was that we are not an outlier. Nobody can be an outlier in the range that we found. And so, it is very difficult.

But, as you say, I think that was the most persuasive piece of evidence that was presented, at least to me, on changes in the dollars-per-man-rem. So, it is extremely valuable, but, boy, I echo strongly that translation from the Department of Transportation's regulatory structure to our structure is a breath-taking exercise for anyone to undertake.

VICE CHAIRMAN STETKAR: Anyone else have anything?

(No response.)

If not, thank you very much. You covered an awful lot of ground and kept pretty well to the schedule. I very much appreciate it. Thank you.

What I would like to do now is we received a request from Pilgrim Watch to make some comments. So, I would like to entertain that, and we have allocated 10 minutes for that.

Are they here or are they -- they should be on the phone line. So, we need to open up the bridge line, please.

Ms. Lambert is probably screaming at the top of her lungs. We can't quite hear you yet. Have faith.

Ms. Lambert, are you out there? If you

are, could you just say something? We can't tell whether the line is open without hearing something.

(No response.)

And we don't hear anything. So, it is not quite open yet.

MEMBER BROWN: There it just came back in.

VICE CHAIRMAN STETKAR: There we are. I believe, Ms. Lambert, are you there?

MS. LAMBERT: Yes, I am.

VICE CHAIRMAN STETKAR: Okay. You have the floor.

MS. LAMBERT: Oh, great. Can you hear me now?

VICE CHAIRMAN STETKAR: We can. You are loud and clear.

MS. LAMBERT: Okay. Great.

Mary Lambert, Pilgrim Watch.

Good morning, everybody.

I have provided you with detailed discussions of what is wrong with the current cost/benefit analyses and how the code, in particular, that is approved by NRC and used, the MACCS2, ignores or dramatically underestimates the likely consequences in a severe accident.

VICE CHAIRMAN STETKAR: Ms. Lambert, I

don't want to interrupt you, but if you have papers near your microphone, could you keep them away a little bit? We are hearing scratching coming through, if you are moving something. So, if you could just be aware of that --

MS. LAMBERT: Oh, okay.

VICE CHAIRMAN STETKAR: -- it would help our transcript. Thank you.

MS. LAMBERT: Anyway, what is needed, obviously, is to incorporate the lessons learned from Fukushima into our method of doing consequence analyses. And so, in the few minutes given here, I will try to hit the highlights or, in terms of public safety, the low points of what is wrong.

The first point is the probability of a core damage event post-Fukushima is about 10 times what NRC currently assumes the likelihood of an event. And that is because, previously, there was simply TMI and Chernobyl that went into probabilities, and now we can add Units 1 through 3 at Fukushima. Which if you calculate it out, brings about in core damage events about one in every seven years or in NRC-speak 1 event per 2,900 reactor-years of operation, as opposed to what currently is used, and would be used, to assess whether to put the post-Fukushima recommendations perspective in the cost/benefit analysis at 1 in 31,000 reactor-years.

That is a significant difference, and it is important to incorporate this in PRAs going forward because, obviously, in PRAs the probability of an accident is multiplied by the consequences. So that the currently too-low probability will significantly trivialize any offsite consequences.

My second point is that the amount of contamination projected to be released is underestimated in the MACCS2 analysis used now, which seriously reduces the apparent offsite costs. And the reason for this is that the code ignores releases from the spent-fuel pool, ignores aqueous releases, restricts the duration of releases to one day -- whereas, Fukushima's have been going on for months -- and minimizes the amount of cesium-137 likely to be released in a severe accident.

All of these mean that, if you underestimate what is released, it is very obvious that you will be underestimating any offsite consequences. Spent-fuel pool releases, for example, cannot be continued to be ignored. For example, in my neighborhood reactors -- and I am looking at them now -- Pilgrim, a spent-fuel pool fire would release eight times more cesium-137 than a core release. And Dr. Jan Beyea estimated for the Massachusetts Attorney General the cost of a 10-percent release from the pool of cesium-137 at $105 to $175 billion, and 100-percent release of cesium-137 at approximately $342 to $488 billion. And this is without considering the likely interactions between a reactor and a failed spent-fuel pool.

There is clearly no rational basis to ignore a spent-fuel pool accident because accidents are severe and cause economic consequences because they relate to radioactivity, not whether they come from the core or spent-fuel pool. And also, it ignores the likely interaction between a core accident and a spent-fuel pool accident in a severe accident situation, especially in Mark I reactors and Mark II's.

Secondly, Fukushima showed that you cannot ignore contamination from aqueous discharges. Currently, what is considered only are atmospheric releases. In other words, only half of what can be released in the pathway is modeled.

We have seen very clearly at Fukushima the situation of what is called "feed and bleed". And then, the issue, also, of what is deposited from the atmosphere on vegetation on the ground and how it then goes into the groundwater and into nearby water sources.

This would be important. Again, an example in my area, the Massachusetts marine economy was estimated at $14.4 billion in 2004.

The Commissioners, in SECY-11-0089, and again in their vote in September, acknowledged that aqueous releases should be part of consequence analyses, but we haven't seen that effectuated.

Third, accidents continue to be limited to one to four days. Because they, obviously lasted longer Daiichi-Fukushima, and therefore, there would be more significant deposition offsite and, importantly, during a longer timeframe there are considerable winds, which then would increase the geographic area impacted.

Currently, the MACCS2 allows for modeling for plume in what is called the Iplume III model. However, licensees have yet to even take advantage of that. And more importantly, four days compared to what we was seen to happen at Fukushima is not adequate.

Next, the amount of cesium-137 likely to be released is minimized, which seriously decreases offsite costs. And it is assumed that the majority of the release will be noble gases and only a small portion of cesium-137. In the assumption, somehow it is treated as gospel that the cesium will be plated-out or scrubbed in the torus. However, we have seen in Fukushima, No. 1, that that is not necessarily so. And also, we have seen that, and known before, that accidents in which the damage is sufficient to open pathways from the core to the containment, there will not be sufficient water available to trap the radioactive releases of concern, nor will the pathway be so complex and tortuous that a significant amount will stick to the surfaces before reaching the containment atmosphere.

Similarly, if the containment fails early enough, there would be insufficient time for the aerosol to settle on the reactor building floor. And the importance of cesium-137 is not only for the 30-year half-life, but also for the fact that cesium is water-soluble and very, very difficult to clean up.

A second way --

VICE CHAIRMAN STETKAR: Ms. Lampert?

MS. LAMBERT: Yes.

VICE CHAIRMAN STETKAR: I don't want to cut you off too much here because I want to make sure have enough time, but we have allocated 10 minutes for you.

MS. LAMBERT: What does the clock say now?

VICE CHAIRMAN STETKAR: We are running a little -- pardon?

MS. LAMBERT: What does the clock say now?

VICE CHAIRMAN STETKAR: You have got about two minutes left.

MS. LAMBERT: Okay. Let me hurry, then.

VICE CHAIRMAN STETKAR: Okay.

MS. LAMBERT: A second major point in economic consequences is the minimization of the area impacted. That is by the use of the Gaussian straightline pump, which is embedded in the MACCS2 model. However, by large water bodies, by river valleys, changes in topography, it is an inappropriate model because these are complex areas.

The code dramatically underestimates the cost of decontamination. It ignores waste disposal. It assumes cleanup occurs just in a year. It assumes that the hosing buildings or plowing fields gets rid of contamination, where it just moves from one place to another. It ignores the forest, wetlands, water that can't be cleaned up. It ignores, as I said, cesium-137.

And there is no agreed-upon cleanup standard. The cost of cleanup is very, very elevated in any standard that is more than 500 millirems a year. There are a myriad of other significant costs. You cannot underestimate the fact that health costs are underestimated by ignoring everything, cancer incidence and other health effects. The dose response is based upon old research, not current research, et cetera. And there are a myriad of economic consequences that are not considered.

The point being that these are important issues to address now. We have an antiquated system that we knew before Fukushima was underestimating offsite cost. So, therefore, when used, the mitigation in the cost/benefit analysis that the public deserves to decrease the likelihood of an accident is never put into play.

And it is patently absurd to use a consequence analyses method that has assumptions that pre-Fukushima to use in a cost/benefit analysis to determine whether to put in place recommendations that have been learned as important post-Fukushima. It is going in circles. It is backwards.

And thank you for the opportunity.

I will say that, although NRC staff has

said over and over they didn't have the time to get into the nitty-gritty, the details of what is wrong with what is being done now, it doesn't really hold water when you look at the sensitivity analyses that have been done for the New York Attorney General --

VICE CHAIRMAN STETKAR: Ms. Lampert, I am going to have to cut you off here.

MS. LAMBERT: Oh, okay.

VICE CHAIRMAN STETKAR: But thank you very much, and I appreciate your comments very much. I assure you your written comments from the 15th and the 22nd go into much more detail, and I assure you that all the members have them and that we will take them into consideration. So, thank you very much.

What I would like to do, Mr. Chairman, is see if there is anyone else from the public, either in the room or on the bridge line, who has any other comments that they would like to make.

The bridge line is open. We do have someone in the room.

MR. RICCIO: Hi. This is Jim Riccio with Greenpeace.

And it doesn't seem like the microphone is working.

VICE CHAIRMAN STETKAR: It is, I believe.

MR. RICCIO: Okay. Just to back up Ms. Lampert's comments, so long as you continue to underestimate both the risks and consequences of a nuclear accident. you are not going to address the risks appropriately.

I have continually pointed out that it is your own agency that points out that your PRAs may be flying half-blind.

(Laughter.)

I still haven't gotten a real-good answer about whether or not the NRC still stands by the Lanic memo from several years ago that pointed out that you just don't adequately address about half the core damage probability. You are just not modeled in your PRAs.

So, rather than argue why you shouldn't take steps to protect the public health and safety or our property, perhaps you should take the lessons learned from Fukushima and do it now to get ahead of the curve.

I understand the problems you are going to have working land contamination into your current rubric. But that is not adequate reason to not address the problem.

You have had warning. You have had

repeated warnings. You were able to duck the issue after Chernobyl because you pooh-poohed the Russian design. Now that you have a GE Mark I that has melted down and blown up, you can't really ignore that issue. If you do, I am afraid -- you know, I see the staff is trying to do a good job. The further you get up this building, the more difficult it becomes for the public to trust what is being done.

We expect a strong letter from this Committee on both this and the other issues coming out of Fukushima. If not, I suspect we will probably have to go to Congress once silly season is over with and, basically, put some pressure on this agency to do the right thing.

We had hoped we wouldn't have to do that. You should have learned your lessons from Fukushima rather than having to be forced to do the right thing by external pressure.

Thank you.

VICE CHAIRMAN STETKAR: Thank you very much.

Any other members of the public have comments?

(No response.)

Bridge line, anyone out there?

(No response.)

Hearing none, Mr. Chairman, I will turn the meeting back to you.

CHAIRMAN ARMIJO: Okay.

VICE CHAIRMAN STETKAR: And I have used up probably several months' worth of my excess time.

(Laughter.)

CHAIRMAN ARMIJO: There goes your bonus.

VICE CHAIRMAN STETKAR: There goes the bonus.

(Laughter.)

CHAIRMAN ARMIJO: Anyway, look, let's reconvene -- take a recess for about -- let's try to catch up a little bit. Let's get back at 10:25.

(Whereupon, the foregoing matter went off the record at 10:13 a.m. and went back on the record at 10:25 a.m.)

CHAIRMAN ARMIJO: Okay. We are ready to start again.

Our next topic is the role of filtered venting systems. Let's see, who is leading us through this one.

Steve?

MEMBER SCHULTZ: Thank you, Mr. Chairman. I appreciate the opportunity to move forward with this.

In introducing this topic, I want to recognize that the Committee has met with the staff on the issue of filtered vents for BWR Mark I and Mark II containments several times over the last six months. We met in June, September, the beginning of October, and the end of October in both half-day and full-day Subcommittee meetings. And the staff has met with the full Committee once to provide a briefing on this topic as well.

We had the opportunity for those briefings because the staff has been working toward a report to the Commissioners at the end of this month. They are set to meet that goal. Their work has been diligent and their opportunity, again, to meet with this Committee has been frequent and has been very helpful to the Committee as well as, we hope, to the staff.

With regard to the discussion today, we did have a Subcommittee meeting yesterday. Just for the record, the Subcommittee for this work is the Fukushima Subcommittee. This is a Committee of the Whole of the ACRS Committee. So, all of us have had an opportunity to participate in all of these Subcommittee meetings.

Yesterday we met with the staff, and they provided us with a detailed review of the discussion we are going to hear today. They are going to provide a summary. We had some questions yesterday that they also committed they would return and respond to. We are on schedule, the Committee is on schedule to write a letter on this topic in the course of our deliberations in this meeting.

In addition to the staff's presentation, we also will have an opportunity for public comment. We have had a request from Mary Lampert from Pilgrim Watch, and we have offered her an opportunity, in particular, to make a presentation at the end of the meeting, and we will have an opportunity for other public comments as well.

The staff is going to present not only their reviews of the work that they have done, but also their recommendation which has been formed. John, I will let you frame that in terms of the recommendation and the endorsement that you have received from the Steering Committee that monitors all of the Fukushima work for the Commission.

With that, I will turn the discussion over to Bill Ruland to introduce the staff and the topic.

MR. RULAND: Thank you, Dr. Schultz, and thank you, Mr. Chairman. And good morning, everyone.

I think at this stage this subject needs no introduction. I would just like to say thank you to the Committee for their attention and their questions. It helps us sharpen our arguments and make the paper better.

I would just like to say thank you to the technical staff. As you know, yesterday's meeting went with minus-two-days preparation. I thought the staff did really an outstanding job. So, maybe we should have more storms, so that we can by without that extra presentation. Well, maybe not.

(Laughter.)

So, I just wanted to acknowledge that and say thank you to John, Bob, and the rest of the team.

With that, Bob Fritz, are you going to start it up? Or John?

MR. MONNINGER: Thank you, Dr. Schultz and ACRS members and Bill.

My name is John Monninger. I am the Associate Director of the Japan Lessons Learned, Project Director, within the Office of Nuclear Reactor Regulation.

Dr. Schultz, you mentioned we did have the meeting yesterday. So, maybe we will incorporate by reference our opening comments from yesterday's meeting.

(Laughter.)

With that said, we did use the NRC's existing regulatory framework. In doing so, the evaluation also included consideration of several key factors that are not readily represented in quantitative terms. And this is sort of our bottom line that we would open up our discussion.

When you look at a comparison of only the quantifiable costs of the proposed modifications that the staff went through, if they were to be considered safety enhancements, they would not justify new requirements related to severe-accident containment venting systems for Mark I and Mark II containments.

However, when those costs and benefits are considered with other qualitative factors, such as the importance of containment systems within the NRC's policy of defense-in-depth, the staff concludes that a reasonable argument can be made to require the installation of filtered fence systems for Mark I and Mark II containments, and the staff is recommending such action.

So, that sort of sets the framework for our discussion today. We will move to slide 1. Then slide 2, we are going to present the draft paper.

From that, we propose to move to slide 7, which is a draft outline of the paper. So, we essentially used the same slides from yesterday, but tweaked to one slide and added about eight backup slides in the back.

MEMBER SCHULTZ: Thank you, John. I think that is beneficial for those who were not here yesterday.

MEMBER RAY: Yes, there are a few.

MR. MONNINGER: So, with that, should we just skip a bunch of slides or should we go one-by-one and see if there is a need for a discussion?

MEMBER SCHULTZ: We can move through the slides --

MR. MONNINGER: One-by-one?

MEMBER SCHULTZ: -- one-by-one, but only stopping at those that you would like to discuss.

MEMBER POWERS: I am intrigued by your opening comment that said we have looked at the quantitative and we arrive at a conclusion no vent. So, we have looked more broadly. And then, you said, in order to protect containment systems, there is benefit to some additions here. And that is definitely interesting.

The question I have is one of consistency. Here is where I get a little dissonance in looking at this. When I looked at the Fukushima accident, I say, gee, there is a lot about this accident that I am not going to know for a long time because it takes a while to get into these plants, and even once you get in, it takes a little while to interpret everything you find and generalize it, like that.

But the one thing I know absolutely is there were a couple of hydrogen detonations in the reactor building, where most of my equipment used in the aftermath of the design-basis accident is located. And this that you are looking at here would provide no protection whatsoever against that.

So, are you pursuing that issue?

MR. MONNINGER: We believe the filtered vent, which is Option 3, provides a significant solution for hydrogen control and mitigation; for hydrogen control and mitigation within the primary containment; for hydrogen control and mitigation that would potentially get to the reactor building or to the spent-fuel pool. And we have included that within our qualitative analysis.

The staff's thought process there is you would have a vent system that we have a high level of assurance, then, we know where the hydrogen -- well, you know where it is being generated. And most likely, for most sequences, it is going to go to the wetwell and then to the drywell.

But they would vent that hydrogen -- there are existing procedures, the existing EOPs -- direct venting. Even if the containment pressure is not high, they direct venting for hydrogen control.

Using any vent system, whether it is Option 2, 3, or the performance-based approach, Option 4, we believe would significantly address the hydrogen issue.

One potential issue out there is whether the vent path is opened and then, subsequently, closed. So, you know, the question comes down to the residual pressure within the containment and what happens to the penetrations with the high temperatures, et cetera.

The staff's thought is that, if venting was to occur, be it part of core damage or after core damage or for hydrogen control, whatever, if there is not that significant forcing function, Delta pressure across the boundary, even though the seals may be degraded, you are less likely to experience the concerns with hydrogen migration from primary containment to the reactor building.

So, within the staff's analysis or within the staff's discussion within the Commission paper, we have said we believe to a large extent severe accident venting, if there is a design system for it, would significantly address the NTTF Issue 6 for Mark I's and II's. And we say, with that, we would still go back and look at residual issues for ISLOCA or containment bypass, and we would still do some type of assessment looking into containment penetrations.

But, to a large extent, whether that is 50, 70, 90 percent, we believe if containment venting is done in a manner that takes away that pressure, the Delta pressure across your containment boundary --

MEMBER POWERS: No question about it.

MR. MONNINGER: Okay.

MEMBER POWERS: If you don't have the Delta-P, you do not eliminate the threat, but you mitigate it substantially.

MR. MONNINGER: Yes, and the staff identified with the venting option that is part of the EPRI analytical approach. We don't believe that that argument necessarily extends to the cycling of the valves, that it would necessarily address the hydrogen, because you would still have that Delta pressure across your containment.

MEMBER POWERS: Similarly, the other

lesson that I will emerge, but it is more speculative, is that a critical decisionmaking process exists in the operators to activate venting systems. And there is a confidence in our operating processes that operators will make that decision to activate the venting with extremely high reliability.

I wonder, is that really true? And are you looking to see if that is really true?

MR. MONNINGER: In qualitative terms, we believe if a filter was on the vent, it would facilitate the decisionmaking --

MEMBER POWERS: There is a filter on the vent.

MR. MONNINGER: If an additional filter was added in addition to the suppression pool, the deposition, the plate, et cetera, within the primary containment, if an additional filter was added, we believe that would provide added confidence to the decisionmakers onsite and plant operators to use that venting system. We believe there would be residual questions in one's mind without a dedicated filter system added. We believe it would complicate the decisionmaking.

MEMBER POWERS: I understand how your argument goes on that.

MR. MONNINGER: Yes.

MEMBER POWERS: My question really is, do we mean that is the issue that would be in the operators' minds at all plants when they were considering whether, in fact, to vent or not? I think it is pretty clear that that was in the minds of the Japanese operators, or at least we think it is. Time will tell on that. But is that what is in the minds of our operators when they have to make, are called upon to make a decision to vent or not?

MR. MONNINGER: I wouldn't have a basis to say --

MEMBER POWERS: Yes.

MR. MONNINGER: The procedures currently have a statement upfront saying, you know, vent irrespective of the dose and the offsite consequences.

MR. DENNIG: Yes, that is one of the unknowns and the uncertainties that we think can be addressed by a filter containment venting system. We don't have to agonize about what an operator is thinking, what he knows at a particular time.

MR. MONNINGER: One other thing is, with in the staff's proposal, we have proposed a passive rupture disc. So, if the training assumed the actuation of the passive rupture disc, there is also a bypass around it where they could manually vent. We believe there is one thing if one is trained to go and take this action. There is another thing within your training within your analysis you know that this is going to happen, and if for some reason you want to do it a little bit earlier, you can do that. So, we believe adding the passive system there takes some of that burden from the decisionmaker away, knowing that that has been designed into the system.

MEMBER POWERS: If you are waiting for me to ask another question --

MR. MONNINGER: Yes.

MEMBER POWERS: -- I don't have one right now.

(Laughter.)

VICE CHAIRMAN STETKAR: The first time we have heard you being speechless?

MEMBER POWERS: Maybe I was a little too cryptic in this. I have some more questions, but --

MR. MONNINGER: So, we will step through them, and then, if there are questions -- we are going to present our paper, our agenda, the taskings, the schedule update, and then discussion of the paper.

There were two taskings. They moved the filter vent from an additional issue to Tier 1. The second tasking was, when you come back to talk to us about the filter vent, please discuss the pros and cons for those accident sequences where filters would and would not be beneficial. So, that was the second tasking.

MEMBER BLEY: I'm sorry, I hadn't thought about this until you were just talking containment. Usually, rupture discs are there to protect equipment. Now we are talking about a rupture disc that is there to protect the public.

What I am worrying is, would this have to be a special, unique-shaped rupture disc, so nobody could put the wrong disc in place? I mean, if it doesn't go when it is supposed to go, we are not just protecting a condenser or some other piece of equipment. It is actually there to eventually protect the public after it protects the plant.

Have you thought about that aspect of it?

MR. MONNINGER: So, if you look at the first rupture disc for the system, it would go back to the Pilgrim design back in the eighties. And they have proposed and they came in with a licensing action, and it wasn't to protect the equipment. You could say it does protect the equipment. It protects the containment from gross failure, would be the notion, and probably take away some of that decisionmaking.

I think the other example would be for the slick system where you have the explosive valves in there, the squib valves. Another example would be for the ABWR, the GE Advanced Boiling Water Reactor. There is a rupture disc in that line.

And we talked about there are maintenance provisions, there is in-service testing, there is qualification --

MEMBER BLEY: You can't really test one of these.

MR. MONNINGER: But you can place a squib valve.

MEMBER BLEY: You know, you have got to put a new one in.

MR. MONNINGER: But you can take these rupture discs out every five years and send them out and see if they broke like they were supposed to break.

MR. BETTLE: Yes, they are manufactured typically in a batch. So, you have the same material in them, the same construction, all the same tolerances, and then they test and burst a few of them. And then, also, to see that there is no deterioration while in service, there is a periodic inspection. So, they open it up.

MEMBER BLEY: The deterioration would probably help you out here.

(Laughter.)

MR. BETTLE: You certainly want one to actuate for a DBA LOCA sequence.

MEMBER BLEY: That's true.

CHAIRMAN ARMIJO: But Fukushima had rupture discs in their system, and they were set to rupture at very high pressure. By that time, the containment was leaking.

So, your thinking is that to have the rupture disc set to --

MR. MONNINGER: And that would have to be worked out. I mean, if you go back to the origins of venting in Rev 2 to the EPGs, the venting set point was two times design pressure. That was in the early eighties. In Rev 4, which was the EPGs approved, they changed it to something called a PCPL, the Primary Containment Pressure Limit.

It is the lower of four various values. One is the pressure at which the valves can reliably open and close for the containment isolation valves for the ventings. Other is the back pressure for

SRVs. And I forget what the other two parameters are.

But, in my personal opinion, you want to be very deliberate in setting that set point where you want it to rupture. Even if there is a filter on it, you don't want to unnecessarily vent, regardless. You know, the plant should maintain their intactness.

So, you want to be very deliberate with where you set that pressure because, even if it is just the nobles and very, very small amounts of others, there are offsite consequences to it. There are sequences, even though -- for example, TMI. TMI, you had in-vessel recovery. You know, there is always the potential for those accident sequences that were recovered either in-vessel or that did go ex-vessel, but the containment would have never potentially failed. But if you do open the vent, you did unnecessarily release something. So, you want to be very deliberate with that venting set point.

You don't necessarily want to do it too low post-core-damage because, if the containment would have withstood that event anyway without failing, you just resulted in a release.

MEMBER RAY: It is not just the release, but you can't assure that you can reestablish containment integrity after --

MR. DENNIG: Yes, two additional points. One, the system that we are recommending has two paths, one of which is with a rupture disc in it and isolation valves that are normally left open. The other path is a parallel path in which there are isolation valves that are closed.

If the operator has power, and it should have power for prolonged SBO, it can at anytime preempt; it can close off the rupture disc, open up the other line, preserve the rupture disc, just not work with that at all. The rupture disc is there as a failsafe. If nothing happens, the thought is that there is a period of -- normally, we speak in terms of 24 hours where the filter is passive and you have the passive rupture disc. And if, for whatever reason, there is no ability to actively manipulate the vent, that will rupture and relieve through the filter.

And the other point is that there is a maintenance and testing program in other countries where these things are taken out periodically and tested as part of the maintenance issue.

MR. BETTLE: Yes, they are replaced periodically.

MR. DENNIG: Yes.

MR. BETTLE: Five years, 10 years.

MEMBER SIEBER: Does your consideration take into account those situations where containment pressure is used to add to NPSH for --

MR. MONNINGER: Containment accident pressure, back pressure?

MEMBER SIEBER: Right.

MR. MONNINGER: That has been discussed some in the past, and I guess the staff's thought on that is that is an artifact within the DBA analysis. I mean, if you are within these severe accidents, those systems where you are relying upon the back pressure and your core damage in your ex-vessel, those systems most likely wouldn't be there.

MEMBER SIEBER: Okay. Thank you.

MR. MONNINGER: So, the second tasking, the schedule, the paper is due to the Commission the end of November. We are November 1st.

The next slide, an outline of the paper. The majority of the material is within the enclosure. The real decisionmaking process is within Enclosure 1.

Next slide.

This discusses the purpose of the main paper to sort of tee-up all the various issues out there, and to discuss the role of the quantitative and qualitative analysis.

Next slide.

The four options. Kevin, in the previous discussion, he said, for some reason, NRC Option 1 is always the status quo. That changed. So, we took that here also.

The second -- and this is a little bit important -- the second option we called severe accident capable, and the filter vent performance-based approach is the fourth one.

We look at them as feeding upon each other. So, the design requirements within the order for Option 1 which currently exists, we would replicate that for Option 2 and add on four, five, a dozen, two dozen additional requirements for the severe-accident-capable vent. So, it is the 10, 15 design parameters for the existing order plus 10 more for the second one.

Then, you go to Option 3, the filter. You take the design parameters for the existing orders, severe-accident-capable vent, and add filter specs onto it.

The fourth approach, performance-based approach, we look at that as potentially being a rulemaking in the longer-term. But, with that, there seems to be a good logic to pursue, at a minimum, the severe-accident-capable event in the shorter timeframe.

The next slide.

This was our recommendation.

Let's go to the next slide.

MEMBER REMPE: John, I am not sure where the best place to bring this up is, but yesterday there was some discussion about the requirements for this filtered vent. During that discussion, it was mentioned, "Oh, we know very well the state of cesium iodide throughout the accident, and that knowledge is very complete."

And I was vaguely aware that some of the Phoebus data makes it less certain. That has come up recently. And so, I mentioned it to Dr. Powers today, and he said -- I will let Dana answer what he said -- but, basically, that it less complete, that knowledge, at this time. And perhaps that is something that should be factored-in at some point when you are trying to decide what requirements to put onto the filter.

MR. DENNIG: So, this is recent Phoebus information as opposed -- I don't follow it.

MEMBER POWERS: Well, I wasn't present, but somebody approached me and asked, "Do we know the chemical form of iodine produced in reactor accidents?" The chemical and physical form, is that the -- and I said, "Well, we know some things. Do we know exactly? No."

We have over the years thought that perhaps iodine had a tendency to be predominantly cesium iodide. One of the peculiarities of all the tests that have been done is every one of them has produced one picture of a cesium iodide crystal consistently. Pre-tests have done that. The PBF tests at Idaho have done that, and the Phoebus tests have done that.

Unfortunately, they have also shown that iodine can be present as a variety of other materials. In fact, we suspect that iodine is present as nickel iodide. Cadmium iodide seems to be a major species. And there can be a certain amount of vapor iodine.

The precise mix among those I think remains unpredictable at this point. The precise mix among gaseous iodide as molecular iodine and molecular organic iodine is essentially unpredictable at this point.

MR. DENNIG: What I followed up is I am aware at a very high level that Phoebus was cranked into the analyses that was done by other regulators in looking at the filters. So, that is why about the vintage of the information. I don't know for sure if this aspect of it was cranked into what they have already looked at or not.

But I think, ultimately, that would be an issue that would be an uncertainty. That would be something that you would reflect on and decide whether that is uncertainty that could be addressed by a filter containment venting system or it would be outside of what it could do.

But, again, it is the chemical form of the release is an uncertainty. The argument goes that, given that uncertainty, I have this device that is basically passive and it works in a certain way, and I have tested in a certain way. But, ultimately, you have to decide whether or not that in a technical sense addresses that uncertainty.

MR. MONNINGER: Also, to a certain extent, that particular issue wouldn't be limited to Recommendation 3. It would impact Option 2, Option 3, or Option 4. It would seem to impact the holdout within the suppression pool and other scrubbing mechanisms as well.

MEMBER REMPE: I just thought I would bring it up.

MEMBER SCHULTZ: John, would you just revisit the relationship that the staff sees between Option 3 and Option 4. The way you just expressed it sounded as if Option 4 was going to lead to rulemaking, and I thought you said that Option 3 would be an interim approach.

MR. MONNINGER: Yes.

MEMBER SCHULTZ: And I want to understand what you mean by Option 3 would be an interim approach, and we know rulemaking would take some perhaps longer time in terms of decisionmaking --

MR. MONNINGER: Yes.

MEMBER SCHULTZ: -- but certainly information would be gained from it.

MR. MONNINGER: So, that is actually a very good point. The NRC, with all the orders, even when you go back to the 9/11 orders, even though we issue orders, we ultimately follow those up with some type of rulemaking. So, I was probably a little bit sloppy in saying Option 4 would be a rulemaking.

The thought is that any of these orders out there, the existing order or 2 and 3 would also potentially end up in some type of rulemaking. The NRC should have the regs, within the regs. So, the orders is more of a short-term thing.

MR. DENNIG: The order for 3 would be eventually codified --

MR. MONNINGER: Codified, yes.

MR. DENNIG: -- in rulemaking.

MR. MONNINGER: Yes.

MR. DENNIG: And it would be enforced in the more immediate timeframe.

MR. MONNINGER: Yes. So, in the short-term, Options 2 and 3 would result in changes to the plant. The staff view on Option 4 is performance-based approaches are initially pursued through interactive rulemaking process with stakeholders, guidance development, et cetera.

And this is a little bit difficult. We also believe that, even though we are talking about longer-term, performance-based rulemaking, there could be merit in Option 4 for the short-term to issue an order for the severe-accident-capable event.

It would seem like, no matter what you are going to do in Option 4, you would want to at least upgrade the venting system that is being put in to have piping systems, to have valves, et cetera, that were able to withstand severe accident conditions. You would want to potentially avoid -- if you went with Option 4, you would want to potentially avoid the rework from the existing order to move that piping and system to a severe-accident-capable system.

CHAIRMAN ARMIJO: So, just to make sure, no matter which option you take, you will do Option 2.

MR. MONNINGER: Right.

CHAIRMAN ARMIJO: So, that is going to happen for sure?

MR. MONNINGER: For Option 2, 3, or 4, the staff's belief is, at a minimum, would include Option 2.

CHAIRMAN ARMIJO: Right, right. Now, but 4, it is between Option 3 and Option 4; it is "either/or". I mean, you are not going to require a filtered vent and then go with the performance --

MR. MONNINGER: Right.

CHAIRMAN ARMIJO: But Option 4 could lead to a filtered vent.

MR. MONNINGER: Yes, it could.

CHAIRMAN ARMIJO: Okay.

MEMBER CORRADINI: So, can I ask -- I didn't mean to interrupt you, Sam -- can I ask a question?

Since you mentioned timing, the fact that, if I might reverse the thinking process, if you went and thought through this from a performance-based standpoint, would you actually -- and I don't want to use the word "time" -- but let's say time and effort and thinking of it, wouldn't it be a more holistic way of dealing with the current order sitting out there for a hardened vent, upgrading it to the severe-accident-capable vent, and allowing for, but not demanding the exact solution to say in all cases?

MR. DENNIG: I would like to say something about Option 4 at this point.

MEMBER CORRADINI: I figured you guys were ready for this one.

(Laughter.)

MR. DENNIG: I think, in our minds, the issue with Option 4 comes down to, what are the expectations of coming up with information or a solution that is significantly different from what we have found out through CPIP and what other regulators have found out through their studies? I mean, what is new about Option 4 repurposing sprays and wetwells that, in terms of the mechanisms and the processes and the mechanics and the calculations, hasn't pretty much been gone through by the late eighties? What Option 4 would possibly be is a revisiting and recapitulation of work that has already been done.

MEMBER CORRADINI: Can I say, generally, what you are saying is, what was known 25 years ago is no different than what we know if they did it now?

MEMBER POWERS: That is what you just said.

(Laughter.)

MR. DENNIG: The first meeting that we had back in December of last year with the BWR Owners' Group when we first brought up filters as a solution, we were apprised of the fact that, well, they wanted to pursue something along the lines of using sprays. And so, that has been pursued since December last year, I would assume. To date, we have a conceptual study from EPRI that the new wrinkle there is the cycling of the valve. I don't think anything else has much changed.

So, the point being that the end result of Option 4 is likely to be reinventing the wheel, if you will, and we wind up in the same place with an external filter, and in large part because the uncertainties that are involved in the analysis for the internal processes, the core-melt sequences, and so on and so forth, are not going to be resolved by reanalyzing sprays and wetwells. The uncertainties are still going to be there, but I don't think a performance-based approach is going to remove that, nor would it --

CHAIRMAN ARMIJO: Yes, if nothing physically changes, Bob, I don't disagree. But what if they can change the existing equipment in some way to make it more reliable and more effective and show you? Wouldn't that be acceptable?

MR. DENNIG: Yes, if there is a superior engineering solution where you can foresee that emerging in a reasonable period of time, that certainly is something that you would want to consider. And I am just suggesting that, eventually, in a performance-based approach, we will wind up talking about uncertainties in the analysis, and I don't see how that would go away.

MR. MONNINGER: I think internationally or within the U.S. there has been a focus looking at this issue for the past year. No new testing was done. But Bob mentioned the one novel approach was the cycling of the valves. To my knowledge, the other thing that was looked at was external cooling of the torus. But all of the other assessments, you know, the notion of flooding the cavity, using sprays, that is stuff that has been considered and evaluated and known --

MR. DENNIG: And recommended, yes.

MR. MONNINGER: -- for the past 20-some years. So, over the past year, the new, novel approach that has come up has been the vent cycling to be of potential value. But nothing else has come up, and it has been a year.

You have an analytical approach in front of you, a report, and you have interest in doing a pilot study. That is what we have from industry for the past year, interest in doing a pilot study. There is no commitment across the industry to proceed forward on anything.

You know, it is a priority item for the agency, for the Commission. We are given a schedule to produce recommendations, and you take the information that you are given and you develop your recommendations based on that.

MEMBER POWERS: It seems to me that the situation, understanding chronologically what goes off in these systems, is that we have had systems that were designed to suppress steam and we found that they had remarkable capabilities at suppressing source terms as well. They were not optimized for that. We pursued that to the point that it was adequate for the purposes of regulation, but probably not adequate --

probably if you were in the business of optimizing these systems for source-term suppression, you would probably want greater fidelity in the modeling, greater detail in the phenomenology, and things like that.

You know, we took things to the point that you could make regulatory decisions and we said we know enough at this point because we are not going to optimize these systems. Based on that regulatory understanding, I believe some facilities did change their spray nozzling in the drywell sprays. They had vast water capabilities and poor droplet-size capabilities. Well, they changed things because it is easy to do.

Do I tend to say that we know everything about these things down to the finest detail? No, but there is not much driving force to understand very great detail because, quite frankly, they work pretty damned well for being non-optimized systems.

MR. MONNINGER: SO, the four options, we discuss them, slide 10. The staff recommends the filters based on the knowledge that we currently have.

Slide 11, this is important. The basis for our proposal is a cost-justified substantial safety enhancement. The staff is not recommending action, other adequate protection. We have provided our assessment as to whether adequate protection is potentially the appropriate basis or not within the paper. We are pursuing the substantial safety enhancement based on a combination of the quantitative and qualitative factors, in particular, heavy emphasis on defense-in-depth for the containment performance for the Mark I and II containments, the vulnerability, the high-conditional containment failure probability for Mark I and II containment. We believe the current issue in front of us is for the Mark I and II containment for filters.

MEMBER POWERS: Last time I was present when you reviewed this, I did ask the question, but I will ask again. You have taken a defense-in-depth argument here. So, why not two?

MR. MONNINGER: Why not two systems or --

MEMBER POWERS: That's right.

MR. MONNINGER: -- piggybacking or --

MEMBER POWERS: Yes. Why not a redundant, a diverse system, in addition to the filtered vent?

MR. DENNIG: I mean, we have a proposal that involves both drywell and wetwell paths and a passive and active capability, all passing through a filter. The wetwell path would go through the wetwell to the extent that the core stayed in the vessel and you got the blowdown from the SRVs. We think that is adequate, basically. We could put another filter on it, but we don't think that is necessary.

MEMBER POWERS: But there remains a vent path that, unlike many of your vent paths, has actually, we think, has been observed, but you are not addressing it, which one for head failure.

MR. MONNINGER: And that would be the thought on the establishment of the pressure limit in which the passive valves ruptured or they manually opened the valve. You know, a very good engineering assessment of --

MEMBER POWERS: But, then, you are concluding that in all accidents the only way that that effort had failed is due to overpressurization, which may not be the case. It can simply fail by radiological degradation of the elastomer seal.

MR. DENNIG: I don't think we are presuming that the only way that it will fail is from overpressure or cooking at a high pressure and a high temperature for some period of time. I think what we are saying is that we have a proposal that addresses, if not, a large part of the threats to the containment, overpressure threats. That is a benefit that is worth pursuing.

I think we have conceded all along that, if you somehow have a leak in the primary containment elsewhere or under any circumstance, that then there is bypass path. I think we can see that. And so, the judgment is that, on balance, addressing the overpressure threats, especially given that we feel that there is now a requirement to get water under the vessel before core breach, which has the tendency of turning melt-through into overpressure, we think, in combination with that, there is a great benefit to a filtered containment venting system.

MEMBER CORRADINI: So, may I ask -- I am sorry, Dana, I didn't mean to interrupt. Are you done?

MEMBER POWERS: Never, but please go ahead.

(Laughter.)

MEMBER CORRADINI: So, I want to ask, if you are suggesting Option 3, and a licensee were to come in and say, "Well, we have come up with a way that essentially has inventory control, so we don't need a drywell vent, and we can put a smaller internal filter above the wetwell, and that will do it for some sort of performance," is that acceptable, given this

Option 3, or is that out of bounds?

MR. DENNIG: This is, presumably, just the wetwell vent, not a drywell vent?

MEMBER CORRADINI: No drywell vent, and it has been inventory-controlled to eliminate the need for a drywell vent. Because, as you answered Dana's question, the drywell vent does not eliminate the concern he has with the seal.

MR. MONNINGER: But if it is inventory-controlled, and I guess the notion there is you have been flooding the containment, flooding the reactor, and your suppression pool is coming up a higher and higher level. You want to maintain the wetwell vent, so you don't have to go to the drywell.

Well, through your SRVs, the majority of your source term, the general thought is for a station blackout, is going to be within the suppression pool. Or if it is the LOCA, it will eventually come through the downcomers.

So, it has been mentioned before that there is a lot of interest from the industry in keeping the source term within the containment. If you come up with this inventory-control mechanism, that is taking water out and that is the water with the high amounts of source term from your suppression pool --

MEMBER CORRADINI: No doubt.

MR. MONNINGER: -- and you are putting them someplace else on site. So, would they also be within some type of bunkered -- I shouldn't say "bunkered" -- but some type of highly-reliable-type structure to withstand the source term? I mean, is it any much different during the inventory control of that water into a big tank that has got to be protected versus a filtered tank that needs to be checked.

MEMBER CORRADINI: I wouldn't disagree with you. I think that is a fair way of putting it. But my question is --

MR. MONNINGER: Oh, if they came in with it?

MEMBER CORRADINI: If they came in with that, would the staff think that is a reasonable way to satisfy your concern?

MR. MONNINGER: I think we would have to look at it. If you have the explicit order out there, you know, that is the requirements. If we wanted to entertain it, we would have to do some type of discretion or most likely engage with the Commission. If there looked to be significant merits in the approach, we would have to engage with the Commission, because in the end the Commission, if they approve the filter in Option 3, that is what their expectations would be if the staff wanted --

MEMBER CORRADINI: But where I am going with this, John --

MR. MONNINGER: Yes.

MEMBER CORRADINI: -- you can see where I am going with this.

MR. MONNINGER: Yes.

MEMBER CORRADINI: I am basically trying to sneak back into Option 4, which says that, if I have a performance measure and I can come up with ways 25 years later that might be a bit more innovative, it still addresses your concern, because I understand where you guys are coming from.

MR. MONNINGER: Yes, if it has got technical merits.

MEMBER SCHULTZ: Just for the record, Mike, you are talking about 25 years later being now.

MEMBER CORRADINI: Right.

MEMBER SCHULTZ: Not 25 years in the future.

MEMBER CORRADINI: No. Correct. But what I meant to say -- but you are correct here; I'm sorry.

MEMBER BLEY: But, unlike a Reg Guide, we can come up with anything. With an order, it would take something special, some interaction with the Commission to approve --

MR. MONNINGER: You would need to have to interact with the Commission. The staff can always change the orders, rescind orders, modify orders, et cetera. But, given the significance of the potential order, I believe the belief would be we would have to re-engage upstairs.

MEMBER CORRADINI: Yes, I would expect that. Okay. I have made my point.

VICE CHAIRMAN STETKAR: Just out of curiosity, are orders ever written -- I am unfamiliar wit this process -- are orders ever written with that type of option? Or are they simply written as black-and-white "Thou shalt do this."?

MR. MONNINGER: Well, we do on -- I don't want to use the word "performance-based -- but we do try to write the orders to be, to the extent that they can be performance-based, do that.

If you look at the existing order, there is nothing within the existing --

VICE CHAIRMAN STETKAR: I was just looking for a yes or no.

(Laughter.)

MR. DENNIG: Mr. Fretz can correct me, but in the order process, there is a step where the licensee looks at it and says, "I can't do this," and comes back to you and says, "I can't do it." I think at that time there is also an opportunity to say, "I have another way to do this. I can't do it this way. I want to do it this way."

MR. FRETZ: But there are mechanisms for that.

MR. MONNINGER: You could write in the order more options or they have the 20-day clock to come in.

MR. DENNIG: The one technical thing that I would like you to all think about is, at the current time, the emergency procedures or SAMGs have procedures for both drywell and wetwell venting. They are both in there.

We have pretty much focused our attention on wetwell venting. So, I think in terms of a severe-accident-capable event, people think in terms of the wetwell vent.

Well, to the extent that we anticipate the need for and write procedures for a drywell vent, that should be at the same level of performance as the wetwell vent. If we can take out the drywell venting procedures because we are not ever going to use them, we are confident of that, you know, then we can just go with the wetwell. But, as long as there is a provision and a plan, and a foreseeable contingency that involves drywell venting, it should work to the same standard as a wetwell vent.

MEMBER BLEY: Is there a -- and I don't remember seeing it -- is there an intent that if the option you recommend is in place, and we have the blowout baffle as well as the bypass valve, that the procedures would be written to drive the operator to open the valve before you would get to the point of popping the rupture disc.

MR. DENNIG: I don't think we would try to drive the operator in any direction.

MR. MONNINGER: But there is a proposal in from the BWR Owners' Group for early venting to ensure RCIC operation and station blackout, et cetera. And that is all pre-core damage, and we believe there is merit in that type of approach. We hadn't rendered a finding or done the technical analysis. So, you could see the need for early venting for scenarios; in other scenarios, you may want to wait later.

MR. DENNIG: Right. One of the design

issues, again, with the Mark I and with the Mark II is that, because of its size, it not only can trap heat and cause problems that way, and have to be relieved, but it also can interfere with other functions.

And so, there are a number of situations, such as this early venting, that are driven by the containment size. We just feel that, overall, having a filter containment venting system simplifies the planning and the procedures and the thought processes for all those different contingencies, whether it is preserving Cap or making sure that RCIC will continue to work, or making sure that you can blow down from the reactor vessel, that you are in a position where you can do those things without a whole lot of attention and take your attention away from cooling cores, and so on.

MEMBER BLEY: Have you heard anything from the industry on this idea that one of the advantages is simplifying decisionmaking? I hadn't heard this. I missed yesterday's meeting, but I hadn't heard this argument before this round.

MR. MONNINGER: They talk about using it for hydrogen control also. There is 10 or 11 points upfront in the EPRI. I think they would -- I can't put words in their mouth, but, I mean, they do any type of venting, whether it is through the venting or severe-accident-capable, they recognize the merits of venting for the hydrogen control.

The decisionmaking, I don't recall its being discussed in the document. It could be. They are here.

MEMBER BLEY: Maybe they will say something.

MEMBER POWERS: You have a slide up here that says "Evaluation of Options". And so, I am going to ask a question, but it may be inopportune for you to answer this question now. Later may be a better time, but I will ask it now, and you can tell me that people will answer it.

One of my favorites of all the regulations is 10 CFR Part 100 because it is at once technology-neutral and entirely performance-based. In putting forth this recommendation of a filtered vent, you take away that technology-neutralness and being entirely performance-based. Is that a factor when you evaluate these options?

I mean, to my mind, 10 CFR Part 100 is the quintessence of defense-in-depth and what a regulation ought to be, and it simply sets a standard; this is what we want. Now do this and show us that you have defense-in-depth in this design.

MR. MONNINGER: So, there is the old Part 100 and the new Part 100. So, I assume it is the new Part --

MEMBER POWERS: Yes, it is only on in serious terms the siting criteria that I refer to, yes, you are right.

MR. MONNINGER: And actually, I guess in either case I don't have an answer, whether it is old or new.

(Laughter.)

But I can't answer that. I mean, we look at sort of the level of safety at the plant. Are we trying to model it after --

MEMBER POWERS: Yes. I mean, what you say in Part 100 is I don't want your dose site boundary to exceed 25 rem TEDE.

MR. MONNINGER: Right, right.

MEMBER POWERS: Okay. And I don't care how you get there; just get there. And by the way, in your evaluation, please consider a substantial release of radionuclides from the reactor coolant system, consistent with the kinds of things we would get in a substantial core melt. That is what you said. And after that, you don't care. You say nothing about how a designer gets to your prescription.

Now, you could come back and say, "Gee, what I want is not just for the design basis, also for severe accidents, but here is the standard I want to make. And I don't know what that standard would be. Maybe it is the same one and you just extend it into severe accident space. Maybe it is different.

That would be one approach. But you have chosen a different one that says, "Here is a technology that you should add to your system." And now, you have taken onto the regulator an additional burden that the public legitimately can call you to account on.

And I wondered, is that a factor when you look at your options?

MR. MONNINGER: It wasn't an exclusive factor. You know, one thought --

MR. DENNIG: We have looked at this. I mean, we did look at this consistency issue across the fleet. That is one of the things that John will talk about later. That is certainly something that people can bring up. That certainly is, if you want to consider it such, a vulnerability.

So, in that sense, a technology-neutral approach was -- I mean, we realize that there are different ways of doing things in the scheme of prevention and mitigation. If you look at them in one way, they all come out to be the same. And so, there is that argument.

And so, we have proceeded with the recommendation, knowing that that argument is there. I guess how much weight you want to put on that is where you come out.

MR. MONNINGER: If you are to look at the filters, and 12-100, they assume an individual is there. But, for this stuff, you know, severe accidents, you look at the actual population. You give credit for EP, which came up in the previous discussion this morning on economic consequences.

If you were to pursue a potential performance-based approach, the staff is pursuing it under defense-in-depth, defense-in-depth for the second barrier for the containment or the third barrier for the containment. If you were to establish that of filters, it would seem -- and given that the population is most likely evacuated -- it would seem like your metric would be something on land contamination, that you would want your filter to achieve.

The staff isn't pursuing a metric for land contamination. The staff is pursuing filters to address defense-in-depth for vulnerabilities in the Mark I and II containment designs.

So, you know, we are not prescribing some type of land contamination metric. And it would seem like, you know, if you wanted a performance-based approach for the filters, that is potentially --

MEMBER POWERS: It is not a performance-based criterion for the filters; it is a performance-based criterion for what you want to achieve on safety. It is not evident to me that you want to take on this burden as the regulator in prescribing how they achieve some level of safety which you are looking for.

MEMBER RAY: Dana, let me ask you a question at this point. Do we think we can define all of the scenarios that have to be considered in a performance-based approach for a beyond-design-basis severe-accident condition?

It seems to me that the filter is prescribed because I can't do that or I am not confident that I can do it.

MEMBER POWERS: Well, that is why I think that I am a little surprised they come up with the filtered, because, assuredly, I can define severe accident where the filter would, in fact, be failed --

MEMBER RAY: Right.

MEMBER POWERS: -- before the reactor. In fact, I think it is almost assured that in many, many of the seismic initiators, that the filter will fail before the reactor becomes at risk.

MEMBER RAY: Well, I often think of errors in just the sequence with which I go about coping with the events that puts me on a spot I never anticipated.

But, in any event, the point is well-taken. I am just saying the concern with performance, with Option 4, with me is, how do I know I have covered everything that I need to? This seems like a choice that you make in the absence of being able to do that.

MEMBER POWERS: I mean, the answer turns right around. You have built something that, in fact, will not perform in a significant class of accidents.

MEMBER RAY: That's right. Yes, you are quite right about that. But it would in others. So, all right.

MR. MONNINGER: I guess the next slide, slide 13, this was our cost/benefit analysis. As we mentioned, the staff did not conclude that it was cost-beneficial.

And we do have Marty Stutzke on the line for some questions on the PRA and some uncertainty analysis that we did.

And in the backup slide, we have some additional charts. We can discuss those in a few minutes.

Slide 14, then. We present another -- to a certain extent, this was the decision. It is the existing cost/benefit analysis is down here. What does it take to qualitatively walk you across this line or this line? The staff is using sort of a mental model that the cost quantitative analysis is down here, and we are using qualitative arguments to walk us across the line.

VICE CHAIRMAN STETKAR: Okay. John, can you go to 54 in your backup slides now?

MR. MONNINGER: Okay.

VICE CHAIRMAN STETKAR: You knew it was coming.

MR. MONNINGER: Yes.

(Laughter.)

VICE CHAIRMAN STETKAR: Now, first of all, help me out. Is, indeed, the value of the Y-axis millions of dollars on this slide or is it billions of dollars correctly?

MR. SZABO: Do you want me to talk?

MR. MONNINGER: Yes.

CHAIRMAN ARMIJO: Somebody help me.

MR. SZABO: I am Aaron Szabo.

So, what this is, these are probability-weighted numbers.

VICE CHAIRMAN STETKAR: I am asking you -- hold on a second. I just want to know whether that is an "M", or should it be a "B"?

MR. SZABO: It is millions.

VICE CHAIRMAN STETKAR: It is millions?

MR. SZABO: Yes.

VICE CHAIRMAN STETKAR: Okay. So, that is a billion dollars?

MR. SZABO: Yes, the thousand, yes.

VICE CHAIRMAN STETKAR: Yes. All right.

MR. SZABO: But these are all probability-weighted.

VICE CHAIRMAN STETKAR: I understand that. This is what I asked for yesterday.

So, your best estimates are that the costs that you use are actually much lower than the cost that you used in your analysis? Is that the correct interpretation?

Because, if I go back to slide 14 -- go

back to slide 14 -- where the Y-axis is billions with a "B", the range is from $1 billion to $10 trillion, right?

MR. SZABO: Right.

VICE CHAIRMAN STETKAR: And if you look at the break-even point on 10 to the minus 4, two times 10 to the minus 4 core damage frequency, it is around -- I don't know -- $2.5 billion, something like that, that lefthand triangle there.

Now, if I go to slide 54, if those are millions of dollars, and you said you did an uncertainty analysis, well, all of my uncertainty is down way below a billion dollars. So, it says you think you used the upper bounds of your cost estimates, that you are confident that the cost of an accident is on the order of, I don't know, $10-20 million. Is that the right way to interpret this?

MR. SZABO: With slide 14, I think those just used the MACCS2 consequence dollars.

VICE CHAIRMAN STETKAR: Don't play computer codes with me.

(Laughter.)

You said you did an uncertainty analysis --

MR. SZABO: Right.

VICE CHAIRMAN STETKAR: -- on the cost of an accident. And yesterday, I asked for what was that uncertainty analysis. This 54 slide I think purports to tell me what that uncertainty analysis is. I don't care about the particular colors or what the different dots mean right at the moment, or what those other lines mean. This shows me ranges of -- and they are roughly a lognormal distribution with an error factor of 10, which is what I read in the report, but they go way down below the value that I think was used in the analysis. I am trying to understand if that is actually the staff's state of knowledge, that they believe that the value for the costs that were used in the cost/benefit analysis that was represented on slide 14 were, indeed, upper-bound costs from an actual accident.

MEMBER BLEY: Well beyond the 95th percentile.

VICE CHAIRMAN STETKAR: Well beyond the 95th percentile of this uncertainty distribution. And I am trying to understand that.

MR. MONNINGER: So, slide 14 -- this is the actual analysis and the data points. Slide 14 was more of a cartoon, and it isn't the exact value.

VICE CHAIRMAN STETKAR: We don't play with cartoons. I have been doing plots. Okay? I am trying to understand what the uncertainty analysis is telling me.

MR. MONNINGER: Yes. Right, right.

VICE CHAIRMAN STETKAR: I understand what the uncertainty analysis is telling me when you varied the core damage frequencies --

MR. MONNINGER: Yes, yes.

VICE CHAIRMAN STETKAR: -- by a lognormal distribution with an error factor of 10. If the mean value is two times 10 to the minus 5th, the two times 10 to the minus 4th that you used is about the 99th percentile. We are 99 percent confident that the core damage frequency would be less than that two times 10 to the minus 4, which is where we just hit the break-even cost/benefit.

Now I was asking what our best evaluation of the uncertainties on the vertical axis would tell us. I think this is telling us that we believe that the costs that we used were beyond the 95th percentile of our uncertainties on the cost, that we would really believe the cost to be much lower.

And if I am misinterpreting that, I want to understand why.

MR. MONNINGER: So, if you will allow, we have Marty Stutzke, who actually did the analysis. He is on the line and, hopefully, he heard the discussion.

Marty, could you describe, I guess, the uncertainty analysis you did and, in particular, how we changed the consequences? And did we include offsite property damage in the consequences or was it just health consequences, et cetera?

MR. STUTZKE: Yes. Okay. Can you hear me?

MR. MONNINGER: We can hear you.

MR. STUTZKE: Very good.

The uncertainty analysis considered the uncertainty in all of the types of consequences. So, population dose, offsite economic costs, onsite economic costs, and worker dose risk as well. All of those consequences were assumed and now means that we are equal to the results that we got out of the MACCS2 runs, and they also have a lognormal error factor of 10 applied to them.

VICE CHAIRMAN STETKAR: You know, Marty, I understand all of that, if, indeed, the Y-axis value on the slide that we are looking at here, slide 54, has a "B" in it instead of "M", because I can see what you did then. If, indeed, this slide is in millions rather than billions with a "B", I don't understand what you did.

I did two plots. I have been doing two plots here.

(Laughter.)

I don't have the benefit of having visual aids here.

But, from what you said Marty, I would have expected the costs to vary higher and lower substantially around the mean value from the results of the cost/benefit analysis, right? I mean, if you said you used the MACCS2 as the mean and then fit a lognormal with an error factor of 10, that uncertainty distribution would span higher and lower than the mean value, right, considerably, because that is a pretty broad distribution.

MR. STUTZKE: Yes.

VICE CHAIRMAN STETKAR: But, if, indeed, what we are showing here is units of millions of dollars in the uncertainty analysis, then I don't know what was done.

MR. STUTZKE: Well, the uncertainty analysis that I did was focused on calculating the reduction on an annual or a per-reactor-year basis. But we certainly need to consider the remaining plant lifetime, and I believe there is economic discounting in there for the time value of money.

CHAIRMAN ARMIJO: But we can't plot one on the other.

VICE CHAIRMAN STETKAR: But that is still --

MEMBER SCHULTZ: That is still too big.

VICE CHAIRMAN STETKAR: There are uncertainties, not discounting, and things like that. Use the same financial rules --

MEMBER CORRADINI: Can I ask one question just to clarify, Marty? So, is the triangle from Enclosure 5 to the left with a high frequency of a half frequency, is that triangle exactly the same, is that value the same calculation that is coincident with 54 and the value in millions of dollars at the far left end, which is close to or greater than the 95th percentile?

I guess what I am thinking is they are the same value by the same method. If they are not, that is what I guess we want to start with understanding.

CHAIRMAN ARMIJO: I don't think we can overlay this chart on 14 easily.

MR. STUTZKE: They should be the same value, to my understanding.

MEMBER CORRADINI: They should be. Is that correct? They should be the same value?

MR. SZABO: Well, just multiplied by the number of years. This isn't on a per-reactor-year basis. These are totals for the whole fleet.

VICE CHAIRMAN STETKAR: I understand this curve.

MR. SZABO: Yes.

VICE CHAIRMAN STETKAR: Okay. I really do understand slide 14. I understand it. Now maybe I shouldn't, but I thought I really understood slide 14.

And I understand what was done to assess the uncertainty on slide 14, as you slide back and forth horizontally on the core damage frequency scale. I understand it is for the whole fleet. I understand that there is a bunch of magic that is done in terms of discounting financial values, but, indeed, it is a plot.

I asked yesterday for -- there was a statement that said that the cost information is evaluated also -- an uncertainty analysis was done on the cost information, which says that there are uncertainties on the vertical scale. And I asked what were those uncertainties and what does that plot look like, and we see 54. And I think I understand what 54 means, except it doesn't seem to be consistent with what I read in text and what I hear people saying orally to describe what was done.

Follow me?

MR. MONNINGER: Yes.

VICE CHAIRMAN STETKAR: In other words, as Mike pointed out, if, indeed, these are millions, if I look at the blue line at the top of figure 54, the diagonal line, and I trace it up to the place where all of the vertical dots are all lined up, that is about where the lefthand triangle falls on slide 14. Trust me, it is.

That says that the uncertainty analysis did not use the max analysis as the mean. It used it as something like the 95th percentile or higher, and that we are confident, as an agency, that the costs are much lower than that. But that is not what Marty said. Unless the lefthand axis here is actually billions of dollars and not millions of dollars, because, then, it seems to actually make a lot of sense.

CHAIRMAN ARMIJO: That is right; we have it here.

MR. MONNINGER: Aaron, do you have the tables from the reg analysis that you could QA this?

VICE CHAIRMAN STETKAR: It is probably too much detail, but I would like some feedback on that because it is important to understand if, indeed -- well, I don't want to take up more time, but I really want to understand what was done here.

MR. MONNINGER: This afternoon, we understand the Committee may have a letter-writing session.

VICE CHAIRMAN STETKAR: We will, we hope.

MR. MONNINGER: Would it be appropriate if we came back and --

VICE CHAIRMAN STETKAR: Yes. Yes, that would be fine, John.

MR. MONNINGER: Okay.

CHAIRMAN ARMIJO: It would be nice if you could overlay, compare a chart overlaying 54 onto 14.

VICE CHAIRMAN STETKAR: Fourteen.

CHAIRMAN ARMIJO: And then, that would resolve our issues.

MR. RULAND: Can I just suggest something? Part of the problem here is we had different staff members develop different graphs. And you know it; we owe you an answer to come up with what the answer is.

MEMBER CORRADINI: Don't let us do it.

VICE CHAIRMAN STETKAR: Yes, that's right.

You don't want us to do that.

MR. RULAND: That is correct.

MR. MONNINGER: And 54 was explicitly plotted and 14 was meant to be --

CHAIRMAN ARMIJO: Yes, we understand.

MR. MONNINGER: So, we will come back. Okay.

So, we could say go to slide 55, et cetera, but I think we were back in -- would that be fine?

So, these were the backup slides potentially from yesterday. So, maybe we will do that. Slide 55.

And this is the baseline values that were used within the PRA study. We brought this table forth to help explain the prior table on slide 54, and the following slide is the uncertainty, the distribution values that Marty had selected.

I know yesterday there was a question regarding within the consequences it says "Per tables X7 and X8" there. I believe that refers to, it should be to Enclosure 5(b), table 7 and 8. Is that correct, Marty?

MR. STUTZKE: No, unfortunately, those are just plain typos.

MR. MONNINGER: Oh, they are typos.

(Laughter.)

MR. STUTZKE: Because, originally, I thought it would be something like 5C-7.

MR. MONNINGER: Right.

MR. STUTZKE: But it table 7 and 8 in Enclosure 5C.

MR. MONNINGER: Okay.

MR. STUTZKE: Which are, in fact, received from the MACCS calculations from table 7. Table 8 is their input from their regulatory analysis.

MR. MONNINGER: So, slide 57. There was a discussion yesterday, within a process, is inclusion of qualitative arguments consistent with agency process and practice? Back in 1993, there was a Commission paper and a Commission SRM, and this is some of the language regarding the Commission's thoughts at that time on the backfit rule.

Maybe the second sub-bullet there and then subsequent slide, you know, they are basically saying don't be too strict or too rigorous, essentially, is what this slide says on 57.

And then, slide 58 brings up the notion of qualitative arguments within the first and the second bullets there. So, this was sort of the Commission's thoughts and guidance on the backfit rule that leads the staff into the belief that inclusion of qualitative arguments are consistent with the agency's expectations on the backfit rule.

MEMBER POWERS: That is absolutely true. That is absolutely the truth.

MR. MONNINGER: Yes. And then, subsequently, on the next slide, we mention NUREG/BR-0058. So, the stuff from the '93 SRM was then put into NUREG/BR-0058, and it talks about qualitative arguments, et cetera.

And then, the whole issue comes up with the screening criteria that is used for the backfit and to meet the safety goal policy, and issues with the screening criteria being heavily based on core damage frequency, and the notion of defense-in-depth. Yes, there I used the word "defense-in-depth" probably too much; whereas, I meant to imply containment.

MEMBER POWERS: Impossible that you would use the word "defense-in-depth" too much.

(Laughter.)

MR. MONNINGER: I referred to the NUREG. And then, when you do do the word search, it doesn't show up much in the NUREG. It is more in terms of how they treat containment and containment performance.

So, it talks about the balance here for defense-in-depth between the reactor system and the containment. But, then, at the end there, it talks about these measures aren't great for addressing issues associated with relatively-poor containment performance. So, that is within NUREG/BR-0058.

And if we take it to the next slide, they establish additional considerations for containment performance. This is the discussion within the NUREG. I pulled it in its entirety. They are talking about relatively-poor containment performance and that you can't necessarily rely upon the guidelines in there, and additional considerations come into play. A lot of it goes to management discretion as to whether issues should or should not be pursued, a management discretion and a determination that an issue associated with containment is a substantial safety enhancement.

MEMBER POWERS: When you look at this, it all reads very much like the same justifications that came about with the whole idea of wetwell venting. I mean, it seems like you are justifying venting here.

That next step of putting a filter, an additional filter -- there is already a filter on the vent -- but putting an additional filter on it is the step that I don't see. And that comes down to some more quantitative standard you have in mind, but aren't willing to articulate.

MR. DENNIG: In my mind, it gets to the premise that you have a filter on the vent and it is the wetwell. I think everybody understands that there is a large capacity in the wetwell to do that.

MEMBER POWERS: In gallons.

MR. DENNIG: Right, and I think where the concern comes up is, what are the circumstances and what are the conditions, what are the temperatures, what is the saturation state, what is the depth of that pool that is going to determine the DF you are going to get in a particular accident? When we think about that uncertainty, and look at where that uncertainty has been estimated in the past, it basically says that, while you can get a substantial benefit from it under some circumstances, under other circumstances you are not going to get very much.

And so, it is in the terms of that uncertainty that we developed the interest in the external filter. So, that is basically the thought.

MEMBER POWERS: Yes, and it is one that would be fun to pursue in a little more rigor because, for instance, we certainly have seen frequencies to torus failures. I mean, I have got photographs that show you that these things get old; they can fail. And we can certainly conceive of accident scenarios where you don't have the torus. But, then, you don't have your filter system, either, do you?

So, you haven't addressed that issue very well. That is kind of where I get into the difficulty of prescribing a solution.

MEMBER CORRADINI: Versus prescribing --

MEMBER POWERS: Performance criterion.

MEMBER CORRADINI: -- a quantitative performance measure?

MEMBER POWERS: Yes. I mean, that is where the rub comes.

MR. DENNIG: Right. You know, we wind up in here is the performance metric, and how did you estimate the performance metric, and what are the uncertainties.

MEMBER POWERS: We always do that. I mean, that is the whole --

MR. DENNIG: We get right back into that discussion again.

MEMBER POWERS: That is why we have this institution here, is exactly that. I mean, you are the public representative to assure yourself that what the designer has done, he claims he has actually, in fact, done -- I mean, you are never get away from that.

MEMBER RAY: Can we describe a performance requirement that we know we can meet?

MEMBER POWERS: Well, we certainly have one.

CHAIRMAN ARMIJO: Well, I have heard a decontamination factor of a thousand is kind of like a metric that you would want a system, an overall system, to achieve.

MEMBER BROWN: That assumes there is a vent.

MEMBER RAY: No. That is not what I am saying. I am talking about circumstances that Dana was talking about, which are that these things, for one reason or another, don't meet that performance requirement. In other words, you have got to say the performance requirement is associated with certain assumptions, it seems to me.

MEMBER POWERS: Always. Yes. I mean, I don't think I can get away from that.

MEMBER RAY: True enough. But, therefore, the weather seems to fit that same category in the sense that it assumes conditions which might not exist, as you well pointed out, the seismic event that is more likely to destroy the filter than it is the torus.

MEMBER POWERS: See, I don't think I ever get away from that.

MEMBER RAY: Yes, I grant you.

MEMBER POWERS: What I am questioning is, does staff really want to take on the burden of justifying those assumptions?

MEMBER RAY: I don't know that the industry wants to.

MEMBER POWERS: Well, the industry, unfortunately, always gets to.

(Laughter.)

I mean, that is exactly the burden that is imposed on them, is choosing a set of assumptions that can be justified to ultimately the Commission and even more ultimately to the public, in the sense that the Commission is the representative of the public in this case.

I mean, I hate to tell you, but that is the world they live in. If you look historically, it is the burden they took on themselves when they asked for the transfer of nuclear technology from the government that had developed it to the private sector. They voluntarily understood that they were taking on that burden. And now, why staff would want to relieve them of that burden and take it on themselves, a little of a mystery to me. I wouldn't do that if I were you.

(Laughter.)

MEMBER RAY: That is the point that we have been talking about here, is that the problem with the performance requirement is it has got to be something that is achievable.

MR. MONNINGER: So, the next slide is a little bit more discussion on the reg analysis guidelines, discussing difficulties for changes that result in only improved performance and no change in core damage frequency.

The next slide, slide 62, goes back to the eighties, and what we mentioned yesterday was the approval of venting and how the venting, the approval at that time was for both prevention and mitigation of severe accidents. And these are some of the quotes within the staff's SERs at that time.

So, the whole notion for the approval from the NRC for venting has essentially existed for severe accidents since the eighties. We just have not gone as far as to provide, to spec-out design parameters for piping, valves, et cetera. So, that was the next slide.

So, that was what we believe was our followup from yesterday, our takeaways. We did not go through probably slides 15 through 50-some. I am not sure if you want to quickly go through those.

MEMBER POWERS: I am very interested in going through 16.

MR. MONNINGER: Sixteen? Oh, yes, these were our qualitative arguments. As we discussed, you know, defense-in-depth has various definitions out there, but one of the universally-accepted ones is multiple barriers, barriers to the release of fission products from the fuel to the cladding, to the containment, to EP. And the containment is an essential element of that defense-in-depth.

The Mark I's and Mark II's through the PRAs that have been conducted through the years have a historically-high conditional containment failure probability.

MEMBER POWERS: Now that is the catechism that we reiterate, and I do it all the time, is that we have in the BWRs a low, relative to other things, core damage frequency, and that we have a higher conditional containment failure probability. Betwixt the two, they end up about the same as other designs have.

Now you are injecting an additional consideration here, which says now, for defense-in-depth purposes, I would like to have things about the same for each of these essential elements of defense-in-depth. And that struck me as interesting because we have not done that up until now. But, I mean, we have toyed with it 25 years ago, where there was interest in having additional containment failure probability. Initially, I think people trotted out 10 to the minus 3rd as a condition, realized that it was not likely, and then they went up a decade at a time. Finally, we said around .1.

Is that what you are looking for, is something equivalent to a conditional containment failure probability of .1?

MR. MONNINGER: No, we are not specifying the metric. We want to bring the value down, but we are not saying what the value should be.

MEMBER POWERS: Yes. You have articulated it qualitatively, but in your mind, then, you said, "Ah, here I have something."

MR. MONNINGER: Yes.

MEMBER POWERS: And the conditional

containment failure probability is for the --

MR. MONNINGER: We don't even think that the BWRs, the current fleet, meet the .1. Maybe the new reactors do.

MEMBER POWERS: Yes. I mean, from memory, for the representative plants we have done, I think BWRs run between about .8 and .2 or something like that, and PWRs between .3 and .01 and things like that. You want to see those things more aligned with each other.

MR. MONNINGER: Closer. I mean, but the staff does still recognize that the boilers do have a lower calculated CDF. They don't have to be perfectly in line.

But, whereas, we propose this as a pro, slide 16, in enhanced defense-in-depth, we also recognize on slide 24 -- maybe this isn't the best title -- "Consistency Between Reactor Technologies," exactly what you discussed. You know, the CDF containment performance, the level of safety out there.

We recognize that the fleet provides a relative level of safety that is comparable. If we pursue something with the Mark I's and the Mark II containments to address this issue for defense-in-depth, are we being inconsistent across the fleet?

If the fleet has -- there are variations -- a certain level of safety, but we are still pursuing something for the Mark I's and Mark II's, are we being inconsistent? So, we have put this within our qualitative arguments. It is a con against us. It is a negative against us.

So, we have tried to as much as possible throw out a bunch of qualitative arguments that we thought had merit. This is exactly what you are discussing. We are trying to be upfront with it, to say it is counter to the defense-in-depth argument.

Also, there is a slide on the Severe Accident Policy Statement, which essentially laid out the resolution of severe accident issues for operating reactors. And the staff closed out severe accidents for operating reactors in the early nineties, and what we are doing, proposing to do, is actually counter to this. You know, we are reopening severe accidents for operating reactors.

But, with that said, all the orders that were issued this past March do the same thing. Essentially, all the NTTF recommendations reopen it. But we have tried to highlight some of the various pros and cons out there in our qualitative arguments.

MR. DENNIG: We are just arguing in the case of the Mark I and the Mark II, with operating experience from Fukushima and the previously-identified overpressure vulnerability, that the con arguments of the Severe Accident Policy and consistency and treatment of the balance of mitigation and prevention is not controlled for Mark I's and Mark II's, from operating experience, aligning with our previous analysis, and in large part resulting from a previously-identified vulnerability about which something can be done.

MEMBER POWERS: Well, if I go back to 16, the next step you have here is open for the lost containment barrier that we are venting". Again, you already have a filter on this system. What you are looking for is some additional filtration --

MR. MONNINGER: Yes, more reliable.

MEMBER POWERS: -- capability here, not because of the additional filtering capability, but because, I think, it makes it more palatable to do the venting. The venting is what protects the barrier.

MR. MONNINGER: Yes.

MEMBER POWERS: The venting protects.

MR. MONNINGER: Yes, the reactor building and the containment.

MEMBER POWERS: It is really not the filtering. It is the percolativity to do the venting --

MR. MONNINGER: Yes.

MEMBER POWERS: -- that you are trying to enhance with.

MR. MONNINGER: And the filtering and the suppression pool and the plate-out and the sprays. In the argument, we also believe that there is some uncertainty there. We believe variations with the suppression pool, the exact accident sequence you are in, the timing of the sequences, the amount of water, the suppression pool levels, et cetera, all those things, you know, once you have the severe accident, you have that closed coupling between your containment and your reactor. And we believe or our thought is that the filter is, to a large extent, independent upon the conditions within the containment and the reactor. There is much more certainty in the performance of an external filter than a strong reliance upon the coupled containment reactor severe accident environment.

MEMBER POWERS: The idea, there is some sense of independence between the two.

MR. MONNINGER: Yes.

MEMBER POWERS: You know, I think you are probably right. I mean, if we are not too punctilious on this, you come up with that kind of statement. You know, the reduction of uncertainty -- fair enough. You get additional compensation. So, it is two things. It is percolativity to vent and some additional filtration is your argument?

MR. MONNINGER: Yes.

MEMBER POWERS: The final one is filtering improves the confidence to depressurize. Confidence in what? Who is confident?

MR. MONNINGER: The operators. Well, it would be the NRC's confidence, too, if they were to do it. But, also, the operators and the people onsite, they would have improved confidence in a highly-reliable system. And therefore, we believe the reactor building should be accessible for measures post-severe-accident. It provides a high level of confidence that your systems, your normal systems, maybe they weren't available at first; you could go in, you could recover them. You could put in temporary equipment, et cetera. It provides confidence that upfront you have a measure to deal with the source term, take away that forcing function from the containment, and allow you to proceed with the rest of your severe accident management program.

You know, it is not just within the reactor building; it is within the site. I mean, if you looked at not just the radiological field surrounding the reactor building of Fukushima, but just the sheer debris, whether it is the debris from the tsunami or the debris from the reactor building all over the place, we believe a dedicated design system with the filter would provide significant benefits to accident management.

MR. DENNIG: The notion is that confidence certainly increases in the direction of more confidence with a filter compared to without a filter.

MEMBER POWERS: Filters give you more confidence --

MR. DENNIG: Right. To the extent that you want to weigh that as important or not important, again, all these things are qualitative and can't be monetized or quantified.

MEMBER POWERS: We have done it with HEPA filters.

MR. DENNIG: Different people can come down in different places as to whether one thing is important or not. And that is certainly the case.

MEMBER POWERS: And that has been the

thesis of every HEPA filter system I have ever designed. It is two is better than one, and if two is good, we will put three in. That is exactly how we do it.

MR. DENNIG: Somebody could propose that. I don't think we would turn it down.

MEMBER POWERS: I would hope you would turn down a HEPA filter design.

(Laughter.)

CHAIRMAN ARMIJO: I think we need to get to slide 52.

MR. MONNINGER: So, I heard a proposal for a slide 52?

CHAIRMAN ARMIJO: I think unless there are a lot of questions --

MEMBER POWERS: The arguments, I mean the ipso facto assumes you are conceding ongoing release something on the order of half a billion curies into the environment as soon as you say, "I am going to vent." And I would be interested in a discussion of that.

The noble gases come out. There is nothing you can do about them.

MR. MONNINGER: Right.

MEMBER POWERS: And it is a bunch of

radioactivity to release.

CHAIRMAN ARMIJO: I think you have a slide on that.

MR. MONNINGER: Yes, 50 or 51 on the noble gases. Yes. And then, we also have a slide on the small particles.

So, slide 51, there was a question from a previous ACRS meeting on the impact of noble gases on site operation. We engaged our staff within the Rad Protection Branch. They did some analysis looking at it. And for the majority of the meteorological conditions out there, they believed it would have no impact. Given the elevated release, given the wind conditions, the mixing, et cetera, for the majority of meteorological conditions it would have essentially no impact on the site.

Where it would potentially have an impact would be on a plume inversion where it would come directly down on the site. They did do some rough calculations, and there is, I guess, emergency limits for radiological exposure up to once in your life up to 25 rem. They believed it is within those emergency exposure limits.

MEMBER POWERS: These are primarily shine?

MR. MONNINGER: Yes, yes.

MEMBER SKILLMAN: Did you have stakeholder input on that issue?

MR. MONNINGER: Oh, on noble gases? No, not at all. We had the last ACRS meeting. I am not sure if we had any public meetings between that, and I don't recall it coming out of any stakeholder feedback or input.

MEMBER POWERS: So, you would see that site operators would move to shielded locations, the vent would be activated. You would get dispersal, and that is presumably the end of it, save for this peculiar inversion situation.

MR. MONNINGER: Maybe the difference between the filter and the status quo. This issue comes up regardless of venting.

MEMBER POWERS: Yes.

MR. MONNINGER: Where it comes into potential significant for filtering would be that there would be an increased propensity to vent.

MEMBER POWERS: Right.

MR. MONNINGER: You know, it would be there regardless. But if someone had a higher level of confidence than we think the filter would have, they may increase the potential that it would be actuated. So, this would potentially rise a little bit higher. But the potential exists for all venting operations.

MR. BETTLE: It does bring in one other consideration. The existing order, since it was before severe accident, says that the release point would be at the roofline or higher. Well, the European plants, there seems to be probably a reasonably-even mix that the discharges run up the elevation of the elevated release point or released essentially at the roofline. I think the noble gases would be the biggest consideration as to how far up you have to make a release.

MEMBER SCHULTZ: Are there other issues that we would like to have the staff respond to that are in the package that we haven't yet examined?

(No response.)

And then, slide 53, John, would you like to conclude on that?

MR. MONNINGER: Yes.

MEMBER SCHULTZ: Excuse me. Fifty-two.

MR. MONNINGER: So, looking holistically at the analysis that the staff did, considering the input from external stakeholders, the knowledge that we have gained through our international interactions, and when you pull that together in an integrated decisionmaking process, including both the quantitative and qualitative factors, we think it best supports the position for a requirement for filter vents for Mark I and II containments. And the preponderance of that recommendation is based on defense-in-depth considerations.

And that concludes the staff's presentation.

MEMBER SCHULTZ: Any other comments or questions from the Committee before we open to public comments?

(No response.)

Seeing none, I would like to do so. We have had two requests for public comments, one from Steve Kraft and one from Mary Lampert, as I mentioned earlier.

For logistical reasons, I am going to ask Steve to speak first while we open the line. Steve also have family considerations that he needs to meet as well.

So, Steve, please start your comments now while we open the phone lines.

MR. KRAFT: Thank you, Dr. Schultz.

Sitting here, I got a message that my son had a car accident and I have to get out there pretty quick. He is fine; he may not be when I get home.

(Laughter.)

So, let me just make a few comments. And I don't know whether Jeff Gabor might want to make comments a little later.

First, on the question of the industry's commitment, I have listened for now what amounts to a full day of a misinterpretation of our letter. I am not sure what else you want. The paragraph in the letter is clear. The industry is committed to mitigating releases of land-contaminating radionuclides during a severe accident through a performance-based approach to filtering. I am not sure I can make that any clearer.

I would never have been permitted to sign that letter if I did not have the leadership of the industry okaying that statement. So, that is a commitment in the context of what it says.

The second thing I want to say is that proposal that we made for performance-based approaches using filtering strategies solves two problems together, which in our mind makes it a more elegant solution than the external filters because you put water in containment, you quelch the core debris, you arrest the progression of the accident, and you filter at the same time. So, that, to us, is the beauty of doing that.

In listening to the staff -- now I have not read the SECY because it is a draft and we haven't seen it -- but, in listening to the discussions yesterday and today, I get the impression that there is this aura built up around external filters that is probably unwarranted. They are systems and devices like any other. They have their failure modes. I am hoping when I read the SECY I will see them explored, certainly to the extent that filtering strategies have been explored in the SECY.

Again, as the point we made multiple times yesterday in our presentation, for the benefit of those who, unfortunately, couldn't be here because of the weather, both the external filters and filtering strategies only work under the exact same conditions. So, the question is, if you can show in an individual plant analysis that you achieve whatever the performance basis would be -- and I agree with the discussion I heard between Harold Ray and Dana Powers that you would have to have -- what are those assumptions and everything else -- that you then could show you meet that performance basis, and perhaps that would lead to an external filter or some sort of internal filter, as the utility might determine.

Let me talk about cost for a second. I am not going to comment on any individual cost you might have been given by a vendor. That is not my role. I don't know what they are.

But I will tell you this: listening to only the vendors is only half the story. You have to talk to the utilities and ask them what they think of those costs. Traditionally, vendors don't include in their estimates owner costs and other changes that would have to be made in the plant to accommodate the system the vendor is proposing, not to mention other things that need to be done, which would include the possibility of a new building.

So, I think when you add up all those costs, I think you are to the outer edge of the higher numbers as opposed to the edge of the lower numbers. That is independent of the vendor. These are things vendors typically don't know about, and utilities, then, have to take a vendor proposal and run their own cost analysis.

On the question of qualitative analysis, we said yesterday that the qualitative analyses have a role to play. We think that role is fairly limited. There are limited circumstances. But what we would recommend, that when you finalize the SECY, it may be made crystal-clear where the quantitative analysis stops and the qualitative analysis begins, so there is no confusion in the minds of the readers and the decisionmaker as to what they are basing their decision on.

The question about confidence -- I'm sorry, I am using the terms differently. On the SECY, the decisionmakers are, obviously, the Commissioners. In this context during an accident, the decisionmakers are the people at the plant in the technical operations center, et cetera, et cetera.

About whether or not they would open up the valve, open up the vent at the right time, we have the best-trained operators in the world. We drill, we drill, we exercise, and when the new SAMGs come out -- we are rewriting them now. EPRI is working on a new technical basis, and then they will be further amended if we went to filtering strategies. You would have to amend them if you did external filters. We will drill on those. We in the industry and the management that runs these plants have high confidence that that vent will be opened when that vent has to be opened. When I talk the industry leaders about it, they don't even think that is an issue because of the training that we do.

Lastly, listening to the discussion in the first part of the morning on economic consequences of land contamination, and thinking back to the September 11th Commission briefing, it seems to me that we included this in our letter of October 5th, that the four issues, economic consequences of land contamination, Recommendation 1 out of the Near-Term Report, the Risk Management Task Force Report, and this question of filtering, are really one and the same issue. They are all linked. They all have to do offsite consequences, some more directly than others.

I think they need to be looked at together, so you have one way of approaching solving these problems as opposed to four or five different ways of doing it.

That concludes my remarks. I appreciate it. Thank you very much.

MEMBER POWERS: May I ask a question?

CHAIRMAN ARMIJO: Sure.

MEMBER POWERS: There has been a lot of discussion on the confidence of operating the filter.

MR. KRAFT: I'm sorry, Dr. Powers?

MEMBER POWERS: Of operating the filter system or the venting system, and you have indicated that you have a very high confidence. I mean, how do we know that for sure?

MR. KRAFT: Well, we know that for sure on the basis of our training programs, the drills. You can't draw parallels, we don't think, between what happened at Fukushima. Those operators were not as well-trained. Your own reports say this; I am not saying anything new. They don't have plant-specific simulators.

When you read the sequences that you see in the reports and, then, also read the management questions raised by their own reports, particularly the Diet report, I think that you see a picture that does not replicate here. And so, that is what gives us confidence here.

MEMBER POWERS: The only analog that comes to my mind on this operation of the vent is the depressurization of the reactor coolant system and the propensity to get into a long-term station blackout because we operate on batteries so long that we get to the point that we cannot depressurize the cooling system. And that tends to be a fairly-significant severe accident sequence for BWRs.

Can you relate the two? I mean, I presume you train on depressurizing the reactor coolant system. And there, I understand the tradeoff. Depressurizing the reactor coolant system, when, in fact, it does not need to be depressurized, is a tremendous corporate cost. And so, there is some hesitancy to do it.

Here I am not sure, if I am in a severe accident and I know it, I am not sure what the cost of operating the vent is that would cause somebody to be hesitant.

MR. KRAFT: Well, I'm sorry, I don't mean to read something sinister into that question, but --

(Laughter.)

Are you suggesting that corporate management would order actions not be taken --

MEMBER POWERS: No, no, no, no, no. I am putting myself into an operator's position. I am sitting there at the switch. What is going through my mind? I know that if I follow procedures, I cannot be criticized. Okay?

And so, one of the primary justifications that has been presented to us by the staff here is that the hesitancy to operate the vent would be ameliorated in some sense by the existence of an external filter system. So, I am trying to understand that more. And I am trying to understand it from your perspective.

As I said, the only analog I can take that I have seen from this is depressurization of the reactor coolant system in a BWR. There may be better analogs, but that is one that comes to my mind.

MR. KRAFT: Well, here is what I can say: I gave you the answer I could give you which is based on training. We spoke at great length and had a lot of good dialog with the Subcommittee yesterday on our pilot, tabletop pilot. I think the behavior of operators is something that we will look into very deeply. I said we will have SROs involved in those discussions, and it would be a question we will have to explore as to, you know, put yourself in the position of having to throw that switch, open that valve, whatever it is you do to do it. And these folks live in the vicinity. Families are right there. Children are in schools. Those are the issues you are talking about. I think that is a question we are going to have to explore.

But, again, what the industry leadership and management of these plants tell me is that they rely on their training, highly-trained operators, and they do what is required of them. That is the only answer I can give at this point, pending further exploration through our pilot studies.

MEMBER POWERS: Well, if I look at the Fukushima accident, there are huge numbers of issues that I do not know the answer to, pending more detailed examination of the plant and things like that. But a couple of them, one is I got hydrogen explosions, but I didn't think I would have them. I still don't understand those very well.

And the other was a reluctance to vent the systems. And so, I am delighted to hear that you, in fact, are looking at that because I think that is an issue where we have to have absolute confidence that the operators will operate that system. Because the whole idea of wetwell venting was introduced to compensate for the higher vulnerability of the containment, and I would say we have to have it. I have no doubt in the operators myself, but this is one of those things where we definitely won't trust, but verify.

MR. KRAFT: I guess that is a very helpful explanation, and I think that, yes, when we put in the wetwell vent, it was an attempt, it was an effort to make sure that you did filter those releases. If you look at the EPRI report, the filtering of the releases through the wetwell vent, provided you control the pressures of containment so you don't go to saturation of the suppression pool, are identical to the behavior and performance of the traditional water-based filters that you see being used in Europe. So, from that standpoint, the operator is in the same boat, and the filter doesn't make a difference.

MEMBER POWERS: That is right.

MR. KRAFT: But, again, we will take your comments onboard and we will explore it.

Thank you very much for your kindness in letting me be first.

MEMBER SCHULTZ: Thank you for your comments, Steve.

I would like to now ask Mary Lampert from Pilgrim Watch to make her statement.

Mary, as an introduction, I want to let you know, since you are not in the room, that the audience that is here is the same as the audience you spoke with about an hour or so ago. And so, it is not necessary for you to repeat that information.

And then, secondly, we thank you for the document that you sent to us with respect to the discussion you are going to summarize today. It was a very thorough piece of work. The Committee has had it since yesterday and has had a chance to review it.

It will also become a part of the record of this meeting.

So, with that, if you are there, please state your name and make your presentation. We have allotted five minutes.

MS. LAMBERT: Yes. Mary Lampert, Pilgrim Watch.

Thank you for the opportunity.

A filter is, frankly, in summary, a no-brainer. Congratulations for recognizing that.

The public is only protected by a filter's reliable part, not simply by a reliable vent alone. That is viewed for its impact, obviously, on public health and, also, on the workers' health. In a severe accident, when you have the most radiation being put out into the environment, not to have a filter doesn't make any sense.

Also, for the issue of the increased likelihood that operators will use the vent because they would have less hesitancy, recognizing that, irrespective of training, they are, No. 1, human beings and they recognize what they would be releasing and its impact on perhaps their families and everybody else in the community. So, that would be a tendency, as we saw in Japan, where the Japanese workers have a culture of following authority certainly more than here.

Third, hydrogen control is an important benefit.

And fourth, the argument that has been made that the sequence of bad things that have to happen in order for a filtered vent to be useful are so large that they are not going to occur in the United States is an absurdity. We have seen three core-melt accidents in real-time. It is time to learn from actual experience and not by PRA theoretical games.

And if that thought is correct, would the same person recommend getting rid of emergency planning because it is never going to happen here? I should hope not.

Fifth, the statement was made somewhere in this discussion that industry perhaps can't do it. Well, if they can't do it, and the Europeans can and the Japanese are going to be able to do it, then, indeed, we are in more trouble than we realize.

My last point is the go-around between slides 54 and 14 I think perhaps ties back to the original discussion on economic consequences. I think it is an example where the NRC should not modify its cost/benefit analysis to incorporate the lessons learned from Fukushima before using it to assess the cost and benefits of these recommended upgrades. Because during the discussion it was mentioned that they used the MACCS2 in their analyses, their uncertainty analyses, and that could go a long way to explaining the discrepancy.

However, I think the main point is it is time to use common sense and to learn the lessons from Fukushima and satisfy the requirement to put public health and safety first. It is obvious, without a filter, public safety is at risk, and unnecessarily so.

So, congratulations to the staff, and I certainly hope that those on the Committee will be in support also. And thank you again.

MEMBER SCHULTZ: Ms. Lampert, thank you very much for your comments. And again, thank you for your detailed report that you have provided to the Committee.

With that, I would like to ask for other public comments from the telephone line, from the bridge line. If anyone would like to make a comment on the telephone, please state your name and do so.

(No response.)

Hearing none, I would like to turn to the room. We have comments from the public here.

MR. RICCIO: Again, thank you. This is Jim Riccio with Greenpeace.

It is not often that Greenpeace comes out to the NRC --

MR. LEYSE: Bob Leyse. Can you hear me?

MEMBER SCHULTZ: Bob, we have a comment ongoing in the room here. I will call on you later. Thank you.

MR. LEYSE: Good.

MR. RICCIO: It is not often that Greenpeace comes out to the NRC in an effort to praise the NRC staff. This is one of those rare opportunities.

Again, we won't bother you with the long history, the long and troubled history, of the GE Mark I's. But if this agency had a spine, the GE Mark I's never would have been licensed in the first place.

I was at the ACRS meeting 25 years ago where you ducked putting filters post-Chernobyl on Mark I reactors.

One of the things that was interesting that this Committee did not bother to ask the staff, and perhaps it is because they did a good job of presenting it in previous meetings, was whether or not this agency is an outlier when it comes to having filters, external filters, not scrubbing through the suppression pool, as NEI would contend, but real filters on these vents.

Japan has ordered them. Europeans have had them since Chernobyl. The Romanians have ordered them for Cernavoda.

It is about time that this agency and this Committee stop treating Americans like second-class citizens and provide us with the same level of protection that is provided to the Europeans.

Now perhaps I misunderstood what NEI had said earlier, but at every meeting I have been at NEI and the industry have opposed putting filters on these containments. So, perhaps I misunderstood what Mr. Kraft was saying or trying to say.

Now this Committee has, over the last decade or so, boosted power on General Electric Mark I reactors. That has increased the risk. It has also reduced accident response times on these reactors. You have also extended the duration at which the public will be placed at risk by these nuclear reactors by extending the license life of these reactors. Both those two things increase the profit margin for these nuclear corporations which they put in their pocket. We are merely asking that you take some of that coin and force them to spend it on filters that would not only protect the public, but would also protect the workers.

Some of the issues you had around Fukushima were the inability of workers to actually take the steps necessary to protect the core and the reactors because of radiation. A filter would help that out.

Now I know this Committee has a lot of disagreements about the filters and they are getting caught up with the rhetoric of defense-in-depth. As Mary Elizabeth Lampert has said, it is a no-brainer, when this is the only country except for perhaps Slovenia that is not moving rapidly to put these in place. We are just asking that you provide us with a level of protection concomitant with the rest of the industry.

Thanks for your time and consideration. We really could use a strong letter from this Committee to the Commission because we already know that several members of the Committee don't believe that filters are necessary because they said it already.

Again, we would prefer that the Commission review what the staff has done before they make their decision, not merely side with the industry and, again, fail to protect the public.

Thank you for your time and consideration.

MEMBER SCHULTZ: Thank you for your comment.

I would like to go now to Bob Leyse.

MR. LEYSE: Hi. Am I on?

MEMBER SCHULTZ: Yes, you are, Bob.

MR. LEYSE: Okay. If I am not done in two minutes, cut me off.

(Laughter.)

MEMBER SCHULTZ: Thank you.

MR. LEYSE: I have heard nobody talk about a fast-moving accident. If you look at the vent size and all the stuff required for a truly fast-moving accident, the cost is way up there and you might as well forget it.

Now there is about a billion dollars in each PWR class in the decommissioning trust fund. The most cost-effective thing to do would be to spend money like Obama wants to. For all that billion dollars, mass produce a shutdown of all these PWRs that are old because they don't have a containment.

To put a vent on to substitute for the fact that they don't is going to cost so damned much that you might as well forget it.

I hope I am under two minutes.

(Laughter.)

MEMBER SCHULTZ: You are, Bob. Thank you very much for your time.

Are there any other comments? Oh, we have one comment in the room. If anyone else on the phone line would like to make a comment, please be prepared.

MR. GUNTER: Paul Gunter with Beyond Nuclear.

We concur that the hazard analysis on the Mark I containment has long recommended by Dr. Steven Hanauer for the discontinued use of the Mark I because of the unreliability of the containment.

Given the political realities now, we think that the staff's steady judgment on making defense-in-depth deeper by adding these filters is the appropriate option.

I would only add and request that, as we have been monitoring these meetings, we now recognize that Option 3 basically recognizes mitigation for both pre-fuel and post-fuel damage events. In line with the Option 3 now recognizing post-fuel damage service in these vent lines, we are requesting that there also be this verification and documentation process for inline hardened vent line monitoring with radiation monitors that are calibrated to measure post-fuel damage, as part of a verification and documentation process that we think basically is a performance enhancement for this particular Option 3.

And it is my understanding that the current order, EA-2012-050, does not currently provide for inline radiation monitoring other than to cap the monitored calibration at operational radiation levels. So, in order to bring about a performance enhancement, we are requesting additional consideration be provided for calibrating those inline monitors to actually validate, verify, and document radiation releases that would be going through this filtered system.

Thank you.

MEMBER SCHULTZ: Thank you, Paul.

Are there any other comments on the bridge line, on the phone? If so, please state your name.

(No response.)

Hearing none, are there any more public comments from the room?

(No response.)

Seeing none, I would like to thank the

staff for the presentation today again, given that you have spoken with us yesterday and today also in very clear ways to present the case that you have developed moving forward. We appreciate that very much.

With that, I will turn it back over to you, Mr. Chairman.

CHAIRMAN ARMIJO: Okay. Well, thank you very much.

I thank the staff and commenters as well.

We are running pretty far behind schedule. So, what we are going to do is recess for lunch, but I would like to restart our meeting on the long-term cooling for the ABWR design, I want to start that at 1:30.

(Whereupon, the foregoing matter went off the record at 12:41 p.m. and went back on the record at 1:31 p.m.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

1:31 p.m.

CHAIRMAN ARMIJO: Okay. We are going to reconvene, South Texas Project, Units 3 and 4. Dr. Corradini will lead us through this presentation

MEMBER CORRADINI: Thank you, Dr. Armijo.

So, just to remind everybody, I am the Subcommittee Chair for the Advanced Boiling Water Reactor Subcommittee. We have had several Subcommittee meetings, most recently one on October 2nd of this year, where we were briefed about the capabilities of STP Units 3 and 4 relative to providing long-term cooling to the reactor core.

I will go off-script just to remind everybody this is a requirement from the Commission in terms of either during their construction operating license or in design certification phase II, to verify that they have the ability for long-term cooling.

So, at this meeting we want to talk about Nuclear Innovation North America -- that is NINA -- and the NRO staff going over to brief the full Committee about this subject.

Mr. Maitri Banerjee is the Designated Federal Official for the meeting.

So, the rules of participation, as were

announced in The Federal Register, I am sure that all of you remember parts of the meeting are being closed to the public to protect proprietary information. If that we come to that point, I am going to look to Scott to tell us when we have to clear the room to make sure. And I am also asking the NRC staff to help in that, when we get to that point, if necessary.

The telephone bridge line is open to have the public and stakeholders hear deliberations. It won't carry any signal at the closed portion of the meeting. And also, we have a listen-in-only mode for that purpose.

So, at the end of the meeting, when there is time, any member of the public attending the meeting in person or through the bridge line who wants to make a statement, we will turn everything back on, so we can see if there are comments from members of the public.

So, let me proceed with the meeting, and I will call on Tom Tai of NRO to begin the presentation.

Tom?

MR. TAI: I want to thank ACRS for giving us the opportunity, especially after Sandy that devastated the East Coast.

So, hopefully, we will give you any additional answers, if you have any questions.

MEMBER CORRADINI: And, Scott, will you lead us through this initial part?

MR. HEAD: Yes, I will. Appreciate it.

I mirror the comments made earlier. We appreciate this opportunity to gather for this. We did have some travel impact, which I will talk about here in a second.

Here are our attendees for today except for Tim Andreychek. He had a travel issue. So, he won't be here. He is, in fact, listening in.

And you have accommodated us with Jim Tomkins being able to listen in, in case there is a question that comes up. He could not make it from the West Coast.

But the rest of our staff that has been involved in this presentation is here, and we certainly look forward to this briefing.

The agenda, let me just start by saying that this is, in essence, except for two minor facets, the same presentation that we gave at the last Subcommittee meeting. Obviously, we can expand on anything or any of the discussions that we had from that.

There will be a short introduction. We will go over long-term cooling, which is the overall issue, but, then, we are going to focus a little bit more on downstream fuel effects testing, since we spent quite a bit of time on downstream fuel effects testing.

In the Subcommittee meeting, you had asked us to provide a docketed update to some of the followup items, which you had asked in the Subcommittee meeting. And so, we will make sure everyone is aware of that and ask if there are any other questions with respect to those.

MEMBER CORRADINI: And just to remind the members, we all got an email with an attachment that gave all the information we asked about, just to clarify issues such as debris and justification of debris volume, and we have gotten that, I think now, Maitri, about two weeks ago?

MS. BANERJEE: Yes, in a CD, too. There was a separate CD.

MEMBER CORRADINI: Right. Okay. Go ahead. I'm sorry.

MR. HEAD: No problem.

With respect to just the introduction, I will just repeat, basically, the next slide talks about the basis for the ACRS review to answer this question from the Commission regarding long-term cooling. So, that is repeated here.

With respect to long-term cooling features at South Texas, the ABWR includes a robust ECCS. It is three trains, a residual, heat removal; two trains, high pressure, and one train of reactor core isolation cooling, classic, single-failure-proof, but clearly robust and substantial with respect to long-term cooling. It has diverse delivery locations within the reactor vessel and diverse and numerous water sources just to provide the cooling with respect to ECCS.

The strainers are state-of-the-art strainers. They are substantially larger than the DCD. So, their capability is also robust in terms of the expected challenges that they would face.

On the next bullet, I would like to just, as a preview, note that Steve Thomas, our Engineering Manager, spent a lot of time on Units 1 and 2, and certainly I have spent a lot of time on 1 and 2, dealing with sump issues, debris issues on 1 and 2. At this phase of the project, we ask ourselves, what is it that we could be doing from a design standpoint to basically resolve the issues?

And this initially started off clearly

from a strainer's standpoint, or the sump equivalent, at 1 and 2, but, clearly, has evolved into also addressing what we believe are the issues associated with fuel debris or fuel plugging. So, I will read the action one when we get into the details.

So, the containment debris is minimized. In the ABWR, there is no recirculation piping and associated insulation. So that, by definition, minimizes the amount of potential debris that could be generated.

It is a small, inert containment with a closed suppression pool, which in many ways is different than other BWRs, not all BWRs, but it is a closed suppression pool. So, the opportunity for the introduction of material is minimized.

(Interruption on phone line.)

Okay. Where was I? Oh, I will start all over.

Robust ECCS. I'm sorry. So, small, inert containment with a closed suppression pool, it is not something that is easily going to get debris located in it. So, that is important. It is coated. The containment is coated, steel-lined containment. Very importantly, the suppression pool at the water elevation is stainless steel, and it has minimal equipment in the suppression pool. So, again, the potential for generating debris or challenges either to the strainers or the fuel is minimized.

The next point, no fiber or calcium silicate insulation is a decision that was made STP, to basically go to reflective metal insulation for all piping and the containment, including small bore, to minimize the generation of either fiber or calcium silicate, which obviously is a challenge in terms of debris and the plugging of either strainers, sumps, or in our case fuel. So, we made that decision and believe it is an important aspect of the overall case that we are making.

Also, there is no aluminum in containment and there is no zinc other than in qualified coatings. Now, we ultimately had to assume a minimal amount of aluminum just for margin purposes and in discussions with the staff. So, obviously, there is always the potential for maybe aluminum to be introduced in some way or other.

MEMBER SHACK: You didn't actually make that a spec on equipment --

MR. HEAD: Yes, sir.

MEMBER SHACK: -- and things like that?

MR. HEAD: Yes, sir.

VICE CHAIRMAN STETKAR: You don't try to control entry of aluminum during outages?

MR. HEAD: I don't know that we control during outages but, certainly, it is leaving after the outage.

(Laughter.)

And that is what is done at 1 and 2, and 1 and 2 there is a significant amount of bookkeeping because there is aluminum in 1 and 2, but it is part of the bookkeeping. And so, if we were to ever want to make a Mod that had lots of aluminum in it, then it would encounter a 50.59. They would have address the meaning or the implications of that. So, I think the leaving part is more important.

VICE CHAIRMAN STETKAR: Yes.

MR. HEAD: There are trash racks. It will prevent large debris from entering the suppression pool, and mainly from the locations of the most likely breaks in the main steamline in feedwater, that those breaks would encounter, debris would encounter trash racks, so the large debris would not really make it down in the suppression pool.

And then, we have a suppression pool cleanup system which will keep the pool clean, but it also would be part of any sort of early-warning system because the pumps do have strainers involved, and the opportunity to see something that is generated either just during normal operation or maybe the post-SRVs being actuated, starting up or something that we would, ultimately, possibly see something in those strainers. So, it is an opportunity for us to assess whether there is something going on in the suppression pool that we need to take action on.

VICE CHAIRMAN STETKAR: Scott, I have forgotten details. You are planning to run the suppression pool cleanup system constantly during normal plant operation? Most plants don't run it at all, except just before an outage.

MR. HEAD: That is pre-decisional I think at this point.

VICE CHAIRMAN STETKAR: Okay.

MR. HEAD: It is a variable. The pool will be monitored. I mean, right after an outage, we will get to a certain point where we are comfortable that we are not going to leave it in noted containment, and if there is nothing going on in there, we will leave it off. Okay? Maybe we will turn it on later just to assess that, maybe before an outage.

VICE CHAIRMAN STETKAR: I am just trying

to understand, you know, you are saying you are taking credit for it, essentially, but --

MR. HEAD: No, I would not say at this point in time. It is there. It can be used to whatever extent is necessary to address any issues we see.

VICE CHAIRMAN STETKAR: I understand.

MR. HEAD: Now I will just back up a little bit. I was trying to characterize what this pool would look like compared maybe to our visions of the pools of 20 years ago. I mean, I was wrestling between swimming pool versus spent-fuel pool, and I guess I have landed on it is going to be much more like a spent-fuel pool in terms of cleanliness, I believe, in terms of the threat, because of the cleanup ability, because we minimize the threat, and certainly we have minimized the generation that would happen post-accident.

VICE CHAIRMAN STETKAR: My only point was the swimming pools also have cleanup systems which they don't operate, which would also --

MR. HEAD: Some of us have a hurricane. After a hurricane, we find that they don't operate at all, yes, sir, that is true.

(Laughter.)

VICE CHAIRMAN STETKAR: No, no, no. In terms of early warning of debris and things that might be in the pool --

MR. HEAD: Right.

VICE CHAIRMAN STETKAR: -- vines and corrosion products, that sort of thing.

MR. HEAD: See, embedded in all of that, though, clearly, is a plant like 1 and 2 who will operate Units 3 and 4, having an effective corrective action program to be able to assess and to take appropriate actions.

Let me ask, are there any questions on our debris minimization that we endeavored to --

MEMBER SKILLMAN: A question, please.

MR. HEAD: Sure.

MEMBER SKILLMAN: Dick Skillman.

Is that stainless-steel-coated? Or is that not coated?

MR. HEAD: That is not coated.

MEMBER SHACK: The one foot of the fibrous debris that you assume is there, is that somehow in the tech spec? How is it handled in your procedures and your commitments?

MR. HEAD: We have a --

MEMBER SHACK: Okay, that is coming up?

MR. HEAD: -- slide that will address that. I will certainly answer that.

Any other questions on containment debris?

(No response.)

All right. So, as the review unfolded, we also wanted to at least take credit for or recognize the existence of defense-in-depth features. We noted that these don't appear as part of any design-basis credit, but they are, in fact, there with respect to this issue.

MEMBER CORRADINI: So, if I might say it differently, you are not taking credit for it in the current analysis, but these exist?

MR. HEAD: Yes, sir. Now, of course, obviously, a high-pressure core flooder has its role in Chapter 15 per se, but in terms of blockage of the fuel, okay, what we will be saying here is that that comes in at the top of the core and is ultimately available to cool the fuel.

There is a design bypass flow that is used, for example, to cool the control rods. And that flow would be available, also, to ultimately appear at the top of the core and cool the core, the fuel.

We have AC independent water addition, which is in the certified design, which is from a different clean source and is available to the operators to use if they so chose.

And then, this is one of the points that we added that was not in the original slides. We just wanted to make note that we do have the alternate feedwater injection which is an additional water source, a clean water source. It would not involve going through the strainers, and a substantial water source that could be available for cooling that we believe is a defense-in-depth feature that was worth noting and acknowledging.

And then, we also had the operational program to ensure containment cleanliness. That is in our COLA and it is a part of, as I think we have alluded to before, it is a part of people closing out before leaving an outage, and it is also a part of preparing for outages. And so, it is an inherent part of ensuring that you leave the containment in, basically, a design-basis condition when you go to power.

So, that is the overview and part of the history of some of the decisions and history somewhat of the review that has got us to this point.

Any questions? If not, I will continue.

(No response.)

In terms of long-term overview, what we are going to talk about just a little bit more now is emergency core cooling and the ultimate heat sink, and then, the challenges that we addressed as part of the review, the ECCS pump, NPSH, containment integrity, gas accumulation, and downstream chemical effects.

So, as I mentioned before, robust, long-term cooling. The ultimate heat sink has a 30-day supply of water without makeup. That is a design-basis feature. The 30 days is there. Obviously, we all know that makeup would somehow be available for that time, especially in light of recent events. But that is the capability, sizing of the ultimate heat sink.

And as I mentioned before, we have numerous ECCS water sources. The peak clad temperature during the design-basis LOCA is, in fact, about half of the limit, and AC independent water addition serves as an independent backup to the ECCS. Like I say, that is part of the ABWR certified design, and then, alternate feedwater injection.

As I am sure I alluded to when the ACRS reviewed alternate feedwater injection for the rule change, rust accommodated in the rule change. We had the choice between concrete and water, and we chose water because we felt like it would serve us in other forms, other opportunities for it. So, this is one of the reasons we wanted to add it to this discussion.

Okay. Next slide.

Challenge to long-term cooling has been addressed. The strainers meet the NPSA's guidance. They are sized based on very conservative debris loading. They are, in fact, sized on a plant that is not all reflective metal insulation, that, in fact, does have fiber or calcium silicate insulate. And so, they are sized to accommodate that. Obviously, at 3 and 4 they won't be challenged by that. So, they are, in fact, very conservative from that standpoint.

And as alluded to before, AC independent water addition and AFI can provide core cooling without the strainers.

Containment integrity is maintained. The containment design pressure and temperature are met under design-basis LOCA conditions. We discussed that in one of our Chapter 6 presentations.

ECCS gas accumulation has been addressed. We do have a keep-fill system on ECCS. We have design processes to make sure that vents are located appropriately, and we have an ITAAC to make sure that the piping is arranged appropriately. So, we believe the ECCS gas accumulation has been appropriately addressed.

And then, downstream fuel effects, while we believe everything that we have done, in essence, addresses the challenge to downstream fuel effects, we will confirm that by testing on the actual fuel that will be loaded into Units 3 and 4.

So, like I said, that was a significant part of the review, a significant part of ACRS interest. So, just a little more detail on that.

The downstream test will confirm adequacy for the core. That test will be performed at least 18 months prior to operation. That is the commitment we have made in the COLA.

MEMBER CORRADINI: Can I just interrupt you, Scott?

MR. HEAD: Sure.

MEMBER CORRADINI: Can you go back a slide?

MR. HEAD: Sure.

MEMBER CORRADINI: Because I remember you explained this to us in -- actually, you are faster than I am; I am two slides back. Sorry.

(Laughter.)

So, from the standpoint of taking credit, you don't take credit for No. 3 and 4. But if you were to use it, it is early in the accident in terms of ECCS performance. So, really, the lack of taking credit for it changes the timing of when you go into the recirculation mode, in my mind. Have I got it approximately right? Because the way you said it is you are not taking credit for either 3 and 4 or the two lower ones, and that is just, if you did do it, it essentially delays when you would go into the recirculation mode. Correct?

MR. HEAD: Delaying going into recirc mode.

MEMBER SHACK: Yes, would you ever have to recirc if you take credit for those?

MR. HEAD: I would say yes, just later.

MEMBER SHACK: Could you refill the water?

MR. HEAD: I would assume later.

MEMBER SHACK: I would assume later, too.

MR. HEAD: Well, these tanks are huge. They will ultimately need to be --

MEMBER CORRADINI: Right, but my only point was I am with you; I just wanted to make sure that, in my mind, when you said you are not taking credit for it, you essentially are saying, "I am delaying, by using these appropriately, I am delaying when I need to go into recirc model."?

MR. HEAD: Yes, sir.

MEMBER CORRADINI: That would be true?

MR. HEAD: Marty?

MR. VAN HALTERN: There are a couple of aspects. One is if, for some reason, you find that those strainers are failed, you have a water source to keep you going.

MEMBER CORRADINI: How would you know that?

MR. VAN HALTERN: Pump performance.

MEMBER CORRADINI: So, you would notice something in the pump performance in operation while in recirculation mode?

MR. VAN HALTERN: You could see something.

MEMBER CORRADINI: What? I am sorry to take you off-script, but are we talking a different current on the motor?

MR. VAN HALTERN: Yes, if you see fluctuating currents on the motor, that means you could be in a situation where you are cavitating or you don't have sufficient water suction.

MEMBER CORRADINI: I just want to make sure that I understood where this would come in. So, you are thinking not only delaying when you go into recirc mode; it would be, while in it, if you noticed aberrations, you could actually draw upon these tanks --

MR. VAN HALTERN: Yes, sir.

MEMBER CORRADINI: -- and systems?

MEMBER SHACK: Would that help you at all if you had the plugging in the fuel assemblies?

MR. HEAD: Yes, because these would still provide bypass water.

MS. SCHLASEMAN: Because the normal, the design is that the ECCS systems are going to first take suction off of the CSTs, and then they will take suction off of the torus.

MEMBER CORRADINI: By automatic --

MS. SCHLASEMAN: That is by design. That is inherent in the design of BWRs in general and for the ABWR. I mean, I understand it is a recirculation, but it is not like in a PWR.

MEMBER CORRADINI: I am with you there. But the only reason I asked the question is that I am trying to understand, if you wanted to use these, where would they be in the script of using them? And the answer is they wouldn't naturally be called upon after the CST was drained. They would be called upon when in recirculation mode, if you chose to?

MS. SCHLASEMAN: If there was a problem with NPSH with the ECCS systems.

MEMBER CORRADINI: Okay. Okay.

VICE CHAIRMAN STETKAR: In some sense, that doesn't help. That doesn't do anything different for the fuel plugging than the current ECCS because if the strainers are not plugged, but the fuel is plugged, the current ECCS still has the bypass flow.

MR. VAN HALTERN: Correct.

VICE CHAIRMAN STETKAR: So, No. 3 and 4 there don't -- I mean, it is a water source, but it is not a surrogate for the ECCS, for the fuel plugging, for the downstream effects?

MR. VAN HALTERN: If you have already plugged, all this does is provide an additional water source that is clean.

VICE CHAIRMAN STETKAR: It is clean.

MR. VAN HALTERN: But, yes, if you already have --

VICE CHAIRMAN STETKAR: If the strainers are plugged --

MR. VAN HALTERN: Based on our acceptance criteria for the debris, with all the debris that we have designed, you still would not close off that path to the fuel anyway.

MEMBER CORRADINI: Okay. That is fine. All right. Go ahead. Sorry.

VICE CHAIRMAN STETKAR: I just wanted to clarify. You know, there seemed to be some confusion about what function they would provide.

MEMBER CORRADINI: You can go ahead.

MR. VAN HALTERN: We don't have a torus.

(Laughter.)

MS. SCHLASEMAN: Suppression pool. Sorry.

MR. HEAD: Which I will allude to that in another point we will make here in a second.

All right. So, this test that we are going to perform that we will do 18 months prior to operation, we will provide the actual test procedure to the NRC six months prior to the test. As a part of that, as part of the -- we are under review now. We are getting a license here, hopefully, soon. This test could happen at some point in time in the future. Part of that is our commitment to reflect the latest and understand the latest test protocols and, basically, have a state-of-the-art test at that point in time.

So, we, obviously, are aware of what is going on with the PWR Owners' Group. We are members of the BWR Owners' Group that is going to embark upon their own testing program.

And so, at the time we perform that test, if there have been enhancements, changes, protocol changes, then we will reflect those in that procedure for the NRC to be aware of our current expectations regarding that test.

MEMBER SKILLMAN: Where will that test be conducted, please?

MR. HEAD: That is also to be determined. It could be here. It could be Sweden. There is a number of different potential locations for it.

MEMBER SKILLMAN: So, it is a prototypic test of what is --

MR. HEAD: Yes, sir. And there are tests like that which are taking place right now. But in terms of "the where," that could evolve over the next couple of years.

We are licensing specific fuel for the ABWR, the DCD fuel. We expect to be using a different fuel when we load it. Of course, the core will be a new fuel. We have a number of topicals under review. So that, when we get our COL, we are going to submit an amendment to go to this new fuel. So, we would expect the test to be for this new fuel.

MEMBER SKILLMAN: Okay. Thank you, Scott.

Thank you.

MR. HEAD: Sure.

So, anyway, the fuel assembly we will test with the inlet nozzle, tie plate, debris filters, and grid. So, it will look like, at least at this point in time, the lower part, the bottom third of the fuel element.

Conservative mass relative to debris will be the easiest part of the test, including fiber, sludge, rust, dirt, dust, RMI, coatings, and chemical precipitates.

At this point, I would like to stop and note that in our previous meeting we really had something of a misstatement with respect to paint chips and rust. We alluded to using paint chips and rust when, in fact, it will be calcium, I mean silicon carbide surrogates.

With respect to why we did that, well, a lot of us are thinking ahead and actually contemplating what other protocols might be out there in the future. That was really a part of that contemplation, but it is not part of what we are licensing.

So, in our letter to you, I hope it was made clear that all of those --

MEMBER CORRADINI: You are using the surrogate?

MR. HEAD: Yes, sir, we will be using the surrogate. And that is our plan. Unless the state-of-the-art changes as we move forward and there is a defined way to make an acceptable surrogate or an acceptable either different surrogate or actual material, then that is what we will be doing.

So, I hope that corrects that to everyone's satisfaction.

MEMBER REMPE: Just because I have not been involved in the Subcommittee hearings, you will provide the NRC your protocol or your procedure six months in advance. Do they have to approve it like an ITAAC and do they approve the results?

MR. HEAD: Well, some of that, how that unfolds is I don't believe we will be sending it for approval. I think that there is wording and license conditions that are considered appropriate, for example. However, if we were to submit that and the staff called us and told us, "We really are not going to accept your license condition being closed based on that," then most licensing guys will know the right answer at that point.

(Laughter.)

And I expect over the years, between now and that test, that there will be opportunities for future interactions with the staff to understand, either on our project or other projects, to understand what is considered an acceptable protocol. And that is where we would expect to be.

And so, I may be dancing around your answer because I don't know at that point in time what approval would look like in licensing space.

MEMBER REMPE: Sometimes when they do these tests, they get unexpected results.

MR. HEAD: Absolutely.

MEMBER REMPE: So, that is why I was wondering about, when the results come in, who reviews that and approves it.

MR. HEAD: Well, fortunately for us, we believe unacceptable is clearly defined. And we will go over that here in a second. It has to pass a very specific pressure or Delta-P really. And if it doesn't pass that -- and it is very conservative -- if it doesn't pass that, then it fails.

And at that point in time, we will probably approach the NRC about either some sort of maybe changing the test or we will have to actually go back and ask for a change to the whole licensing approach, the design basis that we have, that we have something that challenges more than we expect.

Now we believe, as I alluded to before, that in removing all the challenges -- and as we will talk about in a second regarding -- what is the 1 cubic foot of --

MS. SCHLASEMAN: Latent fiber?

MR. HEAD: -- latent fiber, that we believe we positioned ourselves to pass the test.

The protocol for the test, as I mentioned, will follow industry experience. It is based on the PWR guidelines, and there will be multiple tests at multiple flow rates to represent different post-LOCA conditions. It is also to give us some sort of idea that we have actually got acceptable results in terms of a band of what we might expect to see on these sorts of tests.

And the last bullet is just reflecting that this acceptance criteria that I have talked about was based on computer analysis of what actual flow is needed to keep the core fuel element cool. We believe it has a factor-of-eight margin in it with respect to the acceptance criteria that we have to meet. And that acceptance criteria is included in the license condition.

So, any questions or comments on this?

(No response.)

Okay. And then, again, we have gone over this in some detail already. We wanted to make note of the defense-in-depth that we believe that exists with respect to this issue and the overall long-term cooling issue itself that it is important to note that exists.

So, I will go on to with respect to the downstream fuel effects, the design features and operational programs prevent adverse downstream fuel effects. We have minimized the challenge. We have opportunities to see if there is a challenge to the suppression pool. We have a test to confirm that debris will not adversely affect fuel, that the material that we do believe there, we are going to confirm does not challenge the cooling of the fuel. And we have that defense-in-depth analysis that ultimately shows that fuel blockage can be accommodated.

So, let me stop there. That is my overall briefing at this point. But now I would like to go to, at the last Subcommittee meeting, you did ask us four questions. You allowed us to docket our response. I have no presentation per se on those.

Obviously, we can discuss them. Some of it is proprietary, but I would ask if the Committee has any questions on what we have provided.

MEMBER CORRADINI: So, let me just clarify.

MR. HEAD: Sure.

MEMBER CORRADINI: The slide and what we have here is not proprietary, but if the Committee wants to talk in detail about any of the things, we will have to close the --

MR. HEAD: We are all prepared to keep it -- if you follow-on questions. If there is some stuff, if we got into the defense-in-depth analysis, we might have to, but I believe we can have certainly a discussion where we think we can have it.

MEMBER CORRADINI: So, you will alert me when --

MR. HEAD: Yes, sir.

MEMBER CORRADINI: Okay. Fine.

MEMBER CORRADINI: Let the members ask, if they have additional questions.

MEMBER SHACK: Well, again, my question is about the commitment for the 1 cubic foot. I mean, you are going to test the 1 cubic foot.

MR. HEAD: Yes, sir.

MEMBER SHACK: You have a basis for it, but what happens if I find -- or I will be checking to see if I have 1.5 cubic feet?

MR. HEAD: With help fro my staff here, I may rephrase that. Our commitment is really to zero, but zero is --

MEMBER SHACK: It is a really small number.

(Laughter.)

MR. HEAD: It is a really small number, and it is a challenge to not -- you know, say challenge zero. But we believe with the plant that we are designing and building, that we have done everything to make latent fiber as non-existent as possible. Clearly, you could find some. Clearly, some could exist.

And so, based on our discussions with the staff, we felt like a relatively-small amount of fiber might possibly exist. We, in fact, ultimately went with 1 cubic foot. That was based on what TEPCO observed in some of their evaluations, that in K6 and K7 that it was, in fact, a very, very small amount that was found, basically, in ropes.

And so, as this evolved, it was really a licensing-basis approach and it gave us something to include in the test that would, we think, provide us a conservative challenge to the fuel test.

But the answer to your other question, which I can allude to what happens at the operating units, is there are different places to make findings regarding finding stuff. During an outage, you have a closeout where the outage says, "I'm done." Then Operations goes in. If Operations finds something, well, then, you have a condition. You have something that needs to be assessed. If Operations says they are closed out, then quite often the resident inspectors go in. If they find something, then it is another opportunity to assess.

If you shut the plant down and someone goes in and finds something that they weren't expecting, then it is another opportunity for the corrective action program to be used to figure out why that happened, what needs to take place. It is more than likely they won't end up accumulating 1 cubic foot fiber. They will find something else that shouldn't have been there, but it is part of what you would expect. If you did find 1 cubic foot of fiber or more, then there is probably a reportability situation you would be looking at. Those corrective actions would be included in an LER. On 1 and 2, we have submitted LERs on finding stuff inside containments. So, that would be part of the process.

So, we are designing for zero. We know it is not zero. If we find something too big, then the appropriate actions would be taken.

Does that answer your question?

We provided you information on the surrogates and in the letter. Basically, it is a lot of surrogates and we understand the concerns with surrogates, but that is the current industry position.

We have focused on 6C as the protocol and alluding to the PWR Owners' Group program as the protocol at this point in time. We believe that is appropriate. And then, we provided a summary which included quite a bit of analytical results regarding our defense-in-depth analysis.

The only thing I would note there maybe for the Committee is all of our plugging analysis starts at -- am I getting ready to say something proprietary here?

MR. VAN HALTERN: The restriction is at about 15 minutes.

MR. HEAD: Right. That is not proprietary.

All the analysis that we have done for the reloading and for the acceptance criteria for the license condition is assumed at five minutes, the decay heat at five minutes. The decay heat for the defense-in-depth is done at 15 minutes, and it is a difference I would like to note. That is also, we believe, much sooner than most of the debris if we challenge the fuel.

So, with that summary, I would ask if we --

MEMBER CORRADINI: I was at the Subcommittee meeting. So, I will let other members, if they have questions.

MR. HEAD: And here is our summary. We use adequate core coolant to meet long-term requirements. We have 30 days' worth of cooling. Design-basis LOCA peak clad temperature is about half the limit.

The other challenges, containment integrity, gas accumulation, NPSH for the strainer, have been satisfactorily addressed.

We summarize our process, the approach that we are using with respect to the ECCS suction strainers and the downstream effects on the fuel. And we believe that STP meets the regulatory requirements for long-term cooling.

MEMBER CORRADINI: Questions by the members?

(No response.)

Okay. Why don't we thank you and make a switch? The staff, or some of the staff, will come up and give their discussion on kind of the summary of their review.

Thank you very much.

MR. HEAD: Thank you.

MEMBER CORRADINI: Tom, you are going to lead us through this?

MR. TAI: Yes.

MEMBER CORRADINI: What are you looking for?

MR. TAI: I am looking for the drive.

MEMBER CORRADINI: You have a CD to put in?

MR. TAI: Yes.

MEMBER CORRADINI: There you go. You found it? Good. All right.

MR. TAI: Good afternoon.

Thank you for having us here.

We have the same team in here as last time to make this presentation. We are using basically the same slides because, other than the STP letter that addresses your questions from the previous meeting, we don't have any new material to look at.

MEMBER CORRADINI: That's fine.

MR. TAI: So, Jim, if you want to go through the same thing?

MR. GILMER: Okay. Good afternoon.

Most of this material you have heard before, but I will try to insert what staff did in reviewing as we move along.

As you heard from the applicant, long-time cooling is not only provided by the residual heat-removal system and high-pressure coated pipes. Long-term suppression pool cooling is maintained by operating the RHR and the suppression pool cooling mode, similar to the operating of BWRs.

The analysis showed that the containment pressure can be maintained well below the design values. And the analysis also shows that adequate core cooling is maintained by keeping the RPV level above the top of the exit fuel. I will add there that probably, by design, the ABWR LOCA is relatively-benign because there is no large piping below the top of the active fuel.

VICE CHAIRMAN STETKAR: Jim, for those last two bullets on slide 2 --

MR. GILMER: Yes?

VICE CHAIRMAN STETKAR: -- containment pressure below design and water level above top of fuel, is there margin? And if so, how much in each of those conditions, please?

MR. GILMER: I will let Hanry address the containment margin, containment pressure.

MR. WAGAGE: It was below the percent. I don't exactly know the margin, how much margin there is.

MEMBER SKILLMAN: Is it half, a third, 99.9 percent? How close is it?

MR. GILMER: One of the points we have is that we did the review two years ago, and our memory has kind of faded.

MEMBER CORRADINI: If you need to, we can get back to Mr. Skillman. But you want to know what the calculation is versus the margin, the design margin, right?

MEMBER SKILLMAN: Well, there is a design value. Is it half? I am just curious. Are we just skimming by or is it lots of margin?

MS. BANERJEE: It is on your safety values.

MR. WAGAGE: Mike tells me he has it from our Safety Evaluation. The calculated short-term feeder line breaker picture was 281 kilopascals-g, and the design pressure is 309 kilopascals-g. It is about 28 kilopascals-g.

MEMBER CORRADINI: Thank you.

MR. GILMER: And regarding the water level, my recollection is that it was a number of feet above the top of exit fuel. I don't remember the number. Maybe Mr. Van Haltern from Westinghouse who did the analysis would remember that.

MR. VAN HALTERN: Yes, this is Martin Van Haltern from Westinghouse.

MEMBER CORRADINI: You just have to bring it down a bit (referring to the microphone). Sorry.

MR. VAN HALTERN: I am not quite as tall.

MEMBER CORRADINI: That is all right.

MR. VAN HALTERN: The feedline break, which is the limiting break that we have been looking at, the low feedline break above top of active fuel is about 2.5 liters, so 7.5 feet or so. There is maybe a smaller line below that that may be 1, 1.5 to 2 meters.

So, in long-term cooling, when you go off at least to that level, those smaller breaks should go above that. You have 2.5 to 3 meters of water above the top.

MEMBER SKILLMAN: Thank you. Thank you.

MR. GILMER: Okay. The staff review approach is consistent with the group and other Advanced Design, the AP1000, for example, in terms of long-term cooling.

The basic objective is ensuring the requirements for 50.46, Part (b)(5), are met. And this assessment included the ECCS piece, the ECCS strainer performance, the downstream fuel effects, and the chemical effects.

You heard a lot already about the suction strainer design. Staff is satisfied that it meets the requirements in Regulatory Guide 1.82, Revision 3.

It is also bounded by the Reference Japanese ABWR strainer analysis, which was used quite a bit in the evaluation for South Texas.

You have also heard about the commitment to 100-percent reflective metallic insulation and stainless steel liner for the suppression pool and the suppression pool cleanup system. There is also other design reasons for very minimal debris that could make its way to the suppression pool. ABWR has a very tortuous paths from either steamline breaks or feedwater line breaks. That could be a source of the debris. Very limited access to the suppression pool.

The administrative procedures for foreign material exclusion in the cleanliness programs, their commitment to that, they have those in place.

And also, procedural restrictions for restrictions on fiber sources, calcium silicates, aluminum, and trisodium phosphate.

For in-vessel effects, South Texas demonstrated to the staff that a void fraction of .95 could be maintained, and they used the Galvin Code, which was previous approved, the old ABBCE fuel methodology.

The South Texas calculated peak cladding temperature is as low as in the 10 CFR 50.46 acceptance criteria.

You heard a lot already about diverse injection paths and water sources.

And then, the fuel tests will be done prior to fueling must demonstrate minimal in-pressure on the core flow due to debris.

Okay. I mentioned already the much-reduced likelihood that latent debris will make its way to either the strainers or to the fuel. The restricted access to containment would be inerted during operation, especially during cleanup, and the operation of program administrative procedures for material controls.

One of the key ones, by design, is the elimination of a large recirculation piping. And I mentioned before all breaks are above the top of the active fuel. Corroded aluminum and zinc is presumed to precipitate in gelatinous form. And ABWR design features that minimize the transport of accident-generated debris, and again, the diversity of water sources in the delivery systems. The analysis has a built-in factor of four safety factor for additional conservatism.

There is a license condition document in the staff Safety Evaluation for Appendix C of the STP FSAR. Well, first, I should say the STP design incorporates by reference the certified ABWR, but, as mentioned by the applicant, the fuel to be loaded will be different than the certified fuel.

The purpose of the license condition is that whatever fuel ultimately gets loaded can be demonstrated to perform satisfactorily with debris. The license condition is really an equation which is test acceptance pressure drop as a function of flow that must be met. Or, at that point, then, staff would be, NRC would be informed and then we would have to agree on the steps to be taken.

MEMBER SHACK: In the PWR Owners' Group, when they are performing those fuel blockage tests, at least the ones I have seen so far, they have actually sort of characterized the fibers as the fibers coming through the strainer filters. They have done that by actual tests. I mean, they capture the fiber that bypasses their strainer in the test, and then they characterize that fiber in terms of lengths and things like that.

I am assuming that is not available for ABWR. Does the staff have some sort of rule of thumb that they would use to define an acceptable length of fiber, fiber length distribution for these fuel tests, the data?

MR. WAGAGE: Actually, that ABWR will use the same operating experience from other plants, but this condition doesn't have so much fiber to do bypass testing, as 1 cubic foot of fiber, as in the past. Therefore, the testing is going to be comparable with other plants' testing, to be fine, small pieces of fibers similar to other plants.

MEMBER CORRADINI: So, just to say it differently, no, but you will use similar characterizations that are currently --

MR. WAGAGE: Yes.

MEMBER REMPE: And so, part of your review of the test plan will include water chemistry effects, the rate at which the fiber is added, and all that. And if you have some questions, you apparently don't have the right to dictate that they change the procedure, but informal discussions will heavily encourage them to change the procedure?

MR. GILMER: Yes, there will be using similar steps to what the PWRs have done already in terms of the order of mixing, the timing.

MEMBER REMPE: Water chemistry, et cetera?

MR. GILMER: That is our understanding, yes.

MEMBER REMPE: Okay.

MEMBER SCHULTZ: Excuse me, Jim. On that previous slide, the third bullet, where we talk about that the test acceptance criteria must be met for any type of fuel before it can be loaded, what is the characterization of "any type of fuel"? If the fuel design is to be changed, does that mean that there are specific criteria and descriptions of the fuel that constitute a change, to undergo this testing and testing schedule?

MR. GILMER: Well, what has been done is

STP knows that they will have to submit a fuel amendment to the staff. The proposed fuel will be the Westinghouse ABV Optima 2 BWR fuel.

So, staff has reviewed the type of topical reports associated with that, most of which has already received NRR prior approval, and it is being used in some operating BWRs currently. So, there is a fair amount of operating experience with it. And the BWR Owners' Group does plan to test the Optima 2 fuel along with all the GE series of fuels.

MEMBER SCHULTZ: But are there, then, set criteria? Moving forward, if the fuel design is to change, what would require, again, an acceptance test associated with a new fuel design?

MR. GILMER: Well, we believe the acceptance test would cover any BWR type of fuel. It has to be thermodynamically compatible with the certified fuel. Otherwise, you would have to change a lot of the Chapter 15-type safety analyses.

MEMBER SCHULTZ: Yes, I am looking at this a little bit differently, and I shouldn't, that it is really a test that demonstrates -- it is more of a demonstration test for what you would anticipate to be an acceptable fuel design that will go through the acceptance testing?

MR. GILMER: Yes. But, thermodynamically, it has to be able to fit in the core as it was really in the certified design and perform in the same way as well for the Chapter 15 analyses.

MEMBER SCHULTZ: Okay. So, the testing is going to be done for a class of fuel, if you will, a class of fuel type that will be expected to fit into the reactor versus a fuel-type-by-fuel-type review?

MEMBER SKILLMAN: Yes. I would not call it a class. It would be the specific fuel that will be loaded.

MEMBER SCHULTZ: Okay. I understand. Thank you.

MR. GILMER: Okay. So, staff believes that the acceptance criteria will be sufficient to demonstrate the long-term cooling for the plant.

MEMBER SKILLMAN: Jim, let me ask this: what if there is a mixed-core proposal where you have two different types of fuel assemblies in there? How does that get handled?

MR. GILMER: Well, that, again, would require a license amendment and a new review by the staff, similar to what they are doing now with the mixed-core --

MEMBER SKILLMAN: Okay. Thank you.

MR. GILMER: In summary, the staff believes that adequate core cooling can be maintained and pressure and temperature in the containment are below the design values, and finally, that 50.46 requirements are satisfied.

Any questions from the members?

MEMBER SHACK: I would just follow up on Dick's question, I guess. Would they have to redo a fuel test every time they change the fuel design? I mean, is that something we expect now from operating reactors when they come in with a new fuel design, that we will also have to do a performance test for the blockage?

MR. GILMER: I believe so. There may be some considerations for extremely-minor changes, similar to what we have, for example, in the G-STAR process for the operating coolant. But any significant changes, they would be coming back.

MEMBER SKILLMAN: I can imagine that this could become a 50.59 issue, when in reality it is a much larger issue than that. And so, when you say "brought back to the staff for review," that gives me comfort that this is much larger than a licensee's 50.59 evaluation of a new super fuel.

MR. GILMER: We certainly agree with that.

MEMBER SKILLMAN: Okay. Thank you. Thanks, Bill, for the followup.

MR. GILMER: Other questions?

MEMBER CORRADINI: Members, any members have further questions?

(No response.)

Otherwise, thank you very much.

Mr. Chairman, back to you.

CHAIRMAN ARMIJO: Dr. Corradini --

MEMBER CORRADINI: Oh, I'm sorry. Excuse me. I apologize.

Can we turn on the bridge line to see if there are comments from the members of the public? Excuse me.

MEMBER SHACK: Once we hear crackling, we know it is live.

(Laughter.)

CHAIRMAN ARMIJO: That's our signal.

MEMBER CORRADINI: Okay. Any members of the public?

(No response.)

Going once. Okay, I think we have none.

CHAIRMAN ARMIJO: Okay.

MEMBER CORRADINI: Any members of the audience, or I should say the observers, have comments?

(No response.)

Okay. Mr. Chairman, back to you.

CHAIRMAN ARMIJO: Well, thank you, and thank the staff and the NINA staff for good presentations.

MEMBER CORRADINI: I know the NRC staff always wants to listen to us, but to the NINA staff, we will be at least going through, hopefully, a draft reading.

CHAIRMAN ARMIJO: Yes. Yes, we intend to read the letter, a draft letter, today and give Mike some guidance about if there are any changes that are proposed by the members.

But I think we are very close to being back on schedule. Thank you, Dr. Corradini.

It was a short lunch break, but I would like to just take 15 minutes just to get some coffee and get to work on the letter. So, let's be back here at quarter of 3:00.

Thank you.

(Whereupon, at 2:33 p.m., the meeting went off the record.)

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Consideration of Economic Consequences within the NRC's Regulatory Framework

Kevin Coyne, RES/DRA

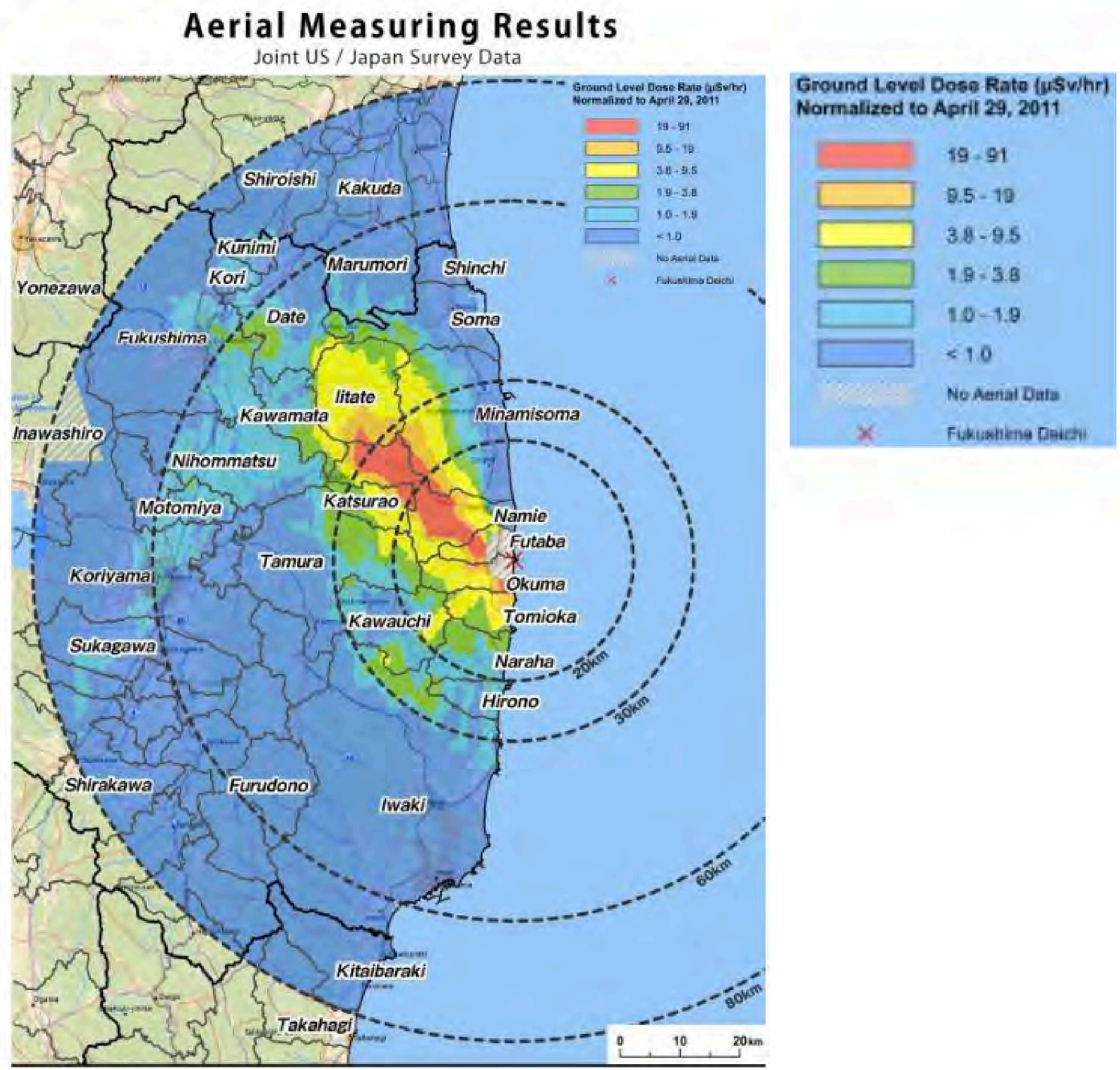
ACRS Full Committee Briefing

November 1, 2012

PURPOSE AND AGENDA

- To provide a briefing on SECY-12-0110 and seek ACRS feedback
- Topics:
  - Tasking and status
  - NRC authority to consider property damage
  - Property damage considerations in NRC analyses
  - SECY-12-0110 options and recommendation
  - Public meetings and Commission feedback

MOTIVATION FOR SECY



STATUS

- Staff received tasking in early April.
  - Due date of August 7, 2012 to OEDO
- Agency-wide working group active.
- Staff held public meetings in May and Aug 2012.
- Staff submitted SECY-12-0110,"Consideration of Economic Consequences within the U.S. Nuclear Regulatory Commission's Regulatory Framework" to the Commission on August 14.
- Commission briefing held September 11, 2012.
- ACRS subcommittee briefing held Oct. 2, 2012.

TASKING

- Provide a vote Commission paper, with options, to address the following policy question:
  - *To what extent, if any, should NRC's regulatory framework modify consideration of economic consequences of the unintended release of licensed nuclear materials to the environment?*
  - Tasking included 10 detailed questions/subtopics to be addressed

LEGAL AUTHORITY

- NRC requirements relating to adequate protection concern radiological health and safety and common defense and security.
  - NRC must find reasonable assurance of adequate protection before it can issue a license or amend an existing license.
  - Adequate protection is a safety standard.

- Distinct from adequate protection, the NRC has authority under the Atomic Energy Act to “minimize danger” to property.
  - Offsite Property Damage (OPD) can include:
    - Costs of destroyed or damaged property,
    - Costs of relocation from real property, and
    - Loss of business revenues

OPD CONSIDERATIONS IN NRC ANALYSES

- Regulatory Analysis: Structured analysis of proposed requirements, estimating benefits and costs.

- Backfit Analysis: When determining if the proposed backfit is cost-justified.

- National Environmental Policy Act (NEPA) Analyses: Depending on the nature of the proposed regulatory or licensing action, the NEPA analysis may include consideration of potential damage to offsite property.

REGULATORY ANALYSIS

- What is purpose of regulatory analysis (RA)?
  - To identify and evaluate the likely consequences of rules.
  - Decision tool for policymakers.
  - Rationale for action.
  - More transparent of agency decision-making.

- When is RA used?
  - Per Office of Management and Budget Circular A-4, a regulatory analysis is a tool regulatory agencies use to anticipate and evaluate the likely consequences of rules.

BACKFITTING AND ISSUE FINALITY

- Purpose of NRC backfitting and issue finality provisions.
  - Regulatory stability.
  - Reasoned and informed agency decision-making.
  - Transparency of agency decision-making.

- When must NRC address backfitting and issue finality?
  - If proposed NRC action falls within intended scope of backfitting and issue finality.
  - If proposed NRC action constitutes a backfit or is subject to issue finality.
  - If no exceptions to preparation of a backfit analysis apply.

Regulatory Requirements:

10 CFR 50.109	Operating Reactors
10 CFR 52	New Reactors
10 CFR 70.76	Subpart H
10 CFR 72.62	Independent Spent Fuel Storage Installation
10 CFR 76.76	Gaseous Diffusion Plants

BACKFITTING: FOUR STEP PROCESS

- First Step: Is the NRC action subject to the backfit rule?
- Second Step: Is there a backfit?
- Third Step: Do one of the exceptions in 50.109(a)(4) apply?
  - Compliance,
  - Necessary for adequate protection, or
  - Defining or redefining what is needed for adequate protection.

BACKFITTING (cont.)

- Fourth Step, Part 1: Does the backfit provide substantial increase in protection to public health and safety or common defense and security?

- Fourth Step, Part 2: Is the cost of the backfit justified in light of the increase in protection?
  - The RA methodology and specific values and parameters are used to perform a backfit cost-benefit determination.

NEPA

- Requires a Federal agency to analyze the potential environmental impacts of its proposed action and any reasonable alternatives to proposed action.

- Procedural statute—does not mandate particular outcome.

- Under NEPA, agency must take a “hard look” at the potential environmental impacts.

- NRC performs an environmental impact statement for new reactors and operating reactor license renewals.

- Severe Accident Mitigation Alternatives (SAMA) and Severe Accident Mitigation Design Alternatives (SAMDA).

Regulatory Requirement:

NEPA implementing regulations are in 10 CFR Part 51.

SAMAs & SAMDAs

- What is the purpose?
  - To ensure that alternative nuclear power plant design features and operational procedures with the potential for improving severe accident performance are identified and evaluated from an environmental standpoint.
  - SAMA and SAMDA do not apply to other facilities or materials licenses.
- When are they needed?
  - All applications for combined licenses under 10 CFR Part 52 (SAMDAs and SAMAs).
  - Certain applications for limited work authorizations under 10 CFR Part 50 (SAMDAs only).
  - All applications for license renewal if a SAMDA analysis was not prepared earlier for the plant (SAMDAs only).
  - Design certification rules (SAMDAs only).

CONCLUSIONS FROM STAFF REVIEW

- Staff has flexibility to consider offsite property damage.
- Staff recommended enhanced coordination to increase staff efficiency.
- Staff identified areas where framework could be altered if Commission so desired.

SECY-12-0110 OPTIONS

- Option 1: Status Quo
- Option 2: Enhanced Consistency of Regulatory Analysis Guidance
- Option 3: Exploring the Merits of Potential Changes to the Regulatory Framework

OPTION 1

- Pros
  - Maintains regulatory stability.
  - Requires minimal additional resources.

- Cons
  - May not accomplish consistency across programs.
  - May not be responsive to possible stakeholder concerns.
  - May result in inefficiency.

OPTION 2

- Pros
  - Systematic approach to updating guidance and addressing agency-level needs.
  - More comprehensive guidance for methods and parameters.
  - More harmonized regulatory analysis guidance.
- Cons
  - Would require more resources than Option 1.
  - May not be responsive to possible stakeholder concerns.

OPTION 3

- Pros
  – Provide a Commission statement on the importance of land contamination.
  – Allows for stakeholder input to proposed revisions.
- Cons
  – Could increase regulatory uncertainty.
  – Increased complexity.
  – Would require substantial staff resources.

RECOMMENDATION

- Staff recommends Option 2.
  - Would enhance the currency and consistency of the existing framework.
  - Would be done more systematically.
  - Would provide more comprehensive guidance.

NEAR TERM ACTIONS

- Continue to update regulatory analysis guidance
- SRM from 9/11/12 Commission Briefing: CA notes due 4/16/13
  - Provide the Commission information about how other countries factor economic consequences into their regulatory processes.
  - Inform the Commission how other Federal regulatory agencies handle this issue.

CONSIDERATION OF ADDITIONAL REQUIREMENTS FOR CONTAINMENT VENTING SYSTEMS FOR BWRs WITH MARK I AND MARK II CONTAINMENTS

ACRS Full Committee Meeting

November 1, 2012

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Purpose

- To discuss the staff's draft Commission paper and proposed recommendations on imposing new requirements related to containment venting systems for boiling water reactors with Mark I and Mark II containments

Agenda

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- Taskings
- Schedule update
- Discussion of draft SECY paper and proposed recommendation

Tasking (1)

- SRM on SECY-11-0137, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned"
  - The staff should quickly shift the issue of "Filtration of Containment Vents" from the "additional issues" category and merge it with the Tier 1 issue of hardened vents for Mark I and Mark II containments such that the analysis and interaction with stakeholders needed to inform a decision on whether filtered vents should be required can be performed concurrently with the development of the technical bases, acceptance criteria, and design expectations for reliable hardened vents

Tasking (2)

- SRM from August 7, 2012 Commission Meeting on status of actions taken in response to lessons learned from the Fukushima Dai-ichi accident
  – In the forthcoming notation vote paper on filtered vents, the staff should include a discussion of accident sequences where the filters are and are not beneficial

Schedule

U.S.NRC
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- Current Schedule
  - November 30 SECY Paper to Commission
  - November 20 SECY Paper to EDO
  - ACRS Interactions
    - November 1 Full Committee mtg
    - October 31 Subcommittee mtg
    - October 26 Draft Rev. 2 Commission Paper
    - October 19 Draft Rev. 1 Commission Paper
    - October Subcommittee mtg
    - September Subcommittee mtg
    - June Subcommittee mtg

Draft Paper Outline

- SECY Main Paper and Enclosures
  1. Evaluation of Options
  2. Design and Regulatory History
  3. Foreign Experience
  4. BWR Mark I & II Containment Performance During Severe Accidents
  5. Technical Analyses (MELCOR/MACCS/PRA)
  6. Stakeholder Interactions
  7. Draft Orders

Main Paper

- Discuss issues associated with severe accident containment venting and relevance to Mark I and II containments
- Identify potential options
- Basis for staff’s recommendation
- Discuss role of quantitative analysis and qualitative analysis
- Provide concise writeups referencing enclosures for details

Options Considered

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1. No change (EA-12-050)
2. Severe accident capable vent
3. Filtered vent
4. Performance-based approach

Proposed Recommendation

- Option 3 – Filtered Vent
  - The NRC staff finds that the combination of quantitative and qualitative factors best supports the installation of filtered venting systems at BWRs with Mark I and II containments

Basis for Proposed Recommendation

- Cost-justified substantial safety enhancement
  - Quantitative analysis
  - Qualitative analysis
    - Enhances defense-in-depth (containment vulnerabilities and severe accident uncertainties)
    - Filter provides a fission product retention capability independent of plant accident response

Enclosure 1
Evaluation of Options

- Summary of considerations in decision-making
- Consideration of adequate protection
- Decision on substantial safety enhancement
- Inclusion of qualitative arguments
- Presentation of results including sensitivity analysis

Cost-Benefit Analysis

Quantitative Cost/Benefit Analysis Per Plant				
	Severe Accident Capable		Filtered	
Total Costs ($k)	(2,027)[1]		(16,127)	
Core Damage Frequency	$2x10^{-5}$yr	$2x10^{-4}$/yr	$2x10^{-5}$/yr	$2x10^{-4}$/yr
Total Benefits ($k)	938	9,380	1,648	16,480
Net Value (Benefits – Costs)	(1,089)	+7,353	(14,479)	+353

(1) As discussed in Enclosures 1 and 4, the costs for severe accident capable vents for Mark II containment designs will likely be higher. The higher cost reflects the likely need to modify the containments to prevent molten core debris in the lower drywell sump drain lines from causing a bypass of the suppression pool. Avoidance of wetwell bypass is needed to make the severe accident capable vents a viable option for the Mark II containment design.

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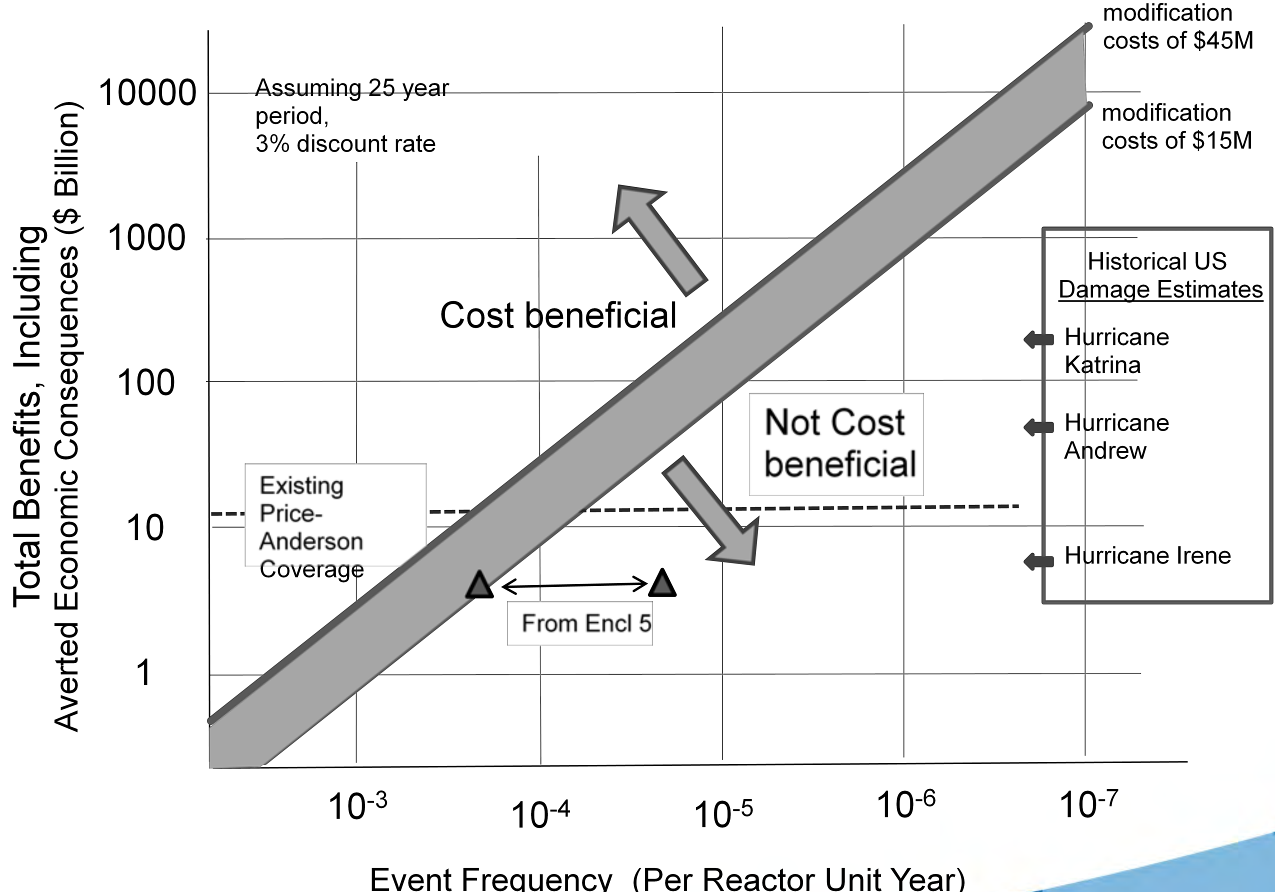
Break Even Cost/Benefit Considerations



Qualitative Arguments

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- Providing defense in depth
- Addressing significant uncertainties
- International experience and practices
- Supporting severe accident management and response
- Improving Emergency Preparedness
- Hydrogen control
- Severe Accident Policy Statement
- Independence of barriers
- Consistency between reactor technologies
- External events
- Multi-unit events

Enhances Defense-in-Depth

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- Containment is an essential element of defense-in-depth
- Addresses high conditional containment failure probability
- Filtering compensates for the loss of the containment barrier due to venting
- Filtering improves confidence to depressurize containment to address other severe accident challenges

Uncertainties

- NUREG 1855

  "In implementing risk-informed decisionmaking, the U.S. Nuclear Regulatory Commission expects that appropriate consideration of uncertainty will be given in the analyses used to support the decision and in the interpretation of the findings of those analyses."

- Uncertainties in prevention and mitigation of severe accidents
  - Event frequency
  - Severe accident progression
  - Radiological consequences
  - Economic consequences

International Practices

- Extraordinary Meeting of Members of Convention on Nuclear Safety recommended "measures to ensure containment integrity, and filtration strategies and hydrogen management for the containment"
- Consistent with decisions of most European countries, Canada, Taiwan, and Japan

Severe Accident Management Decision Making

- Each option enhances the management of the accident by allowing operators to focus on recovery actions other than preventing gross containment failure
- Each proposed option provides some benefit but filtered systems are the simplest
- A performance-based approach could be integrated into other severe accident management activities and procedures

Emergency Planning

- The most benefit in terms of reducing the demands on emergency planning would be associated with Option 3 (filter) while the proposed change with the least benefit would be from Option 2 (unfiltered venting)

Hydrogen

- Improves operator confidence in a “clean” release for hydrogen control
  - Allows early operator intervention to vent hydrogen and control containment pressure
  - Sustained lower pressure reduces leakage of hydrogen thru penetration seals
  - Decreased leakage reduces threat from hydrogen explosion to reactor building, spent fuel pool, and emergency responders

Severe Accident Policy Statement

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- The Severe Accident Policy Statement specifies that severe accident design features could be imposed on operating reactors using the established backfit process
- The importance of the qualitative factors suggests a need to revisit portions of the current regulatory framework (including the Severe Accident Policy Statement)
- The status quo option fits the current policy statement and its traditional application

Independence of Barriers

- Minimize dependencies and address the high conditional failure probability of Mark I and Mark II containments following a compromise of the preceding barriers (fuel and coolant system)
- The filtered system would provide the most independence while the unfiltered vent could result in large releases in the attempts to reduce containment overpressure conditions

Consistency Between Reactor Technologies

- While the proposed improvements to venting systems for BWRs with Mark I and II containments address a known weakness in the severe accident performance for those plants, the pursuit of these improvements without resolving broader issues (e.g., NTTF Recommendation 1 and Severe Accident Policy Statement) introduces the possibility for inconsistent treatment of severe accident capabilities for the various reactor technologies

External Events

- Beyond design basis external events such as the 2011 earthquake and tsunami will challenge normal and emergency power and cooling systems at a nuclear power plant
- There is a significant advantage to having installed equipment and/or strategies in place to address such events and conditions and thereby avoid the nuclear power plant compounding the consequences from the event

Multi-unit Events

- A concern highlighted by the Fukushima accident is conditions or events (e.g., external hazards) which challenge multiple units at a nuclear facility
- There is a significant advantage to having installed equipment and/or strategies in place to address such multi-unit events

Enclosure 2
Design and Regulatory History

- Summarize the licensing and design considerations for Mark I and Mark II containments
- Why are Mark I and Mark II containments being discussed?
  - Ability of designs to withstand severe accident challenges
  - Defense in depth
  - Residual risk

Enclosure 2
Design and Regulatory History

- Mark I Containments
  - WASH-1400 & NUREG-1150 found that Mark I containments could be severely challenged if a severe accident occurred
  - Relatively small volume
    - Gas and steam buildup affect pressure more dramatically
  - BWR cores have ~3 times the quantity of zirconium as PWRs
    - Potential for hydrogen gas and containment pressurization

Enclosure 2
Design and Regulatory History

- Mark II Containments
  - Similar to Mark I, the most challenging severe accident sequences are station blackout and anticipated transients without scram
  - Risk profile dominated by early failure with a release that bypasses the suppression pool
  - Hardened venting was considered not beneficial because of unacceptable offsite consequences without an external filter like MVSS
  - Staff did not recommend generic backfit of hardened vent, but recommended a comprehensive evaluation as part of the IPE program

Enclosure 2
Design and Regulatory History

- Mark I Containments
  - Containment Performance Improvement Program
    - Determine what actions, if any, should be taken to reduce the vulnerability to severe accidents
    - Staff recommended
      - Improve hardened vent
      - Improve RPV depressurization system
      - Provide alternate water supply to RPV and drywell sprays
      - Improve emergency procedures and training
    - Commission approved hardened vent
    - Other recommendations evaluated as part of IPE program

Enclosure 3
Foreign Experience

- Status of filtered vents and regulatory basis in other countries
- Identify basis for pursuing filtered vents
- Identify any operational experience or adverse systems interactions

Enclosure 3
Foreign Experience

- Staff visited Sweden, Switzerland, and Canada
- Insights from visits and public meetings consistent with previous findings
  - 1988 CSNI Report 156, Specialists’ Meeting on Filtered Containment Venting Systems
- Together, FCVS and containment flooding scrub fission products from core debris and remove decay heat

Enclosure 3
Foreign Experience

- Technical Bases Summary
  - Manage severe accident overpressure challenges
  - Defense-in-depth to address uncertainties associated with severe accidents
  - Significantly reduce offsite release
- After Barsebäck filter was installed, subsequent filter costs considered low to modest

Enclosure 3
Foreign Experience

- Quantitative Bases Summary
  - Release performance goal
  - Risk informed
    - Level 1 frequencies low but not sufficient
    - After the decision, ensure equipment performance is acceptable generically and on plant-specific basis
      - Acceptable not judged quantitatively – “significantly reduce”, “almost eliminate”, etc.
      - Factored into emergency planning

Enclosure 3
Foreign Experience

FCVS Status at Non-U.S. BWR Facilities

FCVS Status	GE Mark I	GE Mark II	ABB Mark II	GE Mark III	Other	ABWR	Totals	
FCVS Operational	1	0	6	1	5	0	**13**	30%
Committed	6	7	0	5	4	3	**25**	57%
Considering	1	0	0	1	0	0	**2**	5%
No FCVS	2	2	0	0	0	0	**4**	9%
Non-U.S. Totals	**10**	**9**	**6**	**7**	**9**	**3**	**44**	

Enclosure 4
Mark I & II Severe Accident Performance

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- Containment Spray Systems
- Containment Flooding
- Containment Venting
- Decontamination by Drywell Spray
- Decontamination by the Wetwell
- Mark I Containments
- Mark II Containments
- Decontamination by External Engineered Filter Systems
- EPRI Evaluation of Severe Accident Venting Strategies for Mitigation of Radiological Releases
- Passive Containment Vent Actuation Capability
- Early Venting

Enclosure 4
Mark I & II Severe Accident Performance

- EOPs, SAMGs, and EDMGs describe multiple containment vent pathways and use of portable pumps for reactor and drywell injection with focus on preventing core damage

Enclosure 4
Mark I & II Severe Accident Performance

- DW Sprays for Decontamination
  - Spray headers designed for DBA purposes (pressure control and heat removal) with flow rates of 1,000's GPM
  - Portable pumps with flow rates in low 100's GPM which is good for cavity flooding and not as effective for decontamination

Enclosure 4
Mark I & II Severe Accident Performance

- Suppression Pool for Decontamination
  - SRV discharge via T-quencher in bottom of subcooled suppression pool
  - Downcomer pipes which discharge higher in the suppression pool at or near saturation temperatures

Decontamination Factors

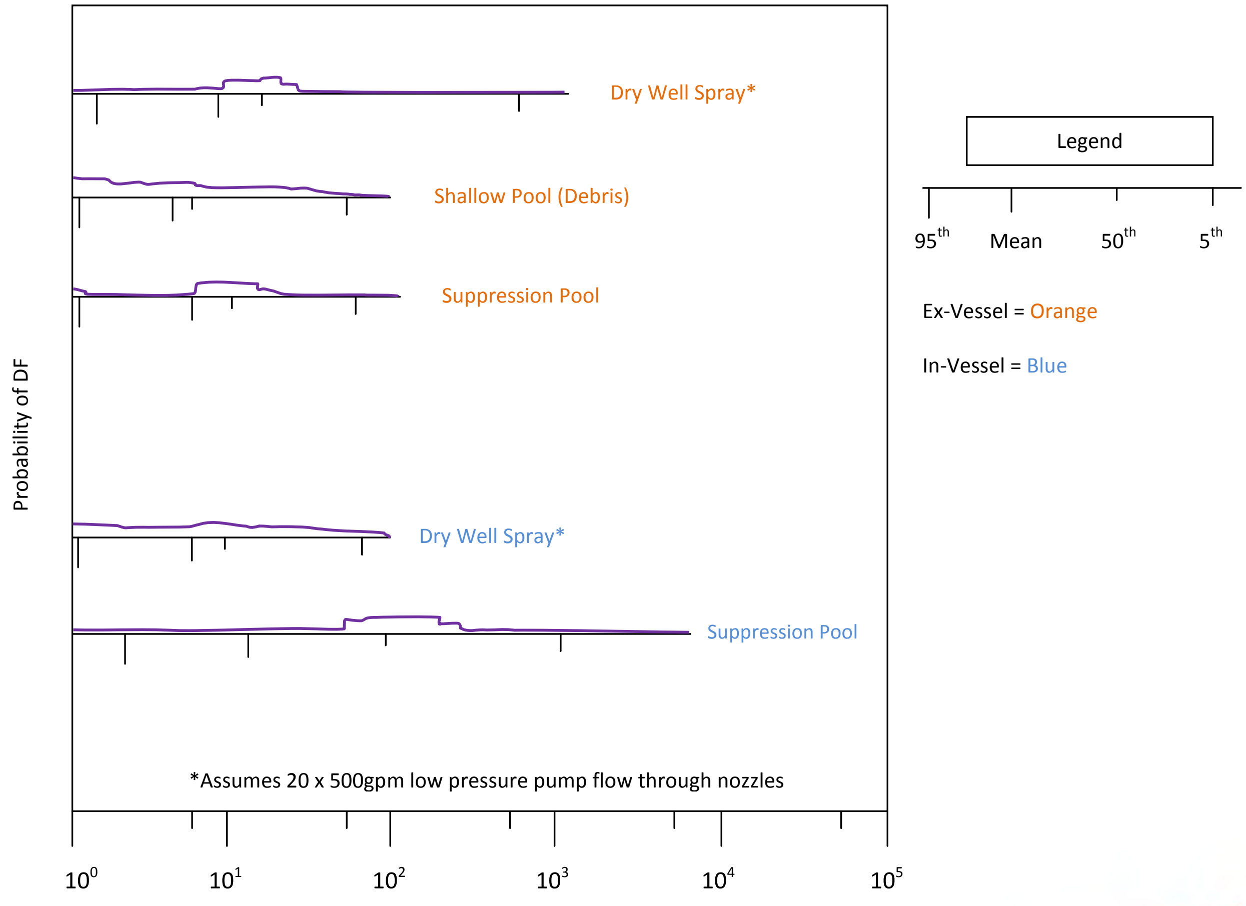


FIGURE 1: Uncertainty Distributions for Cesium Decontamination Factors (DFs)
Mark I Containment – Peach Bottom

Source: "Assessment of In-Containment Aerosol Removal Mechanisms."
BNL Technical Report L-1535, 1992

Enclosure 4
Mark I & II Severe Accident Performance

- EPRI Investigation of Strategies for Mitigating Radiological Releases in Severe Accidents
  - Employs a portable pump to flood drywell cavity and maintain suppression pool subcooling
  - Controls containment pressure near design value for holdup, settling, plate-out, spray effect, and high velocity discharge into suppression pool
  - Cycles containment vent valves to maintain containment pressure band (substantial reliance on instrumentation, valves/actuators, and operator actions)
  - Swap-over from WW to DW vent after 20 hours as containment floods up

Enclosure 5a
MELCOR

- Based on SOARCA MELCOR modeling
- Accident sequences
  - Informed by SOARCA and Fukushima
  - Long-term SBO (base case 16 hr RCIC)
- Mitigation actions
  - B.5.b and/or FLEX provide core spray or drywell spray (300 gpm)
  - Containment venting
- Sensitivity analysis
  - Spray flow rate and timing, wetwell versus drywell venting, and RCIC duration

Insights from MELCOR Calculations

- Water on the drywell floor is needed to prevent liner melt-through
  - Also scrubs fission products and reduces drywell temperature
- Venting prevents over-pressurization failure
  - Wetwell venting is preferable to drywell venting
- Need combination of venting and drywell flooding
  - More reduction in fission product release
  - Maintain reactor building integrity

Enclosure 5b
MACCS2

- Offsite population doses, including doses to off-site decontamination workers
- Individual latent cancer fatality risk and prompt fatality risk
- Land contamination
- For different thresholds of Cs-137 concentration in soil (Ci/km2)
- Economic costs

Insights from MACCS2 Calculations

- The health effect of interest is latent cancer fatality risk, which is controlled in part by the habitability (return) criterion
  - Essentially no prompt fatality risk
- In terms of long-term radiation, the most important isotope is Cs-137, and most of the doses are from ground shine
- There is a non-linear relationship between decontamination factor and both land contamination area, health effects, and economic consequences

Enclosure 5c
PRA

- Conditional containment failure probability
- Insights from Severe Accident Mitigation Alternatives (SAMA) Analyses
- Technical approach
- Results
- Uncertainties

Enclosure 5c
PRA

- To estimate the risk reduction resulting from installation of a severe accident containment vent for use in regulatory analysis
  - 50-mile population dose (Δperson-rem/ry)
  - 50-mile offsite cost (Δ$/ry)
  - Onsite worker dose risk (Δperson-rem/ry)
  - Onsite cost risk (Δ$/ry)
  - Land contamination (Δconditional contaminated land area)

Enclosure 6
Stakeholder Interactions

- Numerous public meetings
- Stakeholder input and presentations
  - Filter vendors
  - Public interest groups
  - Regulated industry

Enclosure 7
Draft Orders

- Considerations
  - Assessing proposed implementation date
  - Provide high level technical requirements
  - Detailed guidance document to be developed with consideration of stakeholder input

Previous ACRS Questions

- Uncertainties on particle removal capabilities
  - Discussed in Enclosures 4 and 5a
  - Particle removal efficiency is dependent upon various parameters including particle size
  - Submicron particles are difficult to remove
  - Uncertainty in particle size distribution given an accident

Previous ACRS Questions

- Impact of noble gases on site operations
  - Elevated release with stable meteorological conditions have a relatively low impact
  - Elevated release with unstable meteorological conditions (i.e., plume washdown to site) would have greater impact
    - Shielded locations should limit doses to regulatory limits

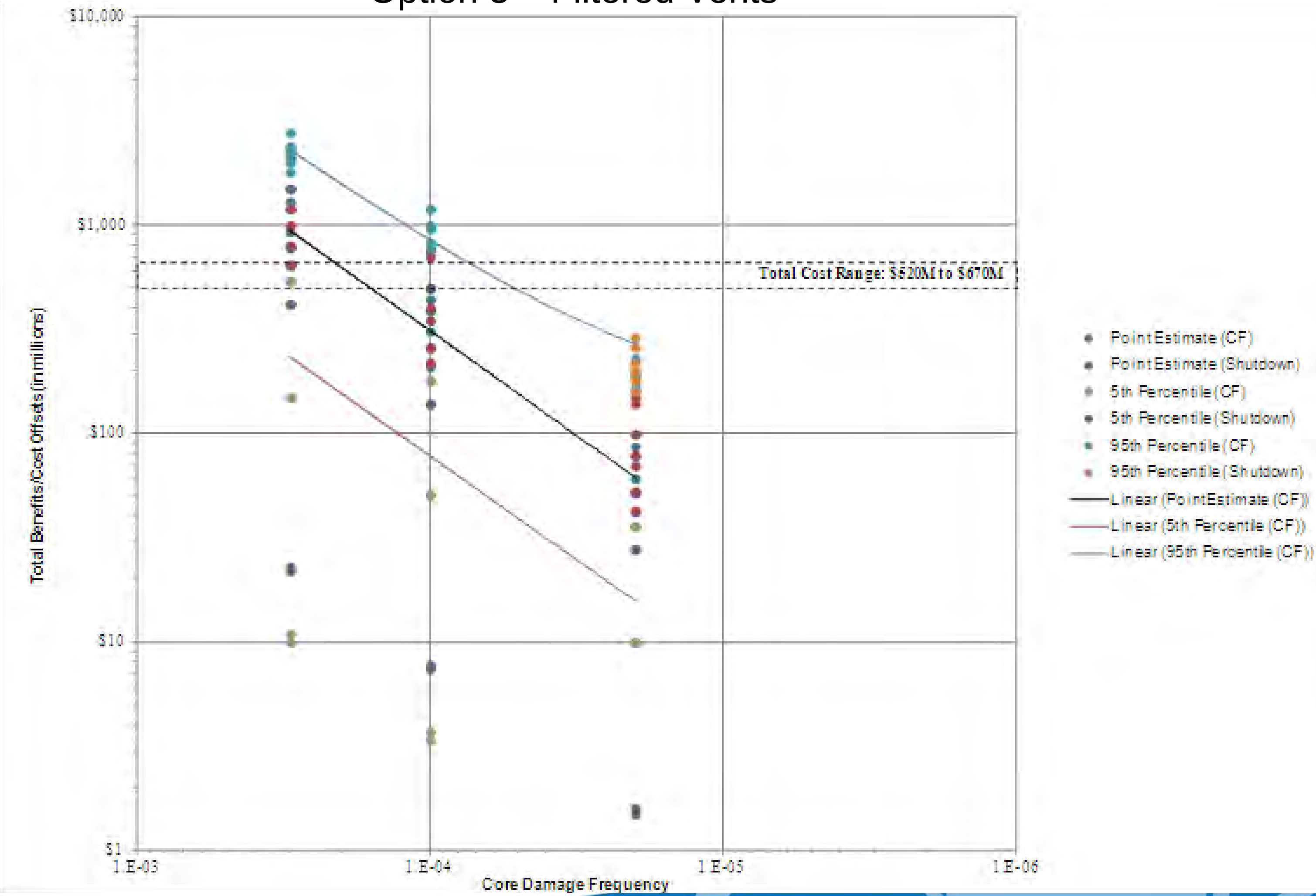
Conclusions

- The NRC staff finds that the combination of quantitative and qualitative factors best supports the installation of filtered venting systems at BWRs with Mark I and II containments (Option 3)

Backup Slides

Sensitivity Analysis

Option 3 – Filtered Vents



Risk Analysis

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Table 6. Parameter Values Used in the Risk Evaluation

Parameter	Value		Basis
CDF	2E-5/reactor-year		SPAR external hazard models
Fraction of total CDF due to external hazards	0.8		SPAR external hazard models; review of previous PRAs
Breakdown of sequence types for internal hazards	Other (not SBO, bypass or fast)	0.83	SPAR internal hazard models
	SBO	0.12	
	Bypass (ISLOCAs)	0.05	
	Fast (MLOCAs, LLOCAs, ATWS)	0.01	
Breakdown of sequence types for external hazards	Other (not bypass)	0.95	Review of previous PRAs; engineering judgment
	Bypass	0.05	
Probability that SA vent fails to open	Mod 0	1	
	Mods 1, 3, 5, 7 – other or SBO	0.3	SPAR-H method (manual vent; longer available time)
	Mods 1, 3, 5, 7 – fast	0.5	SPAR-H method (manual vent; shorter available time)
	Mods 2, 4, 6, 8	0.001	Engineering judgment (passive vent mechanical failure)
Conditional probability that offsite power is not recovered by the time of lower head failure given not recovered at the time of core damage (internal hazards)	0.38		Historical data (NUREG-6890)
Probability that portable pump for core spray or drywell spray fails	0.3		SPAR-H; consistent with SPAR B.5.b study done by Idaho National Laboratory

Risk Analysis Uncertainties

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Table 12. Uncertainty Distributions

Parameter	Mean		Distribution
CDF	2E-5/reactor year		Lognormal; error factor = 10
Fraction of total CDF due to external hazards	0.8		Beta; α = 0.5, β = 0.125
Breakdown of sequence types for internal hazards	Other (not SBO, bypass or fast)	0.83	Dirichlet α_1 (other) = 41 α_2 (SBO) = 6 α_3 (bypass) = 2.5 α_4 (fast) = 0.5
	SBO	0.12	
	Bypass (ISLOCAs)	0.05	
	Fast (MLOCAs, LLOCAs, ATWS)	0.01	
Breakdown of sequence types for external hazards	Other (not bypass)	0.95	Beta; α (bypass) = 0.5, β (bypass) = 9.5
	Bypass	0.05	
Probability that SA vent fails to open	Mod 0	1	Held constant
	Mods 1, 3, 5, 7 – other or SBO	0.3	Beta; α = 0.5, β = 1.167
	Mods 1, 3, 5, 7 – fast	0.5	Beta; α = 0.5, β = 0.5
	Mods 2, 4, 6, 8	0.001	Beta; α = 0.5, β = 499.5
Conditional probability that offsite power is not recovered by the time of lower head failure given not recovered at the time of core damage (internal hazards)	0.38		Beta; α = 0.5, β = 0.816
Probability that portable pump for core spray or drywell spray fails	0.3		Beta; α = 0.5, β = 1.167
Consequences	Per Tables X-7 and X-8		Lognormal; error factor = 10 Within a given consequence category, consequences were assumed to be totally dependent.

SECY-93-086 “Backfit Considerations”

- Staff Requirement Memorandum
  - The safety enhancement criterion should be administered with the degree of flexibility the Commission originally intended
  - The standard is not intended to be interpreted in a manner that would result in disapprovals of worthwhile safety or security improvements having costs that are justified in view of the increased protection that would be provided

SECY-93-086 “Backfit Considerations”

- Staff Requirements Memorandum
  - … these words embody a sound approach to the “substantial increase” criterion and that this approach is flexible enough to allow for qualitative arguments that a given proposed rule would substantially increase safety.
  - The approach is also flexible enough to allow for arguments that consistency with national and international standards, or the incorporation of widespread industry practices, contributes either directly or indirectly to a substantial increase in safety. Such arguments concerning consistency with other standards, or incorporation of industry practices, would have to rest on the particulars of a given proposed rule.

NUREG/BR-0058
Regulatory Analysis Guidelines

- 3.3 Implementation Guidance
  - The NRC philosophy for safety goal evaluations involves the concept of defense-in-depth and a balance between prevention and mitigation. This traditional defense-in-depth approach and the accident mitigation philosophy require reliable performance of containment systems. The safety goal evaluation focuses on accident prevention, that is, on issues intended to reduce core damage frequency (CDF). However, to achieve a measure of balance between prevention and mitigation, the safety goal screening criteria established for these evaluations include a mechanism for having greater consideration of issues, and associated accident sequences, with relatively poor containment performance.

NUREG/BR-0058
Regulatory Analysis Guidelines

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- 3.3.2 Additional Consideration of Containment Performance
  - To achieve a measure of balance between prevention and mitigation, the safety goal screening criteria established for safety goal evaluations include a mechanism for having greater consideration of issues, and associated accident sequences, with relatively poor containment performance.
  - The NRC recognizes that in certain instances, the screening criteria may not adequately address certain accident scenarios of unique safety or risk interest. An example is one in which certain challenges could lead to containment failure after the time period adopted in the safety goal screening criteria, yet early enough that the contribution of these challenges to total risk would be nonnegligible, particularly if the failure occurs before effective implementation of accident management measures. In these circumstances, the analyst should make the case that the screening criteria do not apply and the decision to pursue the issue should be subject to further management decision.

NUREG/BR-0058
Regulatory Analysis Guidelines

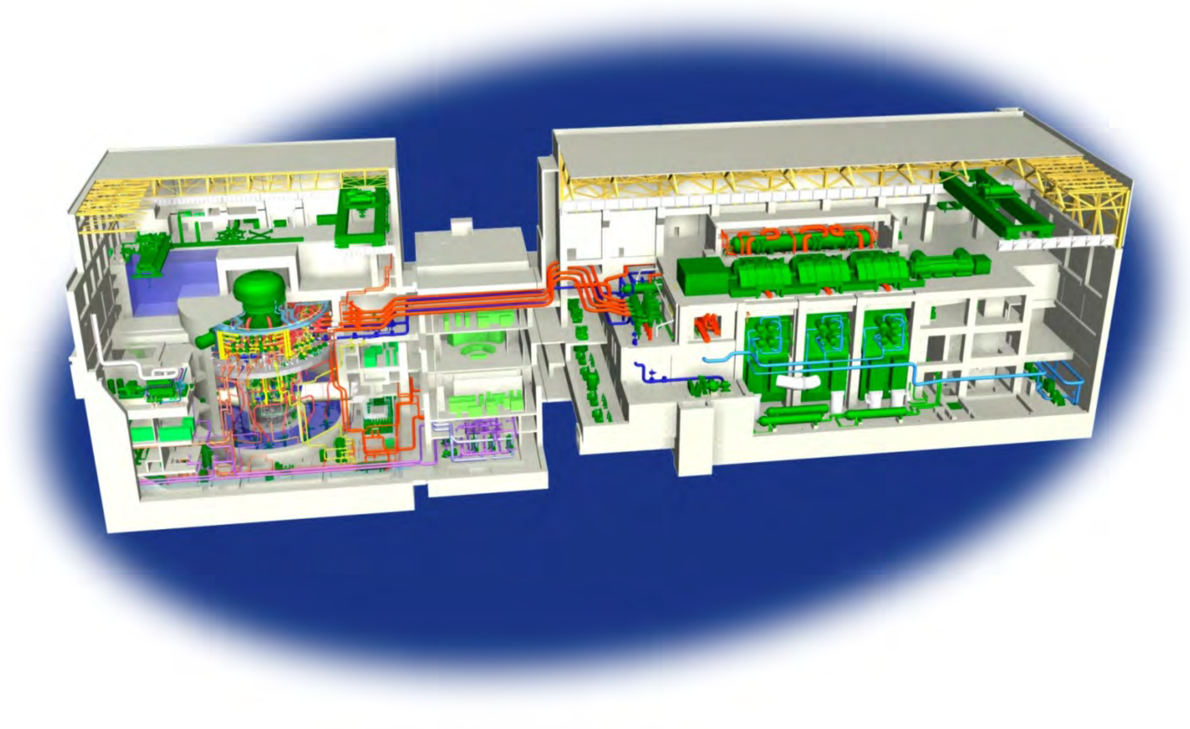
- 3.3.2 Additional Consideration of Containment Performance
  - Furthermore, note that the safety goal screening criteria described in these Guidelines do not address issues that deal only with containment performance. Consequently, issues that have no impact on core damage frequency (ΔCDF of zero) cannot be addressed with the safety goal screening criteria. However, because mitigative initiatives have been relatively few and infrequent compared with accident preventive initiatives, mitigative initiatives will be assessed on a case-by-case basis with regard to the safety goals. Given the very few proposed regulatory initiatives that involve mitigation, this should have little overall impact from a practical perspective on the usefulness of the safety goal screening criteria.

BWR Containment Venting

- NRC Safety Evaluation of “BWR Owner’s Group – Emergency Procedure Guidelines, Revision 4,” NEDO-31331, March 1987 (Letter dated 9/12/88 from A.C. Thadani to D. Grace)
  - p.5 – “Even though containment venting was approved in Revision 2, there were no detailed analyses to establish a venting pressure limit. In Revision 4, more detailed guidance is given to establish the containment vent initiation pressure. The improved guidance on containment venting will help to prevent and mitigate severe accidents.”
  - p.6 – “The hydrogen control guidelines included for the first time in Revision 4 will help to mitigate severe accidents.”
  - p.12 – “The staff’s basis concern was (and remains) that venting even if it results in some radiological consequences should only be undertaken as an extreme means to prevent core damage or as a last resort measure to prevent the irreversible and unpredictable rupture of the containment which would otherwise lead to a larger release. The underlying strategy of containment venting is to prevent core melt and in extremely rare cases the choice of limiting potential release of radioactivity to avoid uncontrolled release.”

South Texas Project Units 3&4 Presentation to ACRS

Long Term Cooling



Attendees

Scott Head	NINA Manager, STP 3&4 Regulatory Affairs
Caroline Schlaseman	MPR/TANE
Robert Quinn	Westinghouse
Martin Van Haltern	Westinghouse
Tim Andreychek	Westinghouse

Agenda

- Introduction
- Long Term Cooling
- Downstream Fuel Effects Testing
- Questions From Previous Subcommittee Meeting
- Summary

Introduction

- May 8, 2008 Staff Requirements Memorandum asked ACRS to advise Commission on adequacy of design-basis long term cooling approach for each reactor type
- Main focus was ability of safety systems to provide adequate core cooling for extended periods of time when the ECCS recirculation mode is activated during a design basis accident

STP 3&4 Long Term Cooling Features

- Robust ECCS
  - 3 trains Residual Heat Removal, 2 trains High Pressure Core Flooder (HPCF), and one train Reactor Core Isolation Cooling
  - Diverse delivery locations and water sources
- Conservatively sized state-of-the-art ECCS suction strainers
- Containment debris minimized
  - No recirculation piping and associated insulation
  - Small inert containment with closed suppression pool
  - Coated, steel-lined containment
  - Stainless steel lined suppression pool with minimal equipment
  - No fiber or calcium silicate insulation
  - No aluminum; no zinc other than in qualified coatings
  - Trash racks prevent large debris from entering suppression pool
  - Suppression Pool Cleanup System
- Fuel cooling defense-in-depth features
  - High Pressure Core Flooder
  - Design bypass flow
  - AC Independent Water Addition
  - Alternate Feedwater Injection
- Operational program to ensure containment cleanliness

Long Term Cooling Overview

- Long term core cooling
  - Emergency Core Cooling System (ECCS)
  - Ultimate Heat Sink (UHS)

- Potential challenges to long term cooling addressed
  - ECCS pump NPSH
  - Containment integrity
  - ECCS gas accumulation
  - Downstream and chemical effects

Long Term Cooling

- Robust long term cooling
  - Ultimate Heat Sink (UHS) has adequate water to provide cooling for 30 days without make-up
  - Numerous ECCS water sources to keep core cooled
    - Peak clad temperature during design basis LOCA is about half of the limit
  - AC Independent Water Addition (ACIWA) serves as independent backup to ECCS
  - Alternate Feedwater Injection (AFI) also provides backup cooling

Challenges to Long Term Cooling Addressed

- Strainers meet NPSH guidance
  - Strainers sized based on very conservative debris loading
  - ACIWA and AFI systems can provide core cooling without strainers (as a backup)
- Containment integrity maintained
  - Containment design pressure and temperature met under design basis LOCA
- ECCS gas accumulation addressed
  - Keep-fill systems on ECCS discharge
- Downstream fuel effects (including chemical effects) will be confirmed to be acceptable by testing

Downstream Fuel Effects Test

- Downstream test to confirm adequacy of flow to the core
  - Performed at least 18 months prior to operation
  - Detailed test procedure reflecting industry downstream testing experience will be provided to NRC at least 6 months prior to the test
- Fuel assembly test with inlet nozzle, tie plate, debris filter and grids
- Conservative debris amounts relative to those expected
  - Including fiber, sludge, rust, dirt/dust, RMI, coatings, and chemical precipitates
- Protocol for test will follow industry experience
  - Protocol based on PWROG guidelines
  - Multiple tests at multiple flow rates representative of post-LOCA conditions
- Acceptance criteria developed using GOBLIN computer analysis
  - Conservative factor of 8 margin in acceptance criteria
  - Acceptance criteria included in license condition

Defense-in-depth

- Separate analyses show that long term cooling can be maintained even if fuel assembly inlet blocks completely
  - High Pressure Core Flooder flow from above the core can cool fuel
  - Design fuel assembly bypass flow can provide necessary cooling

Downstream Fuel Effects Summary

- Design features and operational programs prevent adverse downstream fuel effects
- Downstream test to confirm that debris will not adversely affect fuel
- Defense-in-depth analyses show complete fuel assembly blockage can be accommodated

Questions from Previous Subcommittee Meeting

- Provide basis for 1 ft^3 fiber (#102)
- Provide more information on debris surrogates (#103)
- Discuss the protocol for downstream fuel effects test (#104)
- Provide a summary of the defense-in-depth analyses (#105)
- NINA Letter on 10/16/12 documented the response to these questions

Long Term Cooling Summary

- There is adequate core cooling to meet LTC requirements
  - ECCS and UHS are more than adequate to provide 30 days of cooling
  - Design basis LOCA peak clad temperature about half the limit
- Challenges to LTC (containment integrity, ECCS gas accumulation, and strainer NPSH) satisfactorily addressed
- Challenge to LTC from debris passing through the ECCS suction strainers and causing downstream effects on the fuel is addressed by:
  - Design features and operational programs which exclude challenging materials
  - Downstream fuel test to confirm that debris will not adversely affect the fuel
  - Defense-in-depth analyses showing complete fuel blockage can be accommodated
- STP 3&4 meets regulatory requirements for long term cooling

Long-Term Cooling for ABWR STP Units 3 and 4 November 1, 2012

Jim Gilmer: Downstream Effects (Reactor Systems Branch)
Greg Makar: Chemical Effects (Component Integrity Branch)
Hanry Wagage: Containment (Containment and Ventilation Branch)
Tuan Le: Component Integrity (Engineering Mechanics Branch)

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ABWR Long-Term Cooling

- Long-term core cooling is provided by RHR and HPCF pumps
- Long-term suppression pool temperature is maintained by operating RHR in suppression pool cooling mode
- Analysis showed that containment pressure can be maintained below its design value
- Analysis showed that adequate core cooling can be maintained by keeping the RPV level above the top of active fuel

ABWR Long-Term Cooling (continued)

- The staff review approach for STP Units 3 and 4 is consistent with previous LTC reviews, and ensures that the requirements of 10 CFR 50.46(b)(5) are satisfied. The assessment includes:
  - ECCS strainer performance
  - Downstream effects
  - Chemical effects

Strainer Performance

- STP 3 and 4 ECCS suction strainers designed in accordance with RG 1.82 Rev. 3
  - Bounded by Reference Japanese ABWR strainer analysis and testing
- Primary containment - 100% Reflective Metallic Insulation
- Suppression pool
  - Stainless steel liner
  - Suppression pool cleanup system
- FSAR describes the Foreign Material Exclusion and cleanliness programs
- Restricted from containment by administrative procedures: fiber, CalSil, Al, and TSP

In-Vessel Effects

- STP demonstrated through analysis that 0.95 void fraction is maintained
- STP calculated peak cladding temperature is well within criteria specified in 10 CFR 50.46
- There are diverse ECCS injection sources and injection paths to core
- Fuel tests must demonstrate low impact on core flow due to debris blockage

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Conservatisms in STP Design/Analyses

- The relative reduced likelihood of latent debris generation compared to operating BWRs and PWRs (restricted access to the containment, the suppression pool cleanup system, the operational program for suppression pool cleanup)
- Minimal LOCA-generated debris (elimination of recirculation piping, no fibrous insulation)
- All breaks above top of active fuel
- All corroded aluminum and zinc assumed to precipitate in gelatinous form
- ABWR design features that minimize the transport of accident-generated debris
- Diversity of ECCS delivery locations, systems, and water sources
- The analyses include a factor of four conservatism

License Condition 06.02-1

- STP incorporates by reference the certified ABWR design
- The License Condition ensures that the fuel to be loaded will perform satisfactorily with debris blockage
- The proposed license condition includes test acceptance criteria that must be met for any type of fuel before it can be loaded
- FSAR COM 6C-1 commits to submission of the test results and analyses at least 18 months prior to scheduled fuel load
- FSAR COM 6C-2 commits to provide the complete, detailed test plan (which will reflect Industry experience in performing such tests) six months prior to the tests

License Condition 06.02-1 (continued)

- Acceptance criterion provides conservative measure of long-term fuel performance over the expected operating range

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Long-Term Cooling: Conclusion

- Adequate core cooling is maintained
- Containment pressure and temperature are maintained below containment design values
- STP meets 10 CFR 50.46(b)(5)

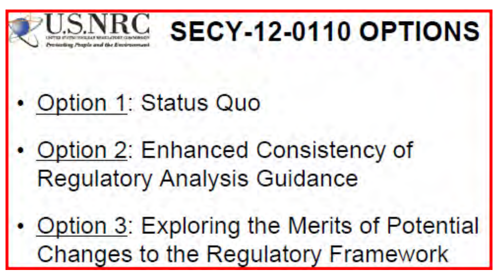
UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
<u>BEFORE THE ACRS</u>

October 15, 2012

PILGRIM WATCH COMMENT REGARDING ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS) MEETING OF THE ACRS SUBCOMMITTEE ON RELIABILITY AND PRA

Pilgrim Watch (Herein "PW") respectfully provides comment to the ACRS and to the ACRS' Subcommittee on Reliability and PRA. The comments are essentially the same as those PW provided to the NRC Commissioners on September 13, 2012 and equally pertain to the ACRS' deliberations.

Background: At the August 29 Public Meeting (Slide 17), the Staff reviewed three options set forth in SECY-12-110 and will recommend that the Commission approve Option 2, September 13^{th}.

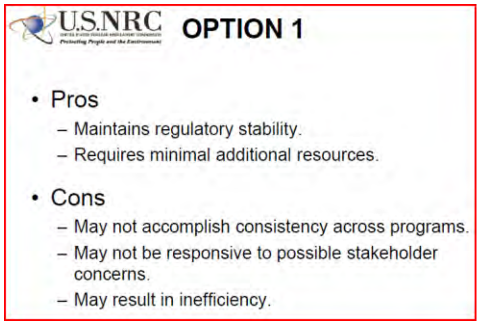


The Staff also suggested that Pilgrim Watch ("PW") provide written comments regarding SECY-12-10 and these options. For the reasons set forth in more detail below, PW recommends that none of the Staff's three options be approved in their present form. Instead, PW recommends that the Commission accept an amended version of Option 3: <u>change the regulatory framework to incorporate the real-world lessons learned from Fukushima.</u>

I. Options - Pros and Cons

For each of its options, the Staff presented what it viewed as that Option's Pros and Cons. PW's evaluation of the three Options is significantly different.

A. Staff Option 1, status quo



Simply stated, Staff Option 1 "maintains regulatory stability" by doing nothing; it "requires minimal additional resources" because it requires neither the NRC nor the industry to take any steps in response to what both should have learned from Fukushima.

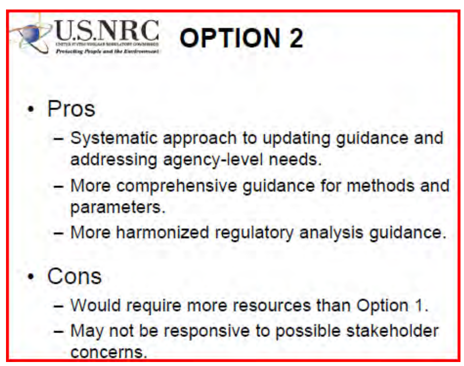
The primary appeal of Staff Option is saving the industry money. If industry is allowed to continue to use the current MELCOR Accident Consequence Code System (MACCS2) computer program that underestimates offsite consequences, than industry will not be required to spend any money or take any steps to implement measures that would reduce risk. (2) Option 1 simply maintains the fiction that a severe accident such as that at Fukushima will not cause anything more than minimal offsite economic consequences, in a misguided attempt to minimize public fears of nuclear power after Fukushima.

The best that could be said for the "Cons" noted by the Staff is they are understated. If "stakeholders" includes the public that would be affected by a severe accident, Option 1 plainly is not responsive to any of their very real concerns. "May not accomplish consistency across programs" apparently means that the option ignores even the minimal steps that the NRC has taken in response to Fukushima. As for "inefficiency," doing nothing is usually efficient, it is simply not productive.

More basically, maintaining the "status quo" means that the NRC and industry will continue to base the assumed economic consequences of a severe accident on the 16 year old MACCS2. That code has never been validated. It relies on false assumptions, ignores many costs, leaves the choice of inputs to the user, and severely underestimates what the offsite consequences of a severe accident are likely to really be. If the MACCS2 has been used to perform a cost-benefit analysis at Fukushima Daichi, it would have told the regulators that nothing should have been done to avoid the actual catastrophic results.

Beyond that, preserving the status quo after Fukushima continues to ignore NEPA's requirement that the NRC take a "hard look" at new and significant information. The Staff effectively admitted at the August 29 Public Meeting that it has not taken a "hard look." Its excuse was that it did not have the time to consider the computer models in any detail. This is at best questionable; high-speed computers are readily available to run analyses to compare the values of the current MACCS2 against the results of an updated MACCS2 that incorporated lessons learned from Fukushima. The Staff's recommendation lacks any scientific or quantitative basis. PW reasonably expected that Staff would perform sensitivity analyses to measure how much an economic consequence (output) - total offsite economic costs – changed by varying an input based on real-world lessons learned from Fukushima. Sensitivity analyses are routine and readily achievable with today's high-speed computers.

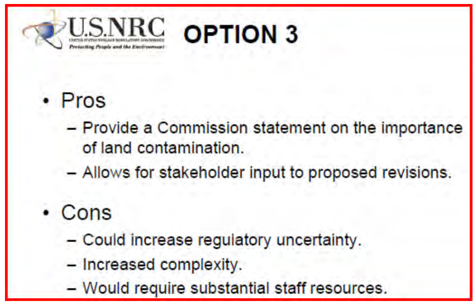
B. Option 2: Enhanced consistency regulatory guidance.



The key word in Staff Option 2 is "guidance." As with Option 1, there is no thought that either the NRC or the industry would actually be required to do anything. "More resources" is simply more than "minimal," but once again there is no suggestion that the NRC would commit the resources that would actually be required to do anything, or even to appear to be "responsive to possible stakeholder concerns."

The primary appeal of Staff Option 2 continues to be that it save the industry money by allowing it to continue to use an accidence consequence analysis that will maintain the fiction that there cannot be any accident here, and that even if one should occur there would not be any offsite economic consequences.

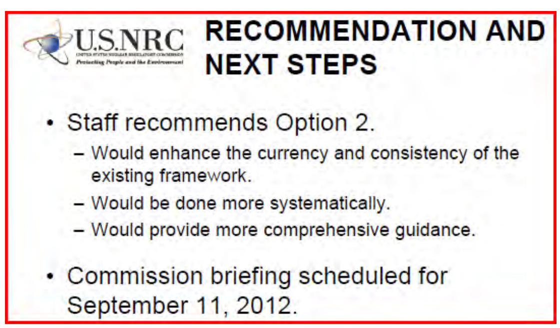
C. OPTION 3: Exploring merits of potential changes to the regulatory framework.



Here again, what is missing is the idea that anyone should actually be required to do anything. The added thought this time is that it isn't even necessary to make a decision. Rather, the Commission should "kick the can down the road" before even making a "statement."

If "stakeholder input to proposed revisions" means that the Staff would seriously consider public input rather than simply that of the industry, it would be a step forward. But the Staff's conclusion that having to commit "substantial staff resources" is a "CON" provides no assurance whatever.

D. NRC Staff Recommendation:



The Staff's Recommendation that the Commission provide "more comprehensive *guidance*" by "enhancing ... the *existing* framework" similarly provides no assurance that the NRC will give any realistic consideration of the likely real economic consequences of a severe accident, or require that the industry take any steps to mitigate those damages.

II. Pilgrim Watch Recommendation:

Change the Regulatory Framework to Incorporate the Real-World Lessons Learned (and should be Learned) From Fukushima.

There is a very long list of lessons that the NRC and the nuclear industry should have learned from Fukushima. The following are among the most important. The NRC's current methodology for estimating the consequences of a severe accident either ignores or drastically underestimates all of them.

1. The probability of a core damage event is ten times what the NRC has assumed.

2. The NRC's "economic consequence" analyses cannot continue simply to ignore the enormous (far more than a core melt-down) damage that a spent fuel pool accident will cause. Luckily, to date the Fukushima "accident" has "only" resulted in three core melt-downs. But the NRC cannot continue to ignore that only "luck" has insured that Fukushima's spent fuel pools have not failed also (especially Unit 4's), and that they may well fail in the not-distant future.

3. In the event of a severe accident, there will be enormous aqueous radioactive releases and damage. The NRC's approved consequence analyses cannot continue to ignore aqueous releases.

4. There is no rational basis for the NRC/industry assumption that an accident will last only a day (usual industry practice) and in any event not more than 4 days (MACCS2 code's maximum limit)

5. There is no rational basis for the NRC/industry assumption that the only radioactive release that needs to be considered is an atmospheric (forget about aqueous) release from the core (forget about the spent fuel pool), and even then only noble gasses and a small fraction of the Cs-137 in a core need be taken into consideration.

6. Similarly, there is no rational basis for the NRC/industry assumption that a radioactive release will only affect a very limited geographic area defined by an outdated straight-line Gaussian plume.

7. Clean-up and Decontamination is an enormously expensive job, extending over decades. Hosing down buildings and plowing under fields does not clean-up or decontaminate. The NRC cannot continue to ignore: that there is no cleanup-standard; that clean-up cannot possibly take just one year; that it has given no consideration to what can and must be done to the tons of contaminated wastes; that clean-up after a nuclear explosion is not comparable to clean-up after a nuclear reactor accident; and that forests, wetlands and water simply cannot be cleaned and will re-contaminate areas.

8. The MACCS2 code used by industry (with the NRC's approval) to model economic consequences of a severe accident is, at best severely limited in what it can do and what it cannot. Even in those areas where the MACCS2 code has some capability, the NRC cannot continue to allow industry to manipulate the way in which it uses the code to intentionally minimize potential consequences; ignore real health costs; create essentially useless evacuation time estimates; choose the input parameters into the model; and choose to average the code's inputs by a mean and not the 95th percentile.

A. Probability and Probabilistic Modeling

Fukushima raised baseline > 10 times - from 1 event per 31,000 RY to 1 event per 2,900 RY

The probability of severe core damage and accompanying radioactive release can be estimated in two ways. One is by direct experience and the other by Probabilistic Risk Assessment (PRA). Fukushima has expanded our knowledge by direct experience, and the lessons that should be learned provide a reality check on PRAs.

The MACCS2 that NRC and industry use to conduct PRAs have little or no basis in direct experience**.** For example, the MACCS2 code restricts the times for cleanup and decommissioning after a severe accident to one year. After Chernobyl, the Russians quit after four years and the Japanese estimate that it will take decades to clean-up after Fukushima.

If that code has been used to perform a cost-benefit analysis at Fukushima Daiichi in January 2011, the predicted offsite consequence costs would not have justified the cost of taking any mitigation steps to reduce the risk of a severe accident. This tells us that PRA, by itself and as currently run, is inadequate. The risks, and problems, inherent in probabilistic modeling, particularly as it is now practiced by the NRC and nuclear industry, are legion. For example:

1. By using probabilistic modeling and incorrect parameters in a SAMA analysis, a licensee can arrive at a result that downplays the likely consequences of a severe accident, and thus saves the licensee money by incorrectly discounting possible mitigation alternatives. This could have enormous implications for public health and safety. A potentially cost effective mitigation alternative that could prevent or reduce the impacts of that accident would likely not even be considered.
2. Consequence analysis multiplies the probability of an accident by the consequences. By multiplying large consequence values by very low probability, the consequence values appear unrealistically very low – far lower than the real-world lessons from Fukushima show. Probabilistic modeling that uses a low probability number can, and likely will, underestimate the deaths, injuries, and economic impact likely from a severe accident. No matter how high the potential consequence values may be, if they are multiplied by a low probability number, the consequence figures on which decisions are based become far less startling. For example, if an analysis shows that the consequences of a severe accident radioactive would include 100,000 cancer fatalities, PRA would reduce the "risk" on which any SAMA was based to only 1 cancer fatality per year by assuming (and there is no basis for anything other than an assumption) that associated probability of the release was 1/100,000 per year.
3. PW is not arguing that probability is not taken into consideration, but it must be taken with caution and tested against real-world experience, particularly as it relates to SAMA analyses. Kamiar Jamali's (DOE Project Manager for Code Manual for MACCS2) *Use of Risk Measures in Design and Licensing Future Reactors,*[1] explains that "PRA" uncertainties are so large and so unknowable that it is a huge mistake to use a single number coming from them for any decision regarding adequate protection. "Examples of these uncertainties

[1] Kamiar Jamali, *Use of Risk Measures in Design and Licensing Future Reactors,* Reliability Engineering and System Safety 95 (2010) 935-943

include probabilistic quantification of single and common-cause hardware or software failures, occurrence of certain physical phenomena, human errors of omission and commission, magnitudes of source terms, radionuclide release and transport, atmospheric dispersion, biological effects of radiation, dose calculations, and many others." (Jamali, Pg., 935) (Emphasis added)

4. Probability analysis has other pitfalls. PRAs do not consider human error. More important, PRAs project into the future and assume (based on very little real experience) that there is a likelihood that an accident scenario will occur in hundreds, if not thousands, of years is vanishingly small. But no reactors have operated more than 45 years, and there have been at least six severe accidents.[2] The uncertainty inherent in predicting the future must be respected by making certain that appropriate and up-to-date assumptions are used in the analysis.

Fukushima showed Probabilistic Risk Assessments (PRA) uncertainties are extremely large and that it is a huge mistake to use a single number coming from them as the basis for any decision regarding adequate protection. Examples of these uncertainties include, for example: probabilistic quantification of single and common-cause hardware or software failures, occurrence of certain physical phenomena, human errors of omission and commission, magnitudes of source terms, radionuclide release and transport, atmospheric dispersion, biological effects of radiation, dose calculations, and many others.

The probability analysis that lies at the heart of the regulatory framework needs to be changed to incorporate the real-world lessons learned, and should be learned, from Fukushima.

B. The Probability of a Core Damage Event

The NRC's current baseline estimates that there may be *one Core Damage Event per 31,000 RY* (years of reactor operation). Fukushima raised the number of *actual* core damage events at Generation II commercial reactors in the last 34 years to five[3] - TMI, Chernobyl and Units 1 though 3 at Fukushima. Based on this actual experience, the likelihood of a significant accident core melt in any given year is about 1 in 7 years.

[2] Including the 1961 fatal accident at SL-1.
[3] This does not include the fatal accident at SL-1 in 1961.

The NRC prefers to speak in terms of events per year (or years) of reactor operation. The five Generation II commercial reactor core melts occurred in a world-wide fleet of 440, with a total of 14,484 reactor years of operation (RYs) as of May 16, 2011. In NRC-speak, this translates to a core damage frequency of 3.4E-04 per RY (or **1 event per 2, 900 RY**). No matter how stated, the probability of *one core-melt for every 2,900 RY* (years of reactor operation) is more than ten times the current baseline estimate of only **1 event per 31,000 RYs**. Put another way, based upon observed experience with more than 400 reactors operating worldwide, a significant nuclear accident has occurred approximately every seven years (2900/400=7.25). [4]

Whether thought of in terms of one accident every seven years or one event every 2,900 reactor years (the year could be tomorrow or many years later), it could hardly be clearer that future SAMA analyses should be done using a baseline CDF that is at least an order of magnitude higher than that currently used.

Further from direct experience at Fukushima SAMA options to implement (based on updated cost-benefit analyses based on Fukushima's direct experience, not analyses based on pre-Fukushima assumptions/inputs) are measures to mitigate: structural damage; multi-day station black-out; loss service water and or loss fresh water supply; containment venting and hydrogen control systems upgraded using passive mechanisms; measures to prevent spent fuel pool fires, low-density, open-frame racks; filtered venting that uses passive mechanisms.[5]

C. Spent Fuel Pools

Today, there are about 1,230 irradiated spent fuel rods, containing roughly 37 million curies (~1.4E+18 Becquerel) of long-lived radioactivity in Fukushima's pool No. 4.[6] The No. 4

[4] These two quite different ways of stating probability of a Core Damage Event (once every seven years or once in every 2,900 reactor years) is perhaps one of the clearest examples of the ability of a PRA to confuse and mislead the public.

[5] Massachusetts Office of the Attorney General Request for Hearing Pilgrim License Renewal (Dr. Gordon Thompson Report, New and Significant Information From Fukushima Daiichi Accident in the Context of Future Operation of the Pilgrim Nuclear Power Plant, June 1, 2011, Section VI.I, beginning pg., 14, NRC Electronic Library, EHD)

[6] Currently available information is that the about the total of number of spent fuel assemblies are being stored at the Dai-Ichi site is between 10,833 and 11,138. In either event, they contain about 330 million curies (~1.2 E+19 Bq) of long-lived radioactivity. About 130 million of the 330 million curies is Cesium-137 — **roughly 85 times the amount of Cs-137 released at the Chernobyl accident** as estimated by the U.S. National Council on Radiation Protection (NCRP). The total spent reactor fuel inventory at the Fukushima-Daichi site contains nearly half of the

pool is about 100 feet above ground, is structurally damaged and is exposed to the open elements. If an earthquake or other event were to cause this pool to drain this could result in a catastrophic radiological fire involving nearly 10 times the amount of Cs-137 released by the Chernobyl accident. It would also cause a shutdown of all six reactors, and would affect the common spent fuel pool containing 6,375 fuel rods, located some 50 meters from reactor 4. None of these radioactive fuel rods are protected by a containment vessel; all are open to the air.

The danger presented by spent fuel is the reason that the NRC recommended that all Americans within 50 miles of Fukushima be evacuated. Yet the NRC's economic consequence analyses (inexplicably for any reason other than the potential cost to the industry of dealing with the issue) continue to ignore the consequences of a spent fuel accident. No rational analysis could do so. Accidents are severe, and cause economic consequences, because they release radioactivity - whether from the reactor core or a spent fuel pool, the consequences are the same - except that the amount of radioactivity caused by a spent fuel accident would dwarf that caused by a core melt-down.

The importance of a spent fuel accident, and of requiring SAMAs to model spent fuel pool releases, is illustrated by pointing to Pilgrim, where a spent fuel pool fire could release more than 44,010,000 curies of Cs-137, an amount 8 times more than a core release. Further, a spent fuel pool fire would result in releases going higher into the air and significantly impacting locations at greater distance with denser populations.

Dr. Beyea estimated the cost of a 10% release from a spent pool fire to be $105-175 billion dollars; and that a 100% release of C-137 would cost somewhere between $ 342 - $ 488 billion. (Beyea, 10) Entergy's LRA SAMA, based on currently approved NRC models, considered only the release of a relatively small amount of C-137 from the reactor core[7].

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total amount of Cs-137 estimated by the NCRP to have been released by all atmospheric nuclear weapons testing, Chernobyl, and world-wide reprocessing plants (~270 million curies or ~9.9 E+18 Becquerel).

[7] The Massachusetts Attorney General's Request for a Hearing and Petition for Leave to Intervene With respect to Entergy Nuclear Operations Inc.'s Application for Renewal of the Pilgrim Nuclear Power Plants Operating License and Petition for Backfit Order Requiring New Design features to Protect Against Spent Fuel Pool Accidents, Docket No. 50-293, May 26, 2006 includes a Report to The Massachusetts Attorney General On The Potential Consequences Of A Spent Fuel Pool Fire At The Pilgrim Or Vermont Yankee Nuclear Plant, Jan Beyea, PhD., May 25, 2006.

And a severe accident from the spent fuel pool at Pilgrim, for example, resulting from human error, mechanical failure, natural disasters, or an act of malice, is reasonably foreseeable. The offsite cost risk of a pool fire is substantially higher than the offsite cost of a release from a core-damage accident.

There are significant potential interactions between the pool and the reactor in the context of severe accidents, especially at Mark I's and Mark II's. In both, as at Fukushima, the spent-fuel pool is located in the attic of the main reactor building, outside primary containment. It shares essential support systems with the reactor. There could be at least three types of interactions between the pool and reactor.[8]

First, a pool fire and a core-damage accident could occur together, with a common cause. For example, a severe earthquake could cause leakage of water from the pool, while also damaging the reactor and its supporting systems to such an extent that a core-damage accident occurs.

Second, the high radiation field produced by a pool fire could initiate or exacerbate an accident at the reactor by precluding the presence and functioning of operating personnel.

Third, the high radiation field produced by a core-damage accident could initiate or exacerbate a pool fire, again by precluding the presence and functioning of operating personnel.

Many core-damage sequences would involve the interruption of cooling to the pool, which would call for the presence of personnel to provide makeup water or spray cooling of exposed fuel. The third type of interaction was considered in a license-amendment proceeding in regard to expansion of spent-fuel-pool capacity at the Harris nuclear power plant. Such accidents are conceivable and would result in a very high magnitude of release.

Although, SAMAs designed to avoid or mitigate conventional accidents may be different than SAMAs designed to avoid or mitigate spent fuel accidents. The radiological consequences of a spent-fuel-pool fire are significantly different from the consequences of a core-damage accident.

[8] Dr. Gordon Thompson, Risks of Pool Storage of Spent Fuel at Pilgrim Nuclear Power Station and Vermont Yankee, A Report for the Massachusetts Attorney General by IRSS, May 2006, Pgs., 12, 16. NRC Electronic Library, Adams Accession Number ML061630088"

D. Aqueous Discharges[9]

Millions of gallons of water were pumped into the Fukushima reactors, and those millions of gallons flowed into the sea. Current NRC economic consequences take no account of aqueous discharges, to say nothing of their affect on either the local or long-distance marine economies.

Post Fukushima Daiichi, it plainly is necessary to update SAMA analyses to take into account new and significant information learned from Fukushima regarding the probability of containment failure in the event of an accident and the concomitant probability of a significantly larger volume of off-site consequences due to the need for flooding the reactor (vessel, containment, pool) with huge amounts of water in a severe accident, as at Fukushima.

This was recognized by the Commission.[10] But the Commission also should do something about it. Direct contamination from water pumped into a reactor would add to that resulting from aqueous transport and dispersion of radioactive materials through subsurface water, sediments, soils and groundwater, plus atmospheric fallout on the waters - resulting in three sources of contamination in the waters. A rational economic analysis must recognize all three.

E. How Long an Accident

The Fukushima disaster was not over a day after it started. Units 1-3 continue to release radioactive materials today - 18 months after the accident began.

The MACCS2 code limits the total duration of a radioactive release to no more than four (4) days, if the Applicant chooses to use four plumes occurring sequentially over a four day period (IPLUME 3)[11]. Licensees have chosen not to take that option and limited analyses to a single plume having a total duration of one day.[12] In any case either a day or a four-day plume is

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[9] Pilgrim Watch Request For Hearing On A New Contention Regarding Inadequacy Of Environmental Report, Post Fukushima, November 18, 2011; Pilgrim Watch's Petition For Review Of LBP- 12-01,January 11, 2012, NRC's EHD, Pilgrim LRA.

[10] SECY-11-0089, Enclosure 1, pg., 29; http://www.nrc.gov/reading-rm/doc-collections/commission/secys/2011/2011-0089scy.pdf; and Commission Voting Record, Decision Item SECY-11-0089, September 21, 2011, http://www.nrc.gov/reading-rm/doc-collections/commission/cvr/2011/2011-0089vtr.pdf

[11] NUREG/CR-6613 Code Manual for MACCS2: Volume 1, User's Guide, 2-2

[12] The MACCS2 uses a Gaussian plume model with Pasquill-Gifford dispersion parameters (Users code 5-1). Its equation is limited to plumes of 10 hour duration.

plainly of insufficient duration in light of lessons learned from Fukushima. The Fukushima crisis stretches over many months. A release that goes on for the better part of two years will cause offsite consequences that far exceed one that lasts only a day.

F. All Radioactive Releases Must be Considered

The only releases considered under current NRC practice are noble gases from the core and a small fraction of the core inventory of Cs-137. One fundamental lesson that should be learned from Fukushima is current practice necessarily, even if perhaps not intentionally, drastically underestimates many releases that cause significant damage and economic consequences.

Even if we were to put aqueous discharges and radioactive releases from spent fuel pools to one side, there is no justification for not modeling the total potential amount of Cs-137 from the core. For example the Cs-137 inventory in Pilgrim Station's core has the potential of releasing more than twice the amount of Cs-137 than was released at Chernobyl. The amount of Cs-137 released during Chernobyl in 1986 was 2,403,000 curies; the amount of Cs-137 in Pilgrim's Core during license extension will be 190,000 TBq or 190,000 X 27 Ci = 5,130,000 curies.

However, and consistent with permitted NRC and industry practice, Entergy's LRA MACCS2 model apparently estimated costs based on a release only (i) of noble gases in the core inventory and (ii) a small fraction of the core inventory of CsI. [PNPS Radionuclide Release Category Summary, Figure E.1.1].

The regulatory framework changes should require: (1) modeling the actual amount of Cs-137 from the core and not basing release as current practice on noble gasses and a small fraction of the core inventory of Cs-137; (2) including release from the spent fuel pool; (3) not allowing use of codes that have not been validated by the NRC such as the MAAP code; (4) requiring modeling aqueous discharges, not simply atmospheric; and (5) using complex air dispersion models instead of the straight-line Gaussian plume embedded in the MACCS2; and modeling releases over an extended duration, as occurred in Fukushima, that considers multiple changes in wind direction and plumes contaminating wider areas.

G. Radioactive Release Concentration.

Current NRC practice ignores aqueous releases, and thus takes absolutely no account of where radioactive liquids discharged into a body of water are likely to flow. Radioactive liquid from Fukushima has been detected at the West Coast of the United States.

Current NRC practice with respect to determining the geographic concentration of atmospheric radionuclides released in a severe accident is also inadequate - and once again designed to minimize predicted economic consequences and potential industry mitigation costs. The atmospheric dispersion model embedded in the MACCS2 code is a steady-state, straight-line Gaussian plume model that assumes meteorological conditions that are steady in time and uniform spatially across the study region. The plume model is not appropriate for sites located near large bodies of water, river valleys and varied topography. It underestimates the area likely to be affected in a severe accident and the dose likely to be received in those areas. Variable plume models such as AERMOD or CALPUFF are appropriate, and readily available.

The NRC knows this. For example NRC made a presentation to the National Radiological Emergency Planning Conference[13] concluded that the straight-line Gaussian plume models cannot accurately predict dispersion in a complex terrain and are therefore scientifically defective for that purpose [ADAMS - ML091050226, ML091050257, and ML091050269 (page references used here refer to the portion attached, Part 2, ML091050257).] Most reactors, if not all, are located in complex terrains. In the presentation, NRC said that the "most limiting aspect" of the basic Gaussian Model, is its "inability to evaluate spatial and temporal differences in model inputs" [Slide 28]. Spatial refers to the ability to represent impacts on the plume after releases from the site e.g., plume bending to follow a river valley or sea breeze circulation. Temporal refers to the ability of the model to reflect data changes over time, e.g., change in release rate and meteorology [Slide 4]. Because the basic Gaussian model is non-spatial, it cannot account for the effect of terrain on the trajectory of the plume – that is, the plume is assumed to travel in a straight line regardless of the surrounding terrain. Therefore, it cannot, for example, "'curve' a plume around mountains or follow a river valley." NRC 2009 Presentation, Slide 33. Further NRC says that it cannot account for transport and diffusion in coastal sites

[13] What's in the Black Box, Dispersion, Prepared for 2009 National Radiological Emergency Planning Conference, Stephen F. LaVie, Sr. Emergency Preparedness Specialist, Nuclear Security and Incident Response, Division of Preparedness and Response, Adams Accession No. ML091050257

subject to the sea breeze. The NRC says that the sea breeze causes the plume to change direction caused by differences in temperature of the air above the water versus that above the land after sunrise. If the regional wind flow is light, a circulation will be established between the two air masses. At night, the land cools faster, and a reverse circulation (weak) may occur [Slide 43]. Turbulence causes the plume to be drawn to ground level [Slide 44]. The presentation goes on to say that, "Additional meteorological towers may be necessary to adequately model sea breeze sites" [Slide 40].

Significantly, the NRC 2009 Presentation then discussed the methods of more advanced models that *can* address terrain impact on plume transport, including models in which emissions from a source are released as a series of puffs, each of which can be carried separately by the wind, (NRC 2009 Presentation Slides 35, 36). This modeling method is similar to CALPUFF. Licensees are not required, however, to use these models in order to more accurately predict where the plume will travel to base protective action recommendations.

Likewise, EPA has recognized the need for complex models. For example EPA's November 2005 Modeling Guideline (Appendix A to Appendix W) lists EPA's "preferred models" and the use of straight line Gaussian plume model, called ATMOS, is not listed. Sections 6.1 and 6.2.3 discuss that the Gaussian model is not capable of modeling beyond 50 km (32 miles) and the basis for EPA to recommend CALPUFF, a non - straight line model.[14] DOE, too, recognizes the limitations of the straight-line Gaussian plume model. They say for example that Gaussian models are inherently flat-earth models, and perform best over regions of transport where there is minimal variation in terrain. Because of this, there is inherent conservatism (and simplicity) if the environs have a significant nearby buildings, tall vegetation, or grade variations not taken into account in the dispersion parameterization.[15]

Fukushima made clear the importance of accurate meteorological modeling. The radioactive liquid releases from Fukushima have travelled thousands of miles through the Pacific Ocean. The radioactive atmospheric releases have not travelled simply in a straight line.

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[14] http://www.epa.gov/scram001/guidance/guide/appw_05.pdf

[15] The MACCS2 Guidance Report June 2004 Final Report, page 3-8:3.2 Phenomenological Regimes of Applicability

H. CLEANUP/DECONTAMINATION[16]

Actual cleanup costs are the "Elephant in the Room" that NRC and industry have tried to avoid. After the real-world experiences in Japan proper modeling of these costs can no longer be avoided. Cleanup costs realistically assessed will result in major offsite costs requiring the addition of a large number of mitigations. The cost formula used in the MACCS2 underestimates costs likely to be incurred.

Lessons learned from Fukushima are highlighted in the following March 2012 Associated Press article, *Japan decontaminates towns near tsunami-hit nuclear plant, unsure costly effort will succeed*. [17]

> FUKUSHIMA, Japan — Workers in rubber boots chip at the frozen ground, scraping until they've removed the top 2 inches (5 centimeters) of radioactive soil from the yard of a single home. Total amount of waste gathered: roughly 60 tons.
>
> One down, tens of thousands to go. And since wind and rain spread radiation easily, even this yard may need to be dug up again.
>
> * * *
>
> Experts leading the government-funded project cannot guarantee success. They say there's no prior model for what they're trying to do. Even if they succeed, they're creating another problem they don't yet know how to solve: where to dump all the radioactive soil and debris they haul away.
>
> The government has budgeted $14 billion (1.15 trillion yen) through March 2014 for the cleanup, which could take decades.

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[16] See for example: Decl. Francois Le May ML 1204813411 (5/18/12) Exh. NYS 0000241 (Dec 21, 2011) & NYS000242 (Dec 21,2011) New contention 12-C: NYAGO's expert ran a SAMA with higher damage costs and longer time decontaminate Cleanup from 1 year (Entergy) to 200 years→ NY costs from $1/person to $100,000/person (Entergy) to $2,000,000

[17] Japan decontaminates towns near tsunami-hit nuclear plant, unsure costly effort will succeed, Mari Yamaguchi, Associated Press, March 5, 2012, http://www.washingtonpost.com/world/asia_pacific/japan-decontaminates-towns-near-tsunami-hit-nuclear-plant-unsure-costly-effort-will-succeed/2012/03/05/gIQAQ0VHsR_print.html

* * *

> Radiation accumulates in soil, plants and exterior building walls. Workers start cleaning a property by washing or chopping off tree branches and raking up fallen leaves. Then they clean out building gutters and hose down the roof with high-pressure water. Next come the walls and windows. Finally, they replace the topsoil with fresh earth.
>
> * * *
>
> Experts say it may be possible to clean up less-contaminated areas, but nothing is promising in the most contaminated places, where any improvement is quickly wiped out by radiation falling from trees, mountains and other untreated areas.
>
> * * *
>
> "It's largely trial and error," said Kazuaki Iijima, a radiation expert at the Japan Atomic Energy Agency, which is supervising the pilot projects. "Decontamination means we are only moving contaminant from one place to another. We can at least keep it away from the people and their living space, but we can never get rid of it completely."
>
> Then there's the question of finding places willing to accept an ever-growing pile of radioactive waste.
>
> The Environment Ministry expects the cleanup to generate at least 100 million cubic meters (130 million cubic yards) of soil, enough to fill 80 domed baseball stadiums.
>
> * * *
>
> The waste would remain in the longer-term storage for 30 years, until half the radioactive cesium breaks down. Then it would still have to be treated and compacted — using technology that hasn't been fully developed yet — before being buried deep underground in enclosed containers.

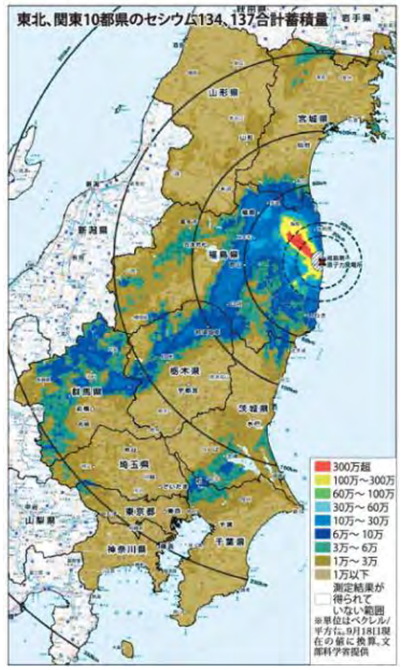
Nothing in current NRC approved economic consequence analyses even tries to address the real-world lessons of Fukushima. The disaster in Fukushima has laid bare one truth: A disaster here would result in losses requiring the government to make payouts of epic proportions. That's because Fukushima is budgeted to cost 14 billion dollars *simply* through March 2014, according to Japanese experts. If there is a severe nuclear reactor accident in the US, the Price-Anderson Fund can't handle those kinds of losses. The money cap in Price Anderson is based on a MACCS analysis, also.

The current NRC approved consequences models:

- Underestimate both the size of the area likely to be contaminated, and the extent of contamination.
- Underestimate the volume of waste.
- Underestimate how long cleanup and decontamination will take.
- Ignore that forests, wetlands, and bodies of water essentially cannot be cleaned up or decontaminated.
- Ignore that the technologies needed for cleanup have not even been developed.
- Ignore there is not even a cleanup standard.
- Are based on estimates of what is required for nuclear weapon cleanup, rather than the very different problems presented by nuclear reactor accident.
- Minimize consequences by assuming a straight-line Gaussian plume model, ignoring aqueous discharges, and ignoring that an accident can persist over many weeks and months.
- The huge volume of waste is underestimated; and that there are no available safe disposal options is ignored. In fact waste disposal is not modeled.
- The time that decontamination will take is underestimated. Technologies to cleanup have not been developed; current cleanup methods used in Japan and assumed in US models do not work- hosing down buildings and plowing under fields. They are based on nuclear weapons cleanup that is a different from cleanup after a nuclear reactor accident. Many radionuclides, like Cs-137, have long half-lives.
- Contamination in certain media simply cannot be decontaminated-forests, wetlands, water - from groundwater to oceans; and in turn runoff will re-contaminate cleaned areas.
- No Cleanup Standard

<u>**The Contaminated Area**</u>

The cost of cleanup fundamentally reflects the size of the area contaminated, and the level of contamination. A year ago, the Japanese press reported that the Fukushima accident contaminated 13,000 square kilometers (an area nearly equivalent to the size of Connecticut (land area and water). The contaminated area extended in all directions and at considerable distance from the site.[18] The Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) map showed the spread of radiation from Fukushima across 10 prefectures, including Tokyo and Kanagawa.[19].



So far as PW knows, no one has even attempted to calculate how much of the Pacific Ocean and connecting waters have been contaminated by aqueous discharges.

Beyond "how large an area," is the question of "how contaminated?" The level of contamination in the affected areas depends on both the size of the release at any point in time, and also on its duration. The Fukushima release has continued for months.

The basic lesson to be learned from these simple facts is that any remotely adequate economic consequence analysis must take into account the very real likelihood of a large level release that continues for a long period of time and contaminates many thousands of square miles. Current NRC economic analyses unrealistically limit the duration of the radioactive release, the size of the affected area, and the radiation source.

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[18] *Estimated 13,000 square km eligible for decontamination* Asahi.com (Asahi Shimbun), Oct 12, 2011

[19] Mainichi News, http://mdn.mainichi.jp/mdnnews/news/20111007p2a00m0na009000c.html; Gov't radiation info in English http://radioactivity.mext.go.jp/en/

- Duration: The Fukushima disaster persisted over many months. But the NRC approved consequence code, MACCS2, limits the total duration of a radioactive releases to no more than four (4) days, if the user chooses to use four plumes occurring sequentially over a four day period.[20] Licensees choose not to take that option and limit economic cost analyses to a single plume having a total duration of less than a day. However a longer release such as that at Fukushima will cause offsite consequences that will increase contamination, and result in required re-decontamination, and significantly increase cleanup costs and the overall cost-benefit analyses.
- Size of Affected Area. How large an area will be contaminated, and where that area is likely to be, depends on assumptions made about the radioactive plume. Fukushima showed that the plume did not travel simply in a straight-line.[21] However the NRC approved computer code, MACCS2 assumes a straight-line Gaussian plume model that limits the spread of contaminants to a pie-shaped wedge.[22] This ignores that winds are complex and variable near large water bodies, along rivers, and hilly terrain so that a much larger geographic area, in multiple directions, is impacted. Fukushima taught that no plume can safely be assumed to travel in a straight line, and it is obvious that plumes from releases extending over many months will be variable.
- Non-Atmospheric Releases. The economic consequence analyses approved by NRC only model atmospheric releases and plumes. Fukushima also showed that contamination is also spread by aqueous discharges. In Japan enormous quantities of contaminated water flowed into the Pacific Ocean as result of "feed and bleed" and from runoff into groundwater, streams and other water bodies from contaminants deposited by atmospheric releases on land.

- What Can't Be Cleaned-up? Lessons learned from Fukushima show that forests, water and shorelines, for example, cannot realistically be cleaned up and decontaminated. For example the Japan Times reported in September 2011[23] that

[20] NUREG/CR-6613 Code Manual for MACCS2: Volume 1, User's Guide, 2-2
[21] Gov't radiation info in English http://radioactivity.mext.go.jp/en/
[22] NUREG/CR-6613/SAND97-0594, Vol. 1,Code Manual for MACCS2:Volume 1, User's Guide, May 1998 D. Chanin, M.L. Young
[23] Institute probing radioactive contamination of Fukushima forests, Japan Times,, Sep. 17, 2011

> In August, the government acknowledged difficulties in removing soil and ground cover from the forests, due mostly to the volume of radioactive waste that would be generated by the effort.
>
> "Huge volumes of soil and other (contaminated) items would be involved because the forests occupy a huge area."
>
> The government effectively shelved any approach to decontaminating forests when it said that removing both the contaminated soil and compost materials would strip the forests of important ecological functions, including water retention.

Real world experience also shows that bodies of water, such as the Pacific, cannot be cleaned up either. Further, ocean currents may re-circulate the contamination for years contaminating and re-contaminating beaches and marine life increasing costs from a continuous need to cleanup and pay for damaged to the environment[24].

Losing a forest or marine life is a serious economic consequence. The NRC's economic consequence analyses cannot properly ignore.

Waste Volume and Disposal

Lessons learned from Fukushima show that the Japanese Environment Ministry expects the cleanup to generate at least 100 million cubic meters (130 million cubic yards) of soil, enough to fill 80 domed baseball stadiums.[25]. The Yomiuri Press reported that disposal sites refuse to accept 140,000 tons of tainted waste.[26] Because there is no available storage for the high volume of waste and no community willing to host the disposal site,[27] waste is piling up and run-off from it contaminates and re-contaminates groundwater and property.[28] The problem cannot be solved soon because the technology is not there and cesium-137 takes 30 years to decay one half-life.[29]

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[24] Fukushima's radioactive sea contamination lingers, Andy Coghlan, New Scientist, Sept 30, 2011; Radioactive cesium may be brought back by Ocean in 20-30 years , Tokyo Times, 09.16.11
[25] Ibid
[26] *Daily Yomiuri* - Disposal sites refuse to accept 140,000 tons of tainted waste March 4, 2012
[27] Mainiichi Press, *Residents near Fukushima mountains face nuclear recontamination every rainfall, October 11. 2011*
[28] Ibid
[29] Ibid

The Japanese Government's clean-up budget for the next two years is $14 billion; the NRC's estimate is nowhere near that.

The present U.S. cost model (MACCS2) does not account for the disposal and storage of waste and assumes that cleanup can be quickly accomplished.

Decontamination time is a major variable in determining cleanup costs. To determine the time required for cleanup, licensees improperly use the MACCS2's Sample Problem A, designed for testing only.[30] Sample Problem A assumes to achieve a decontamination factor (DF) of 3 reducing contamination 67% will take 60 days; and to achieve a DF of 15 to reduce contamination to 93.3%, 130 days. There is no basis for these assumptions. Chernobyl spent 4 years and quit; Japan estimates decades. The MACCS2 code restricts the time for cleanup to simply one year. It is unreasonable and not justified.

There is no excuse for ignoring waste storage, and Fukushima proved (and continues to prove) that latter is a pipe-dream. The NRC economic consequences model also does not account for costs incurred for safeguarding the wastes and preventing their being re-suspended. Even optimistically assuming an available radioactive waste repository, it seems unlikely that there would be a sufficient quantity of transport containers, and many communities will quite certainly object to the millions of tons of hazardous materials being transported through them.

Technologies for Cleanup Not Developed - Current Methods Ineffective

Cleanup methods used in Japan, and assumed in NRC approved US models, do not work. Hosing down buildings and plowing under fields does not remove contamination. It simply moves it to another place, such as the groundwater, to reappear at a later date and require more monies to either start again or bare the cost. NRC knows this. For example the *MACCS2 Code Manual* notes that the MACCS2 computer model does not assume that plowing will move the radiation to below the root zone for crops or reduce root uptake and food doses to the consumer of such crops. Thus, it cannot be said that the decontamination strategies identified remove the radiation from the environment. Also the fact that cesium is soluble, which means that precipitation events or fire-hosing can actually facilitate cesiums binding to structural surfaces or spread it into a community's infrastructure (*e.g.*, sidewalks, gutters, drains, sewer pipes) and

[30] NYS000241, December 21, 2011, Pre-filed written testimony of Dr. Francois J. Lemay, NYS Contention 12-C

ecosystem (*e.g.*, groundwater, streams, lakes, reservoirs).[31] The ability of cesium and other fission products to bind to surfaces is especially pronounced for porous or rough surfaces.[32]

A reasonable question is why the MACCS2 code, NRC and Japanese authorities assume hosing and plowing under fields was cleanup. The likely, and unacceptable, answer is that the needed technologies for cleanup have not been developed - their development is predicted to be decades down the road - and the that cost of actually removing all of the contamination too big to even think about - far more than the $14 billion budgeted through 2014 by the Japanese government. However, the fact that the cost of any real clean-up is unimaginable is no excuse for the NRC pretending it isn't real and not requiring modeling it in NRC approved economic analysis.

The Faulty Premise of the NRC's Clean-Up Model[33]

The MACCS2 economic consequence analysis is based on WASH-1400; and WASH-1400, in turn, was based on clean up after a nuclear explosion Cleanup after a nuclear bomb explosion is not comparable to clean up after a nuclear reactor accident and assuming so will underestimate even the limited costs that the NRC economic analysis takes into consideration.

Particle Size: Nuclear weapon explosions result in larger-sized radionuclide particles; reactor accidents release small sized particles. Decontamination is far less effective, or even possible, for small particle sizes. Nuclear reactor releases range in size from a fraction of a micron to a couple of microns; whereas nuclear bomb explosions fallout is much larger- particles that are ten to hundreds of microns. These small nuclear reactor releases get wedged into small cracks and crevices of buildings making clean up extremely difficult or impossible. Further reactors release Cs-137 that are no only small particles but soluble. Cesium particles are capable of ion exchange with sodium and potassium in materials such as concrete and migrate over time into the interior and cannot be washed off. Plutonium on the other hand is insoluble.

[31] Chanin, D.; Murfin, W. (1996). *Site Restoration: Estimation of Attributable Costs from Plutonium-Dispersal Accidents*, SAND96-0957, DE9601166, Sandia National Laboratories. Original 300-dpi OSTI version available at: http://chaninconsulting.com/downloads/sand96-0957.pdf (10.4 MB), OCR-readable courtesy S. Aftergood, FAS, E-12.
[32] Ibid, 5-8, E-1, E-3, E-4, E-8, E-11
[33] Chanin, D.; Murfin, W. (1996). *Site Restoration: Estimation of Attributable Costs from Plutonium-Dispersal Accidents*, SAND96-0957, DE9601166, Sandia National Laboratories. Original 300-dpi OSTI version; NYS000241, December 21, 2011, Pre-filed written testimony of Dr. Francois J. Lemay, NYS Contention 12-C,

Mass Loading: Nuclear weapon explosions result in fallout involving large mass loading where there is a small amount of radioactive material in a large mass of dirt and demolished material. Only the bottom layer is in contact with the soil and the massive amount of debris could be shoveled, swept up with brooms or vacuums resulting in a relatively effective, quick and cheap cleanup that would not be the case with a nuclear reactors fine particulate. The Japanese are learning this the hard way, as those in Chernobyl before had discovered.

Type Radiation Released: In addition, a weapon explosion results in non-penetrating radiation so that workers only require basic respiration and skin protection. This allows for cleaning up soon after the event. In contrast a reactor release involves gamma radiation and there is no gear to protect workers from gamma radiation. Therefore cleanup cannot be expedited, unless workers health shamefully and unethically is ignored. Decontamination is less effective with the passage of time.

Clean-up Standard

How clean is clean (the cleanup standard) will determine the cost of cleanup and public acceptance. Currently the NRC and EPA have not agreed on a cleanup standard.[34] The potential standard ranges from 15 mrem/yr to 5 rem/yr. The General Accounting Office (GAO) agrees that the difference in current EPA and NRC cleanup standards have implications for both the pace and ultimate cost of cleanup.[35] It is not possible to talk about economic consequence analyses absent pre-set cleanup standards.

Likewise, firm standards were not pre-set in Japan prior to the accident. Real world experience there shows that the public will not tolerate a relaxed standard. The public expects cleanup to reach pre-accident levels.[36] The same will be true here.

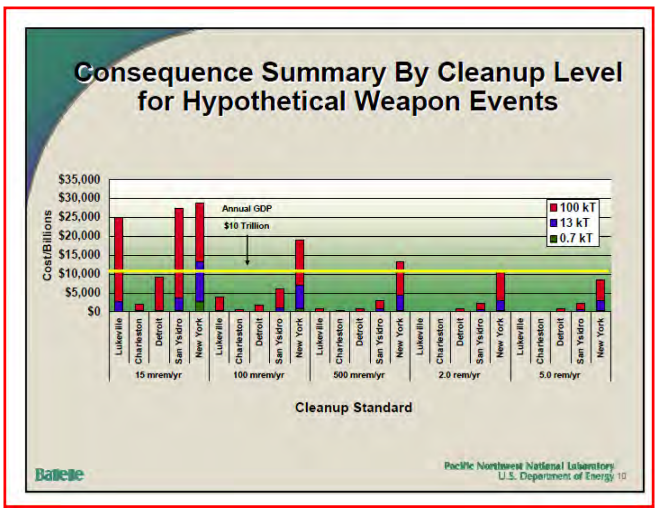
[34] See Pilgrim Watch's Request For Hearing On New Contention; the information upon which this contention is available from a trade publication INSIDE EPA; please see report and supporting documents at http://environmentalnewsstand.com/Environmental-NewsStand-General/Public-Content/agencies-struggle-to-craft-offsite-cleanup-plan-for-nuclear-power-accidents/menu-id-608.html

[35] GAO, "Radiation Standards Scientific Basis Inconclusive, and EPA and NRC Disagreement Continues," June 2004

[36] *In One Japanese City, Hot Spots to Avoid,* Wall Street Journal, Phred Dvorak, Sept 3, 2011

The economic consequences of a radiological event are highly dependent on cleanup standards and cleanup costs generally increase dramatically for standards more stringent than 500 mrem/yr. This was shown true by two studies commissioned by the US Department of Homeland Security for the economic consequences of a Rad/Nuc attack. Although considerably more deposition would occur in reactor accident, magnifying consequences and costs, there are important lessons to be learned from these studies.

Barbara Reichmuth's study, Economic Consequences of a Rad/Nuc attack: Cleanup Standards Significantly Affect Cost, 2005,[37] Table 1 Summary Unit Costs for D &D (Decontamination and Decommissioning) Building Replacement and Evacuation Costs provides estimates for different types of areas from farm or range land to high density urban areas. Reichmuth's study also points out that the economic consequences of a Rad/Nuc event are highly dependent on cleanup standards: "Cleanup costs generally increase dramatically for standards more stringent than 500 mrem/yr."



A similar study was done by Robert Luna, *Survey of Costs Arising from Potential Radionuclide Scattering Events,*[38] concluded that,

[37] Economic Consequences of a Rad/Nuc attack: Cleanup Standards Significantly Affect Cost Barbara Reichmuth, Steve Short, Tom Wood, Fred Rutz, Debbie Swartz, Pacific Northwest National laboratory, 2005
[38] Survey of Costs Arising From Potential Radionuclide Scattering Events, Robert Luna, Sandia National laboratories, WM2008 Conference, February 24-28, 2008, Phoenix AZ

…the expenditures needed to recover from a successful attack using an RDD type device …are likely to be significant from the standpoint of resources available to local or state governments Even a device that contaminates an area of a few hundred acres (a square kilometer) to a level that requires modest remediation is likely to produce costs ranging from $10M to $300M or more depending on the intensity of commercialization, population density, and details of land use in the area." (Luna, Pg., 6)

G. MACCS2 CODE

The MELCOR Accident Consequence Code System (MACCS2) computer program is used by industry with NRC's approval. The MACCS2 code, and its predecessor the MACCS code, were developed for research purposes not licensing purposes –for that reason they were not held to the QA requirements of NQA-a (American Society of Mechanical Engineering, QA Program Requirements for Nuclear Facilities, 1994). Rather they were developed using following the less rigorous QA guidelines of ANSI/ANS 10.4. [American Nuclear Standards Institute and American Nuclear Society, *Guidelines for the Verification and Validation of Scientific and Engineering Codes for the Nuclear Industry*, ANSI/ANS 10.4, La Grange Park, IL (1987). The code is not Quality Assured.[39]

David Chanin, who wrote the FORTRAN for the MACCS2, is clear that the code does not provide useful economic cost information:[40]

> If you want to discuss economic costs … the 'cost model' of MACCS2 is not worth anyone's time. My sincere advice is to not waste anyone's time (and money) in trying to make any sense of it." (and) "I have spent many many hours pondering how MACCS2 could be used to calculate economic costs and concluded it was impossible."

Prior to Fukushima, parties in license renewal adjudications showed that the MACCS2 severely minimized costs and required updating - for example, the license renewal adjudication proceedings at Pilgrim (Pilgrim Watch) Indian Point (New York State) and Seabrook (NECNP).

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[39] Chanin, D.I. (2005), "The Development of MACCS2: Lessons Learned," [written for:] *EFCOG Safety Analysis Annual Workshop Proceedings*, Santa Fe, NM, April 29–May 5, 2005. Full text: the development of maccs2.pdf (154 KB), revised 12/17/2009. http://chaninconsulting.com/index.php?resume.

[40]

Real-world experiences from Japan confirm that the cost formula and assumptions contained in the MACCS2 underestimate the costs likely to be incurred as a result of a severe accident. Many are discussed in the foregoing discussion - incorrect assumptions regarding the probability of a core damage events, spent fuel pool events and amount of Cs-137 released from the core; assuming that only atmospheric releases (and not aqueous releases) are consequential and that the plume moves in a straight line; assuming that accidents are over in a day or less; and assuming that cleanup and decontamination can be readily accomplished and waste disposal ignored.

There are other fundamental deficiencies in the code, including incorrect assumptions regarding health costs and evacuation time estimates, and what economic variables are necessary to include. And equally important is the fact that the NRC has allowed to use licensees to manipulate their use in the code for no reason other than to reduce that the licensees will be required to do to avoid another Fukushima.

Health Costs & Evacuation Time Estimates

The health costs resulting from a severe accident directly depend on who was exposed and for how long, and the latter in turn depends on whether evacuation was timely and successful.

Evacuation Time Estimates (ETEs): With no apparent complaint from the NRC, licensees consistently use faulty, in some cases almost ludicrous, assumptions about who should evacuate and how long it will take them (to say nothing of the far greater number of individuals who will, and in many cases probably should, try) to evacuate. If realistic evacuation times and assumptions regarding evacuation are not used; if they were, analyses would show far fewer will evacuate in a timely manner, and the inevitable result will be increased health-related costs.

The standard KLD time estimates used are based on NUREG/CR-7002 and telephone surveys. These documents contain multiple incorrect assumptions. Examples include: the population will follow a staged evacuation ignoring the public's almost instant ability to communicate; a straight-line Gaussian plume defines the evacuation "key-hole" where the public knows winds are variable and will act accordingly; and there will only be a 20% shadow evacuation out to 15 miles from reactor and the rest of the population will not attempt to evacuate disproved by real-world experience such as TMI and Graniteville. The telephone surveys regarding evacuation used to justify these assumptions were carefully designed not to tell the responders why evacuation might be ordered. Responders were not told the survey was for a nuclear reactor accident. The public responds differently in a nuclear disaster than a storm.

Further the KLD's do not take into consideration the many variables that would slow evacuation: shadow evacuation; evacuation time estimates during inclement weather coinciding with high traffic periods such as commuter traffic, traffic during peak commute times, holidays, summer beach/holiday traffic; notification delay delays because notification is largely based on sirens that cannot be heard indoors above normal ambient noise with windows closed or air conditioning systems operating.

Health Effects Radiation: Having artificially reduced the potential number of potentially effected (not only through inaccurate evacuation times but also by assuming that only those in a small geographic areas will potentially be effected and only for a short time), the NRC economic consequences analysis goes on intentionally to further underestimate the cost, not only in dollars but also in human suffering.

The effects of radiation exposure on public health after an accident rarely are immediately evident. The latency period for cancers, diseases and reproductive disorders extends over many years. Lessons learned from previous accidents and the most recent report by the National Academies of Sciences (BEIR VII), and studies by Cardis and the Techna River Cohort, all show that the assumptions in the MACCS2 concerning health impact are outdated and underestimate health effects.

1. Value of Life: NRC value assigned to life is far lower than other federal agencies. Other agencies value life at $ 5-9 million. For example EPA values a life lost at $6.1 million (U.S.E.P.A., 1997, The Benefits and Costs of the Clean Air Act, 1970 to 1990, Report to US Congress (October), pages 44-45). The GAO reported that it is hard to justify below $5 million whereas NRC remains at $3 million. If NRC raised its valuation then more retrofits would be justified.

2. $2000/person-rem conversion rate: The population dose conversion factor of $2000/person-rem used by licensees in the code, and allowed by NRC, to estimate the cost of the

health effects generated by radiation exposure is based on a deeply flawed analysis and seriously underestimates the cost of the health consequences of severe accidents.

This conversion factor is inappropriate. It does not take into account the significant loss of life associated with early fatalities from acute radiation exposure that could result from some severe accident scenarios. Neither does it properly estimate the generation of stochastic health effects by failing to take into account the fact that some members of the public exposed to radiation after a severe accident will receive doses above the threshold level for application of a dose- and dose-rate reduction effectiveness factor (DDREF).

The NRC approved $2000/person-rem conversion factor is apparently intended to represent the cost associated with the harm caused by radiation exposure with respect to the causation of "stochastic health effects," that is cancers and not deterministic effects, commonly known as radiation sickness[41] The value was derived by NRC staff by dividing the Staff's estimate for the value of a statistical life, $3 million (presumably in 1995 dollars, the year the analysis was published) by a risk coefficient for stochastic health effects from low-level radiation of $7 \text{x} 10^{-4}$/person-rem, as recommended in Publication No. 60 of the International Commission on Radiological Protection (ICRP). (This risk coefficient includes nonfatal stochastic health effects in addition to fatal cancers.) But the use of this conversion factor in SAMA analyses is inappropriate in two key respects and as a result underestimates the health-related costs associated with severe accidents.

First, the $2000/person-rem conversion factor is specifically intended to represent only stochastic health effects (e.g. cancer), and not deterministic health effects "including early fatalities which could result from very high doses to particular individuals."[42] However, for some of the severe accident scenarios evaluated, large numbers of early fatalities could occur representing a significant fraction of the total number of projected fatalities, both early and latent. This is consistent with the findings of the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437).[43] Therefore, it is inappropriate to use a conversion factor that does not include deterministic effects. According to NRC's guidance, "the

[41] U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, "Reassessment of NRC's Dollar Per Person-Rem Conversion Factor Policy," NUREG-1530, 1995, p. 12.
[42] U.S. NRC (1995), op cit., p. 1.
[43] U.S. NRC, Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437, Vol. 1, May 1996, Table 5.5.

NRC believes that regulatory issues involving deterministic effects and/or early fatalities would be very rare, and can be addressed on a case-specific basis, as the need arises."[44] How for example can this be justified in a spent fuel pool fire accident?

Second, the $2000/person-rem factor, as derived by NRC, also underestimates the total cost of the latent cancer fatalities that would result from a given population dose because it assumes that all exposed persons receive dose commitments below the threshold at which the dose and dose-rate reduction factor (DDREF) (typically a factor of 2) should be applied. However, for certain severe accident scenarios considerable numbers of people would receive doses high enough so that the DDREF should not be applied.[45] This means, essentially, that for those individuals, a one-rem dose would be worth "more" because it would be more effective at cancer induction than for individuals receiving doses below the threshold. To illustrate, if a group of 1000 people receive doses of 30 rem each over a short period of time (population dose 30,000 person-rem), 30 latent cancer fatalities would be expected, associated with a cost of $90 million, using NRC's estimate of $3 million per statistical life and a cancer risk coefficient of 1×10^{-3}/person-rem. If a group of 100,000 people received doses of 0.3 rem each (also a population dose of 30,000 person- rem) a DDREF of 2 would be applied, and only 15 latent cancer fatalities would be expected, at a cost of $45 million. Thus a single cost conversion factor, based on a DDREF of 2, is not appropriate when some members of an exposed population receive doses for which a DDREF would not be applied.

A better way to estimate the cost equivalent of the health consequences resulting from a severe accident would be simply to sum the total number of early fatalities and latent cancer fatalities, as computed by the MACCS2 code, and multiply by not a $3 million figure but a higher life valuation, in line with other federal agencies. It is not reasonable to distinguish between the loss of a "statistical" life and the loss of a "deterministic" life when calculating the cost of health effects. The NRC does so. Why? The only apparent reason is to save the industry money.

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[44] U.S. NRC, "Reassessment of NRC's Dollar Per Person-Rem Conversion Factor Policy (1995), op cit., p. 13.

[45] The default value of the DDREF threshold is 20 rem in the MACCS2 code input

3. Health Impacts Ignored: Wrongly, the NRC analysis does not even consider cancer incidence. Neither does it consider many other potential health effects from exposure in a severe radiological event (National Academy of Sciences, BEIR VII Report, 2005).

4. Recent Studies Ignored: The NRC's SAMA analyses need to be based on current research. Recent studies published on radiation workers (Cardis et al. 2005[46]) and by the Techa River cohort (Krestina et al (2005[47]) show a marked increase in the value of cancer mortality risk per unit of radiation at low doses (2-3 rem average). Both studies give similar values for low dose, protracted exposure, namely (1) cancer death per Sievert (100 rem). Using the results of the study by Cardis et al. and use of the risk numbers derived from the Techa River cohort a number of additional SAMAs would become cost effective.

5. Indirect health costs ignored: They include, for example, medical expenditures for treatment, losses in time and economic productivity, liability resulting from radiation health related illness and death, and caregivers evacuating and leaving patients unattended, as at Fukushima. All of these are economic consequences.

Other Economic Consequences

Lessons learned from Fukushima demonstrate that the MACCS2's assumptions of what economic variables to model are too limited and serve to underestimate offsite economic consequences**.** In addition to those already discussed, any realistic analysis of economic consequences would have to consider the following.

1. Indirect economic effects or the "multiplier effects ignored:" Depending on the business done inside the building contaminated, the regional and national economy could be negatively impacted. A resulting decrease in the area's real estate prices, tourism, and commercial transactions could have long-term negative effects on the region's economy.

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[46] Elizabeth Cardis, "Risk of cancer risk after low doses of ionising radiation: retrospective cohort study in 15 countries." *British Medical Journal* (2005) 331:77. Referenced Beyea

[47] Krestinina LY, Preston DL, Ostroumova EV, Degteva MO, Ron E, Vyushkova OV, et al. 2005.Protracted radiation exposure and cancer mortality in the Techa River cohort. Radiation Research 164(5):602-611.

2. Economic infrastructure ignored: The MACCS2 considers the costs of farm and non-farm decontamination and the value of farm and nonfarm wealth; however, nowhere in the economic consequences analysis is there any discussion of the loss of, and costs to remediate the economic infrastructure that make business, tourism and other economic activity possible. Economic infrastructure is the basic physical and organizational structures needed for the operation of a society or enterprise, or the services and facilities necessary for an economy to function. The term typically, and as used by PW, refers to the technical structures that support a society, such as roads, water supply, sewers, power grids telecommunications, and so forth. Viewed functionally, infrastructure *facilitates* the production of goods and services; for example, roads enable the transport of raw materials to a factory, and also for the distribution of finished products to markets. Also, the term may also include basic social services such as schools and hospitals

3. Other economic costs ignored: The economic consequences should, but does not, include the business value of property and the incurred costs such as costs required from job retraining, unemployment payments, and inevitable litigation. Further, one of the cited general criticisms of the MACCS2 Code is that "the economic model included in the code models only the economic cost of mitigative actions.[48]"

MANIPULATING THE CODE

In order to ensure realistic cost-benefit analyses, the NRC cannot continue to allow as a matter of policy licensees to choose how they will use the MACCS2 code. Section 6.10 of the 1997 User Guide, Generation of Consequence Distributions, explains. It says, "Under the control of parameters supplied by the user on the EARLY and CHRONC input files, the EARLY and CHRONC modules can calculate a variety of different consequence measures to portray the impact of a facility accident on the surrounding region. *The user has total control over the results that will be produced.*"[49] (Emphasis added)

Because the licensee is a business, its focus is on both the bottom line and dispelling public

[48] 1997 MACCS2 User Guide

[49] User Guide for MACCS2, the Code Manual for MACCS2: Volume 1, User's Guide, SAND97-0594, which was written in 1997. Chanin, D.I., and M.L. Young, Code Manual for MACCS2:Volume 1, User's Guide, SAND97-0594 Sandia National Laboratories, Albuquerque, NM, (1997)

fear of nuclear power; therefore, the licensee will use its “control over the results that will be produced” to minimize offsite consequences/costs. It is NRC’s responsibility to fulfill its legal obligation to protect public health, safety and property to take control.

Examples User Control of Inputs Minimizing Consequences

- **Clean-up Economic Costs:** New York States Contention 12-C expert, Dr. Francois Lemay reviewed applicants SAMAs in license renewal and found that all used values derived from Sample Problem A. Those values do not account for site specific circumstances and underestimate costs.[50] The underestimation of costs is primarily due to Sample Problem A’s input values for the CHRONC Module. The underestimation is mostly due to costs and times for decontamination that were unrealistic given what is currently known about decontamination data and the complexities of an urban and hyper-urban area such as that surrounding Indian Point and many other reactors that are now located near densely populated areas. To illustrate from Lemay’s Testimony:

[50] NYS000241, December 21, 2011, Pre-filed written testimony of Dr. Francois J. Lemay, NYS Contention 12-C, pg., 63-70

Table 13: Summary of ISR proposed inputs and calculated OECRs (costs in 2005 USD)

Parameter	Description	Entergy's value	ISR's proposed input value		ISR's calculated OECR ($/yr) and ratio[a]	
			Minimum	Maximum	Minimum	Maximum
CDNFRM (DF=3)	Per capita cost of nonfarm light decontamination	$5,184	$19,000	$272,000	4.21E+05 (1.99)	1.25E+06 (5.88)
CDNFRM (DF=15)	Per capita cost of nonfarm heavy decontamination	$13,824	$90,000	$898,000		
TIMDEC (DF=3)	Time required for light decontamination	60 d	2 y	15 y	6.44E+05 (3.04)	1.20E+06 (5.66)
TIMDEC (DF=15)	Time required for heavy decontamination	120 d	4 y	30 y		
VALWNF	Per capita value of nonfarm wealth (2004 USD)	$208,838	$284,189		2.51E+05 (1.18)	
DPRATE	Depreciation rate	20%	20%		2.12E+05 (1.00)	
DSRATE	Societal discount rate for property	12%	5%	7%	1.87E+05 (0.88)	1.95E+05 (0.92)
POPCST	Per capita cost of long-term relocation	$8,640	$10,640	$49,857	2.23E+05 (1.05)	4.41E+05 (2.08)
FRNFIM	Nonfarm wealth improvements fraction	80%	90%		2.19E+05 (1.03)	
Using all of ISR's proposed input values					**9.07E+05 (4.28)**	**1.47E+06 (6.96)**

Notes: [a] The ratio shown in brackets is the ratio of the ISR-calculated OECR to the Entergy-calculated OECR ($2.12E+05/yr).

Q: If all of the ISR proposed inputs are used, what is the effect on the OECR?

A: The OECR is determined to be between 4 and 7 times the currently calculated Entergy value of $212,000/year.

Q. Does this conclude your testimony?

A. Yes.

Pre-filed Written
Testimony of François J. Lemay
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- **Meteorological Inputs**: PW discussed in the foregoing a fundamental defect in the MACCS2 code is that its meteorological inputs to the code are all based on the straight-line Gaussian plume model. This model does not allow consideration of the fact that the winds for a given time period may be spatially varying. The 1997 User Guide for MACCS2, SAND 97-0594[51] makes a related point: "The atmospheric model included in the code does not model the impact of terrain effects on atmospheric dispersion." Indeed, the MACCS2 Guidance Report, June 2004,[52] is even clearer that inputs to the code do <u>not</u> account for variations resulting from *site-specific* conditions. (1)The "code does not model dispersion close to the source (less than 100 meters from the source);" thereby ignoring resuspension of

[51] Chanin, D.I., and M.L. Young, Code Manual for MACCS2:Volume 1, User's Guide, SAND97-0594 Sandia National Laboratories, Albuquerque, NM, (1997)

[52] MACCS2 Guidance Report June 2004 Final Report page 3-8:3.2 Phenomenological Regimes of Applicability

contamination blowing offsite. (2) The code “should be applied with caution at distances greater than ten to fifteen miles, especially if meteorological conditions are likely to be different from those at the source of release.” There are large potentially affected population concentrations more than 10-15 miles from reactor sites. (3) “Gaussian models are inherently flat-earth models, and perform best over regions where there is minimal variation in terrain.” What sites if any are located in flat-earth sites?

Matters are made worse by leaving the choice of input parameters to the user. Users may choose to leave input meteorological data for only a single year and using precipitation data was collected from a *single, on-site* weather station. [Example Pilgrim Application ER, E.1.5.2.6] One year of data is insufficient; seasonal wind distributions can vary greatly from one year to the next and “*The NRC staff considers 5 years of hourly observations to be representative of long-term trends at most sites*[53]. Further, the simple fact is that measurements from a single onsite anemometer will not provide sufficient information to project how an accidental release of a hazardous material would travel.

- **Averaging:** The licensee conducts SAMA analyses. The NRC does not, and as far as can be told it does not even have the ability to insure than a licensee's analysis is correct. The outcome of a SAMA analysis, controlled by the licensee, is functionally dependent on the statistical input parameters chosen by the licensee.[54]

  The MACSS2 consequence code has 3 modules. The ATMOS module computes the dispersal pattern of radionuclides as a function of downwind distance using a Gaussian plume model. The EARLY module utilizes the radionuclide dispersal data generated by ATMOS, together with additional user-specified data, to calculate individual and collective radiation doses and associated health impacts to the affected population resulting from “early” exposures; e.g. those occurring within a user-specified period after the radionuclide release, usually a week. The CHRONC module utilizes the same inputs from the ATMOS module as EARLY, but calculates doses and other consequences resulting from exposures subsequent to the emergency-phase period evaluated by EARLY. The CHRONC considers

[53] NRC Regulatory Guide 1.194, 2003
[54] See Declaration of Edwin S. Lyman, PhD. Regarding the Mechanics of Computing Mean Consequences in SAMA Analyses, November 22, 2010.

doses resulting from groundshine, resuspension, and consumption of contaminated food and water.

CHRONIC also contains features designed to assess the economic consequences of radiological releases, and models intermediate and long-term protective actions (decontamination, interdiction, condemnation) that can affect both chronic radiation doses and economic costs. The Output file “averages” consequences from EARLY and CHRONC and **permits the user to “average” using any one of several percentiles**, including “mean,” 90th percentile, and 95th percentile. It is then necessary for the SAMA analysis to determine which statistical parameter should be used as input into the SAMA analysis: e.g., the mean, the median or the 95th percentile. Once this input parameter is chosen, then the population dose-risks and off-site economic dose risks can be calculated, summed and compared to the costs of mitigative measures. The choice of statistical input parameter determines the level of protection which mitigative measures would be expected to provide.

Dr Lyman in an affidavit for Pilgrim Watch explained that, “A choice of 95th percentile, for example, means that mitigative measures would be considered cost-beneficial if they were no more expensive than the value of the averted risk to the public from a severe accident for 95 percent of the meteorological conditions expected to occur over the course of a year. In contrast, use of the mean consequences would imply that measures would be cost-beneficial if they were no more expensive than the (significantly lower) value of the averted risk to the public for an accident occurring under average meteorological conditions. This is analogous to the situation of a homeowner who is considering whether to spend the money to install windows to protect against a 20-year storm or just an average storm.

CONCLUSION

The foregoing shows that The Staff’s recommendation to approve Option 2 is wholly unsatisfactory. The regulatory framework needs to be changed. Without change, the NRC's analysis of the economic consequences of a severe accident will continue to significantly minimize the consequences from a severe accident so that the retrofits needed are not cost justified, and the likelihood of an accident will remain far higher than it should be.

The lessons that should be learned from Fukushima make obvious not only the need for change, but also the magnitude by which the current model's minimization of costs unacceptably fails to require many SAMAs that would be cost effective if the described defects in the analyses were addressed. In *Duke Energy Corp.*, at 13, the board said that "[w]hile NEPA does not require agencies to select particular options, it is intended to 'foster both informed decision-making and informed public participation, and thus to ensure the agency does not act upon incomplete information, only to regret its decision after it is too late to correct' (*citing Louisiana Energy Services* (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 88 (1998))." It then said "if 'further analysis' is called for, that in itself is a valid and meaningful remedy under NEPA."

The fundamental deficiencies in the NRC approved economic consequence analysis require that the regulatory framework itself must be changed. Unless they are changed, none of the recommendations from the Lessons Learned Task Force will ever be implemented. Because the guidelines for how the NRC and industry will conduct backfitting cost-benefit analyses are rooted in *pre-Fukushima* assumptions, there is little or no chance that any analysis based on the current economic consequences assumptions and methodologies will show that any possible offsite consequences are greater than the cost of the backfit.

Dr. Edwin Lyman, Senior Scientist at the Union of Concerned Scientists summarized it well:[55]

> One might think, therefore, that the NRC should modify its cost-benefit analysis guidelines to incorporate lessons learned from Fukushima *before* using such an analysis to assess the costs and benefits of the other recommended upgrades to safety requirements. Indeed, the Near Term Task Force considered development of a new post-Fukushima regulatory framework to be its top recommendation.
>
> However, the Commission ordered the staff to put such an effort on the back burner, effectively leaving it to be resolved only *after* all the other recommendations had been addressed. This has created a pattern of circular reasoning that could endanger the implementation of all the other proposed actions, and could leave the NRC chasing its tail for years to come.

[55] Going in Circles, Dr. Edwin Lyman, Union Concerned Scientists, December 22, 2011. http://allthingsnuclear.org/nrcs-post-fukushima-response-going-in-circles/#

Respectfully Submitted,

(Electronically signed)

Mary Lampert
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October 15, 2012

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
<u>BEFORE THE COMMISSION</u>

October 26, 2012

PILGRIM WATCH COMMENT REGARDING SECY-12-110, CONSIDERATION OF ECONOMIC CONSEQUENCES WITHIN THE NRC'S REGULATORY FRAMEWORK -PRICE ANDERSON COVERAGE CLEANUP COSTS

Michael Cass, Vice President and General Counsel for American Nuclear Insurers made a presentation to the NRC Commissioners regarding nuclear indemnity with respect to the effects of offsite contamination at the September 11 Briefing on Economic Consequences. Pilgrim Watch (hereinafter "PW") believes the subject requires further clarification.

The central question is whether Price Anderson fairly covers offsite economic costs. American Nuclear Insurers (ANI) implied that it does to the NRC Commissioners, September 11, 2012; later NRC OGC representative told ACRS that he doesn't know, October 3, 2012; Inside EPA investigative report, supported by emails between EPA, NRC, and FEMA obtained by FOIA, July 2010 concluded that Price Anderson only partially covered partial - it did not cover cleanup. (Please see attachment) The Inside EPA report said that,

> NRC officials also indicated during the meetings that the industry-funded account established under the Price Anderson Act -- which Congress passed in 1957 in an effort to limit the industry's liability -- would likely not be available to pay for such a cleanup. The account likely could only be used to provide compensation for damages incurred as the result of an accident, such as hotel stays, lost wages and property replacement costs, the documents show, leaving federal officials unsure where the money to pay for a cleanup would come from.

PW explained in *Pilgrim Watch Comment Regarding Secy-12-110, Consideration of Economic Consequences within the NRC's Regulatory Framework* that actual cleanup costs are the "Elephant in the Room" that NRC, the nuclear industry and its insurers have avoided. After the real-world experiences in Japan proper modeling of these costs can no longer be avoided. If cleanup costs were realistically assessed, it would result in major offsite costs requiring the addition of a large number of mitigations to reduce the probability of a severe accident and require far larger insurance coverage in Price Anderson. The cost formula used in the computational tool (MACCS2) to calculate economic consequences of a severe accident severely underestimates costs likely to be incurred. The Price Anderson Act based its coverage limit on the MACCS. It has the same cleanup assumptions and methodology as MACCS2.

Price Anderson Coverage versus Reality

Price Anderson is the nuclear industries indemnity or insurance, established by Congress in 1957. The purpose is to indemnify the industry against liability claims in the event of an accident and ensure monies for the public. Act establishes a no fault insurance type system in which the first approximately \$12.6 billion (as of 2011) is industry-funded as described in the Act. Any claims above the \$12.6 billion would be covered by a Congressional mandate to retroactively increase nuclear utility liability or would be covered by the federal government. The amount has not been changed in over 50 years, and is painfully insufficient as NRC, industry and its insurers know. For example:

<u>Lesson learned from Fukushima</u>: The Japanese government has budgeted \$14 billion *through March 2014* for the cleanup which could take decades The Japanese Environment Ministry expects the cleanup to generate at least 100 million cubic meters or 130 million cubic yards of soil, enough to fill 80 domed baseball stadiums (*Japan decontaminates towns near tsunami-hit nuclear plant, unsure costly effort will succeed,* Associated Press, Mari Yamaguchi, March 5, 2012) It is no wonder that ANI does not cover these expenses nor the NRC-approved MACCS2 consequence code models these expenses.

<u>Long before Fukushima</u>, NRC knew that cleanup was prohibitive and therefore should be avoided. The more effective a radiological decontamination is (*i.e.,* the more radiation removed), the more difficult and expensive it will be, requiring from partial destruction to complete demolition of buildings and removal of vegetation, soil and trees. For example, a Decontamination Factor (the ratio of the radiological contamination before the cleanup and the radiological contamination after the cleanup) of 3, meaning 67% of the radiological contamination is removed, could entail, among other things, the removal of lawns and gardens and the removal of roofs on structures. Additionally, radiological decontamination efforts also require sufficient disposal capacity for the radioactive waste that must be removed (*e.g.,* soil, crops, building debris). Finding disposal site(s) is a huge if not insurmountable hurdle, as shown in Japan today. The situation is unlikely to be any different in the United States based on a history of unwillingness of most states to host even low-level radioactive waste sites and objections by communities along transportation routes.

As recognized by the 1987 OECD *Pathway Parameter* report[1] and the *Site Restoration* report[2], a Decontamination Factor of more than 10 (90% radiological contamination removed) would likely involve

[1] http://www.oecd-nea.org/nsd/docs/1988/csni88-145-vol2.pdf
[2] http://chaninconsulting.com/downloads/sand96-0957.pdf

removal and disposal of large amounts of soil and the wholesale removal (or demolition or razing) of many types of structures and the disposal of the resulting building wastes. Both *Pathway Parameter* and *Site Restoration* recognize that achieving Decontamination Factors greater than 10 in both farm and non-farm areas would require the demolition of all structures, the removal and disposal of all the rubble, scraping of the remaining surface soil until the selected cleanup level was reached, and disposal of all rubble and scraped soil as radioactive waste.

The acute difficulty (if not impossibility) of achieving Decontamination Factors greater than 10 for more than a few, select "vital facilities" was known to the NRC as far back as the mid-1970s, as reflected in the 1975 WASH-1400 report[3]. Instead of recognizing this and dealing with it, NRC industry and ANI simply ignore it. Neither NRC nor ANI model actual cleanup costs in consequence analyses. As a result, SAMA analyses never find that any mitigation is justified and Price Anderson does not provide sufficient monies. The game is rigged.

Post Fukushima, we hope the Commission will take this opportunity and correct the current method to assess offsite costs in a severe accident required to protect health, safety and property.

Respectfully Submitted,

(Electronically signed)

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October 26, 2012

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[3] *See Site Restoration*, Section 2.8, discussing WASH-1400

ATTACHMENT

The central question is whether Price Anderson fairly covers offsite economic costs? American Nuclear Insurers (ANI) implied that it does to the NRC Commissioners, September 11, 2012; later NRC OGC representative told ACRS that he doesn't know, October 3, 2012; Inside EPA investigative report, supported by emails between EPA, NRC, and FEMA obtained by FOIA, July 2010 concluded that Price Anderson only covered partial costs-not cleanup. Excerpts follow:

1. **Sept 11, 2012 Commission Meeting: Briefing on Economic Consequences, Michael Cass, Vice President and General Counsel for American Nuclear Insurers (ANI) Presentation**

ANI Coverage

- Bodily Injury
- Property Damage
- Covered Environmental Cleanup Costs
- Reasonable Additional Expenses incurred by States, Counties, and Municipalities in responding to an evacuation

All coverages triggered by the nuclear energy hazard

Cass, Transcript pg., 16 says that:

Covered environmental cleanup costs are also defined by the policy. These costs would include loss, costs, or expense arising out of a governmental decree, order, or directive requiring a person to pay for, monitoring, testing for, cleaning up, neutralizing, or containing environmental damage. Environmental damage is defined as contamination by nuclear material. Now, these environmental cleanup costs are indemnified when they result from an extraordinary nuclear occurrence, or an ENO, which is a defined term under the Act, and it's further defined in your regulations at 10 CFR, Section 140.83.

All these coverages are outlined in the facility form policy that reactor licensees procure from ANI. Coverage grants continue to apply, inform the basis for coverage under the secondary financial protection program master insurance policy. We refer to that SFP policy as a following form policy in that its grants of coverage and other terms and conditions follow those of the underlying primary insurance policy. So, there's a seamless transition between the underlying primary policy and then the secondary financial protection program. Next slide, please.

Cass response Cmr. Ostendorff, Transcript, pg., 54 says that:

COMMISSIONER OSTENDORFF: Thank you. Anybody else in the panel want to offer any comments on that? Okay.

Let me go to Mr. Cass for a minute. On your Slide 5, you'd talked about the covered environmental cleanup costs and the property damage, et cetera. Can you just talk for a minute at a high level about, you know, how the ANI policy coverage would affect somebody who has lived in the Fukushima evacuated area for the last 18 months, had to move out, take their wife and kids, shut down their business. Just kind of the basic things, the considerations that would be applicable to providing coverage in that kind of scenario. And Commissioner Magwood was getting to that with his comments on Fukushima. I'd appreciate if you could talk about coverage in that kind of scenario.

MICHAEL CASS: Sure. Well, the immediate needs of that family would be taken care of. Their lodging, medical costs, food, shelter, clothing, that kind of thing, since they were displaced from their home. Ostensibly because either the home was contaminated or at risk of contamination, and they were within an evacuation zone that was declared by the government or some -- in this case, would be the local government that would declare protective actions that would be required. Following that, the next -- so, first you have the immediate needs taken care of. Then the next step would be if they worked at an establishment that was also affected by the evacuation order or was contaminated or potentially contaminated, then we would address their lost wages. If they were a business owner, we would address their lost business -- the economic losses from their business.

Cass, Transcript, pg., 55 says that:

Longer term, that's where things -- depending on the nature of the accident, the level of contamination, the recovery that's anticipated. If their property was -- let's take their home. If their home was contaminated, we would either respond by cleaning it up. If it was pre-habitable, then that would be the end of their loss, theoretically. If it was not to be cleaned up, then there would be some payment for the value of that property, and that would, theoretically, solve their claim for their lost property. They would be made whole for that property, based on some economic evaluation of the value of that property -- pre-accident, of course.

If it looks as though the consequences of the accident are going to exceed this level of protection that we have available right now of $12.6 billion, then it would be up to ANI or, potentially, the NRC to file a petition with the court to come up with a compensation plan for the entire population and economy that was affected by this accident. If it looks like the funds are not going to be adequate to cover it, then we have to come up with a plan, and a plan for both compensating the various constituents that are affected, how much they're going to be compensated for, whether additional compensation needs to be -- additional funds need to be acquired through some other mechanism besides what's currently structured in Price Anderson.

And there was a plan, a skeleton of a plan put together, I believe it was in 1990 timeframe following the Three Mile Island accident that tends to form a framework that we would -- that would be a beginning point that we would use and then attempt to put some additional details into that plan. But, you know, that's essentially how it would work.

COMMISSIONER OSTENDORFF: Thank you very much. Thank

2. ACRS, Joint Meeting of Regulatory Policies & Practices and Reliability and Probabilistic Risk Assessment Subcommittees (October 2, 2012)

Transcript, pg., 14

MEMBER CORRADINI: So maybe you're going to get to this. So does Price Anderson fit into this at all?

MS. BONE: Price Anderson came in a topic early in the discussion. We mention it in the legal authority enclosure. But it became more of a background point really than part of our options or recommendations. But we have working group members

Transcript, pgs., 15-16

MEMBER ARMIJO: But, just at a top level, how much of the economic consequences are covered by Price Anderson? You know, compensation for loss in the U.S., what fraction of the economic consequences did you calculate are actually insured in one way or another?

MEMBER CORRADINI: Actually, you've actually got to what I was hoping you'd say, which is my intention is that's equivalent of no-fault insurance. Anything off-site should be covered under Price Anderson.

MEMBER ARMIJO: That's what I thought.

MEMBER CORRADINI: That's what I thought too.

MEMBER ARMIJO: But I'm not sure.

MS. BONE: Sure I see our OGC rep here

MR. PESSIN: Good afternoon. My name is Andrew Pessin, I'm an attorney in the Office of General Counsel. I assisted the workgroup in drafting

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the legal opinion that supported this paper.

Price Anderson Act is on the background of land contamination and this paper is more looking at the front end. It's looking at what is our authority to regulate licensees to prevent contamination of land, or to mitigate that kind of contamination. So it's to prevent it.

Price Anderson doesn't kick in until the land is already contaminated. So that's not the focus. So it was not the focus of this paper.

MEMBER ARMIJO: But my question was just really simple. Is there compensation available to people who've been damaged, or property that's been damaged, through Price Anderson?

MR. PESSIN: I believe so. But again we didn't look at that as part of this effort.

Mr. Pessim, NRC OGC, says that he does not know.

3. **InsideEPA, Investigative Report, *Agencies Struggle To Craft Offsite Cleanup Plan For Nuclear Power Accidents*, November 22, 2010, Douglas. Guarino and accompanying emails between EPA, NRC, DHS obtained by FOIA (http://insideepa.com/)**

Agencies Struggle to Craft Offsite Cleanup Plan for Nuclear Power Accidents Monday, November 22, 2010

EPA, the Nuclear Regulatory Commission (NRC) and the Federal Emergency Management Agency (FEMA) are struggling to determine which agency -- and with what money and legal authority -- would oversee cleanup in the event of a large-scale accident at a nuclear power plant that disperses radiation off the reactor site and into the surrounding area.

The effort, which the agencies have not acknowledged publicly, was sparked when NRC recently informed the other agencies that it does not plan to take the lead in overseeing such a cleanup and that money in an industry-funded insurance account for nuclear accidents would likely not be available, according to documents obtained by Inside EPA (Part 1 and Part 2) under the Freedom of Information Act (FOIA).

Environmentalists concerned with nuclear safety and cleanup issues say indications in the FOIA documents that the government has no long-term cleanup plan in the event of an emergency casts doubt on the nuclear power industry's ongoing efforts to revive itself. The industry currently has 22 applications to build new nuclear power plants pending before NRC and is marketing itself as a source of carbon-free emissions.

"This is a revelation that should call into question efforts to revive the industry," one environmentalist says. "Certainly there should be no new [power plant] construction if this issue can't be resolved." The activist adds that the lack of a cleanup plan is "pretty ironic because nuclear energy is not a new technology or issue. The first nuclear reactor was built in 1942 -- that's 68 years ago."

A spokesman for the Nuclear Energy Institute (NEI), which represents the nuclear power industry, says officials believe such cleanups would be handled by the insurance fund despite assertions in the documents to the contrary. The NEI spokesman also downplays the likelihood of such a cleanup being necessary, saying accidents are "highly unlikely to occur."

Staff for the three agencies began meeting to discuss the issue last year, when NRC officials indicated to the other agencies that they do not, as some federal officials had previously assumed, plan on leading cleanup oversight in the event an accident at a nuclear power plant dispersed radioactive contamination off the reactor site and into the surrounding area. NRC suggested EPA would be the appropriate agency to lead such an effort, according to the documents. While NRC and FEMA require nuclear plants to have emergency response plans, it is not clear these plans extend beyond the initial aftermath of an accident or apply to radiation dispersed over large areas, the documents say.

However, the NRC officials also indicated during the meetings that the industry-funded account established under the Price Anderson Act -- which Congress passed in 1957 in an effort to limit the industry's liability -- would likely not be available to pay for such a cleanup. The account likely could only be used to provide compensation for damages incurred as the result of an accident, such as hotel stays, lost wages and property replacement costs, the documents show, leaving federal officials unsure where the money to pay for a cleanup would come from. (Emphasis added)

This summer, EPA staff began drafting a white paper on the issue in preparation for emergency drills the agencies were planning for August that documents say were expected to involve high-level administration officials, including either President Obama or Vice President Biden.

Disagreements over EPA Authority

The white paper was never completed amid disagreements between EPA staff over what authority the agency may or may not have to clean up after a power plant accident.

A July 27 draft of the white paper cites Superfund as a possible source of cleanup funding -- either through EPA's appropriation-driven Superfund trust fund or the agency's authority to sue parties responsible for contamination under Superfund law. But EPA staff disagree on whether Superfund is applicable to cleanup after a nuclear power plant accident, calling into question its viability as both a source of funding and cleanup authority.

Some EPA staffers argue that "special nuclear material from a nuclear incident" is exempt from the types of toxic releases governed by Superfund, according to the documents. Others suggest that such material is typically commingled with chemicals and other radioactive materials that are covered by the law, meaning EPA would be able to assert its Superfund authority to conduct a cleanup.

In internal e-mails, EPA staff provides examples of instances where the agency has been involved with cleanups at nuclear power plant sites due to the sites being contaminated with chemicals. For example, Mary Ballew, of EPA Region I, on Aug. 18 forwarded examples of EPA involvement with power plant decommissioning due to chemical contamination to Stuart Walker, of EPA's Office of

Superfund Remediation and Technology Innovation (OSRTI). Ballew offered to talk to any lawyers in EPA headquarters "that say that the nuke plants don't have chemicals."

According to the information Ballew provided, Region I has been involved with decommissioning at three nuclear power plants -- Maine Yankee, Connecticut Yankee and Yankee Rowe, MA -- and all three required cleanups under the Resource Conservation & Recovery Act (RCRA) due to chemical contamination.

But Jean Schumann, a lawyer in EPA's Office of Emergency Management (OEM), criticizes suggestions that the presence of chemical contaminants gives the agency the authority to clean up after a nuclear power plant incident. In one Aug. 5 e-mail, Schumann argues it is uncertain whether Superfund law gives EPA such authority when radioactive substances from the accident are commingled with other contaminants. "I think there is enough uncertainty still on what the 'release' exclusion means that we're better off staying at a higher level of detail" in the draft white paper, she writes.

But the ability of other laws to provide funding and authority for cleanup are also severely limited, the draft white paper says. The government's emergency response authorities under the Stafford Act, for instance, expire 60 days after an incident, the draft document notes. A Presidential declaration of an emergency "leads to rather limited financial assistance being made available through FEMA" and a "potentially more useful Presidential declaration of a major disaster" appears limited to "natural events," the document says.

Determining Cleanup Standards

Whether EPA can assert its Superfund authorities over a cleanup after a nuclear power plant accident is significant not just from the standpoint of securing funding for the cleanup, but also in determining what cleanup standards would apply to the situation, Walker, of OSRTI, writes in a June 11 e-mail to Elizabeth Southerland, director of OSRTI's assessment and remediation division.

Walker tells Southerland that if EPA appears to be endorsing non-Superfund cleanup approaches in discussions with the other agencies, policy concerns similar to those surrounding EPA's controversial draft guide for responding to all nuclear emergencies -- known as the protective action guidance (PAG) for radiological incidents -- would arise. With the PAG, officials in EPA's Superfund, water and legal offices raised concerns that the document could set a negative precedent weakening the agency's cleanup and drinking water standards because it included guidelines dramatically less stringent than traditional EPA regulations.

The BP oil spill in the Gulf of Mexico, which prompted some Republicans in Congress to suggest the Price Anderson Act be used as model for oil cleanups, also highlights the significance of the issue, Walker argues.

"Given the current circumstances dealing with the Gulf [oil] spill (e.g., questions about who is in charge, is the federal government in control, etc) not inhibiting our flexibility under [Superfund] is a key issue," Walker adds. "Although possibly not the first choice to take a response action during a [nuclear power plant] incident, EPA should not agree to language that appears to be a legal interpretation that inhibits [the Superfund] option."

In addition, despite the expectations of the other federal agencies that EPA "would be heavily involved in the environmental response work, possibly as the lead technical agency," EPA cleanup officials have "not previously been major players in NRC" led drills meant to simulate the government's response to a power plant accident, Walker says.

Confusion amongst Agencies

Attempts by EPA and NRC officials to answer requests for comment on the issue also highlight confusion within EPA and amongst the agencies over who is responsible for overseeing cleanup. An NRC spokesman told Inside EPA that the "best information" he had was "that EPA would oversee cleanup, based on that agency's" PAGs, which the agency has yet to complete due to the controversy they have generated.

But when EPA spokeswoman Latisha Pettaway was asked to confirm that EPA would in fact take the lead on such a cleanup and to explain what legal authorities the agency would use, Randy Deitz, a liaison between EPA's waste and government affairs offices, called the inquiry "an odd-ball request" that "does not fit well with any particular office. . .Why doesn't [Inside EPA] ask NRC?" Deitz asked. "They regulate the cleanup of NRC regulated facilities. We don't get involved at all."

Jeff Maurer of EPA's Innovation, Partnerships and Communication Office (IPCO) sent Pettaway a similar e-mail about the request for comment, calling it "an inquiry that will not be able to be responded to in a clear cut fashion. . . . This will take awhile," Maurer said.

Asked by Maurer to provide information on whether EPA would apply Superfund or other standards if it was cleaning up after a nuclear power plant incident, Walker explained that EPA has never "spelled this out anywhere" and that final cleanup levels have not "been discussed by the FEMA, NRC, EPA workgroup looking at Price Anderson Act issues. . . . So I don't have a clear answer." Walker did express his personal opinion that EPA should not endorse cleanup standards less stringent than Superfund -- such as NRC's power plant decommissioning standards that allow exposure to radiation as high as 25 and 100 millirems -- however. In other e-mails, Walker expressed concerns that, during the development of the draft PAG, NRC officials suggested cleanup standards as lax as 10,000 millirem, which activists argue equates to a cancer risk of one in three people.

In her response to Inside EPA, Pettaway did not include any of this information or acknowledge that the three agencies were actively studying the issue, however. Pettaway said only that questions regarding whether and how EPA would cleanup after a nuclear power plant incident were "based on hypothetical situations/scenarios" and that EPA could not "give an assessment on something that [was] hypothetical."

A FEMA spokeswoman deferred a request for comment to EPA. The White House did not respond to a request for comment. -- Douglas P. Guarino

Emails obtained by Inside EPA by FOIA (available from InsideEPA or Mary Lampert)

The following excerpt from Stuart Walker' email, EPA, says that "The insurance funds are not used to cover cleanup costs associated with the incident."

From:	Stuart Walker/DC/USEPA/US
To:	Charles Openchowski/DC/USEPA/US@EPA
Date:	07/30/2010 06:54 PM
Subject:	Upcoming political level (AA, Administrator, maybe Obama/Biden) exercises emergency and late phase cleanup exercises on Nuclear Power Plant Incident

Dr. Steve Landry, SOE Support Team, reviewed the draft scenario. Dr. Landry explained that the intent of the scenario is to have significant damage that exceeds the cap of the $10 billion Price-Anderson Act (PAA). Additionally, the location chosen for the scenario event should be neither "worst case" nor "best case," but somewhere in the middle.

An NRC representative stated that the PAA actually has a $12 billion cap, but that it is not really the issue. The PAA is an insurance policy for displaced persons/damage in the event of a nuclear power plant incident. Once the $12 billion has been exceeded, the U.S. Treasury will cover costs for displaced people. However, the Insurance funds are not used to cover cleanup costs associated with the incident. The NRC representative also noted that each licensee is insured for over $300 million. Whether or not D/As could recover the costs allocated towards the cleanup is an open question and would be decided by the courts, but PAA is designed to support the people affected by the accident.

a. The following excerpt from the July 27, 2010 Draft White paper says that, " NRC also indicated the Price Anderson Act would be unable to pay for environmental cleanup after the nuclear power plant incident only for compensation for damages incurred (e.g., hotel stays, replacement costs for property and personal items, lost wages etc.

NRC-FEMA-EPA White Paper:
Potential Authorities and/or Funding Sources for Off-site Cleanup Following a Nuclear Power Plant Incident

Background:

- The Environmental Protection Agency (EPA), the Nuclear Regulatory Commission (NRC), and the Federal Emergency Management Agency (FEMA) began a series of quarterly meetings in 2009 to discuss unresolved concerns regarding off-site environmental cleanup following a nuclear power plant incident.
- NRC recently indicated to FEMA that they would not be taking the lead for off-site environmental cleanup after a nuclear power plant incident. NRC suggested EPA would be the appropriate agency to lead such efforts.
- NRC also indicated the Price-Anderson Act would be unable to pay for environmental cleanup after a nuclear power plant incident, only for compensation for damages incurred (e.g., hotel stays, replacement costs for property and personnel items, lost wages, etc).
- FEMA convened a workgroup to discuss the following issues related to nuclear power plant incidents: potential Agency roles (e.g., who would lead cleanup efforts); cleanup authorities; and fund sources.
- Evaluation of language from the *Price-Anderson Act*, the *Stafford Act*, and EPA's previous policies and expectation that the *CERCLA* (Comprehensive Environmental Response, Compensation, and Liability Act) would generally not be used for response actions to address releases from NRC-licensed sites including nuclear power plants, may indicate a potential gap in authority to perform or oversee and fund off-site cleanup following a nuclear power plant incident, depending on the circumstances of the incident and the subsequent declarations of the federal government.
- The Report to Congress from the Presidential Commission on Catastrophic Nuclear Accidents (See Attachment D)[1]: outlines a number of concerns regarding nuclear power plant incidents. The report covers the sourcing of funds under a "Major Disaster," a "Catastrophe," and how to prepare and respond to a "catastrophic disaster."
  - Current plans do not cover "long-duration accidents that have impacts over large land areas".
  - The authority of the Court to award damages does not extend to executive branch powers.

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Objective:

- Provide current understanding on potential authorities and sources of funding for off-site cleanup following a nuclear power plant incident.

b. The following excerpt from the July 27, 2010 Draft White paper lays out the potential cleanup authority and funding source of the Price Anderson Act. It essentially repeats what EPA's Stuart Walker email's said in the first example, "ANI does not cover environmental cleanup costs under their primary insurance policy. It is anticipated that the secondary insurance policy will behave in a similar manner."

Potential Cleanup Authority and/or Funding Source # 1: *Price-Anderson Act*

- Examples of Potential Circumstances Where It May Be Appropriate to Use the *Price-Anderson Act*: In addition to an accident, the nuclear power plant incident may be the result of: theft or sabotage; the transportation of nuclear fuel to a reactor site; or the storage of nuclear fuel at a reactor site.

- Possible Actions under the *Price-Anderson Act*:
    - o Provide financial assistance to utilities operating nuclear power plants that have experienced an incident.
    - o For individuals who have suffered damages:
        - ▪ Those who suffered bodily harm, sickness, or disease will receive financial assistance.
        - ▪ Evacuees receive property damage and loss expenses as well as living expenses.
    - o Local and State governments can receive financial assistance to assist with evacuations, sheltering, and other immediate response activities.

- Funding Source for the *Price-Anderson Act*:[2]
    - o Under the *Price-Anderson Act*, American Nuclear Insurers (ANI) provides nuclear power plants with financial assurance by creating insurance funding pools under both a primary and a secondary insurance policy.
    - o **Primary Insurance Policy:** Each year, a premium is paid by utilities that operate nuclear power plants – this premium provides offsite private insurance of $300 million.
    - o **Secondary Insurance Policy:** If an incident exceeds the $300 million, each reactor would pay a prorated share of up to $95.8 million. This secondary pool contains approximately $8.6 billion.

- Potential Gap in Covering Off-site Cleanup under the *Price-Anderson Act*:
    - o These funding pools can only be accessed by a federal agency if the federal agency itself has property that has suffered damages during an incident.
    - o ANI does not cover environmental cleanup costs under their primary insurance policy. While not explicitly stated, there is no expectation that the secondary insurance policy will differ in coverage from the primary insurance policy.

Findings:

Potential Authorities and/or Funding Sources for Off-Site Cleanup Following a Nuclear Power Plant Incident

- *Price-Anderson Act:*
    - o ANI does not cover environmental cleanup costs under their primary insurance policy. It is anticipated that the secondary insurance policy will behave in a similar manner.

c. The following excerpt from the July 27, 2010 Draft White paper from Kathryn Snead, EPA, explains again that there is a gap in authority to perform or oversee and fund offsite cleanup and that, at bullet 3, "NRC also indicated the Price Anderson Act would be unable to pay for environmental cleanup after a nuclear power plant incident only for compensation for damages incurred (e.g., hotel stays, replacement costs for property and personal items, lost wages, etc.

Kathryn Snead To all, Please find attached a draft white paper o... 07/27/2010 03:51:39 PM

From: Kathryn Snead/DC/USEPA/US
To: Stuart Walker/DC/USEPA/US@EPA, Charles Openchowski/DC/USEPA/US@EPA, Jennifer Mosser/DC/USEPA/US@EPA, Susan Stahle/DC/USEPA/US@EPA, Lee Tyner/DC/USEPA/US@EPA, Jean Schumann/DC/USEPA/US@EPA
Cc: Lee Veal/DC/USEPA/US@EPA, Jeffrey Blizzard/DC/USEPA/US@EPA
Date: 07/27/2010 03:51 PM
Subject: White Paper on Off-Site Cleanup Following a Nuclear Power Plant Incident

NRC-FEMA-EPA White Paper:
Potential Authorities and/or Funding Sources for Off-site Cleanup Following a Nuclear Power Plant Incident

Background:

- The Environmental Protection Agency (EPA), the Nuclear Regulatory Commission (NRC), and the Federal Emergency Management Agency (FEMA) began a series of quarterly meetings in 2009 to discuss unresolved concerns regarding off-site environmental cleanup following a nuclear power plant incident.

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- NRC recently indicated to FEMA that they would not be taking the lead for off-site environmental cleanup after a nuclear power plant incident. NRC suggested EPA would be the appropriate agency to lead such efforts.

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- NRC also indicated the Price Anderson Act would be unable to pay for environmental cleanup after a nuclear power plant incident, only for compensation for damages incurred (e.g., hotel stays, replacement costs for property and personnel items, lost wages, etc).

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- FEMA convened a workgroup to discuss the following issues related to nuclear power plant incidents: potential Agency roles (e.g., who would lead cleanup efforts); cleanup authorities; and fund sources.

- Evaluation of language from the *Price-Anderson Act*, the *Stafford Act*, and EPA's previous policies and expectation that the *CERCLA* (Comprehensive Environmental Response, Compensation, and Liability Act) would generally not be used for response actions to address releases from NRC-licensed sites including nuclear power plants, may indicate a potential gap in authority to perform or oversee and fund off-site cleanup following a nuclear power plant incident, depending on the circumstances of the incident and the subsequent declarations of the federal government.

Deleted: *CERCLA* (Comprehensive Environmental Response, Compensation, and Liability Act), and

- The Report to Congress from the Presidential Commission on Catastrophic Nuclear Accidents (See Attachment D)[1]: outlines a number of concerns regarding nuclear power plant incidents. The report covers the sourcing of funds under a "Major Disaster," a "Catastrophe," and how to prepare and respond to a "catastrophic disaster."
    - Current plans do not cover "long-duration accidents that have impacts over large land areas".
    - The authority of the Court to award damages does not extend to executive branch powers.

- The following are questions and concerns are unresolved:

DRAFT- DO NOT CITE OR QUOTE *July 27, 2010*

Potential Cleanup Authority and/or Funding Source # 1: *Price-Anderson Act*

- Examples of Potential Circumstances Where It May Be Appropriate to Use the *Price-Anderson Act*: In addition to an accident, the nuclear power plant incident may be the result of: theft or sabotage; the transportation of nuclear fuel to a reactor site; or the storage of nuclear fuel at a reactor site.

- Possible Actions under the *Price-Anderson Act*:
    - Provide financial assistance to utilities operating nuclear power plants that have experienced an incident.
    - For individuals who have suffered damages:
        - Those who suffered bodily harm, sickness, or disease will receive financial assistance.
        - Evacuees receive property damage and loss expenses as well as living expenses.
    - Local and State governments can receive financial assistance to assist with evacuations, sheltering, and other immediate response activities.

- Funding Source for the *Price-Anderson Act*:[2]
    - Under the *Price-Anderson Act*, American Nuclear Insurers (ANI) provides nuclear power plants with financial assurance by creating insurance funding pools under both a primary and a secondary insurance policy.
    - **Primary Insurance Policy:** Each year, a premium is paid by utilities that operate nuclear power plants – this premium provides offsite private insurance of $300 million.
    - **Secondary Insurance Policy:** If an incident exceeds the $300 million, each reactor would pay a prorated share of up to $95.8 million. This secondary pool contains approximately $8.6 billion.

- Potential Gap in Covering Off-site Cleanup under the *Price-Anderson Act*:
    - These funding pools can only be accessed by a federal agency if the federal agency itself has property that has suffered damages during an incident.
    - ANI does not cover environmental cleanup costs under their primary insurance policy. While not explicitly stated, there is no expectation that the secondary insurance policy will differ in coverage from the primary insurance policy.

d. The following drafts repeat the same language.

From NRC-FEMA-EPA White paper: Potential Authorities and/or Funding Sources for Off-site Cleanup Following a Nuclear Power Plant Accident, July 27, 2010, Pg., 3

- Funding Source for the *Price-Anderson Act*:[2]
  - Under the *Price-Anderson Act*, American Nuclear Insurers (ANI) provides nuclear power plants with financial assurance by creating insurance funding pools under both a primary and a secondary insurance policy.
  - **Primary Insurance Policy:** Each year, a premium is paid by utilities that operate nuclear power plants – this premium provides offsite private insurance of $300 million.
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  - ANI does not cover environmental cleanup costs under their primary insurance policy. While not explicitly stated, there is no expectation that the secondary insurance policy will differ in coverage from the primary insurance policy.

At 6,

Findings:

Potential Authorities and/or Funding Sources for Off-Site Cleanup Following a Nuclear Power Plant Incident

- *Price-Anderson Act:*
  - ANI does not cover environmental cleanup costs under their primary insurance policy. It is anticipated that the secondary insurance policy will behave in a similar manner.

At 17,

----- Forwarded by Elizabeth Southerland/DC/USEPA/US on 06/11/2010 12:13 PM -----

From: Stuart Walker/DC/USEPA/US
To: Elizabeth Southerland/DC/USEPA/US@EPA, Davidw Charters/ERT/R2/USEPA/US@EPA, Helen Dawson/DC/USEPA/US@EPA
Cc: Charles Openchowski/DC/USEPA/US@EPA
Date: 06/11/2010 11:57 AM
Subject: Senior management meeting needed to discuss ongoing staff meetings with NRC and FEMA to resolve responsibilities for early, intermediate, and long-term response to nuclear power plant incidents

Hi Betsy,

See attached email from Colby Stanton that began EPA's involvement with NRC/FEMA efforts to clarify how response to a significant release (e.g., Three Mile Island, Chernobyl) from a commercial nuclear power plant (NPP) would be handled.

After 3 meetings with the other Agencies at the programmatic and general counsel staff, both Charles Openchowski and I believe that we need to have a senior level management meeting to discuss EPA's strategy for these efforts.

There are numerous issues that have arisen during these meetings since Colby's initial note, including:

1. Monies collected from nuclear industry to pay out in the event of a "nuclear incident" go to an insurance company for disbursement. It appears the monies may only go for compensating damages (e.g., cost of temporary or permanent relocation, pay for policemen, personal property replacement, etc) and not environmental cleanup.

2. There appears to not be pre-identified source of funding for environmental cleanup. NRC staff anticipates this would be handled by some type of supplemental appropriation.

3. There is a FEMA expectation that EPA would be heavily involved in the environmental response work, possibly as the lead technical agency (think OSC, RPM role). EPA has not previously been major players in NRC exercises for NPP releases.

Charles and I believe we need a senior level management meeting (OSRTI, OEM, ORIA, OGC, and OHS) to discuss:

1. What would be proper role for EPA in these types of events, including the role of each of our primary offices and respective regional counterparts.
   -- There are of resource (FTEs and $'s) implications for EPA's level of involvement both during a real event and during exercises.
   -- There are also policy implications if EPA appears to be endorsing other cleanup approaches even in a remedial contractor role for NPP events, similar to concerns raised regarding the PAGs.

2. Given the current circumstances dealing with the Gulf spill (e.g., questions about who is in charge, is the federal government in control, etc) not inhibiting our flexibility under CERCLA is a key issue. Although possibly not the first choice to take a response action during a NPP incident, EPA should not agree to language that appears to a legal interpretation that inhibits this option.

At 33,

From: Stuart Walker/DC/USEPA/US
To: Elizabeth Southerland/DC/USEPA/US@EPA, Davidw Charters/ERT/R2/USEPA/US@EPA, Helen Dawson/DC/USEPA/US@EPA
Cc: Charles Openchowski/DC/USEPA/US@EPA
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At 36,

From: Kathryn Snead/DC/USEPA/US
To: "Benowitz, Howard" <Howard.Benowitz@nrc.gov>, "Blunt, Kenyetta" <kenyetta.blunt@dhs.gov>, Sara DeCair/DC/USEPA/US@EPA, "DeFelice, Anthony" <anthony.defelice@dhs.gov>, diane.donley@dhs.gov, "Greten, Timothy" <Timothy.Greten@dhs.gov>, grace.kim@nrc.gov, "Milligan, Patricia" <Patricia.Milligan@nrc.gov>, Jennifer Mosser/DC/USEPA/US@EPA, Charles Openchowski/DC/USEPA/US@EPA, Jean Schumann/DC/USEPA/US@EPA, anneliese.simmons@nrc.gov, Susan Stahle/DC/USEPA/US@EPA, Lee Tyner/DC/USEPA/US@EPA, Stuart Walker/DC/USEPA/US@EPA, Jeffrey Blizzard/DC/USEPA/US@EPA
Cc: Lee Veal/DC/USEPA/US@EPA
Date: 05/25/2010 09:57 AM
Subject: EPA-NRC-FEMA Recovery Discussion on Nuclear Power Plant Incidents

To all,

I apologize about the short notice - my fault for taking so long to send this out:

Our next inter-agency discussion on Recovery from Nuclear Power Plant Incidents:
June 3, 2010 from 1 PM - 3 PM
Follows the FRPCC Meeting (with a break for lunch 11:30 AM - 1 PM)
Crystal City Courtyard Marriott
Blue Ridge Shenandoah Conference Room
2899 Jefferson Davis Highway
Arlington, VA 22202

A few action items that were identified during the last meeting:
- Anneliese Simmons, NRC, agreed to provide example text on the insurance exclusion language on cleanup.
- Anneliese Simmons, NRC, agreed to check on what was meant by "clearly identifiable accidents".

At 45

Potential Issue - FEMA looking for someone (e.g., EPA, Corps) to run cleanup of public property after nuclear power plant accident
Stuart Walker to: Elizabeth Southerland, Helen Dawson 12/08/2009 02:17 PM
Cc: RobinM Anderson

Betsy, this is a follow-up email about what I mentioned to you in the hall. Last week I, OEM, ORIA, and OGC staff (including Charles) met with FEMA and NRC policy and general counsel staff.

We were meeting to discuss the role of NRC, EPA, and FEMA after a catastrophic release from a nuclear power plant, and how the compensation clauses of the Price Anderson Act might come into play because of the CERCLA definition of "release" (which makes a reference to Price-Anderson in excluding some releases from CERCLA jurisdiction). In Price-Anderson, Congress in essence set up a federally-backed insurance scheme to compensate victims of a nuclear reactor accident (e.g., Three Mile Island).

I had thought that EPA was there to explain why previous policy from the removal program was incorrect in stating EPA could not respond to such releases under CERCLA authority, but rather EPA had authority but generally expected NRC to have authority over such incidents and did not expect to be involved except for possible help requested by NRC and/or state.

I was surprised to find out that NRC did not intend to be involved in the cleanup or Price-Anderson compensation decisions for contamination that was outside the fenceline of the facility. NRC said that the authority for spending the $10 billion insurance dollars that could become available when the Price Anderson Act is triggered would be lie with an Insurance Company. After those funds were gone, they thought EPA might handle the site cleanup.

NRC does not currently know if the $10 billion can only be used for compensation for damages suffered by members of the public, or if it can be used for site cleanup. Also they have not asked the insurance company if they have any plans/guidance on how they will decide to distribute the monies, whether they have contractors lined up to do the cleanup work or would they expect each affected property owner to do the cleanup after getting a claim paid, or how they will answer the question of "how clean is clean" for purposes of either cleanup or determining what is considered contaminated for the purposes of compensation.

We will be meeting together again as a group. NRC intends on finding out answers to the groups question either prior to that meeting or possibly inviting the insurance company to the next meeting.

fyi, attached is the agenda for the meeting. Below is an email from FEMA the night before the meeting that lays out some of the issues.

The above (12/08/09) paragraph 5 -6 says that, “NRC does not currently know if the $10 billion can only be used for compensation for damages suffered by member of the public, or if it can be used for site cleanup. Also they have not asked the insurance company…how they will answer the question of ‘How clean is clean’ for purposes of either cleanup or determining what is considered contaminated for the purposes of compensation.” By the time they wrote the July 27, 2010 Draft, they were clear that ANI only would pay for damages not cleanup, as the preceding emails show.

At 45,

From: "Greten, Timothy" <Timothy.Greten@dhs.gov>
To: Stuart Walker/DC/USEPA/US@EPA, Kathryn Snead/DC/USEPA/US@EPA
Cc: Charles Openchowski/DC/USEPA/US@EPA, Colby Stanton/DC/USEPA/US@EPA, <grace.kim@nrc.gov>, "Benowitz, Howard" <Howard.Benowitz@nrc.gov>, Jean Schumann/DC/USEPA/US@EPA, Lee Tyner/DC/USEPA/US@EPA, "Milligen, Patricia" <Patricia.Milligan@nrc.gov>, Sara DeCair/DC/USEPA/US@EPA, Susan Stahle/DC/USEPA/US@EPA, "Greten, Timothy" <Timothy.Greten@dhs.gov>
Date: 11/30/2009 07:16 PM
Subject: RE: Agenda: EPA-NRC-FEMA Recovery Discussion

Good evening!

I hope everyone had a good Thanksgiving and made it through Monday.

After reading through the agenda and other notes, I ask that we move the discussion of the Stafford Act to after both Price Anderson and CERCLA have been discussed. Both of the other funding mechanisms should be discussed before we get to the Stafford Act, as both are the appropriate funding avenues before a Stafford Act declaration is made.

That said, I also have a suggestion about what our outcome might be, based on my discussing w/Diane Donnelly today. Please also excuse me if I'm missing key nuances or information here--I might be the newest player in this game.

I'm not sure how much cleaning up after a respectably-size nuclear power plant incident would cost. $50bil? The mechanisms set up by Price Anderson have set up a $10bil pool to pay for certain expenses. After that is exhausted, and for those expenses not covered, what vehicles are available? This is covered under Superfund language...yet my understanding is Superfund is essentially broke, as industry hasn't paid in since the mid 1990s. Likewise, Stafford Act funds are not available until a declaration is issued--and then only in line with what the declaration covers.

The one thing I'm reasonably sure about is the cost for a major long-term cleanup would be in excess of $10bil. If either Stafford Act or Superfund are tapped for $$, the bill is going to be so high that Congress will have to appropriate funds--there is no other way this bill will be paid. And getting those funds will be a political decision negotiated the heads of EPA, FEMA/DHS, NRC, Congress, and the White House.

The first deliverable this group should put together is a memo/paper that reads as a guide through this decision making process, explaining the steps and the different decision points. I think it should shy away from trying to toss the funding burden over the fence and say "superfund must do this!" or "Stafford act must do this", and stick to a neutral explanation of what the consequences of each funding action would be (i.e. "[blank] could be funded by CERCLA--the language allows it. However, CERCLA is incredibly underfunded for something like this). A political tool-kit, if you will, that lays out options and tradeoffs.

The second deliverable would be a memo simply explaining the how of administering a long-range cleanup...that is, no matter who pays for it, it will be a join effort. Each of the agencies has a key ability they bring to the table--EPA understands environmental cleanup/remediation, NRC understands the nuclear power industry, and FEMA has longstanding relationships with state/local government, law enforcement, etc. Both in distributing funding and administering a cleanup, all of these skills would be needed (one agency doesn't have the manpower, either in skill sets or sheer numbers, to pull it off). Also, all of the agencies would essentially be robbing peter to pay paul during a cleanup--they simply don't have standby resources for this beyond a thin bench.

See all of you tomorrow morning!

Tim

The one thing I'm reasonably sure about is the cost for a major long-term cleanup would be in excess of $10bil. If either Stafford Act or Superfund are tapped for $$, the bill is going to be so high that Congress will have to appropriate funds--there is no other way this bill will be paid. And getting those funds will be a political decision negotiated the heads of EPA, FEMA/DHS, NRC, Congress, and the White House.

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See all of you tomorrow morning!

Tim

Re: Fw: Price Anderson Info

Stuart Walker to: Jeff Maurer 08/11/2010 05:44 PM

Cc: Gilberto Irizarry, Kathy Jones, Lois Gartner, Randy Deitz

We haven't ever spelled this out anywhere. Nor has final cleanup levels been discussed by the FEMA, NRC, EPA workgroup looking at Price Anderson Act issues. So I don't have a clear answer, but here are some of my thoughts.

EPA has said that under CERCLA, and some other environmental laws (e.g., SDWA, CAA, AEA) that 25/100 mrem is not protective. So I don't think we would want to say we would promoting that as a cleanup level. Also, at one point during the DHS PAG (guidance for dirty bombs and nuclear weapons) development process NRC said they wanted a final cleanup level of 1 to 10 rem (that is 1,000 mrem to 10,000 mrem) and they wanted to apply those cleanup numbers to nuclear power plant meltdowns. I am not sure if NRC still feels the same way now.

In some of the AA level (OAR, OSWER, OW, OGC) which were followed up by Gina MCcarthy of OAR meeting with Lisa Jackson, it was decided we would NOT be using optimization in the ORIA PAG (Protective Action Guidelines) that would be proposed for final cleanup. We would instead be talking about using existing standards. Since this language still has too be drafted it is not certain if/how specifically CERCLA will be mentioned.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE ACRS

November 1, 2012

PILGRIM WATCH COMMENT WITH REGARD TO RELIABLE HARDENED CONTAINMENT VENTS – REQUEST RECOMMEND FILTERS & RUPTURE DISCS

I. Introduction

Twenty-three U.S. reactors are the same design as the failed Fukushima reactors – all are GE, Mark I, BWRs. Almost forty years ago, the NRC identified a serious design flaw in these reactors - in certain accident scenarios the containment would fail in the event of pressure build up.

A supposed "fix" was recommended, and put into place – a direct torus vent (DTV) to relieve pressure in order to save the containment by releasing unfiltered material directly into the atmosphere. Pilgrim, my neighborhood reactor, like the other Mark I's, assumed that the DTV would work, and that theoretical assumption was the underpinning of its assumed probabilities in accident sequences. "The use of the direct torus vent as a means of containment heat removal has been shown to have a major impact upon the results of Class II accident sequences.[1]" The DTV functioned as a backup to containment heat removal by the suppression pool cooling mode and the containment spray modes of the residual heat removal system.

But this "major impact" was "shown" only by theoretical analysis. The only real tests of the DTV – Unit 1, Unit 2, and Unit 3 at Fukushima, March 2011 – all failed. Three out of three failures is not a good score.

The new and significant information concerning the likely failure of the DTV to prevent containment failure that now must be considered includes:

(1) Properly trained operators decided not to open the DTV when they should have because they feared the effects offsite of significant unfiltered releases;

[1] Pilgrim Nuclear Power Station Individual Plant Examination for Internal Events Per GL-88-20, Volume 1, Prepared for Boston Edison Co., September 1992, pg, 5.0-13

(2) When the operators finally decided to open the DTV, they were unable to do so;
(3) The failure of the DTV to vent led to containment failure/explosions that resulted in significant ongoing offsite consequences.

Prior to Fukushima, concerns regarding the operational safety of the DTV focused simply on accidental releases - measures to assure no single operator error in valve operation could activate the DTV and mistakenly release unfiltered radiation into the environment. Now, after the DTV's first and only real test, it is clear that what is most important is not a theoretical mistaken release; rather the new and significant issue is the likelihood that the DTV simply won't work as currently designed when release is required to save the containment. Both a filter system, and rupture disc must be part of NRC's requirement.

II. FILTERS

A. Introduction

Install filtered vent systems. In an accident like the one at Fukushima, a filtered vent system could reduce the possibility of containment-building explosions, by releasing radioactive gases to the atmosphere through a large filter system. This system traps the most dangerous radioactive species, including cesium 137 and iodine 131, and prevents them from spreading beyond the containment building. A group of nuclear engineers at the University of California originally suggested this idea in 1977. Some countries -- including France, Sweden, and Germany -- have installed filtered vent system at their reactors; and Japan based on lessons learned from Fukushima is installing filtered vents on its reactors. (Bloomberg) The United States has lagged behind and not adopted filtered vents. The NRC has a second chance.

A filtered vent system would also supplement the cooling options available to prevent and mitigate reactor core damage. "Feed and bleed" cooling options – where makeup water is supplied to the reactor vessel, removes decay heat from the reactor core as it warms up, and gets discharged through the safety/relief valves into the suppression pool within primary containment – need some means to remove heat from the primary containment. A filtered vent system enables the containment heat to be removed when other systems have failed to do so.

Fukushima and Pilgrim Watch's filings in Pilgrim Nuclear Power Station's license renewal proceedings (beginning June 1, 2011, Ibid) clearly showed the importance of requiring filtered DTV's in order to:

1. Protect public health in the event that it is necessary to vent.
2. Assure operators follow orders to open the vent. As in Japan, properly trained operators here are likely to decide not to open the DTV when they should because they fear the effects offsite of significant unfiltered releases.

The industry's two main arguments against filtering are:

1. The water in the suppression chamber (wetwell) is an effective filter system.
2. Filters are dangerous because of creating backpressure.

Both arguments are disingenuous.

B. Basis

ACRS is respectfully requested to advise the NRC Commissioners to require that U.S. reactors install filtered DTV's in order to:

- Protect public health in the event that it is necessary to release.
- Assure operators follow orders to open the vent. As in Japan, properly trained operators here are likely to decide not to open the DTV when they should because they fear the effects offsite of significant unfiltered releases.

The industry's two main arguments against filtering are disingenuous. They include:

- The water in the suppression chamber (wetwell) is an effective filter system
- Filters are dangerous because of creating backpressure

1. Lessons Learned From Japan:

The Japanese have learned their lesson from Fukushima and Japan's power utilities plan to install vent systems with filters for nuclear reactors to reduce radioactive releases in the event of an accident; Americans impacted by U.S. BWR Mark I and Mark II reactors deserve the same protection.

Bloomberg - Japan to Install Vent System for Reactors after Fukushima Crisis , Bloomberg, Tsuyoshi Inajima, February 8, 2012 (Attached, Exhibit 6), reported that:

> Japan's power utilities plan to install vent systems with filters for nuclear reactors to reduce radioactive releases in the event of an accident, an industry group said.
>
> The system will cut emission of radioactive particles to less than one-thousandth of usual volumes, the Federation of Electric Power Companies, a group of 10 regional utilities, said in presentation materials at a government meeting yesterday. The companies will also install equipment to remotely vent steam and gas, it said.
>
> Meltdowns and the release of radiation at Tokyo Electric Power Co.'s Fukushima Dai-Ichi nuclear station after the March 11 earthquake and tsunami forced about 160,000 people to evacuate and made areas near the plant uninhabitable. Japan's utilities are trying to improve the safety of nuclear plants, with three of the country's 54 reactors on-line and no date set to resume commercial operations at the others.

2. Suppression Chamber (Wetwell) Insufficient Filter System

The US industry and TEPCO defended their decisions not to add filters to the DTVs by claiming that the water pool in the suppression chamber (wetwell) is as effective as some other kind of filter system that it could have installed when adding the DTVs.

This claim is incorrect. The FILTRA system installed at the Swedish Barsebäck nuclear power station, for example, was **in addition to** any filtration provided by the wetwell pool, not in place of it.[2] Barsebäck had boiling water reactors like in Fukushima and those in the US (the plant has since been decommissioned). Filters were also added to BWRs in Germany and Switzerland.

[2] The filtered venting system under construction at Barseback,1 Aug 1985 **...** A filter venting containment system, bearing the acronym FILTRA will be installed at the Swedish nuclear power plant Barseback. http://www.osti.gov/energycitations/product.biblio.jsp?osti_id=6309422

Furthermore, it's not clear how effective the filter effect of the wetwell on its own really is. A U.S. report from 1988 entitled "Filtered venting considerations in the United States[3]" writes:

> Within the United States, the only commercial reactors approved to vent during severe accidents are boiling water reactors having water suppression pools. The pool serves to scrub and retain radionuclides. The degree of effectiveness has generated some debate within the technical community. <u>The decontamination factor (DF) associated with suppression pool scrubbing can range anywhere from one (no scrubbing) to well over 1000 (99.9 % effective</u>). This wide band is a function of the accident scenario and composition of the fission products, the pathway to the pool (through spargers, downcomers, etc.), and the conditions in the pool itself. Conservative <u>DF values of five for scrubbing in MARK I suppression pools, and 10 for MARK II and MARK III suppression pools have recently been proposed for licensing review purposes</u>. These factors, of course, <u>exclude</u> considerations of <u>noble gases, which would not be retained in the pool.</u> (Emphasis added)

The decontamination factor of 5 for the Mark I containment (as used in units 1 through 5 of Fukushima Daiichi and the 23 in the U.S.) means that <u>80%</u> of the radioactive substances (excluding noble gases) is retained, while <u>20% is released</u>. The FILTRA system installed at 10 Swedish nuclear power plants and one in Switzerland is designed to ensure that in a severe accident 99.9% of core inventory is retained in the containment or the filters.

The difference between releasing up to 20% versus 0.1% is huge; it means up to 200 times more radioactivity is released in the system defended by TEPCO and U.S. BWR Mark I operators versus the enhanced system used in Europe and commercially available worldwide.

Japan has shown that the U.S. industry's and NRC assumptions of the scrubbing effectiveness of the wetwell are wrong. Dr. Frank von Hippel explained over thirty years ago in a briefing to the NRC that,

> For accidents in which the damage is sufficient to open large pathways from the core to the containment, there will not be sufficient water available to trap the radioactive

[3] Filtered Venting Considerations in the United States, R. Jack Oallman, L.G. (Jerry) Human, John (Jack) Kudrick:: http://www.osti.gov/energycitations/purl.cover.jsp?purl=/6945722-maXGrD/6945722.pdf

> materials of concern, nor will the pathway be so torturous that a significant amount wills tick to surfaces before reaching the containment atmosphere. Similarly if the containment fails early enough, there will be insufficient time for aerosols to settle in the reactor building floor.[4]

Further, Dr. von Hipple concluded in *Second chances: Containment of a reactor meltdown,* Bulletin of Atomic Scientists, March 14, 2012[5] that:

> The unspoken argument against requiring that US nuclear power plants be retrofitted with filtered vents was that the industry thought that they were already safe enough and that the expense would be wasteful. And, as today, the commission did not want to force the industry to do more than it was willing to do.
>
> In 2002, the NRC, despite alarming evidence that a pressure vessel had almost corroded through, refused to force an owner to shutdown the reactor for inspection before its regular refueling shutdown. After a review, the NRC's own inspector general concluded: "NRC appears to have informally established an unreasonably high burden of requiring absolute proof of a safety problem, versus lack of a reasonable assurance of maintaining public health and safety."
>
> We failed after Three Mile Island in 1979 to reform the Nuclear Regulatory Commission or force improved containment designs. The tragedy in Japan may have given us another opportunity

3. Backpressure- No Excuse

Industry has argued that filters would be dangerous due to backpressure. Not so. Their argument is about saving money, not safety. Backpressure is an issue, but not an obstacle. Backpressure is an issue that is repeatedly faced at nuclear reactors, and successfully managed. For example:

- In the flow path for water drawn from the condenser and returned to the reactor vessel (BWRs) and steam generators (PWRs), there are filter/demineralizer units that create a backpressure issue.
- In the flow path from the condenser to the offgas stack for BWRs, there are HEPA and charcoal filters that create a backpressure issue.

[4] Bulletin of Atomic Scientists: Containment of a Reactor Meltdown, Frank von Hippel, March 15, 2011, note 16
[5] http://thebulletin.org/print/web-edition/features/second-chances-containment-of-reactor-meltdown

- In the flow path from the secondary containment of BWRS to the elevated release point, there are HEPA and charcoal filters that create a backpressure issue.

The filters impose backpressure because they introduce a resistance to the flow moving through the piping and ducting. To push the flow through the filters requires a differential pressure that would not be present if the filters were not there.

In the case of the condensate paths to the reactor vessel/steam generators, the filters require the condensate pumps installed between the condensers and filters to have greater horsepower to make sure the flow goes through the filters. It costs more money up front to buy the larger motored pumps and then more money to operate them, but those costs are outweighed by the benefits of cleaner/purer water entering the reactor vessels/steam generators.

<u>In the case of the torus vent</u>, if one placed a filter in the existing 8-inch diameter hardened vent pipe, it would result in the pressure inside the containment having to rise to a higher value so as to be able to push the same amount of flow through the hardened vent. This is the backpressure effect. But any engineer worth his or her salt could easily design a system to work despite this effect. This is so by the examples cited. Look at the cases of the condensate filter/demineralizer and the HEPA/charcoal filters already installed at nuclear power plants. They also faced backpressure challenges. In the condensate case, designers did not squeeze the filter/demineralizers into the existing piping. Instead, the existing piping is connected to big metal tanks called demineralizer vessels. They are many feet in diameter and there are typically around 8 of them for a plant the size of Pilgrim. By having water in two pipes flow into larger vessels, the water pressure drops along the way. The backpressure effect is offset by increasing the size of the flow pathway.

In the HEPA/charcoal filter case, the designers did the same thing. The ducting/piping is connected to a larger vessel.

In the torus vent case, a competent designer could install a sand/water/whatever filter system between the connection to the torus and the elevated release point that enabled the desired flow rate to be processed successfully. We understand that it is a ridiculously simple exercise -- the controlling factors are the design containment pressure (which is fixed), the ambient air pressure (which is defined over a fairly narrow range), the specified flow rate through the torus vent line, and the pressure drop across the selected filter media. With these values known, one can easily determine how large the container for the filter media needs to be in order to handle the specified flow rate within the prescribed differential pressure.

It is true that installing filters in the torus vent lines will cause higher pressure inside containment than if no filters were present; but, this is not a "show-stopper." Now, operators are instructed to open the torus vents when containment pressure reaches (x) pounds per square inch (psi). At (x) psi, the opened torus vents keeps the containment pressure below the value that could cause it to catastrophically fail. When the properly designed filters are installed in the torus vent lines, the procedures may need to be revised to guide the operators to open the vent valves at (y) psi (with y psi likely being slightly below x psi to accommodate the backpressure from the filters). With a properly designed filter, the pressure reduction - if any - will be negligibly small.

Therefore, the only reason that a filter could not be installed in the torus vent line is incompetence (capable engineers are unavailable) or cheapness (funds for the capable engineer or their designs is unavailable). We have the skill set to design such a filter system. We simply need the spine to make it happen; we trust NRC will have the spine after Fukushima.

4. Multiple Filtered Designs Available & In Use Today

FILTRA-MVSS (circled) at Forsmark 3, Sweden

One example: Westinghouse FILTRA-MVSS (multi-venturi scrubber system) is described as a passive, self-regulating system for filtered pressure relief of BWR/PWR reactor containments[6]. The system is passively actuated by means of a rupture disc. A typical design basis for the system is a total loss of AC power for 24 hours leading to loss of core cooling ability. This includes a total loss of electrical power from both the external grid and all plat-specific power back-up systems, as well as loss of steam turbine-driven core cooling pumps. It says that

It is designed on Swedish regulations requiring 99.9 % of the core inventory of radioactivity (excluding noble gasses) be retained in the containment or filtered in case of venting; and it has high decontamination factors for gas -carried particles, aerosols and elemental iodines. It is fully passive for at least 24 hours after initial venting and requires no startup time.

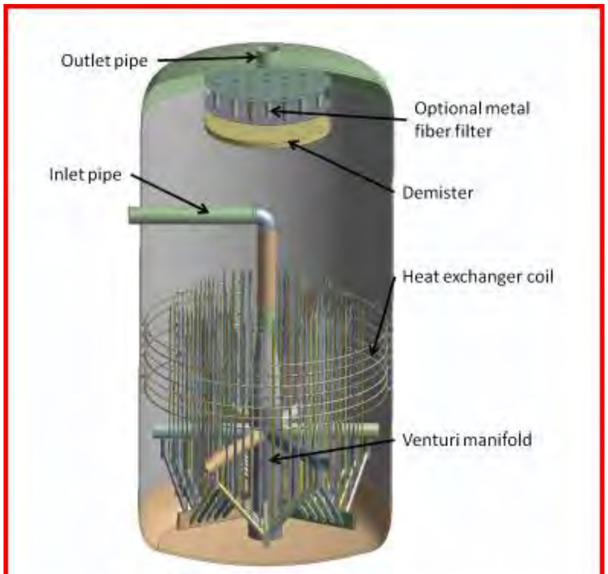
For a BWR, the FILTRA-MVSS would be connected to the hardened vent. The filter consists of several filtration steps, all of which are contained in the tank: the multi-venturi scrubber, a water pool, a moisture separator, and finally an optional metal fiber filter.

Westinghouse describes its benefits as:

- Passive design for at least 24-hours-no operator action required to activate system
- Very high removal efficiencies:
  - Aerosols > 99.00 % decontamination factor (D) > 10,000 with optional fiber filter for smallest particles
  - Elemental Iodine> 99.99% (DF> 10,000)
  - Organic Iodine: > 80% (DF>5)
  - Same DF for all flow rates
- Designed all seismic loads
- Designed wide range postulated accidents
- Ability to avoid and cope with oxyhydrogen combustion
- May be used in feed-and-bleed mode for long-term core cooling

Experience: Westinghouse's FILTRA-MVSS in installed in 10 Swedish NPPs and one Swiss NPP.

[6] http://www.westinghousenuclear.com/Products_&_Services/docs/flysheets/NS-ES-0207.pdf



FILTRA-MVSS system design

IV. REQUIRE RUPTURE DISCS SO THAT NEITHER WATER NOR ELECTRICAL SUPPLY IS NEEDED AND OPERATOR INTERVENTION IS NOT NECESSARY TO ACTUATE THE SYSTEM

A. Basis

1. Rupture Discs: The New York Times reported after Fukushima that[7] five years before the DTVs at the Fukushima Daiichi nuclear plant were disabled by the accident the DTVs were supposed to handle, engineers at a reactor in Minnesota warned American regulators about the very problem. One of the engineers, **Anthony Sarrack**, notified staff members at the NRC that the design of venting systems was seriously flawed at his reactor and others in the United States similar to the ones in Japan. He later left the industry in frustration because managers and regulators did not agree. As Mr. Sarrack said, and Fukushima proved,

> [T]he vents, which are supposed to relieve pressure at crippled plants and keep containment structures intact, should not be dependent on electric power and

[7] *U.S. Was Warned on Vents before Failure at Japan's Plant,* NYT, Matthew Wald, May 18, 2011

workers' ability to operate critical valves because power might be cut in an emergency and workers might be incapacitated.

Mr. Sarrack recommended rupture disks, relatively thin sheets of steel that break and allows venting without any operator command or moving parts when the pressure reaches a specified level. But the NRC gave into those in the industry that argued that if a disk is used that there would be not be a way to close the vent once pressure is relieved in order to hold in radioactive materials – put the "genie back in the bottle." Rather than requiring that such a "way" be provided, the NRC again saved the industry money, and effectively forgot that the major problem that needed to be faced was containment failure.

Rupture discs are provided, for example, on the Westinghouse FILTRA-MVSS described above and used in 10 Swedish reactors and one Swiss reactor.

In a 1988 document, Filtered Venting Considerations in the United States[8] (at 9), it was argued there that "[t]he main restriction by a rupture disc is the inability to vent the containment at low pressures. Postulated reasons for venting at low containment pressure include (a) to reduce driving force from the containment when anticipating vessel failure with an early drywell liner melt-through, b) to remove the containment hydrogen prior to vessel failure and early drywell liner melt- through, and (c) to reduce the containment pressure prior to a high pressure vessel failure to prevent an early containment overpressure failure."

If in fact this is an issue, an easy fix would be a bypass that would likely cost two more valves and extra pipe.

The 1988 document concluded that, "Obvious advantages of a rupture disc system include (a) suppression of venting during design basis accidents and (b) minimizing unnecessary or inadvertent venting."

Further, if the NRC had required a filtered vent, the problem of "clos[ing] the vent once pressure is relieved" would largely alleviate continued release of radioactive materials.

[8] Filtered Venting Considerations in the United States, Oallman, Hulman, and Kudrick, OSTI

A rational requirement would require both filtering and redesign of the DTV venting system to include rupture discs

Further, the opening through containment created by a rupture disc in a filtered vent system is comparable to the containment bypass pathway created when steam generator tubes in pressurized water reactors fail. While the size of the opening may be larger for BWR filtered vent systems (unless multiple steam generator tubes fail), any radioactivity passing through that opening on the BWR passes through a filter before reaching the atmosphere. The flow passing through failed steam generator tubes on a PWR reach the atmosphere with no filtering. The NRC accepts the unfiltered releases through failed steam generator tubes; it should also accept filtered releases through BWR filtered vent systems.

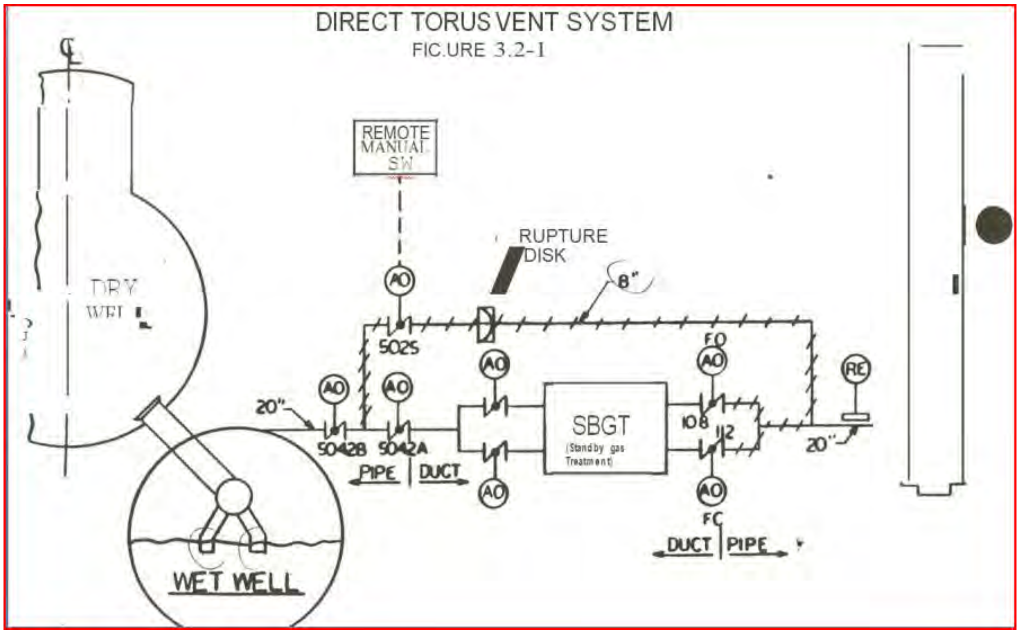
II. PILGRIM'S DTV- HOW IT WORKS- AN EXAMPLE OF WHAT'S WRONG WITH THE STATUS QUO

Pilgrim's DTV is described in Boston Edison's *Initial Assessment of Pilgrim Safety Enhancement, Section 3.2, Installation of DTVS* (Exh.,1) *Attachment to BECO letter 88-126, Section 3.2 Revision 1 "Installation of a Direct Torus Vent System (DTVS)* pages 14,-19B, Rev. 1 (7/25/88) (Exh., 2)

The Initial Assessment says:

> Pilgrim's DTVs provides a direct vent path from the torus air space to the main stack, in parallel with and bypassing the Standby Gas Treatment System (SGTS). The DTVS provides a new 8" line branching off the existing torus purge exhaust line between the containment isolation valves (outside containment) with a reconnection to the existing torus purge exhaust line downstream of the SGTS. The new torus vent line is also provided with its own containment isolation valve and rupture disc, set to relieve at 30 psig.

The following diagram, that shows the branch line with its own containment isolation valve 5025 and Rupture Disc, is included in the attachment to BECO's letter. It will be noted that the Rupture Disc is downstream of valves AO-5042B and AO-5025, and that both of these values are normally closed and are designed to be opened either remotely from the control room or manually.[9]



The accompanying discussion in the BECO letter attachment says, among other things:

- The vent line provides a direct vent path from the torus to the main stack bypassing the SBGTS. The bypass is an 8" line (hatched line in diagram) –the upstream end is connected to the pipe between the primary containment isolation valves AO-5042 A & B. The downstream end of the bypass is connected to the 20" main stack line downstream of the SBGTS valves AON-108 and AON-112.
- An 8" butterfly valve (AO-5025), which can be remotely operated from the control room, is added downstream of 8" valve AO-5052B. This valve acts as the primary containment outboard isolation valve for the DTV line. Test connections are provided upstream and downstream of AO-5025.

- AO-5042B was replaced in 1988 with a DC solenoid valve (powered from essential 125 volt DC) so that it would operate without dependence on AC power. AO-5025 is

[9] Some initial reports indicated that the Fukushima DTV did not include "updates" that were present in US Mark I Reactors such as that at PNPS. Those reports were apparently not correct. Pilgrim Watch's understanding is that the Fukushima DTVs had been upgraded, and are essentially the same as that at PNPS

also provided with a DC solenoid powered from a redundant 125 volt DC source. Both valves are normally closed and are closed in a "fail-safe" position. One inch nitrogen lines are added to provide nitrogen to valves AO-5042B and AO-5025.

- Valve AO-5025 is controlled by a remote manual key-locked control switch. During normal operation, power to AO-5025 DC solenoid will also be disabled by removal of fuses in the wiring to the solenoid valve to assure it cannot be inadvertently opened. The 7/25/88 document said that an additional fuse will be installed to power valve status indication for AO-5025 in the main control room.
- A rupture disc is included in the piping to provide a second leakage barrier. It is designed to open below containment design pressure, but will remain intact up to pressures equal to or greater than those which cause automatic containment isolation during accident conditions.

See also, Chairman Kenneth M. Carr, Responses to Concerns raised by W.R. Griffin, June 21, 1990, Enclosure 2 Possibility Of A Vacuum Breaker Remaining Open (Q.2 Response, pp.,2-3, 5) (Exh.,3)

- Each penetration consists of a vacuum breaker and an air operated butterfly valve in series. During normal operation, valves are closed; the vacuum breaker is maintained closed by the weight of the disc, and the butterfly valve is maintained closed by positive actuator air pressure.
- Therefore, during the entire positive pressure profile of the event, the penetration has two closed barriers in series. It is only during the end of the pressurization phase that the penetration is aligned into its vacuum breaker role. Because of this double barrier protection and the fact the both valves are not expected to change position during the pressurization phase of the event, the staff has concluded that failure of the penetration as a leak tight barrier is not credible and need not be considered in design basis.
- The fact the Pilgrim DTVS rupture disc is designed to rupture at 30 psi is not related to the NRC's recommendation that specified the venting pressure at the containment design pressure. The set pressure for the rupture disc does not

control the venting pressure because there are two closed isolation valves in the flow path.

- These two valves are normally closed and will open manually by the operator if venting is needed. The maximum containment pressure at which the operators are expected to open the vent valve is 56 psig (not 60 psi), which is the NRC recommendation on venting pressure.
- The rupture disc is designed to serve as an additional leakage barrier at pressures below 30 psi. It is designed to open below the containment design pressure, but will be intact up to a pressure equal or greater that those pressures that cause an automatic containment isolation during an accident conditions. Therefore, its presence in the line can effectively eliminate the negative consequences of inadvertent actuation of the vent valves at pressures below 30 psi. The set pressure of 30 psi for the rupture disc satisfies these design objectives.
- The isolation valves, AO-5025 and AO-5042B, are designed with ac independent power supplies. These two valves are powered from essential dc power and are backed up with diverse nitrogen actuation capability. Therefore in case of an SBO event, the valves would be available for venting. The venting concept is mainly designed to slow overpressure transients of the containment. During some ATWS (anticipated transient without scram) events, the pressure in the containment will rapidly increase. Venting pressure could be reached in a matter of minutes rather than hours. Therefore venting may not prevent containment failure because of the high containment pressurization rate but would provide additional time to scram the reactor and delay the core melt.

In other words and greatly simplified, the DTV will vent excess pressure from the containment *only* if normally closed valves AO-5025 and AO-5042b can be opened.

At Fukushima, TEPCO was unable to open the normally closed valves in all three DTV's, and there is no redundancy.[10]

Pilgrim's control room has 2 key locked switches in series that have to be opened manually when the need to use the DTV occurs. If, as happened at Fukushima, the normally-closed isolation valves cannot be opened from the control room, the next step is to try to open the isolation valves manually – but this also proved impossible at Fukushima since radiation levels were too high.

Failed Valves: Pilgrim's DTV isolation valves appear to be essentially the same as those that failed at Fukushima. Supposedly "automatic" systems do fail (as they did at Fukushima) and manual systems may also (both mechanically and because radiation is too high to permit manual operation). Why is there no redundancy?

DC Batteries: *Pilgrim Nuclear Power Station Individual Plant Examination For Internal Events Per Gl-88-20, Volume 1*, Prepared by Boston Edison Co., September 1992 (Exh.4) says that:

- [T] he direct torus vent requires both DC batteries for operation (C.2-10)
- 125VDC Bus (Battery) "A" This bus is required for operation of the direct torus vent. (C.2-14)
- 125VDC Bus (Battery) "B" This bus is also required for operation of the direct torus vent. (Ibid)
- The containment torus venting system would be unavailable if one DC division is unavailable. (C-4-8)

III. CONCLUSION

It is not new that Pilgrim's, or any other BWR Mark I's, containment will not hold up if too much pressure builds up inside nor that U.S. Mark I's like their sister Fukushima reactors

[10] Redundancy, of course, could have been provided at both Fukushima and Pilgrim, e.g., by a parallel vent line with a 50-55 psig rupture disc followed by a normally open valve that would be closed when pressures had dropped to an accept able level, but that would have cost the industry more money.

installed an unfiltered vent to let radioactive gases out in an accident. What is new are two significant pieces of information.

The first is that we now know that an unfiltered vent has unintended consequences beyond poisoning unnecessarily offsite neighborhoods – it makes operators hesitant to use the vent until perhaps too late, upping the probability of containment failure/explosions.

The second is the likely failure of the DTV itself absent being made completely passive by properly installing relief valves as described in the foregoing. Before Fukushima the DTV had not been tested. At Fukushima, DTV systems failed three times in their first real-world tests.

The final cost of the Fukushima disaster remains to be calculated, but it is clearly billions of dollars making these requested fixes cheap. The cost is fully justified; risk for the public will be reduced significantly. Citizens should not be faced with the equivalent of having been assured that we had life boats but not told either that crewman won't launch them or that that they don't float.

Respectfully submitted,

(Electronically signed)
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November 1, 2012

ATTACHMENT

To Filter Or Not To Filter That Is The Question With Only One Sane Answer, David Lochbaum, Union Of Concerned Scientist, 2012

http://allthingsnuclear.org/to-filter-or-not-to-filter-that-is-the-question-with-only-one-sane-answer/

So, the NRC ordered plant owners in 1989 to install hardened containment vents that could stand the high pressures that might occur during an accident.

But this arrangement had its own serious drawback – the valves and dampers connecting the containment airspace with its hardened vent pathway cannot open without electrical power and compressed air. Safety studies performed since the 1980s consistently concluded that accident sequences most likely to require venting the containment involve loss of electrical power and compressed air. So, the hardened containment vents would work during accidents, unless the accidents happened.

So, the NRC ordered plants owners in 2012 to make the hardened containment vents actually workable during accidents.

But this arrangement still has a serious drawback – to harden the containment venting system, the venting pipes were routed around the unhardened filter system and directly to the atmosphere. So if the reliable hardened containment vent is used during an accident, many people may pay a very high price. For while gases released from nuclear power plants during normal operation and during design basis accidents must, by NRC mandate, be filtered, the gases released during more serious accidents are not filtered.

At the NRC's Regulatory Information Conference in March 2012, Commissioner Kristine Svinicki explained why she felt filters were not needed for the reliable hardened containment vents (see video below). Basically, Commissioner Svinicki believes the sequence of bad things that must happen in order to need a filter for containment vents is so long that it will never occur at a U.S. reactor.

But Commissioner Svinicki and all her colleagues unanimously voted to require owners to install reliable hardened containment vents. The long sequence of bad things that must happen before venting is exactly the same length whether the vents are filtered or not – neither one step longer nor one step shorter. Since the Commissioners believe – as demonstrated by their 5-0 vote – that the risk of accident justifies requiring reactors to have reliable hardened containment vents, then that very same risk justifies requiring filters on those vents, to deal with the radiation from the accident that the vents were needed for in the first place.

Conversely, if that risk is not high enough to require filtered venting, then it is also not high enough to require unfiltered venting.

Actually, the issue is wicked simple.

Under normal operating conditions, when BWRs operate above 5% power, gaseous releases are processed through *high energy particulate air* (HEPA) filters and charcoal filters that significantly reduce the radioactivity content discharged to the environment (Figure 1).

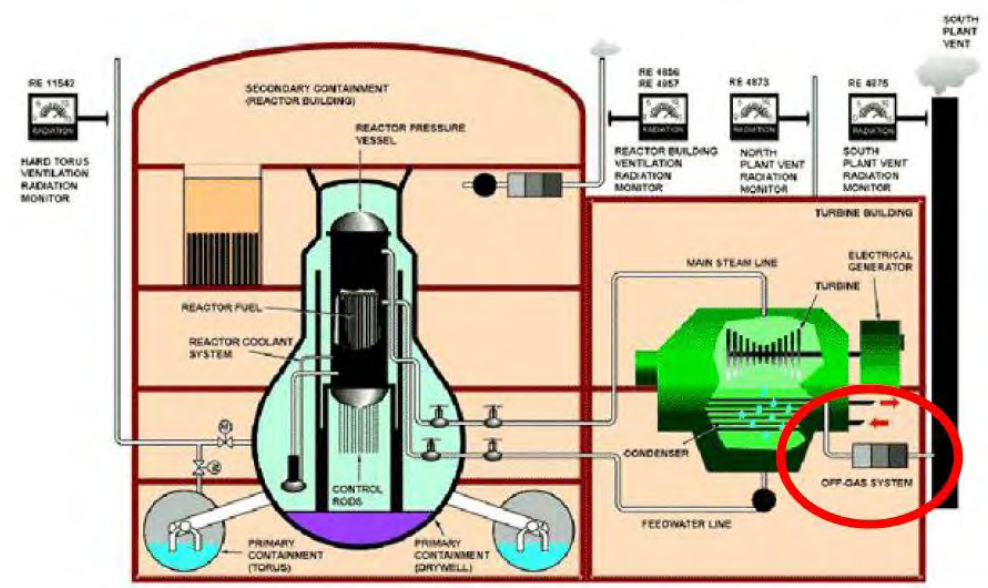

Figure 1

During design-basis accidents, gaseous releases from BWRs are processed through another system with HEPA and charcoal filters that significantly reduce radioactivity levels being discharged. The design objective of this filter system is to remove over 99% of the radioactive particles (Figure 2).

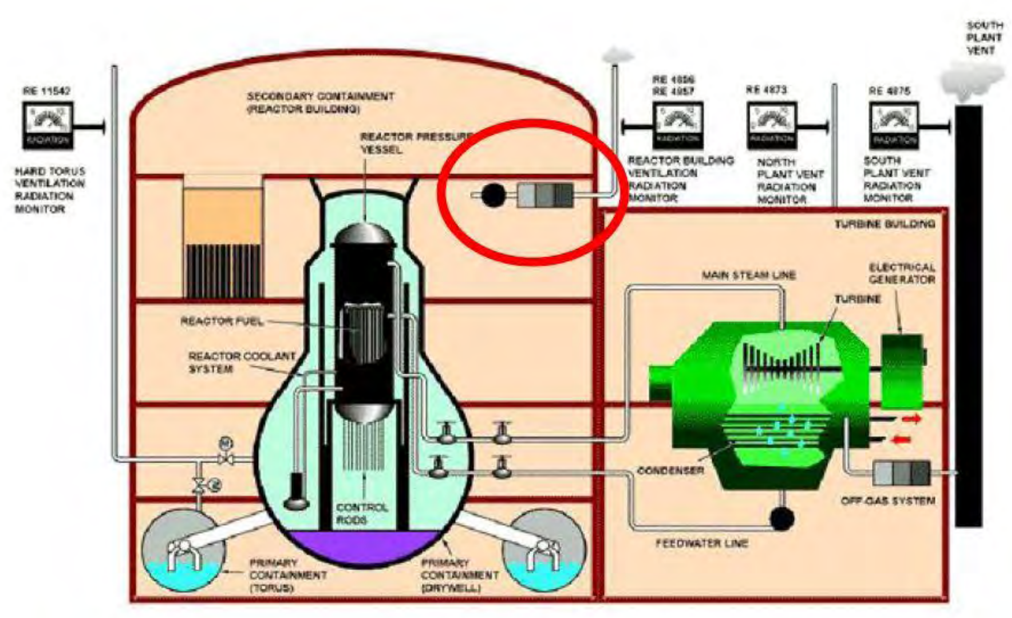

Figure 2.

But during severe, or beyond-design-basis accidents, gases released via the BWR reliable hardened containment vents do not pass through HEPA filters or charcoal filters before being discharged (Figure 3).

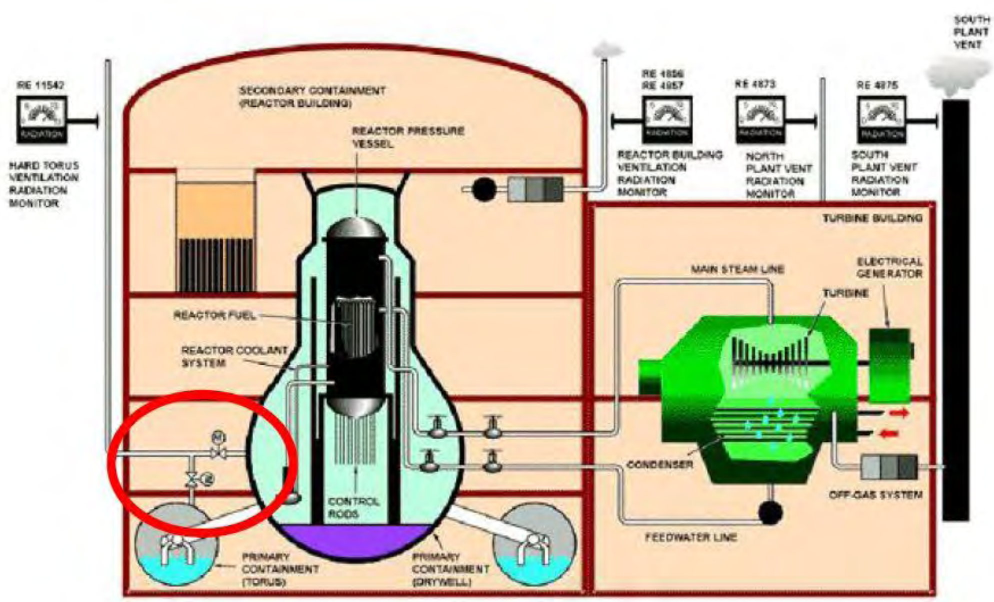

Figure 3.

So, when the radioactivity level to be released is as high as it ever gets, the absolute least amount of protection against it is provided (Figure 4). That's indefensible – and all too simple to remedy.

Relative Scale	Normal Operation	Design Basis Accidents	Severe Accidents
Amount of Radioactivity	Smallest	Medium	Largest
Amount of Filtering	Highest	Highest	Lowest
Threat to the Public and Workers	Smallest	Medium	Largest

Figure 4.

In 1989, the NRC ordered BWR owners to install hardened containment vents.

In 2012, the NRC ordered BWR owners to install reliable hardened containment vents.

This leaves the NRC one order shy of getting it right.

The public is not protected by hardened containment vents.

The public is not protected by reliable hardened containment vents.

The public is only protected by filtered reliable hardened containment vents.

It may take the NRC three orders to get it right.

The NRC will not be serving the American public well if it takes 23 years or more to write and issue this third order. The NRC must get it right now.

If justice delayed is justice denied, filters delayed is protection denied.