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U.S. NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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513TH MEETING

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THURSDAY,

JUNE 3, 2004

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The Committee met at 8:30 a.m., in Room T2B3, White Flint North, Rockville, Maryland, Dr. Mario Bonaca, Chairman, presiding.

MEMBERS PRESENT:

MARIO BONACA	ACRS Chairman
F. PETER FORD	Member
THOMAS KRESS	Member
DANA POWERS	Member
VICTOR RANSOM	Member
STEVEN ROSEN	Member
WILLIAM SHACK	Member
JOHN D. SIEBER	Member
GRAHAM WALLIS	Member
SAM DURAISWAMY	Designated Federal Official

STAFF PRESENT:

MEDHAT EL-ZEFTAWY ACRS Staff

C O N T E N T S

P R O C E E D I N G S

(8:30 a.m.)

CHAIRMAN BONACA: Good morning. I'll go through my reading while they're preparing the presentations.

So this meeting will now come to order. This is the second day of the 513th meeting of the Advisory Committee on Reactor Safeguards.

During today's meeting, the committee will consider the following:

NRC staff response to March 17, 2004 ACRS report on the AP1000 design;

Proposed revisions to standard review plan, Section 5.2.3, 5.3.1, 5.3.3, regarding reactor vessel materials and reactor vessel integrity and process and schedule for revising various SRP sections;

Future ACRS activities and report of the Planning and Procedures Subcommittee;

And preparation of ACRS reports.

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

We have received no written comments or requests for time to make oral statements from members of the public regarding today's sessions.

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

During lunchtime today, we are scheduled to interview three candidates for potential membership on the ACRS. WE will be interviewing the remaining two candidates for potential membership tomorrow at lunchtime.

With that, we will move on the first item on the agenda. That is staff response to the ACRS report on the AP1000 design, and Dr. Kress will lead us through this presentation.

DR. KRESS: Thank you, Mr. Chairman.

Just a reminder to the members. Our March 17th letter outlined a number of items that I guess we could view as like ACRS, requests for additional information, things we wanted to hear more about how the staff and Westinghouse dispositioned them.

We have already heard on several of those items, and we are going to hear some more on the remaining ones.

I would also like to remind the members that we are getting near the end of this process, and on June 25th, I hope your calendar shows it. We are having an Advanced Reactor Subcommittee meeting on the final SER. To me that and the June meeting of the full ACRS represent our final go-round on this, and we'll end up writing our final letter.

So if you have lingering questions, lingering things that you want to get off your chest, why today is the time and June 25th is the time.

With that, I guess my understanding is that we are going to start with Westinghouse this morning.

MR. BURKE: Dr. Kress, Brian Burke, manager of licensing for the AP1000 at Westinghouse.

Our purpose today in the Westinghouse presentation is to give the committee additional information and our perspective on Issues 5, 6, and 7 related to severe accident issues, and Bob Hammersley from our FAI group is our spokesman.

DR. KRESS: Thank you very much.

We remind the members that Issues 5, 6, and 7 were the question of the potential for pure coolant interactions in case in-vessel retention doesn't work.

And six was the question of whether you could produce significant organic iodine in the containment as the film flows down the wall and that exceed 10 CFR 100 under the design basis.

And seven was the potential for catastrophic type failure on a free standing containment vessel.

MR. HAMMERSLEY: Good morning. My name is Bob Hammersley, as Brian said, and I'm going to present the responses for five, six, and seven, and I'm going to wait a second.

(Laughter.)

MR. HAMMERSLEY: Okay. To start with, we thought we'd put these issues in the perspective of the safety goal risk measures because we have worked very hard, of course, to establish a good risk profile for the AP1000, and some of the issues, statements express some interest in the relationship of those issues to the safety goal measures.

So the NRC safety goal policy statement is focused towards no significant risk through the life and health of the public, and the metric for that, of course, is that the fatality and cancer risks should be less than a tenth of a percent for the sum of their causes.

And the numerics for that in terms of quantitative health objectives is risk of prompt fatalities of 5E to the minus 7 correct for year and latent less than 2E to the minus six.

DR. KRESS: Do you know where the five times ten to the minus seven comes from?

MR. HAMMERSLEY: I'm told it comes from a reference document that's used to prepare the slide, the first one.

DR. KRESS: Somehow it seems to be based on the number of automobile deaths that you have per year.

MR. HAMMERSLEY: Yeah.

DR. KRESS: Which is a strange connection.

MR. HAMMERSLEY: Yeah. This, of course, pick up all of the kinds of fatalities that an average person experiences like getting here today or getting home.

DR. WALLIS: Everybody dies sometime.

MR. HAMMERSLEY: Right.

DR. KRESS: Oh, this is accidental deaths.

DR. POWERS: But you haven't as yet.

MR. HAMMERSLEY: These are all active anyway. I thought you mean the specific number of --

DR. KRESS: Yeah, I know the reference. There was a Sandia report.

MR. HAMMERSLEY: For the AP1000 PRA results, we looked at five different risk categories, such as early, intermediate, late containment failures and bypass containment isolation failure, and it quantified the frequency of each of those, and it quantified the source term associated with each of those.

Then we used the MAX code to determine the latent and current fatality incidences associated with those source terms.

DR. KRESS: Did you use some sort of fictitious site?

MR. HAMMERSLEY: Yes, and different population densities and different radii leaving it. So that --

DR. KRESS: I don't even know what ten to the minus 11 is.

MR. HAMMERSLEY: Small.

(Laughter.)

DR. KRESS: It's pretty small. That's right.

MR. HAMMERSLEY: So, of course, we then derived the risk profile for the AP1000 by multiplying the consequences by the frequency of each of those release categories and then summing them all up.

So the kind of numbers that we would obtain for the AP1000 design are E8 to the minus 11 and E to the minus ten, which of course are approximately three orders of magnitude less than the quantitative health objective for the numerics.

DR. KRESS: Was a containment failure by steam explosion screened out of that?

MR. HAMMERSLEY: No, I think it was --

DR. KRESS: It was included as part of it.

MR. HAMMERSLEY: Right, right.

So we conclude then if the AP1000 comparison safety goals show, of course, that additional uncertainties associated with severe accident analysis, such as those you've been discussing today, can readily be tolerated without challenging the safety goal measure. We'll come back and revisit these slides at the end.

So the first issue, number five, summarized on this slide, relates to the exothermic, intermetallic reactions leading to vessel failure that produce a fuel co-interaction ex vessel greater than that currently evaluated, and ACRS would like to view our models in the containment response as to why it doesn't fail.

DR. KRESS: That's a pretty good wrap-up of our issue. I think we were wanting to see what initial conditions you use for the melt when it entered the water.

MR. HAMMERSLEY: Okay. The FCI analysis submitted for the AP600 and included in its certification was used as a basis of going forward with the AP1000. So the details on AP600 on the slide indicate that the Texas code was use to determine the FCI loads that would be experienced in the reactor cavity.

DR. KRESS: I hesitate to ask this question because it's an ACRS type question that just usually runs people up the wall, but do you know what database Texas has been qualified to?

MR. HAMMERSLEY: I don't recall the exact experiments. I know it was compared against some experimental measurement, but I don't recall that. It's been a while sine I ran that.

DR. KRESS: You know, so the thermal hydraulic analysis to deal with design basis accidents, we got a great lance to show that the codes are qualified by proper integral experiments. We hardly look at FCI codes.

MR. HAMMERSLEY: Right.

DR. KRESS: The relationship to the experiments and whether they're qualified or what the models in them are.

MR. HAMMERSLEY: Right.

DR. POWERS: But then we get statements like FCI doesn't fail containment, period.

DR. KRESS: Yeah.

DR. POWERS: Guaranteed 100 percent, no chance of anything else.

DR. KRESS: And so the question is how do we react to that.

DR. POWERS: I know how I'd react.

DR. KRESS: Yeah, but this is sort of a side discussion that the ACRS has had.

So continue.

MR. HAMMERSLEY: The failure mode that was limiting for that analysis was we call a side pinged failure of the RPV. That is to say the interface of the lower hemispherical head and the cylindrical portion of the RPV. The vessel was considered to fail, either just a hinge failure so that we had an immediately large pour like a cauldron just being dumped out or also a failure mode where you just sort of punched a hole in it and sort of burned your way down along the side of the vessel.

It affected the pour rates, looked at a variety of the materials in terms of a metal layer or EO_2, et cetera. It looked at a range of super heats, and I seem to recall several hundred degrees of super heat to smaller amounts of super heat in terms of the conditions of the material released into the reactor cavity.

When these loads were applied then to the containment structural response, the upper bound containment vessel strain that was determined based on them resulted in a strain of the steel shell of the containment of about 3.8 percent, and tests on vessel material show that strains to the capacity of the metal is about 22 to 32 percent strain for an alternate load.

So based on that kind of margin in the strain capacity of the material and the estimated amount of strain induced by the FCI, it was included that the FCI vent failed the containment. It's an integrity of folding fission products in. It would get some local damage to the concrete which would not be a metal membrane.

DR. POWERS: With a three percent strain you don't run into anything in the shield wall that just pokes a hole in the steel vessel?

MR. HAMMERSLEY: No. The base mat was due to the cracking as a result of this, and so underneath the floor area of the reactor cavity/reactor containment was, quote, damaged by that event. It cracked it.

So then we were relying on the strength of the steel shell to maintain this entirely.

DR. POWERS: But, I mean, there's nothing coming through the concrete sticking out that just pokes a hole?

MR. HAMMERSLEY: No, in that region there's obviously rebound in the concrete, but there's not penetrations or access caps or hatches or --

DR. SIEBER: Or steel rods.

MR. HAMMERSLEY: Right. Like I said, there was rebar of course.

DR. WALLIS: Well, remind me of this containment. There's a steel thing with a concrete outside of it?

DR. KRESS: Annulus in between.

MR. HAMMERSLEY: Right.

DR. WALLIS: And the concrete, I mean, 32 percent strain in concrete sounds bizarre.

MR. HAMMERSLEY: No, this is in the steel vessel.

DR. WALLIS: Okay. So the concrete just falls off and then the steel blows up like a balloon?

MR. HAMMERSLEY: Well, it can't fall away because it's --

DR. SIEBER: There's space.

MR. HAMMERSLEY: Right.

DR. KRESS: If the vessel didn't have concrete around it, then it could stand that much strain before it tails --

MR. HAMMERSLEY: Right.

DR. KRESS: -- but if the concrete is there, it would just butt up against it.

DR. SHACK: Well, the vessel material could stand that much strain. When you look at the Sandia integral test, what's the sort of strain that you get to failure before they go there, where you have, you know, more complicated geometries and localization?

You know, I'm pretty sure it isn't 22 to 32 percent.

DR. KRESS: Does anybody know?

DR. POWERS: Somehow the number eight percent comes to mind, but I don't know.

DR. KRESS: Did you want to say something, Rich?

MR. LEE: About Texas.

DR. KRESS: Yeah, okay.

MR. LEE: This is Richard Lee from Research.

You asked about the Texas code validation. We have validated the code against like farrels (phonetic), quotas, and so forth. Also, we are still currently involved with the CS&I Serino (phonetic) program, which are continuing to evaluate the FCI models and experiment with how large is that base, how good it is a calculation. So Core D is still involved with that one.

DR. KRESS: Yeah, my experience with those is that you can backfit the code to it pretty well, but a blind prediction doesn't do very well. Is that a reasonable --

MR. LEE: Well, that is what the CSI wants to find out, is how well can you predict instead of keep fitting it backwards.

DR. KRESS: Yeah.

MR. LEE: So that was one of the tasks, and is still going on for a year or two.

DR. KRESS: Is there a document we could see on that?

MR. LEE: I have to ask. It's unfortunate that Suit Pursuit (phonetic) is not here because he is actually at a Serino meeting in France.

DR. KRESS: We'd like to see that document if we could get it.

MR. LEE: Sure.

DR. WALLIS: Now, this 3.8 percent, this isn't just a spherical balloon or a cylinder. It's attached to a base mat, right?

MR. HAMMERSLEY: Right.

DR. WALLIS: And as it begins to distort, it bends presumably where it's attached to the base mat. So the local strain is much bigger at the place where it bends. Doesn't it snap off the base mat before anything else, before it breaks as a balloon?

MR. ORR: Can I address that question? I'm Richard Orr. I'm responsible for the AP1000 structural design.

The particular evaluation that was done here, the steam explosion results in an impulse load on the bottom of containment. The failure we're looking at is effectively -- the containment vessel is sandwiched between two layers of concrete, and the pressure impulse causes a failure of the concrete base mat. A roughly 40 foot diameters plug of concrete moves down into the ground, and the 3.8 percent strain in the vessel is the stretching of the vessel as the plug is pushed down into the ground.

The calculations show --

DR. WALLIS: It's a vertical stretch.

MR. ORR: It's actually the center plug of concrete on a soil site deflects downwards by about six inches.

DR. WALLIS: And that's the 3.8 percent. It's the concrete.

MR. ORR: The 3.8 percent is the strain. The steel vessel is not anchored to the concrete. It slides relative to the concrete, and there is sort of a discontinuity in the concrete that the vessel has to bridge across. That's what the 3.8 percent strain is calculated from.

DR. FORD: So the 3.8 percent is the local strain on that bridging area?

DR. WALLIS: Yes, and it bulges out into the hole left by that concrete. Is that what it does?

MR. ORR: No, because, as I say, the containment vessel is sandwiched between two layers of concrete. Both layers of concrete and the vessel move down, but there's a 45 degree crack in the concrete that the steel vessel has to bridge across.

DR. FORD: I'm sure somebody has asked this question as a what if type question. What if the steel was corroded? In other words, it did not have its as built structural integrity. Is that such an outlandish scenario?

MR. ORR: I think all of the data available on steel in concrete shows that concrete is one of the best corrosion preventers that there is, and there's six feet of concrete, a minimum of three feet of concrete above the vessel, anywhere from six to 20 feet of concrete below the vessel. So there's no potential really for air flow or water flow.

The steel vessel is inch and five-eighths thick. We do not expect significant corrosion.

DR. WALLIS: So we go back to this 3.8 is the strain at the place where the strain is the greatest.

MR. ORR: That's correct.

DR. WALLIS: Now, first of all, I think it is growing like a balloon, this 3.8, but it's nothing like that at all. It's a local maximum strain.

MR. ORR: Yes.

DR. WALLIS: Thank you.

MR. HAMMERSLEY: Right, localized load.

So the AP600 analysis was then applied for the AP1000 containment. Based on the similarity of the vessel lower heads geometry being the same, then the lower plenum debris characteristics in terms of the materials, three super heat conditions of material coming out, and finally the same dose of failure modes, that is, like a hinged side failure.

There is one of those differences that since the vertical height of the AP1000 pressure vessel is larger than the AP600, the bottom of the lower head of the AP1000 is closer to the floor of the reactor cavity by about half a meter, approximately one and a half meters distance between the bottom of the RPV and the floor of the reactor cavity for the 1000 versus two meters for the 600.

And then the AP600 analysis, since we looked at side failure, that is, a hinge failure, the floor height for the debris and entering the flooded reactor cavity is about four meters for this one radius, plus this two meter difference.

DR. KRESS: What's the implications of the hinge failure versus some other kind of failure?

MR. HAMMERSLEY: I'm sorry. Of the bottom? The implication would be the amount of material that would be --

DR. KRESS: It limits the amount?

MR. HAMMERSLEY: Yes.

DR. KRESS: Do you have a slide showing us how much material was assumed in the Texas calculation, how much metallic amount and how much --

MR. HAMMERSLEY: No, I didn't personally.

DR. KRESS: You don't have that, but that's in --

MR. HAMMERSLEY: I can provide the information, but I don't.

DR. KRESS: Yeah, we'd particularly like to know in your sensitivity analysis how much super heat you had, how much melt was assumed in the calculation. Well, basically those two things.

MR. HAMMERSLEY: Okay. Okay. So I believe that these findings in terms of the mean failure mode and these simulators that are consistent with the NRC staff's findings as well.

So we come to the issue of lower metal layer exothermic reaction scenario. We view that as challenging the vessel bottom, the heavier metals in the bottom and attacking the vessel wall. We view the vessel bottom failure as not the limiting case versus the side failure location because, as I mentioned, the bottom of the vessel is closer to the floor, limits the premixing volume of interacting materials during the FCI event, and the debris participation in the FCI for the bottom failure is viewed as being less because we get similar pour rates through a catastrophic failure of dumping the ladle as the bottom one that we took (phonetic) and there's simply less time for the material to be entering before it encounters a solid surface, which is viewed as figuring the FCI event.

So we concluded that the lower metal layer exothermic reaction failure scenario is bounded by a side hinge failure scenario and, therefore, for the AP1000 we believe that the AP600 results are also applicable and we wouldn't induce containment failure.

DR. KRESS: Well, you know, these are all assertions about what the calculations show and have no reason to doubt them.

I would like to see the calculations. Is there a document that we can go to? Where do we find the actual calculations for this?

MR. HAMMERSLEY: Calculations for the AP600, I'm sure, are in that Westinghouse document control. I don't know --

MR. ORR: They are documented in the AP600 PRA.

DR. KRESS: PRA for AP600.

MR. ORR: Appendix B, as in Boy.

DR. KRESS: Okay.

MR. HAMMERSLEY: I believe that probably answers your question, too, about super heat.

DR. KRESS: Yeah.

MR. HAMMERSLEY: Okay. The second issue for discussion today, Issue No. 6, is organic iodine production where we're considering the acidification of the containment as a result of radiolysis. Again, the material could rise to significant airborne fission product form, in gaseous organic form, and we need to review, you guys need to review what we did about this potential.

We view the formation or organic iodine as resulting from radiolysis organic materials. It involves the availability of elemental iodine, and so we just focus on the generation of the availability of elemental iodine because of the behavior of these films running down the --

DR. POWERS: So you discount totally the idea that you could form gas phase organic iodine?

MR. HAMMERSLEY: No, we didn't ignore that.

DR. POWERS: You'll describe your gas phase modeling then someplace else?

MR. HAMMERSLEY: Yes.

DR. POWERS: Okay.

MR. HAMMERSLEY: So we looked at elemental iodine that could potentially be produced from the conversion of I minus in the water pools of films where the pH is not controlled greater than seven, and we note that for the AP1000 containment design, it does include pH control agent trisodium phosphate for the water pool that collects in the lower compartment and the reactor cavity following the accident.

But there was no specific pH control treatment for the condensate films or any bound of containment dome and shells provided. So we have steaming going on, condensate collecting on the walls and running down, possibility of that being acidified or materials being deposited in it that acidifies it, and there is no treatment of any materials hanging on the walls or something to try to treat that film explicitly.

Cesium iodine, of course, can be deposited on those films and provide a source of I minus that could potentially be converted in the films to elemental iodine given the film was acidified.

DR. KRESS: The major removal mechanism in the containment was diffusiophoresis and thermal phoresis onto the walls?

MR. HAMMERSLEY: That's correct.

DR. KRESS: Okay. So all of the cesium iodine that gets released in a severe accident goes to the walls?

MR. HAMMERSLEY: Right. If you look at the relative contributions of those two deposition mechanisms and this gravitational like sedimentation, about 80 or 90 percent of the deposition is because of diffusio and thermal phoresis.

DR. KRESS: That's what I thought I caught.

MR. HAMMERSLEY: We looked at, therefore, a range of the film residence time, which of course depends on the steam condensation rate, which is varying over this accident because it is really following the PK heat curve in terms of an energy source to make the skin. So the residence time limits the amount of acidification and iodide deposition that could be placed in those water films.

Our estimates are the resident time range from 40 to 260 seconds and that was based on condensation rates that are varying from like 29 to 2.3 kilograms per second.

So this is just a little graphic sort of summary of what we're looking at. We're looking at steam being evolved because of PK heat available in the RPV and condensing on the shelves and running down.

Of course, it gets collected in RWST where it gets either returned to the RPV or the reactor cavity. If it carries any fission products that are deposited in it or acid producing, of course, down in the pool is TSP excreted.

The radiation field that's produced in the containment because of the source term being released can, of course, interact with these water films and perhaps lead to some acidification due to the nitric acid formation of any air that's dissolved in that. So we considered that.

We considered the fission product deposition, especially cesium iodide because that's the source of the I minus, but other, of course, chemical species would be deposited. We --

DR. POWERS: You considered only nitric acid formation in the liquid film or did you consider nitric acid formation in the gas phase dissolving in the liquid film?

MR. HAMMERSLEY: This assessment only looked at the liquid film.

DR. POWERS: But the nitric acid is

actually being formed in the gas phase. In fact, I don't know of radiolytic formation in the liquid phase.

MR. HAMMERSLEY: You say you don't know of it?

DR. POWERS: No. I mean, the typical scenario for nitric acid formation is that you're forming a nitrous oxide in the gas phase that's quite soluble and will go into the liquid film. But I don't think there's any radiolytic. I simply don't know of a radiolytic reaction of nitrogen in water resulting in the formation of acid. There may be. I don't --

DR. KRESS: That's my experience, too, Dana. It comes out of the gas phase and forms there first.

But continue. Did you come up with a pH number from the film?

DR. WALLIS: So that it is clear, you say that the nitrogen goes in and then turns to an oxide in the liquid? Is that where your model is?

MR. HAMMERSLEY: We have used the radiation G value for the generation of nitric acid.

DR. WALLIS: In the liquid?

MR. HAMMERSLEY: In the liquid.

DR. WALLIS: You haven't -- so you are

directly in conflict with what probably happens.

MR. HAMMERSLEY: That's the way we estimated the films.

DR. POWERS: Well, I understand that. I cannot say that I have a comprehensive understanding of radiolytic aqueous chemistry. I guess I'm reasonably informed on it. I'm just unfamiliar with an aqueous phase formation. I'm very familiar with quite a lot of work on G values for the gas phase formation of nitrous oxides that subsequently go into solution forming nitric acid. Quite a large number of studies on that, in fact.

I just don't know for the aqueous stage.

DR. WALLIS: Is the only source of acidity nitrogen?

PARTICIPANTS: No.

DR. WALLIS: There are all sorts of sources?

MR. HAMMERSLEY: Yes.

DR. WALLIS: And they're all small compared with the nitrous oxide?

MR. HAMMERSLEY: No, not really. We also looked at the radiolytic decomposition of the jacket materials on the electric cables, pipelines of material. So when it's exposed to a radiation field, it can be decomposed, and one of the products would be hydrochloric acid in terms of being in the gas form.

So what we would have is cable trades filled with bundles of cables, and of course, they are distributed to through the containment and would be exposed to the radiation field generated in the containment, and when they interact with this jacket material to produce some HCl, which of course had to escape the jacket material matrix and would encounter then a water film on the jacket because of condensation going on in the containment as well as probably water dripping off of different horizontal surfaces of the containment dome, et cetera.

Even if HCl could escape that, it could enter into the fuel bundle, cable bundles and into these interstitial spaces. Of course, some of it might, of course, be produced in the upper layers of it and have an easier path to escape the cable trays.

In this sketch I showed an open cable tray. About 40 percent of the cable trays in the AP1000 design are actually covered. So it would just be another area for the HCl to get out.

We estimated the HCl escaping and such that then it would mix, is soon to mix in forming in the gas space in the containment and be carried to the film, if you will, by the condensation process. So we looked at two sources of acidification, nitric acid and HCl, by this kind of process.

DR. WALLIS: The boric acid is all neutralized in the sump; is that it?

MR. HAMMERSLEY: The boric acid is in the sump. That's right.

DR. WALLIS: It's all neutralized so that it doesn't get up in the vapor?

MR. HAMMERSLEY: Right, because the TSP

DR. WALLIS: Sure.

MR. HAMMERSLEY: Yes. The vapor that is used coming out is steam, without chemicals being carried out the top of the dome, et cetera.

So we looked at the draining film that could be acidified by either a formation of nitric acid or deposition of HCl, and of course, we recognize that during the course of this accident, the radiation field in containment varies as the fission products are released over about a two-hour period according to the source term definition. They decay radiolytically, and then, of course, they're removed by the various deposition mechanisms and then drained into the pool.

So there's a varying radiation field

during this accident.

DR. POWERS: Do you have an idea what that field is?

MR. HAMMERSLEY: You mean what type of field it is?

DR. POWERS: Yeah, what kind of dose rate you're getting.

MR. HAMMERSLEY: The dose rates range from about seven megarads per hour to about an order of magnitude less than that.

DR. POWERS: Yeah, at this change of field.

MR. HAMMERSLEY: Right.

DR. POWERS: And so you have a dose response for the hypalon?

MR. HAMMERSLEY: Yes.

DR. POWERS: And whose is that?

MR. HAMMERSLEY: It comes from actually, I think, an ORNL report.

DR. POWERS: Oh, okay. So it's Ed Dean's stuff.

MR. HAMMERSLEY: Yes.

DR. POWERS: Yeah.

MR. HAMMERSLEY: Okay. So we do those assessments. We estimated a range of pH values due to nitric acid generation of 5.6 to 6.5, and a lower bound on the 4.8 to 6.7 due to HCL deposition. During approximately the first ten hours of the accident, during that time there was a, quote, significant I minus concentration in the film by the deposition process.

DR. POWERS: That is quite a concentration.

MR. HAMMERSLEY: Right.

DR. POWERS: A million gram-moles per liter?

MR. HAMMERSLEY: I'm sorry. Typo. Thank you, Dana.

PARTICIPANT: So what is it supposed to be?

MR. HAMMERSLEY: It should be ten to the minus six.

(Laughter.)

MR. HAMMERSLEY: I think the films would probably stick.

DR. POWERS: Probably exceed the saturation limit there someplace.

MR. HAMMERSLEY: Be like paste or something, but once it gets less than like ten to the minus six or so, the conversion of I minus to I2 falls off because that process looks at the amount of I minus that's available as well as the pH of the solution.

So we know that a very small integral amount of cesium hydroxide -- we estimate about 270 grams -- deposited on the aerosol film would be sufficient to neutralize all of the nitric acid in the HCl deposited or residing in the film over this ten-hour interval, and we try to put that in a perspective, which I'll come to in the next slide. That would be a very small fraction, about a ten of a percent, of the potentially available cesium hydroxide in the core inventory.

DR. POWERS: Now, the difficulty with the argument, of course -- I mean, the advantage of the argument is nobody can say that you won't have a tenth of a percent of the cesium hydroxide or of the cesium converted by the cesium hydroxide that's below the resolution of anybody's predictive capability.

MR. HAMMERSLEY: Right, right.

DR. POWERS: Though the disadvantage of the argument is there's a whole heck of a lot of other stuff coming in there which can affect the pH, as well.

MR. HAMMERSLEY: Correct.

DR. POWERS: I mean, I don't know how to react to this.

MR. HAMMERSLEY: Right, and so this slide talks about the fact that there is a whole range of chemical species that are involved in the source term. We simply note that in the past cesium hydroxied --

DR. POWERS: I've just got to tell you that "specie" is not the singular of "species."

MR. HAMMERSLEY: Okay. If we looked at the cesium being partially tied up, if you will, or combined with the iodine, the total inventory of iodine that would be shut down in the AP1000-4, there would be cesium available to form as much as 373 kilograms of cesium hydroxide. I'm not saying that much is formed. I'm just saying it has the potential.

But the point is that several orders of magnitude different than what would be required to be neutralized in the --

DR. POWERS: I mean, I think you're on safe ground if you say, "Look. I've got 373 kilograms coming in. You can tell me all about the wonderful chemistry of cesium hydroxide. You'll never convince me that .1 percent is not cesium hydroxide."

I think that's a very sound argument. The problem is now you've got to say, "Nothing else coming in there affects the pH other than the things I take into account." I think that's a more difficult argument.

DR. KRESS: It's much more difficulty, and I basically was expecting to see let's assume the pH is five and calculate, use some sort of analysis to say what that would result in terms of the amount of organic iodine produced, which requires some other assumptions. And I was hoping that would give you a bound that you could live with so that you didn't have to make this argument.

MR. HAMMERSLEY: We do make those arguments, too. I'm just trying to put it in perspective.

DR. KRESS: Okay.

MR. HAMMERSLEY: And to your comment, Dana, I did look at a little bit of Phoebus FPT-1 tests, and it was interesting to note that when they did wash all of the containment deposited aerosols off the floor of the containment into the sump, they did see a small up tick.

DR. POWERS: Yeah.

MR. HAMMERSLEY: It wasn't like, you know, two pH units.

DR. KRESS: I don't think you can scale

the --

MR. HAMMERSLEY: No, I'm not trying to. I'm just saying that --

DR. POWERS: It's not a small increase. It's an order of magnitude increase in the hydrogen ion concentration. Unfortunately I don't think it has anything to do with reactor accident phenomena

DR. KRESS: That's right.

DR. POWERS: All right.

MR. HAMMERSLEY: And also it's an aggregate of all the chemical species that were laid down there.

DR. POWERS: I mean, the analysis just running through here, the numbers are putting together, hanging together. If you agree that you're producing only about a little over one and a half moles per hour of HCl out of the hypalon.

MR. HAMMERSLEY: And delivering it to the film, right?

DR. POWERS: Yeah, and delivering it to the film, yeah. Then -- okay. I mean, I don't know the answer to that one at roughly a megarad dose.

DR. KRESS: Yeah. Now, Ed Beam's work put the hypalon in the liquid.

DR. POWERS: Yeah, he did, but his number doesn't depend on that, and his number is actually -- I mean, you can look at the stuff they do on cable embrittlement and you come up with dose numbers not wildly different from Ed's number.

There's been some recent work in Sweden that's kind of interesting that suggests, yeah, it's all true for the first 25 percent of the hypalon, and then after that it tails off, but they don't know why it tails off or not, but I don't think that affects this because I think he's working on the first 25 percent.

MR. HAMMERSLEY: So then based on this assessment, we would just note that a very limited amount of cesium hydroxide could neutralize the film, and so that would lead to the expectation that the film's pH was somehow greater and wouldn't get much conversion to elemental iodine or organic iodine generation in the film.

DR. POWERS: The elemental is a viable thing. The step to go to organic is a little more challenging.

MR. HAMMERSLEY: Right. What we did then is say, well, let's look at a sensitivity study and assume that the amount of cesium hydroxide that gets to the film is zero.

DR. KRESS: Okay. That's what I was looking for.

MR. HAMMERSLEY: Yeah, and try to go through where that would take us in the mechanic consequences all the way out to a dose kind of number.

DR. KRESS: Yeah. Now, that second bullet kind of is your savior, I guess. You're really in design basis space. In design basis space you don't have to calculate on this, but you know, we were interested in severe accidents.

MR. HAMMERSLEY: Right.

DR. KRESS: And your savior there, I think, is the low probability of occurrence.

MR. HAMMERSLEY: Correct. It would be a very, very rare or minor contribution.

DR. KRESS: So, you know, we have to separate our thinking in terms of design basis space. Where are you going to specify source term? That's been accepted, and in severe accident space is what we're now thinking about and now you probably may be saved just by the low probabilities.

That's just the perspective I wanted to give to the members.

MR. HAMMERSLEY: Okay. I'll move through these next couple of slides rapidly then and move on to the next issue.

In that regulatory design basis source term, a three percent conversion of the elemental iodine is treated as being converted to organic iodine, but we're going to continue to use that three percent conversion to address if we put elemental iodine out there, how much of it turns into organic?

DR. KRESS: In other words, you're using the accepted source term for design basis accidents.

MR. HAMMERSLEY: Right, and this is exactly the sourcing that was used for the design basis dose assessments for the AP1000.

And then when I look at having no cesium hydroxide and the potential for acidifying the film would affect this source term definition and then the dose consequence of that.

So we went through some steps to look at, okay, if we looked at the this draining film and we looked at the kind of pH levels that we were estimating, and the iodide concentrations that we got which ranged up to almost ten to the minus three down to ten to the minus six or less, that even if we considered an instantaneous conversion from I minus to I2, okay, what would be the impact of that?

We just note here that some of the

regulatory research suggests that we could take a period of a few hours to pull an equilibrium condition, and these films' residence times are short compared to that. They're like minutes.

So we're not convinced we have complete conversion. Okay, but we simply assumed that we did get instantaneous conversion, and when we looked at the conversion fractions, again, from the Oak Ridge report in terms of the concentration in pH, given the fraction of I minus converted to I2, for the film conditions that we calculated, we saw that as you might see zero concentration of iodide got so small to maybe half of it being converted into elemental iodine.

But for this sensitivity study, it simply said that the conversion fraction is 100 percent. So in effect, we have disassociated ourselves from the significance of the pH of the film. One hundred percent of its pH is like around three or so. So that we're just simply saying, okay, we're really just depending now on how much of the iodide is positive on the film.

We did take credit for partitioning of the iodide or of the elemental iodine, rather.

DR. WALLIS: So you've thrown away all of the analysis and you just assumed that the conversion fraction is one?

MR. HAMMERSLEY: That's correct, at this point.

DR. WALLIS: Could have done that from the beginning.

MR. HAMMERSLEY: We could have.

DR. KRESS: Well, and how we sort of taken a little bit of a turn here in the sense we've discounted the potential for this to be organic iodine, and now we're talking about I2. It's just elemental iodine. So organic iodine has a different partitioning coefficient if you could convert it in the liquid phase.

MR. HAMMERSLEY: Well, to get a partition coefficient between the aqueous and gaseous molar concentrations of the elemental iodine in the film through this expression, which is only dependent on the film temperature.

And we conservatively estimated the film temperature as being the saturation temperature for the partial pressure the steam is changing. So we didn't even try to recognize there was actually a temperature gradient through the film and some mean film temperature expected. We simply used the TSAT for that.

And when we did that, then the fraction of I2 gas in the film is assumed to be all released -- that is in the gaseous form -- is assumed to all be released. That would add approximately 6.4 percent of the iodine aerosol would be, quote, released per the design basis source term.

So the design basis source term says that 95 percent of the iodine is in aerosol, and we're saying that 6.4 percent of that could end up being converted into elemental iodine being released from these untreated films if there was no cesium hydroxide in them.

But a three percent conversion of the elementals to organic form would cause the source term to increase from .15 percent of the iodine being in the organic form to .33 percent, would almost double it.

We simply note that part of the elemental iodine that remains in the film is flowing on the containment surfaces, namely, the dome and the shell that are inorganic paint. And in fact, in their dry state, they're like 85 percent zinc or something.

So we don't believe it's a source of organic material right from those coatings that would be during this draining time available to be producing organic iodine in those films.

We note that in the sensitivity study there are several conservatisms because we're sort of like in -- well, we are sort of moved into the design basis phase thinking from our original severe accident space.

Of course, the core melt event itself has a low probability, 2E to the minus seven or thereabouts for the 1000. Considering the source term, that included three percent conversion of elemental to organic, and I think the three percent is a conservative number. Plus we have enhanced it now by this assessment.

And so a containment leak rate, this was done assuming that a maximum containment leak rate applies for the first 24 hours of the accident, does not credit the fact that the containment pressure would be decaying over time and, therefore, the drive-in potential for the leakage would also increase in proportion to that.

The most conservative weather conditions were used to quantify the chi over Q. So we have a very limiting chi over Q for translating this leak source term to different source calculation points.

We said we didn't have any cesium hydroxide at all in the film, and for the control room part of the dose calculation, no operation of HVAC, which of course would remove some of the fission products that are escaped into the control room, nor resupply of the compressed air until seven days.

So there is a three-hour supply of compressed air available for the operators. So in this assessment, the fourth through seventh day, that wouldn't be available, and we didn't say that it was reestablished, nor was the HVAC retrieved in that period of time.

So the impact on the doses of this additional organic iodine at the site boundary, those changes from 24.7, 7.1; the LPZ, 22.8 to 23.16; and the control room, 4.8 to 5.07 per the sensitivity study.

DR. KRESS: Now, the quantity of iodine that you're putting in the container, was it all put in instantaneously at the start of this and then let it decay by the leak rate? Because I'm picturing you could have a dynamic throttle where amounts going on versus -- so I can't imagine how you would get that number.

MR. HAMMERSLEY: Right. The source term

spreads out the --

DR. KRESS: Oh, you put it in according to the specified source term.

MR. HAMMERSLEY: Right, correct.

DR. KRESS: Okay. That would be another way.

MR. HAMMERSLEY: Right. So what you've done here now is taken what is normally the design basis source term and enhanced it by this to say, well, the design basis source term was developed for other kinds of PWRs and say should we change it for the AP1000 and how much should we change it with respect to iodine and does it make any difference? That's pretty much your story here.

MR. HAMMERSLEY: That's right, and we conclude that the impact on the doses when we do enhance the organic iodide in this fashion can be accommodated by the margins that exist in the AP1000 design and substance.

DR. KRESS: Well, thank you. I pretty well understand what you've done then.

MR. HAMMERSLEY: Okay, okay. The third issue, issue seven, was related to catastrophic failure modes for the containment due to over pressure, and such that a rapid depressurization potentially resuspending freedom packs (phonetic) have been deposited or settled out.

It's noted that the configuration right in the issue statement, that the configuration of the AP1000 with the test fully has a containment and a baffle right around the containment, but nevertheless, with fission product first term impact in terms of the safety goal satisfying it was part of the issue first, and that's why I put together the first couple of slides in terms of the risk perspective profile of this plant.

In order to get a catastrophic failure by over pressure of an AP1000 containment, it had to have a failure of the cooling water system involved in the passive containment cooling system. So failure of the cooling water containment vessel is estimated to be about ten to the minus six per demand, and that even with that loss of cooling, the likelihood of a catastrophic over pressure failure is approximately two percent. So you have to have really adverse weather conditions that still retard the amount of energy that can be removed. So we have two percent failure, given that the PSC cooling has failed and no operator actions are taken to compensate for that.

So this event now in the risk profile is like a ten to the minus eight, and on top of that you have to have core damage, which is like a ten to the minus seven, so very low probability of occurrence of a catastrophic failure of the AP1000 containment.

It would take hours to get an over pressure condition, and during that interval, the operators could take preventive actions, and several preventive actions have been identified. The viability of those would be sort of event dependent. Some of them like climbing up and opening the valves may or may not be viable given the radiation levels that could exist at the time.

But these possibilities are recognized in the severe accident guidance procedures, which helps improve the reliability of these success paths of these other operator reactions made to reestablish the cooling or vent the containment before its catastrophic failure.

In terms of mechanistically looking at the impact of the depressurization, rapid depressurization, we looked into some of the work that had been done and became aware of some of the work in the SIDCOR (phonetic) Program that looked specifically at resuspension being caused by rapid depressurization of containments following a catastrophic failure, and this program was based on both analytical and some experimental work that looked at the ability to resuspend the positive and settled particles, both, quote, dry and wet, so to speak.

And we then looked at the range of the containment volumes and the catastrophic break sizes that were included in that study to see if it had applicability to AP1000, and we find that it does. This program looked at containment volumes up to like 73,000 cubic meters. The AP1000 has about 60,000 cubic meters.

We looked at the same range of plate sizes from a meter to ten square meters in terms of the --

DR. KRESS: Did these resuspension studies include potential for flashing of water and the steam that flashes carrying with it some fraction of the fission products in the water?

MR. HAMMERSLEY: Consider those as being more like local effects that wouldn't sustain the particles to be suspended such that they could be carried out of the containment through the break. You might locally, you know, stir up the pot and get a dust storm, you know, from the mechanical process like that, but it would not be sufficient to cause it to actually be taken out of the containment.

If you're playing off, the bigger the failure, the more rapid the depressurization, the higher the velocities, but the shorter the interval that hey would be applicable. So you have to sort of look at a spectrum of the tradeoffs there.

DR. WALLIS: What's the basis of this ten meters squared, ten square meters?

MR. HAMMERSLEY: In the, quote, catastrophic failure assessments that have been done for the AP1000, typically we pick a meter squared, just as a big oh, and the reason is that for a rapid depressurization, then if a rapid release of the fission products or the source term, but we get an early, large release.

The ten meter squared is simply a sensitivity study kind of number that we said --

DR. WALLIS: If it's really catastrophic, it could conceivably be 100.

DR. POWERS: In some uncertainty work that Dr. Kress organized for looking at large containments, one specifically for the AP600, he did a sensitivity study and found that as they increase the size of the hole, as they got to a region between one and ten square meters, things didn't change very much.

DR. WALLIS: And so making it bigger

wouldn't make any difference.

DR. POWERS: Won't make any difference.

DR. KRESS: It really depressurizes it in a hurry.

MR. HAMMERSLEY: It was also observed that wetted deposits are hard to disburse than dry deposits.

DR. POWERS: That one continues to interest me, intrigue me because I think it's true if you're talking about just velocities over a film. It think it's not true if a wetted film suddenly depressurizes and flashes.

DR. KRESS: Yeah, that's the reason I asked the question about the flashing. You know, you can make a lot of liquid droplets airborne with flashing, and those droplets are going to contain their concentration of fission products.

DR. POWERS: One of the things that never ceases to fascinate me is to know that the rupture of a bubble film produces the highest natural accelerations on the face of the earth, on the order of 10,000 Gs, and so it breaks off things and sends them flying.

DR. KRESS: Makes them small, sends them flying.

DR. POWERS: I mean, that's why you get salt aerosols coming off the ocean.

DR. KRESS: That's why I asked the question of whether the SIDCOR study included that phenomenon.

DR. WALLIS: Surface tension acting on no mats essentially.

MR. HAMMERSLEY: Of course, inside the AP1000 we expect relatively wet conditions either in the films -- this appears to me as being a longer term issue like even for the films. I don't know that there would be a lot of material left in them because of the deposition process. So most all of it would be in the pool, either floating around or dissolved or settled out.

Based on the core study and the similarity of the range of parameters that it used, we concluded that AP1000 catastrophic containment failure would not significantly enhance the fission product source term, and significant would be put in terms of the risk significance. Due to the very, very small frequency of the catastrophic failure itself it could tolerate a change in the source term that would not cause the risk profile to be significantly altered.

DR. KRESS: Even if you released all of

the iodine at that low a frequency, you're probably still within the safety per se.

MR. HAMMERSLEY: We didn't try to specifically quantify the, quote, change in the source term. We think it would be limited, but in the risk profile the event has such a low frequency that we don't think it would challenge the kinds of margins that we have demonstrated here.

DR. WALLIS: To put some numbers on these expressions like "significant" and "greatly reduces" and so on, "would not significantly enhance," it would be good if you could actually put a number on it, if you know more clearly what you meant.

DR. KRESS: With a rule of thumb you could just take the ratio of the amount of iodine released and multiply the risk by it. So this number, the four times ten to the minus 11 actually comes out from a number that you get with a -- I don't know. Your source term comes out a MAX for that, I guess.

MR. HAMMERSLEY: I think the source term is quantified in MAAP, and MAX is used to do the fatality.

DR. KRESS: Yeah, the MAAP gives you the source term for that.

MR. HAMMERSLEY: Right.

DR. KRESS: And I suspect that's a pretty low amount of iodine in there, but even if you made it a factor of ten more, your risk is still pretty low.

MR. HAMMERSLEY: Right.

DR. KRESS: Even if you made it a factor of 100, the risk is pretty low. You're really saved here by the low probability, low frequency.

MR. HAMMERSLEY: So that's simply the point we're making here again, is that because of the margins of the safety goal, that the uncertainties with these issues are quite powerful, challenging the safety goal conclusion for the AP1000.

DR. KRESS: And for the severe accidents, I guess that's the only criteria we can use.

MR. HAMMERSLEY: Right. Thank you.

DR. KRESS: So let me see if I can --

MR. HAMMERSLEY: That's the end of my presentation.

DR. KRESS: Yeah. -- see if I can capitalize this. For the FCI, you did enough sensitivity studies with the AP600 and the Texas code to show that your containment still doesn't fail, and these sensitivity studies would cover a relatively wide range of metallic melt poured at a certain rate with a certain super heat.

MR. HAMMERSLEY: Right.

DR. KRESS: And that sensitivity might cover what you would expect in the uncertainties of the AP600 and AP1000.

MR. HAMMERSLEY: Right.

DR. KRESS: But the iodine, you showed the low potential for organic production, but you went ahead and enhanced it by a certain amount anyway, and you also enhanced the I2 source term and showed you still stayed within 10 CFR 1000 in design basis space.

MR. HAMMERSLEY: That's right.

DR. KRESS: And for the sensitivity study on severe accident source terms, the potential for catastrophic containment failure you said probably wouldn't enhance the source term much, and even if it did, your low probability keeps you within the safety goals.

MR. HAMMERSLEY: That's right.

DR. KRESS: Well, I appreciate it.

MR. HAMMERSLEY: Thank you.

DR. KRESS: I guess now it's time for the staff to give us their viewpoint on some of these. Now, I think staff was going to talk about all seven issues.

MR. SEGALA: Yeah, just give a quick

overview of the seven issues.

DR. KRESS: I don't know if I'd call them issues or just items for further discussion might be a better characteristic.

MR. SEGALA: Okay. Good morning. I'm John Segala. I'm the lead project manager for the AP1000 design certification application.

I'm going to try to go through my slides pretty quickly. I'm going to give a quick status of where we are in our review, some major milestones coming up, and provide an overview of the issues in your letter.

What I'd like to focus on on this slide is May 18th we provided a response to your interim letter. We've also on May 25th sent you the advanced copy of the final safety evaluation report, which has received branch chief concurrence, and the document is currently in our Office of General Counsel for review.

Really quick upcoming scheduled milestones. On June 25th we have the future plant design subcommittee meeting, and July 7th through 9th, I don't know which day it is yet, the full committee meeting, and on September 13th, we're going to issue the final SER and the FDA.

All right. The first issue in your letter was ADS squib valve function. In the summary, you agreed with the staff that the ITAAC assures that the valves meet their design basis specifications.

In our response to you, we summarized what we discussed at the last full committee meeting. It's a simple design, meets ASME, Section 3 of the ASME code, has redundant diverse actuation, and we did a PRA sensitivity study that showed even if you increased the failure rate, it didn't make much difference on the PRA results.

And there were ITAAC that had Bill to do a type test for the ADS squib valves to insure that they perform.

The next issue was sump screen blockage. In your letter you pointed out the robust design of the AP1000 design to prevent screen blockage, and you recommended an ITAAC to insure compliance with the generic issues.

In our response, we discussed the ITAAC that are in the AP1000 DCD. There's ITAACs for the location of the plates above the containment recirculation sump. The screen surface area, the type of insulation that's used, the location of the bottom of the containment recirc. sump screens, and the dry film density of the coatings.

There's also COL action items that we have. That's a containment cleanliness program COL action item, and there's also a COL action item to have the COL applicant perform an evaluation consistent with Reg. Guide 1.82, Rev. 3. It will also consider chemical debris and applicable research and testing.

But we concluded that, you know, based on the design and the cleanliness program, the minimal fibrous material, that we consider the screens capable of accommodating the debris.

Issue three, code deficiencies. This was regarding the thermal hydraulic evaluation, the models that we did in NOTRUMP and RELAP, and their issue was when we identify deficiencies that we should do some sort of research study to correct these.

AP1000, the work we did for that did identify deficiencies in both NRC and Westinghouse's codes, but Westinghouse was able to bound those. The staff has, although we didn't use TRACE code for AP1000, we're using the APEX AP1000 data as well as ATLATS and UPTF data to assess the TRACE code, and if desired, when we complete our work on that, we could discuss a schedule where we could present that to you.

DR. KRESS: Maybe Dr. Wallis can correct

me, but I think the nature of our issue here was that Westinghouse calculations worked around these deficiencies and bounded them, and on that basis we could approve the analyses, but the deficiencies were still in the code that they use, and now the question was is there some mechanism by which Westinghouse should fix their code to correct those deficiencies.

Can you refresh my memory on that, Dr. Wallis?

DR. WALLIS: We felt comfortable with saying, well, when the code doesn't work, you devise some other method. That means that you accept, somehow always recognize when the code isn't working.

DR. KRESS: Yes.

DR. WALLIS: It would be much more satisfactory to say we'll fix the code so that we don't have to face this issue.

DR. KRESS: Yeah, and we were talking about fixing Westinghouse,

DR. WALLIS: About fixing all of the codes.

DR. KRESS: All the codes. Okay.

MR. SEGALA: Because I think, you know, 5046 doesn't require that they have one code that does everything. So from a meet the regulations standpoint what Westinghouse did was satisfactory.

DR. KRESS: Yeah, I think we --

MR. SEGALA: I think from the staff's point of view, we're going ahead and reassessing our codes to make sure that --

DR. WALLIS: Well, we felt uncomfortable with the fact every time you come up with a new design or a new situation, you run the code. You have to be alert for the situations where the code isn't doing a good job, and then if you have to work around it, and that's not a very satisfactory tool for evaluating reactor safety if you have to sort of be alert all the time for when it isn't doing a very good job and perhaps work around it.

DR. SIEBER: Well, there was another issue, which I think of as a continuity issue where you run the code for a while and then you determine that the code is not functioning properly in doing the calculations. So you insert a bounding calculation in that space and then assume that when the code begins to function again that there's continuity from the point where it stops to the point where it started again.

And to me it wasn't clear that -- I guess I became convinced that it was okay after we talked about it enough, but it wasn't clear to me in the beginning that there was this degree of continuity, that one could assume that the code had, even though it had not performed properly through a portion of the calculation.

So I think there is that additional subtle factor.

MR. SEGALA: I think what we tried to do when we had Westinghouse revise the DCD, as well as our FSER, to try and make it clear exactly what the evaluation model is.

DR. SIEBER: Right.

DR. WALLIS: Anyway, we will be hearing more about the TRACE code as part of our review RES' work, and I'm sure that we'll ask them for these assessments. I don't think our comments will hold up AP1000, though I suppose if this works, every time that we see codes drawn we might say now we've had enough of this with working around codes. You're going to have to fix them for good.

MR. SEGALA: Okay.

DR. SIEBER: Or make your reactor vessel taller.

MR. SEGALA: Issue four from your letter was this issue on verifying Pi group range of .5 to

2 as appropriate. This range has been used as a de facto standard in scaling analysis. This issue is generic. We don't think this is an issue specific only to the AP1000, and the staff plans to develop and document procedures to define appropriate Pi group ranges.

DR. KRESS: What is the status of those plans?

MR. SEGALA: What is the status of those plans, Steve?

This is Steve Pajoric from the Office of Research.

MR. PAJORIC: This is Steve Pajoric from Research.

What we are planning on doing is, and when we're completing our documentation of the scaling evaluation, we're going to include a section in that document to discuss the range of the Pi groups.

There's two things that we're looking at at trying to get some foundation on this. One, to develop a procedure that when you define a Pi group and you see something that is close to a limit -- let's say it's two in this case -- how you would evaluate its impact on the scaling evaluation.

We had done that once with Barino

DiMarzo's more of a simplification of the entire system in order to range the parameter that affected that Pi group and see its impact on the full scale plant. What we'd like to try to do is to write down this procedure and how you would do this from period to period within a transient.

DR. KRESS: I think one of our worries was that you might be on the edge of a regime change, and in going from one of these Pi groups, from the prototype to the actual test, that you might change the regime and make a markedly different change in the kind of behavior, thermal hydraulic behavior, he has.

So is that part of your thinking on --

MR. SEGALA: That's part of our thinking, although, you know, we've got to admit that's going to be something that's very difficult to try to address.

DR. KRESS: Because it's going to be specific to the kind of -- I mean, the idea is, I think, you're going to develop a procedure for looking. You're not going to actually come up with a Pi group range. I don't see how you could come up with one.

MR. SEGALA: No, I don't think it is going to be a -- no, the limit is .5 to 2.2 or anything. It's --

DR. KRESS: No, I think you're going to come up with a way to determine whether or not for this specific application that that's appropriate and doesn't skew your results too far.

MR. SEGALA: Yes.

DR. KRESS: Well, that's what we were looking for.

MR. SEGALA: And the other aspect of that as well is with this bottom-up scaling approach. There, where you're looking at the individual processes, that's probably the place you're more likely to identify one of these bifurcations.

In fact, I think in AP1000, that's really how we came upon the liquid entrainment issue. We were below some threshold. Then as we looked at higher superficial gas velocities in the vessel and in the loops, suddenly it looked like you were above some threshold.

DR. KRESS: Made a quantum change.

MR. SEGALA: Yes.

DR. WALLIS: These Pi groups don't really capture bottom-up regime changes, do they? They're not like -- these Pi groups are dimensionless groups that come from the equations.

DR. SIEBER: Right.

DR. KRESS: Yes.

DR. WALLIS: And so some of that would be captured in the code. The code running through a set of Pi groups would show transitions to --

DR. KRESS: That may be part of the procedure.

DR. WALLIS: But it wouldn't show changes in fundamental regime due to some dimensionless group.

DR. KRESS: But anyway, we will look forward to reviewing this, and it's an interesting subject, and I think it has relevance for certification of the reactor designs.

MR. PAJORIC: And I think as John pointed out it is a generic issue and that we'll see the same thing in ESBWR ACR700 as we have to deal with other scaling issues.

DR. KRESS: That's why we'd like to see something relatively soon on it.

MR. PAJORIC: Okay.

DR. KRESS: Okay. Thank you, Steve.

MR. SEGALA: And issue five, in vessel retention, fuel coolant interactions, Westinghouse gave a presentation on that. The staff provided you a copy of ERI's report. I think you may have gotten that yesterday.

DR. KRESS: Yeah. We haven't had time to read it yet.

MR. SEGALA: Haven't had time to review it.

In general, the report, our FCI analysis considered a bottom failure scenario where metallic melt at a higher super heat may be released, and we concluded that ex vessel FCI for AP1000 would not challenge containment integrity.

Our contractor has a backup slide presentation if you're interested in seeing it.

DR. KRESS: Does it have the initial conditions that he used? What code did they use, your contractor?

MR. SEGALA: The contractor?

MR. SANKATIRI: Mo Sankatiri from ERI.

For the FCI calculations for AP1000, we used PM alpha SPROS code, which was developed by Professor Theophanis (phonetic). This is the same tool which was used also for AP 600. At that time we also used the Texas code as well.

DR. KRESS: Does your backup slide have how much pour rate you assumed and --

MR. SANKATIRI: Yes, yes.

DR. KRESS: -- the super heat?

MR. SANKATIRI: We have all of that information in the backup slides. I think there's a copy available. We'll be happy to give it to you and also present the material if you're interested.

DR. KRESS: Well, I'd like to have a copy of the slides.

MR. SANKATIRI: Certainly. We'll pass it on to you. There's a copy around. I'll give it to you.

DR. KRESS: Okay. Thank you.

MR. BAHADUR: There's two presentations here.

MR. SEGALA: That's just one of them. We have the other one over there as well. The other presentation should be in the box as well.

DR. KRESS: Yeah, you can continue. We'll look at these later.

MR. SEGALA: On the organic iodine issue as well, Westinghouse discussed that. What Westinghouse presented to you today on their sensitivity analysis we had a public meeting with them yesterday, and that was the sort of first time that we had seen that.

So we're planning to perform an audit of that sensitivity analysis within the next week, and it may or may not result in us performing independent analyses.

If desired, we can present our findings of our evaluation on June 25th.

DR. KRESS: Yeah, I think you ought to plan on doing that.

MR. SEGALA: Okay.

DR. POWERS: I mean, I just ran through a quick and dirty calculation, and I make no claims of high accuracy, but when I assume something like a megarad per hour dose rate to the atmosphere, I get something like three/thousandths of a mole of nitric acid per second forming, which means over two hours or one and a half hours of the major source term you'd be putting up about 15 moles of nitric acid into that solution versus their 1.5 moles of cesium hydroxide.

Presumably if memory wasn't failing I could do a back-of-the-envelope calculation on the nitric acid, but I come up with different numbers on this.

DR. KRESS: So you would conclude that it's likely --

DR. POWERS: Well, I don't conclude anything, Tom. I conclude that I ought to look at it a little closer.

DR. KRESS: But the implications are it could be acid.

DR. POWERS: Well, you have to understand that the lower pool has trisodium phosphate.

DR. KRESS: Yeah, the lower pool is buffered.

DR. POWERS: Buffered, and typically if you don't have a lot of hypalon in the containment and you just confine to ten hours, you very seldom neutralize the trisodium phosphate over ten hours. You usually nail it in about 24 hours or something like that. So you're really looking at this film argument, and that's a great place to look.

You also need to look at the recent stuff, which as we're getting direct conversion on paint --

DR. KRESS: Even this zinc coating.

DR. POWERS: No, I don't know of anybody that has tested the zinc coating. It takes conventional.

DR. KRESS: You wouldn't expect it to convert much.

DR. POWERS: Well, not having much organic and having a little bit of --

DR. KRESS: Well, it has to have impurities in it.

DR. POWERS: Having a little bit of organic are about the same in some of these cases, but I mean, I just can't say. I don't quite understand the --

DR. KRESS: What you know is tested then.

DR. POWERS: Maybe. Well, I think the thing to do is do something like they did do, which is say, okay, suppose it is as bad as it is. You know, then what does it do?

DR. KRESS: Yeah, that may be --

DR. POWERS: I mean, iodine is always a problem because you calculate, and you say, okay, I've got three percent iodine converted into organic iodide, and now I release that.

Well, that's fine, but now you still have three percent of your organic iodine in the containment. I think it just keeps on turning.

DR. KRESS: It keeps coming, yeah.

DR. POWERS: It just keeps generating itself. I mean, what you release doesn't --

DR. KRESS: It's a steady source.

DR. POWERS: Yeah, and so you have to be very clear. I mean iodine is always a problem that way, and so they have a different mechanism, nitric acid, than I'm assuming here, and I'm just not familiar with their mechanism. I don't say it's wrong. I am just not familiar with it.

DR. KRESS: We look forward to your review.

DR. WALLIS: Does this mean we want to hear evaluation on June 25th?

DR. KRESS: Yeah.

DR. WALLIS: You do?

DR. KRESS: Yeah, I think so. We want to hear what the staff thinks about it.

MR. SEGALA: Okay. Issue seven, Westinghouse also discussed our review. We looked at the frequency of catastrophic containment failures are small. We discussed this in the letter, and in general, resuspension would not have a noticeable impact on the Commission's safety goals.

DR. KRESS: In that bullet did you consider the splashing effect as part of the resuspension or did you rely on the edcorithane (phonetic) also?

MR. SEGALA: Bob, do you?

MR. PALLO: Yeah, this is Bob Pallo, PRA Branch.

We really kind of look a look at the frequency of these events that we're dealing with. We didn't try to -- we hadn't previously assessed this. We can look at it in the SER, but we know the frequencies are extremely small, and what we did is we just took a look at like some of the 1150, NUREG 1150 source terms for some of the most severe source term categories and looked at the consequences.

And if one goes and looks at the probability to an average individual within one mile and ten miles in those calculations for a severe source term, and we looked at like an IS LOCA type of a release that had like --

DR. KRESS: About 50 percent of the --

MR. PALLO: I t was actually like 70 percent cesium, well, 80 percent iodine, and the individual probabilities of prompt fatalities are like .03 in the individual probability of latent cancer fatalities, .002 for even these severe releases.

So you take that and say even if this resuspension or for that matter the inorganic iodine issue. If you dialed it up to the huge release fractions, you take it in conjunction with the low frequency of events, and you still have at least an order of magnitude safety goals. So that's our answer to that.

DR. KRESS: Okay. Thank you, Bob.

MR. SEGALA: Okay. In our letter, we also provided responses to some comments that you made that weren't necessarily issues. There was a comment on materials where you made a comment saying ongoing future studies may suggest material and environmental changes that will be addressed at the CLL stage.

And all we did in the letter was describe the change process that was in Part 52. I wanted to make it clear that this wasn't something that was really simple. Oh, we just changed the material properties and we're done.

This is a standard design, and there's a change process that you have to go through.

For aerosol removal, you made a comment that you look forward to reviewing the staff's aerosol removal analysis. We provided that in the response to you, along with some curves. We have a backup presentation if you'd like to hear it, but --

DR. KRESS: I think we have time if you would present that to us.

DR. FORD: Could I just come back to the materials? The tone of your reply saying it's difficult to do, I don't read into that that the staff would not aggressively push if there were changes in the understanding of, for instance, the weldability of the 52, 152, or the stress corrosion resistance of 690, which is going to be materials of choice currently.

If there was not changes in our knowledge as we go forward, the staff would not aggressively push either the vendor or the reactor designer would attack these problems, depending on what Part 52 says.

MR. SEGALA: If there was a significant issue, we would pursue making those changes. All I described is that there is a process that you have to go through. It's not something --

DR. FORD: And regardless of how difficult it is, it would be done.

MR. SEGALA: We would do it if there was a safety issue there.

DR. FORD: Okay.

MR. SEGALA: Okay. Just in general, we're still on schedule to meet the September 13th due date to issue the FSER.

DR. WALLIS: So what is going to happen on June 25th?

DR. KRESS: We're going to review the draft of the FSER mostly, and then they're going to maybe produce or give us their impression of a couple of these issues, the organic iodine, for example, and

I think that's about it.

DR. WALLIS: Do we have this draft SER?

MR. SEGALA: Yes, we just received it.

DR. WALLIS: You have it somewhere?

MR. SEGALA: Yes, we just got it, and you have it.

DR. WALLIS: It's the same as the one I had some time ago?

MR. SEGALA: No, no, no. This has just been received last week.

DR. WALLIS: Oh, it's in the mail or something?

MR. SEGALA: Yes.

DR. WALLIS: Because I get these CDs with no labels on them and the box is unlabeled and I don't know what they are.

DR. SIEBER: This one had a label.

MR. SEGALA: This one has a label.

DR. WALLIS: Okay.

MR. SEGALA: We elected not to give you hard copies because we didn't want to burn that many trees.

DR. POWERS: And then we're going to look at this SER on the 25th.

DR. KRESS: The 25th.

DR. POWERS: And then in July you're going to try and write a letter on this?

DR. KRESS: Yes, that's the plan, and that may be our final letter.

DR. POWERS: And where you're just really cutting down on the amount of time we have to examine this.

DR. KRESS: Yeah.

DR. POWERS: Boy, I'm nervous about that.

DR. KRESS: Well, we can talk about it and if we need more time. The staff wants to issue their FSER in September I think it is, and we don't have an August meeting, a full ACRS meeting. So that's the reason for the tight schedule, part of the reason.

DR. POWERS: I mean, you run into a problem. There's only so many pounds you can put into a five pound bag, you know. It's not a great deal more than five.

DR. WALLIS: You can put ten to the six moles into it though.

(Laughter.)

DR. KRESS: We would like to see your MELCOR calculations if you have it, if you're prepared to show them.

MR. SEGALA: Okay. We need an overhead

projector.

DR. POWERS: Mr. Kress, I'm going to recuse myself from this discussion. I'm just simply too closely associated with the MELCOR code.

DR. KRESS: You may give us statements of fact.

DR. POWERS: Since I know no facts on this particular study, I won't even be able to do that. I'm just too closely associated.

DR. WALLIS: Are you even more closely related than Dr. Kress?

DR. KRESS: I'm not very. I have some distant relationship.

DR. WALLIS: I thought he was the father, and you couldn't be much more closely related than that.

DR. KRESS: Oh, no, no, no. MELCOR was developed at Sandia. Now, I was on the review committees.

DR. WALLIS: Oh, I thought it was something you were interested in a long time ago.

DR. KRESS: No, no.

DR. POWERS: These studies take place right across the hall from me. I presume I could tell you the warts on these things.

DR. KRESS: MELCOR has some fission product release stuff that I developed, but I don't think that's relevant to the containment.

MR. DROST: Good morning. My name is Andre Drost. I'm from PRA Branch, and I'm assisting my colleagues with aerosol part of source term analysis.

And just to begin with, since Westinghouse chose the alternative source term, that is, aerosol based form of fission product, a few remarks needs to be said.

The alternative source then requires thermal hydraulic input as well as aerosol model, which is not specific by our Bible, which is NUREG 1465. So that gives us a little bit of leverage and subjectivity of choosing models and calculations.

Westinghouse chose a single thermal hydraulic scenario as an input, as a thermal hydraulic input to aerosol model which is a mechanistic model based on a NAUA code, which is a BIN code that divides spectrum of sizes into BINs and then follow the physics of aerosol.

DR. KRESS: They didn't use MAAP for that?

MR. DROST: They did use MAAP as a thermal hydraulic input to --

DR. KRESS: Oh, they got the thermal hydraulics out of there.

MR. DROST: Yes.

DR. KRESS: Okay.

MR. DROST: The scenario they chose is what they call a 3BE accident, one of many low pressure accidents, which is a double ended break of direct vessel injection line, which is actually an eight inch line, but there is a four inch restrictor nozzle in the vessel.

Obviously there is a question why this, not the other one. There's no good answer to that unless we would require to do the whole spectrum of analysis, which at some point would have led to monumental activity.

We accept this scenario based on the fact that it is representative of certain class of accidents. It is risk dominant, and it follows the spirit of NUREG 1465, which implies LOCA as well as low pressure accident as representative for that.

But for those who are less familiar, I bring the picture right here. To change the direct vessel injection line is here, one break and one is unavailable. Scenario follows basically that you're running out of water. Therefore the core gets heated, uncovered. Eventually the water seeps into containment and floods the break and gets into the water, and that stops the design basis accident.

Again, there's a certain degree of subjectivity, of choosing the events.

Well, initially Westinghouse was suggesting to use direct AP600, the removal rates, which we kind of objected. We thought that although the plans are basically the same if you scale everything, but from the aerosol behavior point of view there are significant differences. It's taller. Therefore, the resonance time is higher. Plus the amount of fission product, the inventory is not one to one. Seventy percent is more. It's like almost doubled because of longer cycle.

So we challenged that assumption. Eventually Westinghouse submitted that mechanistic model which is the best estimate use of MAAP, as well as mechanistic code NAUA, and they included three phenomena: gravitational settling, diffusiophoresis, as well as thermal phoresis.

We accept those phenomena as a valid mechanism to remove aerosol into container. We did independent analysis of aerosol behavior using alternative code, which is MELCOR, and as a source of thermal hydraulic conditions for a Monte Carlo centering. We actually took one round, which was made by ERI, and we simplified MELCOR model taking just the containment part, and we ran 200 samples to come up with 95, 95 percentile and 95 confidence level.

This part of the analysis was done by Sandia. We chose 13 parameters that affect aerosol behavior, and I might say as everything in the uncertainty analysis, that is very subjective choice. Obviously there are formulas and correlations, but the choice is subjective as well as ranges of values and distributions are highly subjective.

It took a while to come up with those ranges, and we chose basically engineering judgment for those choices.

The issue was -- well, let me go back. The final distributions of uncertainty are presented here. After 200 runs, we have distribution of uncertainties in time which shows where are possible values of removal rate for aerosol.

Now, there was a question which percentile to choose as a basis for calculations, and that's a little bit a generic issue. When you have uncertainty analysis, we have distribution. We have those percentiles. We have mean values, medium values, 595 percentile. So the issue is which one is appropriate to choose for, and traditionally the regulatory approach is to use conservative values, which would be either five or 95 percentile depending on the issue.

However, we chose the median value as appropriate for that, for this particular analysis for a variety of reasons, and actually we think it is one of the worst case scenarios. You have to assume a lot of failure to get to this scenario. It is actually very hard to map AP1000. You have to have many, many failures.

Talking about subjective judgments, I think that the mean value is the least sensitive to those engineering judgments obviously. So that's more stable in any analysis. Those initial choices of the ranges and distributions is highly subjective, and we chose those values and distributions with some kind of a conservative box.

We also had a precedence that in the one case of very streamlined deposition research, went through similar analysis and they decided that sometimes on a case-by-case basis use of median value is appropriate because of other conservatism building in another part of analysis.

Then if that is not enough, when you go to your dose calculation, you have another averaging of values in time so that as another layer of subjectivity as well as conservatism.

So for all of those reasons, we think that the choice of 50 percentile is appropriate.

I don't have a slide which would compare all the distributions that we come up with, but we did compare MELCOR thermal hydraulic. We compared the uncertainty analysis based on MELCOR thermal hydraulic with the uncertainty analysis based on MAP thermal hydraulics, as well as we compare a single point, if you will, the removal rates as calculated by MELCOR itself. If that will be a single analysis by MELCOR, the removal rates would be like that.

Now, there's a lot of paralysis that we would have to explain why those peaks and valleys are here, and that would take a little longer presentation to explain.

Qualitatively, that picture is similar to uncertainty analysis which was done using MAAP calculations, and numbers are roughly the same, anywhere between .4 and .8. Our analysis doesn't have that spike at about eight hours because we are using time averaging, while at Westinghouse, we were using very fine time to pick up each possible thermophoresis and diffusiophoretic removal.

So it's hard to judge which one is correct because of all of those uncertainties involved. Somewhere in about two hours into the accident the shape of those are roughly the same; however, there are differences between one and two hours. As you can see MAAP thermal hydraulic indicates that at the very beginning the accommodation factor is very small and it goes up while MELCOR thermal hydraulic leads to opposite conclusion.

And we are not sure what Y is, but that's --

DR. WALLIS: Can I ask you something about these curves? Now, you show 95 percentile here. These aren't individual runs. At each particular time you are calculating a percentile from the results of a set of runs?

They're not particular runs. These curves don't represent --

MR. DROST: This one or any of the --

DR. WALLIS: -- don't represent a run.

MR. DROST: This is uncertainty analysis based on MELCOR thermal hydraulic. This one --

DR. WALLIS: They don't represent a run, and with that red curve at the top, it's not a particular run. It is the 95th percentile of runs.

MR. DROST: Of 200 runs. That's correct.

DR. SHACK: At a given time.

MR. DROST: At a given time. That is correct.

DR. SHACK: A slice.

MR. DROST: A slice in time, yes.

DR. WALLIS: Now, I understand how statistically they get 95th percentile at one particular time. If you're going to get 95th percentile on a curve, is there a theory for that? Continuous 95th percentile, is there a statistical theory for that?

DR. POWERS: They did time slices and just draw a curve.

DR. WALLIS: I know. I understand what they do, but I think the more places you want to get the 95th percentile, I think the more runs you need.

MR. DROST: Well, I have an answer, but I'm afraid to expose my ignorance in statistics. We follow advice of our contractor for Sandia. My understanding was that he made 200 runs from zero to whatever hours, and each run gave him some value.

DR. WALLIS: Yeah, I understand that.

MR. DROST: But that's all I know about

statistics. He applied standard formulas.

DR. WALLIS: I may be stupid, but I think if you want to get a statistical distribution at three hours and a statistical distribution at six hours, let's say, you need more runs than if you just wanted it at three hours alone, and then if you're going to say you're going to get it at all of these hours, I think I'd like to see the derivation.

Maybe my colleague, Dr. Powers, can help me with that and you don't need to worry about it.

DR. POWERS: Well, when you take about 200 samples of anything from a Monte Carlo distribution, assuming that they're all independent and, okay, these parameters are probably reasonably independent, you should have about a 99 percent confidence that you've sampled the --

DR. WALLIS: That's true any time. I'm just concerned about applying it to a whole curve, but we can talk about that separately.

DR. KRESS: These are the actual lambdas you're plotting.

MR. DROST: These are actual lambdas, right. At any given time there's a distribution of lambdas. That's all I can say. The concept is based on whatever MELCOR chooses, and those are subjective averaging because should we use every time step as a basis for these curves, there would be something like this jumping up and down because that is one run. For one run MELCOR went from zero to whatever hours, and that is one time shot, well, one shot as a function of time where --

DR. WALLIS: You could do statistics on just the peak values or you could do statistics on, you know, some of them where the peaks move around. Then you smooth everything out when you do that.

MR. DROST: That is correct.

DR. WALLIS: At the peaks you'll get a higher.

DR. KRESS: Yeah, that may be the difference between the two curves you've showed on the previous.

MR. DROST: That is the difference -- you mean between that and MELCOR? Absolutely.

DR. KRESS: They ran one case, and they're going to get something like this.

MR. DROST: Actually, the MAAP based analysis is similar to one single MELCOR round. The smooth curves --

DR. KRESS: What causes that peak at eight hours?

MR. DROST: I am not sure. I presume it at some point is a hydrogen burn, and the thermophoretic mechanism overtakes the removal rate. We are still trying to digest all of those numbers.

In general, the method that we chose is pretty generic, and it can be applied to any parameters. In fact, in the future, we think that maybe we can implement that as a permanent feature of MELCOR, do some other certainty analysis.

DR. KRESS: You know, these two cases are basically using the same -- no, they're not using the same thermal hydraulics because MELCOR calculates --

MR. DROST: That would be MAAP MELCOR, right.

DR. KRESS: So they may be having different thermal hydraulic --

MR. DROST: They are.

DR. KRESS: -- but they have got probably comparable aerosol models in them as far as I remember.

MR. DROST: MAAP has different aerosol model than MELCOR.

DR. KRESS: Oh, yeah.

MR. DROST: But Westinghouse used similar methodology to MELCOR. It's a BIN code which follows basically the first principle --

DR. KRESS: Is the blue curve strictly a MAAP calculation?

MR. DROST: No, this is MAAP for hydraulic with --

DR. KRESS: With a NAUA?

MR. DROST: No, with MELCOR sampling runs. This is --

DR. KRESS: I see.

MR. DROST: Yes. This curve is equivalent to that one without time averaging. That is, to study, to understand why our numbers are different from Westinghouse we chose MAAP thermal hydraulic and using the same sampling methodology. So that is a MAAP base, and this is MELCOR based, but both studies were made with MELCOR sampling methodology.

DR. SHACK: The trouble is that you get a very distorted picture from the average run because what you may be seeing is the time shift in the peak rather than you know. Any given history looks like the other one. That is, the thing actually goes up, but the peak moves around, and so all you're looking at is the average of where the peak ended up, and so you're really looking at very different beasts when you look at the average curve and any individual curve.

MR. DROST: Yes. That is correct.

DR. WALLIS: That's the problem of saying that you've got these 95 percentiles of a whole curve if you're going to move things around.

DR. SHACK: Well, what question are you asking?

DR. WALLIS: That's right. That's right. If you start asking, "What's the peak?" you know, then you've got a completely different answer.

DR. SHACK: You get a different answer.

DR. KRESS: But, I mean, what you have to remember in aerosol removal is it's a time averaging.

DR. WALLIS: Of course. That's why it's appropriate for this problem, and if you're interested in PCT, it would be stupid to average and say our average PCT is way down --

DR. SHACK: What you might want is the average under this whole curve, and we probably shouldn't even be looking at this thing on a Pi basis. We want some integrated --

DR. WALLIS: That's right, and you can do that. That's the honest way to do it.

DR. POWERS: Compared to the divergences of opinion on aerosol physics and the AP600, this is complete agreement.

DR. WALLIS: The bottom line is that the one at Westinghouse is okay?

MR. DROST: The bottom line is that our baseline removal rates are lower -- some were -- than those chosen by Westinghouse, but the other part of the analysis which our colleague may present or describe gives those calculations.

Well, we need the same dose limits through different way. That's the bottom line, but in general, our numbers are smaller than Westinghouse.

DR. KRESS: But not much smaller.

MR. DROST: Not much. It's like the difference between .4 and .5.

DR. KRESS: In aerospace, those are equivalent.

CHAIRMAN BONACA: Exactly. It seems incredible agreement.

DR. KRESS: So thank you very much, Andre.

MR. DROST: Thank you.

DR. KRESS: And I guess unless -- yes?

PARTICIPANT: Jim wants to say something.

DR. KRESS: Okay.

MR. LYONS: Thank you.

This is Jim Lyons. I'm the program

director for the new reactors work.

And to kind of follow up to what Dana had said earlier about the size of the document you got and the time frame, I'd really like to encourage the committee to continue to work towards our schedules.

DR. POWERS: Jim, how do I do that if I can't read the thing except when I have a computer?

MR. LYONS: Well, we can get you hard copies if you need that.

DR. POWERS: Have you got somebody to carry it for me?

MR. LYONS: Well, there's the problem. It's only 2,600 pages. I don't understand the problem.

DR. POWERS: This is a formidable chore you're throwing at us.

MR. LYONS: I understand that, and I guess the thing that I'd like to point out though is that the draft SER that we have reviewed before, that you all had reviewed had reviewed a year ago, from that we had 174 open items, and we're going to discuss those open items at the June 25th meeting. So we'll show you how we resolved those things that weren't resolved at the time of the draft.

And you know, other than the resolution of those open items, the main changes in the document are technical editing that has been going on over the past months, and so, I mean, we were really working to try and get you that document 30 days before the subcommittee meeting so that you would have at least that time to look at it, and we know that that is a very large document, and we just appreciate whatever of your work it takes to get through that.

We'll be happy to work with Med between now and the subcommittee meeting to make sure that we present to you the things that you need to see or want to see at that meeting so that, you know, we can help you through that review.

DR. KRESS: Is it possible we could get a hard copy of that, Ed? I don't like sitting in front of my computer reading that.

DR. EL-ZEFTAWY: I have one hard copy. I guess if some of the members want hard copy, let us know now so that we can get the numbers and get the copies.

MR. LYONS: Right, and we'll take that to printing and we'll get that.

DR. KRESS: I would certainly like one because it would take me forever to print that out.

MR. LYONS: Oh, yeah. You almost have to

decide what you want to read and print out those sections. We understand. It is a pretty large document.

DR. POWERS: Right. It's just impossible. I mean if you had it today --

DR. KRESS: Yeah, I guess maybe I don't even want -- if it's that thick I don't want it either.

DR. POWERS: You've got to read it, and then you've got to get back to him and say, "Okay. On the 25th I want to see these things."

You had better read faster than I do.

DR. KRESS: You're right, Dana. It's a problem.

DR. WALLIS: But you'll go blind looking at a computer screen, too.

DR. KRESS: Yeah. What if this slips to the September date? Is that a real hard date?

MR. LYONS: The September date is a hard date, yes. We have committed to the commission, and there's a lot of interest in us meeting that date and the September 13th date. So everything is set to do that because even with the committee's letter in July, there is still processing of the document, of the actual printing and everything else that it's going to take to finish the processing, to get us to be able to issue that by September 13.

DR. WALLIS: Well, I guess we just have to have a CD, and we have to scan it, and then we have to print out the bits we're most interested in.

DR. KRESS: I think that's the approach we'll have to take.

MR. LYONS: Trust us. It's a very good document.

DR. POWERS: Okay. Now, let me understand. I don't have the CD now.

MR. LYONS: I will get you one.

DR. POWERS: I will not get the CD until the 17th of June, right?

DR. EL-ZEFTAWY: No, no, you'll have it today.

DR. KRESS: We can give you one to take home with you.

DR. EL-ZEFTAWY: We have the CDs today.

DR. SHACK: Do all of the members get it or just the members --

MR. LYONS: No, all of the members are going to get it.

DR. WALLIS: You're going to give it to us today?

MR. LYONS: Yes.

PARTICIPANT: And we can have hard copies tomorrow.

DR. POWERS: And I can't read it until I have a computer.

DR. WALLIS: Maybe they'll lend you a computer.

(Laughter.)

PARTICIPANT: You can get one for about a buck 99 now, I think.

(Laughter.)

DR. KRESS: I think this will have to be an audit type. You'll have to look at the part you're most familiar with and interested in.

MR. LYONS: Right, and I think if you focus on the open items, too, if you were satisfied with the draft SER that those were the key open items and that those open items are resolved, I think that --

DR. POWERS: Okay. So when I go in here and I find the thing that I'm interested in and I say, well, they did this completely lousy and I don't like this at all --

DR. KRESS: Well, I'm going to review Chapter 15.

DR. POWERS: -- and somebody comes back and says it doesn't matter because the core melt frequency is ten to the minus 19, then I say, "No, it's not," because I didn't read that part.

DR. WALLIS: That's right. You assume that the bit you found is typical of the rest of the document.

DR. KRESS: Well, you know, a lot of the FSER talks about open items and also deals with the Chapter 15 design basis accidents, and I think for certification, I think that's probably what we ought to focus on, how they met the design basis accident criteria.

DR. POWERS: Do I understand correctly that every technical issue that is deemed resolved by this document can never be raised again?

DR. KRESS: That's true.

DR. POWERS: And so we're going to slop through this thing, and that's protecting the public all right.

DR. WALLIS: Well, is it self-sufficient? You read this document, and then you say, "Ah, you're referring to a Westinghouse document." Now we've got to take that one out.

DR. KRESS: To a large extent I view this like some of the license renew things. We have to rely on the staff who has done a real good review, and we more or less audit that by looking at specific parts of it, but I think we will have to fall back on relying on the staff having done a good review. I think that's our only alternative.

And you know, we like to look for things that the staff might not have looked for, like are there --

DR. POWERS: Maybe we'll bring those up and they'll say, "Well, that's in the 1400 pages they didn't read."

DR. KRESS: Yeah. I understand your problem, Dana. I don't know what to do about it.

Well, with this, I guess we'll turn it back to you, Mario.

CHAIRMAN BONACA: Okay. And we'll take a break until ten of 11.

(Whereupon, the foregoing matter went off the record at 10:35 a.m. and went back on the record at 10:53 a.m.)

CHAIRMAN BONACA: Okay. Let's get back into session.

The next item on the agenda is the propsoed revisions to SRP sections and process and schedule for revising the SRP.

Dr. Ford.

DR. FORD: Yes. The presentation you're going to hear is two parts, as I understand it. The first part is in relation to changes in SRP subsection relating to materials, and the second section is relating to the NRR plans for revisions to the other SRP chapters and how and when these will be presented to us.

With regard to the first part, I believe that the staff expectation is that we will issue then a waiver on ACRS review sine there are no technical changes to the materials related subsections, and there are no backfit considerations.

So let me pass it on to Rob and Peter. Please.

MR. KUNTZ: Good morning. My name is Rob Kuntz, NRR.

MS. RIVERA: And my name is Aida Rivera, NRR.

MR. KUNTZ: Like we said, we are here to discuss the standard review plan update process that NRR has begun. The purpose of today's presentation, first, like was stated earlier, to present a summary of the changes to SRP Sections 523, 531, and 533, and request a waiver of ACRS review, and then inform ACRS of NRR's process and plan to begin updating the SRP, some sections in Fiscal Year '05 and '06, and obtain ACRS agreement on the potential work load and the schedule established for SRP updates in the next two fiscal years.

The agenda. First we'll go through the summary of changes on the three SRP sections that I mentioned earlier, give some background on the NRR's plan, including the October 31st, 2003 SRM; go through the SRP development process, our plan for moving forward, and summarize.

First start with the summary of the changes to the three SRP sections, 523, 531, and 533. As noted, there's no technical changes to these SRP sections. Sine technical changes were not required to update these SRP sections, the ACR review is not considered to be necessary. The technology for lightwater reactor applications and the areas covered by these sections has remained essentially unchanged.

DR. FORD: Now, I think there's going to be a fair amount of discussion on this particular one slide, which I think is the only slide you have on the TO subsections.

MR. KUNTZ: Right.

DR. FORD: It would help us, I think, to understand, first of all, what is the scope of the SRPs. Is it only to lightwater reactors?

MR. KUNTZ: Correct.

DR. FORD: It is not to non-lightwater reactors.

MR. KUNTZ: Right.

DR. FORD: And is it to new reactors or replacement or parts to old reactors? Both new reactors, new lightwater reactors and to replacement/repair of old reactors; is that correct?

MR. KUNTZ: Correct.

DR. FORD: Okay. The first question I had is I've read through the three documents, and I would maybe quibble as to whether some of the changes you have in that one, for instance, on surface grinding that you have on the first two aren't technical changes, but there's more guidance.

But my question is more of a philosophical one. The current SRP on these three areas was obviously written some time ago because there's a predominance of focus on BWR stainless steel pipe cracking, and specifically that from NUREG 0313.

There is very little specific guidance to a staff engineer as to how to deal with, for instance, nickel based alloys in both Bs and Ps. As you know, there have been problems for nickel based alloys for both those reactor designs, and I'm puzzled as to why a new staff engineer who is coming in to review a replacement or repair option on an old reactor or for design aspects for a new reactor would not be guided as to how they should attack those particular problems which have arisen, and they're not mentioned in the latest revision.

MR. KUNTZ: I'll turn this over to Keith Wickman who is staff.

MR. WICKMAN: Keith Wickman from NRR.

I actually did the updates. There is a section, and there I'd have to dig it out, but there is a section that expresses caution about the use of nickel based alloys, particularly the 600 and its weld materials 82 and 182. Okay? It doesn't specifically prohibit it, but there is a cautionary paragraph in there. Okay?

And you will have to realize that people that review this are going to be talking to other people as well and knowledgeable people in this area. PWSCC is a big issue for PWRs and certainly IGSCC for BWRs. So there is a cautionary note. There's no prohibition against using such materials, but in recent applications like the AP1000, okay, if you use a 182 material in contact with the fluid, that was not allowed, and they did not do that, for example.

So I think it's clear. I think that cautionary note is sufficient.

CHAIRMAN BONACA: I have not reviewed the SRP, but I imagine that the SRP guides you to supporting documents. I mean, it provides references to whatever documents you have to go for for information, regulatory guides or whatever.

MR. WICKMAN: In the SRP, there are a list of references, and there are references to other document like generic letter 8201 for IGSCC and other things. There is not in existence yet a comprehensive document that addresses PWRCC.

CHAIRMAN BONACA: I understand, but when I look at those references there, 17, 22 and seven, those must be including a body of information even recent information, I imagine. Try to understand the actual, you know, burden for newer information to the SRP versus the revised references.

I imagine most of the information would be either in the references.

DR. FORD: Well, that's true, except I don't understand what's the constraining item here, but most of the references that are given are reg. guides or NUREGs.

MR. WICKMAN: Well, again, the SRP just documents current requirements. It does not create new requirements. Okay? It documents current requirements. The purpose of an SRP is to provide guidance to the NRR staff for review of new applications. All right?

Under that circumstance, you don't create new requirements. New requirements are created by modifications to the regulations, for example.

CHAIRMAN BONACA: No, I'm not referring to that. I was thinking that some of the references now would have information relating to PWSCC and so on and so forth. I mean, this is not new requirements. It seems to me that as you perform the same review that the SRP guides you to do you will have in the references additional information regarding operating experience, acceptability of materials, and so on and so forth.

MR. WICKMAN: Correct.

CHAIRMAN BONACA: And I'm trying to understand that.

DR. FORD: The scenario I'm concerned about, Keith, is that you have in this changing work force that we have here, we have a new staff member coming on, and he's given an SER to review, and he has no guidance in this review phase how to deal with primary water side first order cracking.

MR. WICKMAN: But that new staff member does not do that in isolation. Okay? There are a lot of people looking over his shoulder that do have that experience. Okay?

And, again, the SRP does not create new requirements. For example, in the SRP I cannot say, "Do not use this material." All right? Okay. Again, the SRP documents current requirements; doesn't create new ones. So that's the structure that we're operating under here.

DR. SHACK: Let me take a little different tack on this, Keith. You do refer to reg. guides, like NUREG 0313.

MR. WICKMAN: Oh, sure, sure.

DR. SHACK: I guess that isn't even a reg. guide. The thing I was thinking of is, in fact, there are certain areas where you have essentially stopped updating reg. guides, for example, on water chemistry, and the de facto and, in fact, probably du jour water chemistry control are really the EPRI BWR guidelines.

MR. WICKMAN: Right.

DR. SHACK: But would you ever refer to those in an SRP because those are, in fact, the current requirements for water chemistry? The reg. guides you have on water chemistry circa 1975, you know, should be removed from the list because you certainly wouldn't expect anybody to live by that.

MR. WICKMAN: Well, I eliminated a couple 1975 W caps, okay, that were referenced, for example. Anything that old I agree should not be referenced, but --

DR. SHACK: But I didn't see -- and maybe it was just in the section I had -- you know, as I say, would you reference BWR water chemistry guidelines?

MR. WICKMAN: No question about it, no.

DR. FORD: You said, "No question about it, no"?

MR. WICKMAN: No. Well, what I meant is, no, yes.

(Laughter.)

MR. WICKMAN: No, that could be referenced, but the problem here is you've got one guy doing this. You need another.

DR. SHACK: Well, I was thinking more generally. When you've written an SER on a BWR VIP document, does that make it something that's referenceable then in an SRP?

You know, you've accepted it by an SER.

MR. WICKMAN: My belief is yes, okay? But again, I'd have to go back and talk to some other people to make sure that that is the case because --

DR. SHACK: I mean, Peter and I were just sort of discussing, you know, obviously you're not referencing the open literature on stress corrosion cracking. You know, you have to reference what are accepted regulatory positions.

But I would think that once you've accepted a topical report and written an SER on it --

MR. WICKMAN: Yes, an accepted regulatory position could be referenced, I think. Okay?

DR. FORD: Well, I think that would make your revised version far strong. For instance, the BWR --

MR. WICKMAN: Well, you know, I would appreciate comments like that because one guy looking at this is bound to miss something. Okay?

DR. WALLIS: Well, I think it would help in this slide to clarify in my mind, when the word "technical" and "technology" is used here, what you really mean is regulations. There will be no changes in regulations. The regulations are unchanged, but the state of technology and knowledge is changing all the time.

MR. WICKMAN: Hey, Rob, would you put up that slide, please?

DR. WALLIS: What you mean by technology here is regulation.

MR. WICKMAN: The lightwater technology in the areas that have been revised really hasn't changed. Okay? All right. We're talking about the material areas in the reactor vessel integrity.

DR. WALLIS: Well, you have technically quoted something from regulations. What you mean by "technology" is really the regulation.

MR. WICKMAN: Well, take a look at my slide. Okay? That first sentence says what's the purpose of an SRP. It's to document current requirements. Okay?

DR. WALLIS: See, with technical requirements stemming from regulations --

MR. WICKMAN: From the regulations. Now, in the case of reactor vessel integrity, Appendices G and H were revised. Okay? And so references to the pertinent parts of the revised regulations had to be made. Okay?

DR. WALLIS: All right.

MR. WICKMAN: Is that a technical change? I don't know. But the point is the SRP documents current requirements. It doesn't create new ones.

DR. FORD: Okay. So that means if it documents requirements, it has got to be reg. guide. It has got to be official --

MR. WICKMAN: They've got to be approved. they've got to be approved documents. It could be a generic letter. Okay? As well as a revised regulation. It could be something that has gone through a review process and has been approved for use.

DR. FORD: Would you mind going back to the overhead?

I don't think any of us have got any problem with the vessel, the final one.

MR. WICKMAN: Okay.

DR. FORD: It's the other two, both of which refer to, to a large extent, fabrication, but also materials degradation issues. And there's a large body of information from the industry which NRC has approved. The VIP documents, for instance, and they would make to a new, young staff engineer, albeit working with experienced people, a far better overall view.

MR. WICKMAN: Well, I would certainly appreciate comments like that, specific, okay, that I can improve the update. Okay?

DR. FORD: Because it might impact on your technical changes.

MR. WICKMAN: Well, that's possible, but again, I go back to my original premise here about documentation of existing requirements, and I'd have to look at the VIP stuff.

The VIP stuff is sort of a little funny, okay, a little different the way it has been handled.

DR. SHACK: Well, I guess there's also a difference between something you would accept and something you would require, and I guess that's one of the differences I could see with many of the VIP documents. They don't really represent requirements. They say, okay, if you guys want to use this, it's okay.

MR. WICKMAN: Yeah, and that's exactly what I mean. So I think they have to be careful about how we incorporate certain things in here.

MR. MATTHEWS: Hi. I'm Dave Matthews, Director of Regulatory Improvement Programs.

And I've been overseeing this update

process for over a year now, and we have faced a lot of these issues. Keith might have added to his comment about documenting existing requirements and accepted staff positions because the SRP expands on existing requirements per se and adds to it accepted staff positions that have historically provided guidance to the reviewer on what these regulatory words mean.

Okay? And so accepted staff positions have to be that, and the word "accepted," therefore, connotates staff positions that have been reviewed and vetted through our processes like CRGR, okay, and in some instances Commission review of a generic letter or a bulletin.

So the SRP documents accepted staff positions as explaining and giving a possible approach to meeting a regulatory requirement, not that there aren't others that could be considered.

MR. WICKMAN: Right. It's not always clear what those accepted staff positions are unfortunately.

MR. MATTHEWS: Sometimes they have to be looked at very closely to see if they, indeed, are accepted staff positions. Usually if they would not trigger a need for a backfit review on the part of the

CRGR or the need for an additional regulatory requirement if OGC viewed it that way, then they're viewed as accepted staff positions.

DR. FORD: Okay. Could I suggest that the way to move forward on this, as an engineer/scientist who knows material degradation issues, I had a lot of problems reading this because I knew of all sorts of things which were going on in the industry which suggested a change might be necessary.

MR. WICKMAN: Well, again, so do I. If I could --

DR. FORD: Navigating through the legalistics of --

MR. WICKMAN: But can you reference those changes?

DR. FORD: Exactly, exactly.

MR. WICKMAN: That's the problem.

DR. FORD: It's what's acceptable and what's not.

MR. WICKMAN: Right.

DR. FORD: So if I could suggest maybe a way around this is to have a half day meeting with, say, the materials subcommittee to go over these documents and say, "Hey, I don't agree with what you've said here because there's this data or that data," chemistry guidelines or whatever, and then you can say, "Here. We accept that," or, "no, it is not an acceptable document for this application."

DR. SIEBER: But you can't break new ground in regulatory space, and so it's not clear to me what the review will do unless it's a legalistic kind of a review saying this is what the requirement is. Is it written down? And this is the accepted staff position.

DR. FORD: Yeah. Well, you're getting into a fine line as to --

DR. SIEBER: As opposed to an explanation of what the technology is. You know, that doesn't have a place in the SRP.

MR. MATTHEWS: I would argue that if existence of information would prompt a change in our regulations, then it's worthy of discussion.

DR. SIEBER: That's right.

MR. MATTHEWS: Okay? We are talking about a very fine legal line here, but it's a very dramatic one to the recipient. For example, why the VIP program presents such a challenge is it's a voluntary program that was offered by an owner's group, and so there's an issue there as to whether it was prompted by regulatory requirements.

And we didn't put regulatory requirements in place in deference to that voluntary program. I have a lot of trouble dealing with that as to in regards to a document that is an extension, okay, of the review process against regulatory requirements. So I'm sympathetic with the availability of information that might enhance the quality of the review, but whether it's something that I can give to a young engineer and establish as a requirement is something completely different.

DR. SIEBER: Correct.

MR. MATTHEWS: So that's why I have a little difficulty with the concept of evaluating this new documentation. If a subcommittee wanted to take upon themselves the evaluation of this new information in the hopes that you might encourage us or there might be a sound basis for revising the regulations to require its consideration, that's something we'd always be willing to hear. Okay?

And I would hope that our staff would look at it from that standpoint, too.

I mean, I'll give you a good example. If you look at the old issue associated with steam generator tube integrity, a lot of information there. We were never able to make the cost-benefit associated with changing the rules. All right? But yet we have put out a lot of different guidance documents, and we now have a program where the industry is coming back with a revised set of tech specs associated with this, which they are going to volunteer, and we have said under these conditions those tech specs will be acceptable.

Okay. You won't see any of that in the SRP.

DR. SIEBER: Right.

MR. MATTHEWS: And we're really dealing with the distinction between clear regulations established in the Code of Federal Regulations vetted through the Administrative Procedures Act, and an extension of that with regard to guidance to our reviewers as to what are acceptable ways of meeting those regulations.

When they are in the arena of good "to do" and useful information, we run into a lot of trouble in trying to implement expectations as opposed to something that we can clearly tie to a regulatory requirement, and I think that's Keith's challenge when it comes to his knowledge associated with a lot of these reactor vessel materials and a lot of these materials used in fabrication of reactor coolant system boundaries.

It's an issue of knowing that there's problems out there, but not having a basis to advise licensees to tackle them without having a clear regulatory requirement.

DR. SIEBER: Well, it's even more than advising licensees. It's requiring licensees to do something.

MR. MATTHEWS: Right, and that's the distinction. This is the requirement.

DR. SIEBER: And if it isn't a requirement, it doesn't belong in the SRP, the way I see it.

MR. MATTHEWS: Or it can't be connected directly with it.

DR. FORD: So you're looking upon the SRP more as a regulatory --

DR. SIEBER: Well, it is.

DR. FORD: -- legalistic document, not as a technical guidance to --

MR. MATTHEWS: That's exactly right.

DR. SIEBER: That's correct.

MR. MATTHEWS: Well, said.

DR. FORD: And you're relying on the information to the young staff engineer that he can identify here, here, and --

DR. SIEBER: Well, project manager or reviewer is who uses it.

MR. WICKMAN: Well, again, the young staff engineer, a lot of people are going to be looking over his shoulder. Okay? All right. So he's not going to be doing this in isolation, and so --

DR. FORD: Okay. Well, that makes different guidelines to me as to how I look at this document. I should not be looking at it as a technical reviewer. I should be looking at it as a lawyer almost.

MR. MATTHEWS: I could argue that there's a double edged sword here. We have one purpose in revising and in keeping the SRP current, is to restrain staff members from applying new ideas or unique approaches because they aren't consistent with the existing regulations. Okay?

You put limitations on reviewers. You have to guard what they can expect licensees --

DR. FORD: I do find that a worrying statement.

MR. MATTHEWS: I said it in such a way as to prompt you to worry about it because that is really the case that we have with regard to the regulations.

We have an obligation to keep reviewers and even managers, okay, consistent in their interpretations from one review to the next, and you can't do that by prompting people's speculation as to what would be a better idea.

DR. SIEBER: And, in fact, licensees rely on the SRP, first of all, to establish their case that they meet the regulations, but to keep the staff hones, and a lot of licensees will review the SRP sections for that purpose so that they can go in and argue their case.

MR. MATTHEWS: Let's put it this way. We're held accountable to the SRP by the licensees as much as we hold the licensees accountable for the regulations.

DR. SIEBER: That's correct, as part of the licensing business.

MR. MATTHEWS: It's not really a guidance document in that regard.

DR. FORD: Okay.

DR. SIEBER: So we should turn it over to OGC.

MR. MATTHEWS: Well, possibly. They look at it really, really closely.

DR. SIEBER: I know.

DR. FORD: I'm looking to you as the Vice Chairman.

DR. WALLIS: Do you want to stop the session?

DR. FORD: No, no, no, no, no.

(Laughter.)

DR. FORD: I have a problem with what I've just been hearing disassociating myself from what is technically incomplete on the basis of what the industry has, as well as the licensees. That's not to ignore the facts of the case as to what is down on the paper and which is in the law of the current regulations and the rules.

I don't know how to proceed on this particular request for a waiver on this instance when I know technically it is incomplete.

MR. MATTHEWS: Well, I think things like the VIP do create the problem where if you didn't have VIP you probably would have regulatory requirements, but the VIP thing isn't really a regulatory requirement. So it is kind of a strange beast.

DR. FORD: But I also think that this problem is going to arise in the other SRPs as we go down the line.

DR. SIEBER: Absolutely.

DR. FORD: And, therefore, let's tackle it up front, not just in terms of E3, but what point do we disassociate ourselves from technical reality versus regulatory reality?

DR. SIEBER: Well, you can't make new rules using this mechanism here.

DR. FORD: Technology advances.

DR. WALLIS: But this happens all the time. This happens with codes, too, as I told you, and there are things written in the law which you have to put in the code which really don't make any sense.

DR. FORD: What I guess is it's 20 past 11 now. Let's move on and just table this until discussion at the end, whether it's appropriate to write a letter of waivering. I take it there is not a big urgency on this letter for waivering right now. You don't have to have it today.

DR. WALLIS: No, but I think we could have some discussions afterwards.

DR. FORD: Right.

DR. WALLIS: The other members will educate you about how the NRC works.

(Laughter.)

DR. FORD: Well, it worries me from a technical reality point of view, not regulatory reality point of view.

MR. MATTHEWS: If that a subject that's appropriate for us to offer further views on, we'd be glad to participate in any of those discussions to the extent that it would help you.

DR. FORD: And we would love to do that.

DR. EL-ZEFTAWY: Peter, I think if maybe we set up an informal meeting with the staff for you to talk to them?

DR. FORD: Absolutely.

DR. EL-ZEFTAWY: Yeah, I think that is better, you know, to handle this one.

DR. FORD: Well, and any subset of any colleagues who want to come, too. I think it's going to be a bigger issue than just these three items.

Please.

MR. KUNTZ: Moving on to the work that NRR has done, on October 31st, 2003, an SRM was issued in response to an October 2nd, 2003, ACRS meeting, and that SRM asked the staff to provide the Commission the status approach and plans for maintaining a current and effective set of guidance documents, including the SFE.

Prior to the issuance of that SRM, NRR staff --

DR. WALLIS: Well, I wonder what the Commission meant by current and effective set. Did they have in mind some of the ideas that Peter Ford has in mind or did they have in mind merely completely sort of adherence to --

DR. SHACK: No, we had reviewed a reg. guide that hadn't been revised since the early '70s.

DR. WALLIS: Will the regulations have to be changed?

DR. SHACK: And there were umpteen thousand editions out of date, and then they ask the question whether other regulatory guides were as far out of date, and the answer was yes.

DR. WALLIS: And we said yes. But what you're saying though, Bill, is an important factor in what we've just been discussing. Just make sure your reg. guides and approved documents are up to date. Don't change technical changes.

We're going to come across this thing time and time again if that's your sole criterion.

MR. KUNTZ: Okay. Prior to the issuance of that SRM, NRR had begun a plan to update the SRP. We included a scoping process, a prioritization process and working on scheduling the updates.

The scoping process was to determine the extent of update and estimate the resources required to revise the SRP. We asked the staff to tell us what version is currently being used for reviews. Is there any guidance that has superseded that version? Would the updated SRP section require ACRS, CRGR, or public comment?

Does the updated SRP section require updating of other guidance?

And to estimate the total hours using those questions that it would require them to update the SRP section. Through the scoping process, it's estimated that to completely revise the SRP would be 35 FTE.

DR. POWERS: Do you view that as a large number? I'm surprised it's so small.

MR. KUNTZ: Well, previous estimates were about 50 FTE.

DR. POWERS: Okay. So it's consistent roughly.

MR. KUNTZ: Yeah.

DR. ROSEN: How many FTE does the agency expend per year?

MR. KUNTZ: On?

DR. ROSEN: The total.

MR. KUNTZ: I'm not sure of that answer.

DR. SIEBER: Twenty-six hundred.

MR. KUNTZ: Twenty-six hundred?

DR. SIEBER: Yeah, the number of employees times one.

DR. ROSEN: Well, plus contractors. Well, my point is it's tiny.

DR. WALLIS: It's tiny? It seems to me enormous.

DR. POWERS: It seems to me it's very small.

DR. WALLIS: Thirty-five people working full time for a year?

DR. ROSEN: WE'll update all of that, or if you want to take two years.

DR. POWERS: Yeah, but understand what he's saying. He said they've got to go find out if there has been anything that supersedes what's written in the current document by any branch anywhere. I mean, it's not just sitting down and correcting the language in these SRPs. He's done quite a little research he has to do here.

So I'm surprise it's that small.

DR. ROSEN: And if you look at the three documents we were asked to look at this time, there are quite a few changes in each of them, and they're not just editorial. There's lots of that thing that Dr. Powers has described where there's a whole new paragraph stuck in because there were other things done externally.

DR. FORD: The point is though, from our point of view, Steve, that they're only asking us to approve or comment and review the technical changes. All of those changes you saw in those three are mini editorial or administrative type changes or explanations.

There's no technical changes like "hey, don't use this steel."

DR. ROSEN: Well, wait a minute. Let me push back just a bit. For example, there's a paragraph change put into the thing, a great big red paragraph that gives you a whole new set of references. I'm just doing an abstract here. Just a set of references.

Now, to know whether there was a technical change you have to go read the references, understand the technical content of the references, and think about that in relation to what was there before. It's not a trivial task.

DR. SIEBER: But those references are a limited set of documents. They're reg. guides.

There's SERs on topical reports depending on whether it's a requirement or an accepted staff position. So you aren't really looking at the whole world. You're just looking at a certain set of documents.

DR. ROSEN: But I'm just respond, Jack, to Peter's point that they're not technical. I think that they could be. They aren't all, but they certainly could be.

DR. SIEBER: If you follow the string, it could be.

DR. WALLIS: I don't understand this at all. It seems to me SRP is useless unless it's continually updated and when you have any significant change, and it should be done all the time. As soon as some new thing comes along, it should automatically be slipped into the SRP. Otherwise you get something which is an archaic document.

DR. SIEBER: That's right.

DR. ROSEN: So what that says is there is a need for a continuous updating process rather than this wait 20 years and do it kind of thing.

DR. WALLIS: Yeah, rely on sort of handing down knowledge from the older guys over that 20 years.

DR. ROSEN: Yeah, right, saying, "Oh, yeah, there's a VIP document we've got to consider in addition to this," or something else.

DR. SIEBER: There probably are no references to VIP documents.

DR. FORD: Okay.

MR. KUNTZ: Well, we're addressing that issue, attempting to address that issue in the office instruction that we'll mention later.

DR. ROSEN: But that's the insight we both have. Dr. Wallis is correct. It ought to be something you do as part of the business.

MR. KUNTZ: We'll go into too much later, but the OI states that once you get a section revised that there's a periodic review to insure that the requirements --

DR. ROSEN: The model for this, where the agency is doing I think very well, is the ISG process, the interim staff guidance process and license renewal. Every time those guys figure out there's something new that they're going to require, they stare at their navels for a while and say, "My God, we're going to have to require this. We can't allow it to continue." They put it on the next licensee that comes in, and they put it into the generic aging lessons learned report, the next revision.

But in the meantime, they have this thing called the ISG, the interim staff guidance, that everybody knows is out there. You do GALL plus the ISG. So you always have this continuous update process.

DR. FORD: Carry on.

MR. KUNTZ: Once we've done the scoping process, we move on to prioritize the sections, and we did that to create a prioritized list of SRP sections that can be used. The list can then be used to determine which SRP sections are scheduled to update each fiscal year as resources are available.

We asked the staff to rate each SRP section and three criteria, safety significance, recent industry activity, and stakeholder/Commission interest. So as resources are allocated in the budget, then the highest priority SRP sections will be updated.

DR. FORD: Do I read from that you've got the two, three material subsections? Those were the highest safety significance?

MR. KUNTZ: Well, that was outside of this plan. Keith Glickman and some other rehired annuitants were tasked.

DR. FORD: These were the easy ones.

MR. KUNTZ: Were tasked to do SRP sections in there.

DR. SIEBER: They're sorry now.

(Laughter.)

MS. RIVERA: NRR plans to update the SRP using the NRR office instruction, LIC-200, standard plant process. This office instruction will provide guidance on how to use the SRP and how to prepare a new section, and how to prepare revision to the sections.

The SRP will be revised as new requirements are imposed or as existing requirements are modified.

The development of this office instruction is still in progress, and it will be issued as a final at the end of this month.

And the proposed budget, the NRR put their six FTEs for each fiscal year, and this FTE will be used to update 35 section each year.

DR. ROSEN: See, I'm going to propose a radical change to the way you do business. Instead of budgeting to update the SRP in each fiscal year or whatever, the test plan for each activity regardless of what it is ought to include an increment which is to update the guidance documents as a final step in the closeout of the effort, and all of that budgeting separately for updating SRPs wouldn't be needed.

I mean, it's just another way to do business. I think it's more effective than --

MR. MATTHEWS: We agree 100 percent. We didn't do it for 20 years.

DR. ROSEN: I know. I mean, I agree. You were in the right thing to work your way out of that problem, but to avoid getting back into it I'd propose is radical.

MR. MATTHEWS: You're absolutely correct, and we're hoping to, as we say, institutionalize the revision process and budget for it. You do have to budget for it.

DR. ROSEN: That is the effective and efficient way to do it because when you're done with that, you know. It's very fresh in your mind what you had to use besides what's written in the SR --

MR. MATTHEWS: Some of this comes from the urgency of Commission direction or urgency of the safety need to impose a new regulation. As you well know, get a guidance document out on it, and by the time we reach that point, a lot of times the SRP doesn't even rise to an afterthought.

DR. ROSEN: I've been plagued throughout my career by people telling me we need to have this out right away and I don't care about the documentation.

MR. MATTHEWS: Right. And I'm not saying we fell victim completely to that, but certainly the SRP has fallen victim to that.

DR. ROSEN: That's short sighted if you're thinking about an industry or endeavor that's going to go on for 60 years.

MR. MATTHEWS: If you look at some of the industry accepted and international standards associated with process improvement, you will see that they always include a provision for institutionalizing the change and insuring a revision in documentation process.

DR. ROSEN: At the end of --

MR. MATTHEWS: At the end.

DR. ROSEN: Well, the people who are familiar with it do the budget.

MR. MATTHEWS: Right, right, and this retrenching that we're doing here, frankly, has been delayed several years by virtue of the size of its FTE. You may call it small in comparison to the overall agency budget, but when you start to compare it to an individual office's budget or an individual branch's budget, it starts to take on an enormous size.

And, secondly, it's not just resources in the sense of FTE and hours. It's the talents and availability of people to do the updates. So we don't have 35 highly skilled people familiar with all of the sections to sit down for a year to do it. We don't have the availability of those people.

DR. ROSEN: This agency is like a lot of other places. Don't do what I do. Do what I say. We tell the licensees all the time that we want your documentation to reflect the as built, as operated plant, and if we find out it's not so, we're going to come down hard on you.

MR. MATTHEWS: Well, if you wee to look in our regulations with regard to the fact that a new applicant has to do an assessment of the comparison of his design to the existing SRP and we document that in the regulations as part of Part 5033, it became clear as we had new applicants thinking about coming in for a new reactor design that they were going to be faced with doing that, and yet our SRP was last updated in 1971.

So we detected that we had a big discontinuity. That's what some of this project with your encouragement was undertaken for the reasons of solving. Okay?

DR. ROSEN: Thank you.

DR. WALLIS: It was last updated in 1971? Did I get that right?

MS. RIVERA: Eight-one.

MR. MATTHEWS: Eighty-one. Excuse me. Lost a decade.

DR. WALLIS: It's still a long time.

MR. MATTHEWS: It's still a long time.

CHAIRMAN BONACA: But still, I can go to the first slide we saw and see that SRP Section reactor coolant pressure boundary, reactor vessel, reactor vessel, there are no technical changes. So I mean, I understand where you're going with that, but I'm saying that it is a plan, and as a plan, you know, it is supported by a lot of other information that is available to the staff.

I mean, the way I see it here you're changing mostly your references, supporting documents, regulatory guide.

DR. FORD: Let me try to explain to you why that is to make sure I have got the right message.

CHAIRMAN BONACA: Okay.

DR. FORD: Even though the industry as a whole recognizes that there are changes in the technology since this last review is concerned, those should not be referenced in the SRP unless there's an associated, recognized legal document, i.e., a reg. guide, which supports such a technical change.

DR. SIEBER: A rule.

DR. FORD: Rule. Well, the reg. guide is a -- I know it's not a rule, but it's a recognized document.

DR. SIEBER: It's a way to comply.

DR. FORD: Well, okay, but it's an NRC --

MR. MATTHEWS: It's an accepted staff and Commission position for meeting that regulation. Others can be composed, but they will be compared against that particular provision.

DR. FORD: And that's the view right now. That's why there's a whole lot of zeros in that, and you're correct that within that context they're not correct and they understand they're not correct in terms of what the industry as a whole understands how to manage these problems.

DR. SIEBER: But that's not the purpose of the SRP.

DR. FORD: Exactly, and that's what was explained to me, which I don't particularly agree with, but hey.

MS. RIVERA: Well, our plan is to verify sections in the next fiscal year. So to bring 35 separate sections to the ACRS for review will be a burden not only for the staff, but to the ACRS, too. So we created a group of sections that we call bundles, to group these sections in order to make the process easier on the staff and the ACRS.

These bundles were created based on the similar topics of the sections, and some of the example of these topics will be the reactor vessel, materials journal, and containment, instrumentation and control systems.

So as a result, we were able to create from 35 sections 13 groups of sections, and that's for fiscal year '05, and for fiscal year '06, we were able to create 11 groups of sections.

DR. FORD: Now, just for example, the first one, reactor vessel materials, that's the three that we saw?

MS. RIVERA: Yeah.

DR. FORD: Now, in fact, there are many, many more --

MS. RIVERA: Yes.

DR. FORD: -- related subsections.

MS. RIVERA: But those were the 35

sections that were grouped for the fiscal year. So we took those sections that went through the prioritization process and made the first group of 35 sections that will be updated for your fiscal year, and we divided those into topics and grouped them together.

DR. FORD: But there are subsections within the understanding of materials and internals. For instance, inspection. There's an SRP on monitoring inspections. I've forgotten the number, but it's three, point, something. Does that come into some later lower down bundle?

MS. RIVERA: Yeah.

DR. FORD: Even though it's related technically to that top bundle?

MS. RIVERA: Yes, yes, yes. Because we are also taking into consideration the amount of time that the revision will take place. If it has like more FTE to that section, we will leave it for later in the year. For we grouped these ones because they were easier and they --

DR. FORD: I understand you're doing that from a management point of view in terms of allocations of FTEs, but from a technical point of view, our analysis of whether the technical change or not is relatable to what's going on in the other subsections.

For instance, monitoring and inspection, that technical aspect is secondary to --

MS. DEAN-BURNIE: This is Marsha Dean-Burnie.

In addition to the management point of view, something Dave mentioned early was having certain talent available. So we have certain engineers who can look at certain sections, and we only have so many of those engineers, and given all of the other work they're doing we tried to -- exactly.

DR. WALLIS: Well, sine all you're doing is updating regulations and legal matters, why is the ACRS involved at all?

MR. MATTHEWS: I believe we examined that issue and Marsha can help me here, but I believe we looked at the charter and the MOU, and you have expressed an interest in reviewing revised SRP sections. So we thought we had an obligation, and we felt there also would be a benefit from you advising us in these areas.

MS. DEAN-BURNIE: And really today we just wanted you to be aware of what our plan was coming up and, you know, some of the discussion we had having these examples of discussion.

DR. WALLIS: Well, I think there's no way we can advise you on how many bundles you do per quarter and all of that sort of stuff, although you're asking us to sort of approve your work load. I don't think that's our business.

MR. MATTHEWS: No, I don't believe we were asking that at all. I think we were wanting to --

DR. WALLIS: It says ACRS agreement on work load.

MR. MATTHEWS: -- familiarize you with the process we were going to go through so as to be able to estimate your work load.

DR. POWERS: Your usual procedure on standard review plans, you develop them. You have them reviewed by various bodies. You send them out for public comment. You revise them. It is often the process here to have a member look at it and say, "Gee, do we want to look at it prior to going out to public comment or after public comment?"

It would be useful when you send things over if you accompany it with your judgment on what that decision should be.

MR. MATTHEWS: We can accommodate that request. I think that would help you decide on your own --

DR. POWERS: It would help us.

MR. MATTHEWS: -- to agree to what you need to be involved in a given update. I think that's a great idea.

DR. ROSEN: I think we're going to have to lean as we on this thing. If we find that we're not adding value to this process, I think we will jointly know what to do about that.

MR. MATTHEWS: Let's review a little bit of history, and I think that's a good point. You may recall in recent history -- and I'll give it back five years -- that the instances in which we brought an SRP to your attention were usually prompted by a dramatic technical or technological change, and the best example is the INC addition to the electrical SRP. Okay?

I think we have a couple other ones that were basically --

DR. POWERS: Control room habitability ones.

MR. MATTHEWS: Control room habitability. There were several that we were stepping into an arena where an SRP hadn't gone before. That's the best way I can say it, and therefore, I think there was probably greater value for your participation. This is the first --

DR. WALLIS: Well, power operates. Isn't --

MR. MATTHEWS: Pardon?

DR. WALLIS: Well, no, those were review standards, but they're very similar, right.

DR. ROSEN: It's the human factor stuff that just --

MR. MATTHEWS: Right, right. Power up rate review standard, early site permit review standards were extensions of the SRP, they made reference to existing SRP sections, but they did it in such a way as to say, in effect, I don't want to use this in a pejorative way, but we cherry-picked the SRP and the power up rate area and the ESP arena in order to bring together for a reviewer's benefit all of the applicable SRP sections for that specific reviewer program so that he didn't have to go searching and decide applicability.

But indeed, it was and in some instances we also made minor revisions to the SRP, but the whole idea was to get your input on this as a review document for reviewers and some guidance for the industry.

This is the first time that we've come to you with the idea that we're going to, in effect, do a wholesale review of our existing documentation, and I think it's probably appropriate for you to learn by experience and to apply some judgment as to whether there's a value added for some sections.

And to the extent that we can give you our opinion on that, why don't we take it upon ourselves that when a section comes over, we'll give you an assessment of whether we think there's value to be added by the ACRS' view or whether this is pure proforma and a rote recitation of existing requirements and guidance.

Because there are going to be some sections that are just like that that haven't changed sine '81.

DR. ROSEN: If you say there's a value added, you ought to tell us why.

MR. MATTHEWS: Yeah, I mean, we'll give you our rationale.

DR. ROSEN: Because then we could focus on that.

MR. MATTHEWS: Yeah, or what portions we would suggest you focus on.

DR. FORD: It would be like giving

personal advice on this question going out for public comment., that you lay out clearly the strengths on the SRP because I know if it came out for public comment to many of my colleagues out there, they'd look at these sections here, especially the first two sections.

DR. ROSEN: They'd jump all over it, so to speak. I understand.

DR. FORD: But it's understandable when you put the constraints that you have on what can go into the references with the guidance.

MR. MATTHEWS: I think that's a good point. We sometimes presume people know what an SRP is without giving some thought to the fact that it could be viewed as a new regulatory requirement or a new approach to regulatory policy.

DR. WALLIS: It's a very large document that you get and you put in your library and you almost never look at.

DR. ROSEN: Until an application hit the door.

DR. WALLIS: Until you really need to, and then you sort scrapple around and try to find --

MR. MATTHEWS: Until you're forced to.

DR. POWERS: Having them on the disk where you can just look them up and then the computer -- you know, when things come to you from an applicant and just being able to zip to -- that's wonderful.

MR. MATTHEWS: Well, that's clearly a part of this process. That's one definite step forward that we're making irrespective of the content: retrievability and accessibility.

DR. FORD: Aida?

MS. RIVERA: So we created a model to establish researchers to review the SRP throughout the year, and for each healthy bundle for the fiscal year, we established a quarter where they will be completed. And the quarter was estimated based on the information the staff provided during the scoping process and the resourceability during the year.

So as a summary, the update of the SRP will be accomplished using the NR office instruction, LIC-200, the standard review process that will be available at the end of this month, and during the fiscal year, ACRS will be receiving 13 bundles of SRP update, approximately three bundles per quarter.

DR. ROSEN: That's every month to us.

MS. RIVERA: So we are asking for agreement on the potential work load. This will be for the ACRS, and an agreement on the schedule that we --

DR. POWERS: We'll just take the member we don't like and assign them to him.

DR. WALLIS: I don't have any idea how I can agree on my work load. I have no idea what it is going to involve. I mean, is it going to be a real chore or is it going to be trivial?

DR. POWERS: I mean, I think what they've volunteered to do is offer you a judgment and you know what we're going to do. P&P is going to assign a league member to take a look at it and come back and make a judgment for the committee as a whole.

MR. MATTHEWS: And we'll be happy to consult with you during that process.

DR. POWERS: Sure.

DR. WALLIS: I'm sure we will only look at one where we really have something to say. Most of them we won't have to look at in detail.

MR. MATTHEWS: We uncovered a great many sections that we don't see that there would be anything more than editorial changes because in some regards these plants haven't changed all that much.

DR. WALLIS: And if there are sections --

MR. MATTHEWS: In many regards they haven't changed all that much.

DR. WALLIS: If there are a great many sections that requite just a few minor editorial changes, why does it take so many people to do the work?

MR. MATTHEWS: It takes the evaluation to determine that that's the case.

DR. POWERS: Yeah, I don't think you can pull this off with 30 -- I mean some of these guys think this is easy, and I simply don't think it is because you have to virtually check every single sentence in that thing.

MR. MATTHEWS: That's the staff's --

DR. WALLIS: Every semicolon and all of that stuff?

DR. POWERS: No, it's not the semicolon. It's the sense does that reflect what people are expecting based on the technical positions the branches have taken.

MR. MATTHEWS: Right, and examples of this are if you were to look in a specific area in which we generated maybe two bulletins and three generic letters and staff positions have changed, (a) you look for those elements of those generic letters that haven't been reflected or even referenced in the SRP such that they wouldn't even know of their existence.

Yet they represent the current staff acceptable position in some arenas.

So when it ends up just being semicolons and periods, that's usually a result of that analysis having been done, and all that you're left with is colons and semicolons.

DR. POWERS: And the problem is your reference literature is written in a different genre than the document you're trying -- I mean you just can't copy. I'm going to be surprised if you guys can pull this off for 35 FTEs.

MR. MATTHEWS: Well, I'll share with you that even Mr. Wickman just said, "Gee, I'm not going to be around to do this. Who's going to do this?"

(Laughter.)

DR. FORD: Could I get a feeling of the committee as to we have a request in front of us for a waiver on the ACRS comments on those three subsections because there's no technical changes. We've discussed it. I think we would all agree that there are many changes out in the technical space in the industry, but there are no changes in the regulatory space on these items, which is I understand what we have to make a judgment by.

Do we feel as though we have enough

information in front of us to write a letter waiving our review?

DR. POWERS: Well, I would not. Myself, I would not waive the review. I would say that we will wait until public comments have been received.

DR. FORD: Okay.

DR. POWERS: I find it useful to look at the public comments to see if there is a problem that people had identified and how it was resolved.

MR. MATTHEWS: I have to add for the committee's benefit I don't know that we've said that we will on an individual basis send these individual sections out for public comment. We haven't decided how we're going to proceed with regard to that step in the process.

It may be as a major section or a chapter or we may find it more efficient to do it as a large document. So we're in a little bit of trouble on that one, Dana.

DR. POWERS: Okay.

MR. MATTHEWS: I think we can't tell you that we can give you that decision point. Okay?

DR. POWERS: Just make life tough.

MR. MATTHEWS: I realize that would be attractive if it were a proposed rule, for example.

Obviously that's a decision point that you guys always make a judgment on.

These SRP sections, since there is no real obligation, it's only our public openness that would obligate us to send these out. These used to be something totally within staff control, and I could argue that if I was being strictly legal and de jure on this, this was a staff document.

DR. POWERS: Yeah, you're right.

MR. MATTHEWS: It's not a public document for which we have a collaborative or negotiated process, you know.

DR. POWERS: You are correct.

MR. MATTHEWS: It's not something that I'm looking to NEI to debate with us on some of these issues, except in certain instances. So I'm inclined to think that I'm not going to make the commitment that we're always going to send these out for public comment and that that could be your decision point.

I would suggest that maybe when we say deferral, maybe we're also suggesting to you that one alternative is for you to write a letter, which is to just indicate that to the extent that this document as we've looked at it doesn't involve, and based on the staff's representations, doesn't involve any change in policy, regulatory position, we don't have an interest or a need to look further. And we would look at that as a deferral.

DR. POWERS: I think what you're more likely to get from us is what's called a Larkins-gram that would just say, "Thank you. We're not going to review this."

MR. MATTHEWS: Right.

DR. POWERS: And it won't give you any justification or reason. It just says we don't object.

MR. MATTHEWS: We would view that as having been a base touched.

DR. FORD: I started off asking a question of your view, and Dana has led through an argument. Do you hear a good resolution on this one?

CHAIRMAN BONACA: I mean, that could be the way we handle this, is to not review it. You know, we don't explain why we have decided not to review it at that point.

DR. ROSEN: Well, but we don't have that input from Dave and his people for the 523, 31 and 533. We don't have the input really that says, unless you've given it to us verbally.

MR. MATTHEWS: We thought we did in that

viewgraph, to tell you the truth, but I think it could be expanded upon.

DR. FORD: I guess we all received those things, the full--

MR. MATTHEWS: But the --

DR. FORD: And then we crossed out this. I read through them. So if you're going back to the old idea give it to one member and make him decide, I would agree with that. Within regulatory space, this is not different.

DR. ROSEN: Well, I want to hear that from them as well.

MR. MATTHEWS: Well, I'm suggesting that the footnote that we put on that one viewgraph with the chart --

MS. RIVERA: Slide 4.

MR. MATTHEWS: -- Slide 4, basically expressed that view on our part. Maybe you didn't infer it to be that.

DR. ROSEN: I might not have heard that in all of this discussion.

MR. MATTHEWS: Right, yeah. "Since technical changes were not required to update these standard review plan sections, ACRS review is not considered to be necessary . . . in the areas covered by these sections."

DR. ROSEN: Okay.

MR. MATTHEWS: "Has remained essentially unchanged," and I think what we'd rather say there in the future is not -- this is in response to your point -- not that the technology for lightwater reactor applications in this regard has remained essentially unchanged. It is that the technical requirements.

DR. WALLIS: Right. That's what you should put.

MR. MATTHEWS: And that's really, I think, what our intention was, and Keith admits to that. That explanatory paragraph that Keith had put up, you know, incidentally was a way of Keith to explain that even further, but even that could have used the word "requirements" as opposed to "technology." And I think that may have started us down the wrong road on this one.

Yeah, he did use your requirements, he says.

So with that, if you trust our representation that that's what that paragraph means, we're recommending you don't need to review this in any detail.

DR. ROSEN: Well, we don't trust it, but

we accept it, and we have our own member check.

DR. FORD: Well, I've checked, and you've heard my reservations about the whole thing between regulatory space and reality space, technical reality space.

MR. MATTHEWS: It worries me just a little bit if you want to draw that strong a contrast that regulations and regulatory requirements are disconnected from reality.

(Laughter.)

MR. MATTHEWS: And the reason I say that is because we view that the requirements that still exist and might be followed by an existing plant provide a minimum level of protection, but it is sufficient and reasonable assurance, even though there may be plants who have availed themselves of more advanced technology and taken the benefit of that, and as a result may be viewed as safer plants.

That doesn't mean the plant that is stuck with the requirements imposed originally are unsafe or that they'll provide minimum levels of protection. So I'm trying to --

DR. FORD: My reservations are along the lines (speaking from an unmicked location) -- very, very appropriate.

PARTICIPANT: Peter, use the microphone.

DR. FORD: Oh, I'm sorry. You're very correct to put in the extra technical aspect about the surface grinding, but there are other aspects that have changed within the industry within the last 15 years, which do have an impact on the materials -- sorry. I'm getting a crick in my neck doing this -- on the material specifications because of the interaction between the stress and the environment, I expect.

The environment has changed tremendously in the lightwater reactor.

MR. MATTHEWS: And I would call that technical advances that we may not have availed ourselves in regulatory space.

DR. FORD: And by not making yourselves available to them, you're putting extra burden on the licensee.

DR. ROSEN: Well, but the licensee shouldered that burden. What they do is they come in and say, "We want to do something different than what you would require from a strict reading of the SRP, and here is what it is." And then the staff disposes of that.

DR. FORD: Okay. I think we've come to a

conclusion. Mario, I'll turn it back to you.

CHAIRMAN BONACA: Good.

DR. FORD: Thank you very much.

CHAIRMAN BONACA: Thank you. I thank you for the presentation.

At this point we're going to recess for lunch, and now there are interviews, as you know, and you all belong to Group 1 or Group 2. I will not be able to attend some of those because I've got to see McGaffey at one.

We will start the meeting again at 1:30 sharp because we need to make progress. Tomorrow we are going to lose a quorum by 3:30 I found out. So we need to do all of the work by that time.

(Whereupon, at 11:55 a.m., the meeting was recessed.)

CERTIFICATE

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

Name of Proceeding: Advisory Committee on Reactor Safeguards 513th Meeting

Docket Number: n/a

Location: Rockville, MD

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

Matthew Needham

Matthew Needham
Official Reporter
Neal R. Gross & Co., Inc.

Schedule of SRP Sections to be Updated in FY05

Revision Quarter	Bundle	Section	Title	Primary Division	ACRS Review
1st	1	4.5.2	Reactor Internal and Core Support Materials	DE	1st quarter (December 2004)
	2	6.5.2	Containment Spray as a Fission Product Cleanup System	DE	1st quarter (December 2004)
	3	8.4	Station Blackout [Future]	DE	2nd quarter (February 2005)
2nd	4	3.9.6	Inservice Testing of Pumps and Valves	DE	2nd quarter (March 2005)
		3.9.5	Reactor Pressure Vessel Internals	DE	
		3.9.3	ASME Code Class 1, 2, and 3 Components, Component Supports, and Core Support Structures	DE	
		3.9.4	Control Rod Drive Systems	DE	
	5	7.1-A	Acceptance Criteria & Guidelines for I&C Systems Important to Safety	DE	2nd quarter (March 2005)
		7.3	Engineered Safety Features Systems	DE	
		7.4	Safe Shutdown Systems	DE	
	6	2.5.2	Vibratory Ground Motion [Future]	DE	3rd quarter (April 2005)
3rd	7	6.2.1	Containment Functional Design	DSSA	3rd quarter (June 2005)
		6.2.5	Combustible Gas Control in Containment	DSSA	
		6.4	Control Room Habitability System	DSSA	
		6.2.1.3	Mass and Energy Release Analysis for Postulated Loss-of-Coolant Accidents	DSSA	
		6.2.3	Secondary Containment Functional Design	DSSA	
	8	19.1	Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed	DSSA	3rd quarter (June 2005)
	9	3.8.2	Steel Containment	DE	4th quarter (July 2005)
		3.8.1	Concrete Containment	DE	
		3.8.3	Concrete and Steel Internal Structures of Steel or Concrete Containments	DE	
	10	14.2.1	Generic Guidelines for Extended Power Uprate Testing Programs	DIPM	4th quarter (September 2005)
		12.5	Operational Radiation Protection Program	DIPM	
4th	12	9.4.1	Control Room Area Ventilation System	DSSA	4th quarter (September 2005)
		2.3.4	Short-Term Dispersion Estimates for Accidental Atmospheric Releases	DSSA	
		3.5.1.6	Aircraft Hazards	DSSA	
		9.5.1	Fire Protection Program	DSSA	
	11	4.2	Fuel System Design	DSSA	1st quarter FY06 (October 2005)
		4.3	Nuclear Design	DSSA	
		4.4	Thermal and Hydraulic Design	DSSA	
		4.6	Functional Design of Control Rod Drive System	DSSA	
		NEW*	Spent Fuel Criticality	DSSA	
		5.4.12	Reactor Coolant SystemHigh Point Vents	DSSA	
	13	19.0	Probabilistic Risk Assessment	DSSA	1st quarter FY06 (October 2005)

Note: Schedule is subject to change
* Number of section not yet decided

ST Analysis: evaluation of aerosol removal rates (1)

General Remarks

Application of AST requires T-H scenario and aerosol models not specified by NUREG-1465.

Westinghouse calculation based on a single T-H scenario and mechanistic aerosol model.

Adopted scenario (3BE-1) is a double-ended DVI 4" line break with a failure to activate the intact train. The spillage floods the containment and spills into the vessel.

- scenario acceptance based on the following:

> **It is representative of the "3BE" accident class, which is the dominant contributor to the core damage frequency for the AP1000.**
>
> **The T-H conditions for 3BE accidents are typical for majority of severe accident sequences (fully depressurized and reflooded.)**
>
> **AST was intended to be representative of low pressure core-melt accidents.**

The staff accepts the 3BE-1 accident sequence as a basis for the AP1000 dose analysis.

ST Analysis: evaluation of aerosol removal rates (2)

Westinghouse analysis

Initially Westinghouse intended to use AP600 removal rates for AP1000 aerosol. After the staff raised concerns, Westinghouse submitted BE analysis using MAAP calculated T-H and aerosol mechanistic code STARNAUA. Credit was given for gravitational settling, diffusiophoresis (steam condensation) and thermophoresis (temperature gradient).

Staff accepted these phenomena as removal mechanisms, however questioned the Westinghouse calculated removal rate values.

Staff's analysis

Staff performed an independent aerosol removal rates analysis with an alternative T-H (MELCOR) as an input to Monte Carlo sampling. MELCOR calculated removal rates were also reviewed.

ST Analysis: evaluation of aerosol removal rates (3)

Staff's analysis

13 parameters affecting aerosol behavior were sampled to achieve 95% confidence level (200 tries.) Engineering judgement was used for the choice of parameters as well as for the range and distribution of their values. The sampled parameters are:

- aerosol size
- distribution,
- aerosol void fraction
- particle shape factors,
- aerosol material density,
- non-radioactive aerosol mass,
- particle slip coefficient,
- sticking probability for agglomeration,
- boundary layer thickness for diffusion deposition,
- thermal accommodation coefficient for thermophoresis,
- ratio of thermal conductivity of particle to gas,
- turbulent energy dissipation, and
- multipliers on heat and mass transfer to containment shell.

ST Analysis: evaluation of aerosol removal rates (4)

Regulatory issue

Traditional regulatory approach is to accept a "bounding" value. In the case of probability distributions the widely accepted bounding values are 5% or 95%-tiles.

For AP1000, staff used the median (50%-tile) for the following reasons:

- staff believes that the selected scenario belongs to a "worst case" category,
- median value is the least affected by the user's subjective judgements,
- since the choice of the initial ranges and distributions of the selected parameters is highly subjective, staff introduced a "conservative bias" in its selection,
- there is a precedence of staff accepting the median value in a pilot case of Perry steam line deposition, based on RES opinion that it is appropriate given other conservatisms built into the other parts of the analysis,
- staff's dose calculation code requires yet another "averaging" of the removal rates for the specified time periods, introducing additional subjectivity to the analysis,
- the fully integrated MELCOR calculated removal rates are mostly well above the 5%-tile.

ST Analysis: evaluation of aerosol removal rates (5)

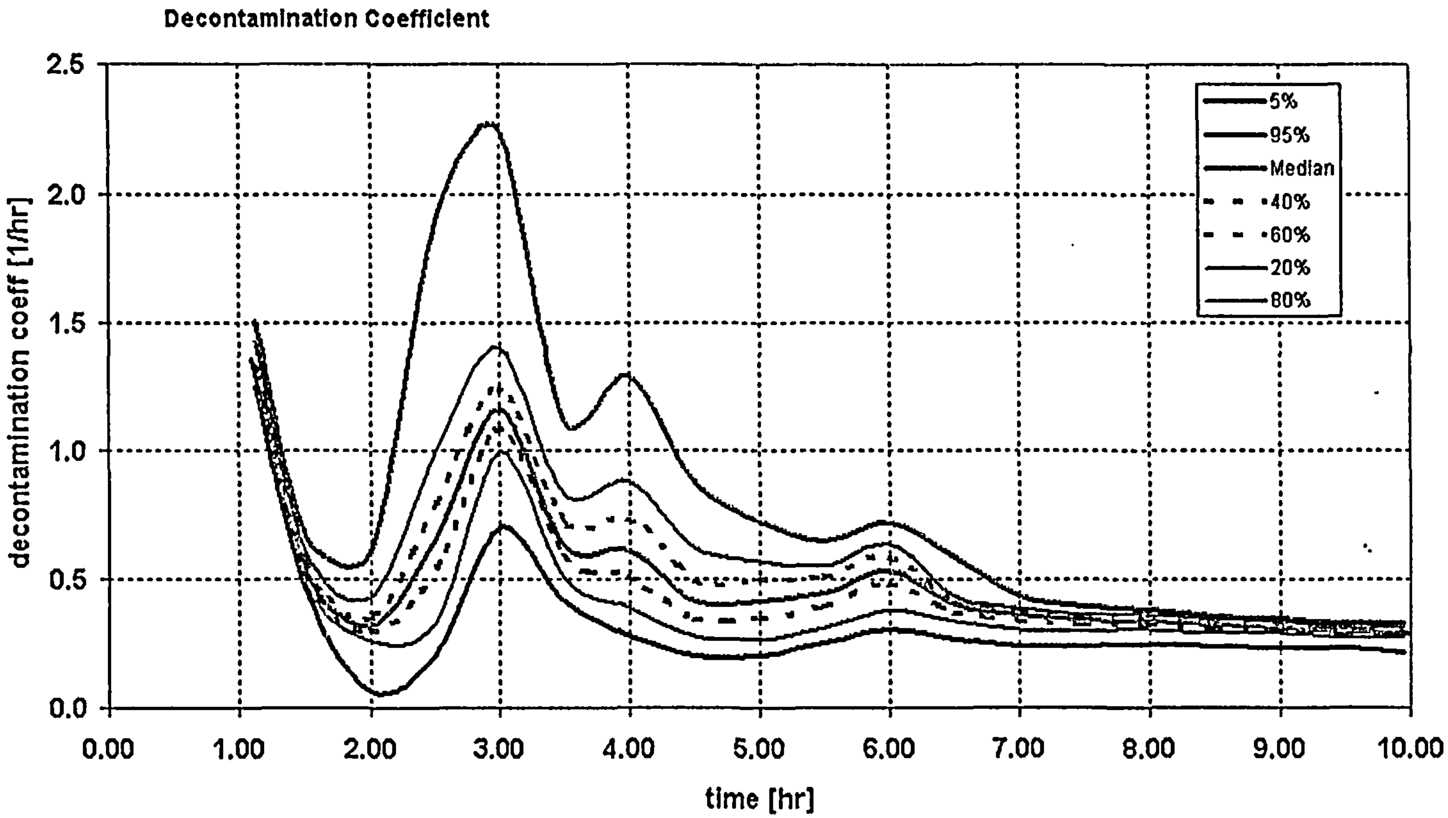
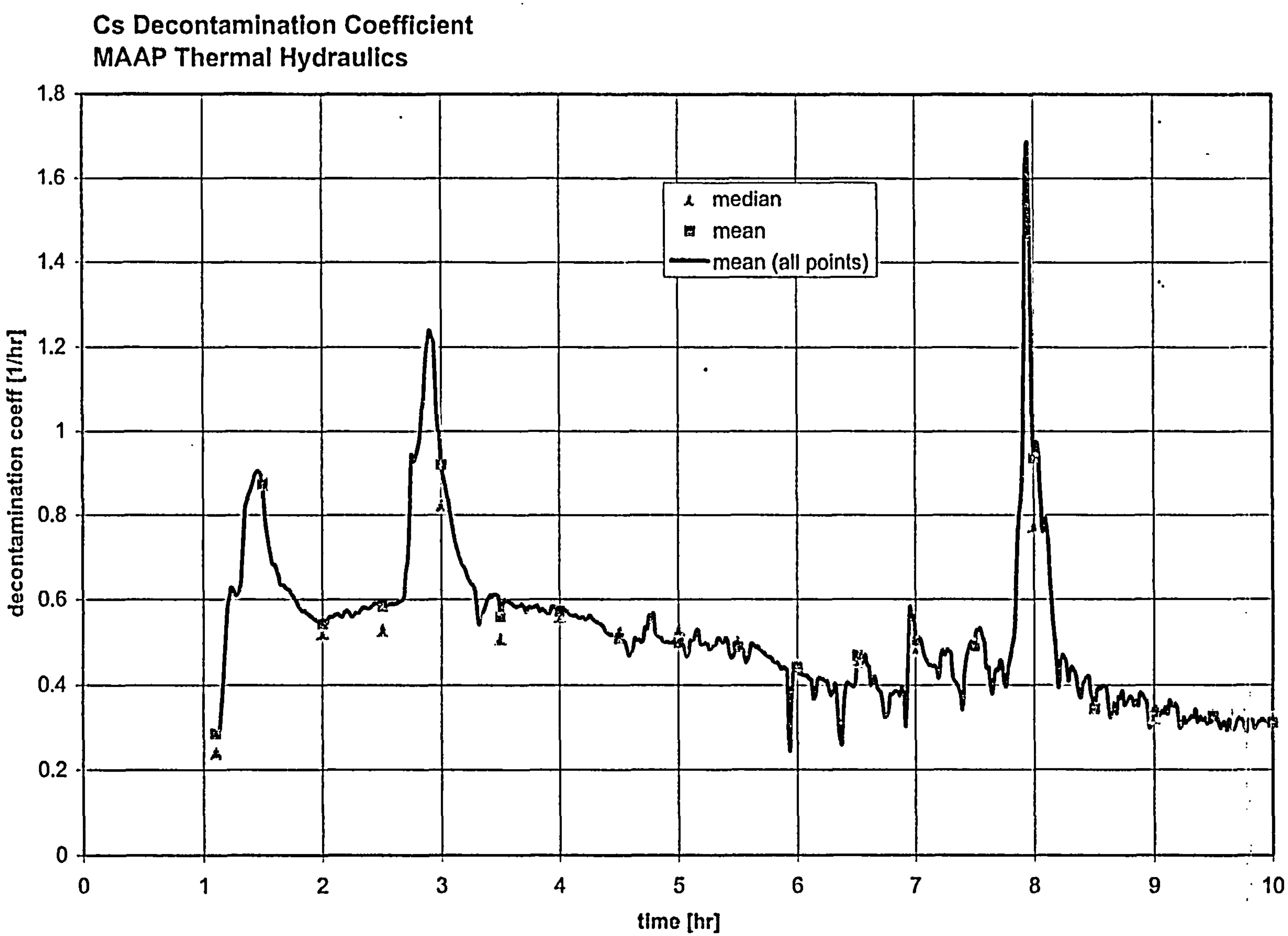
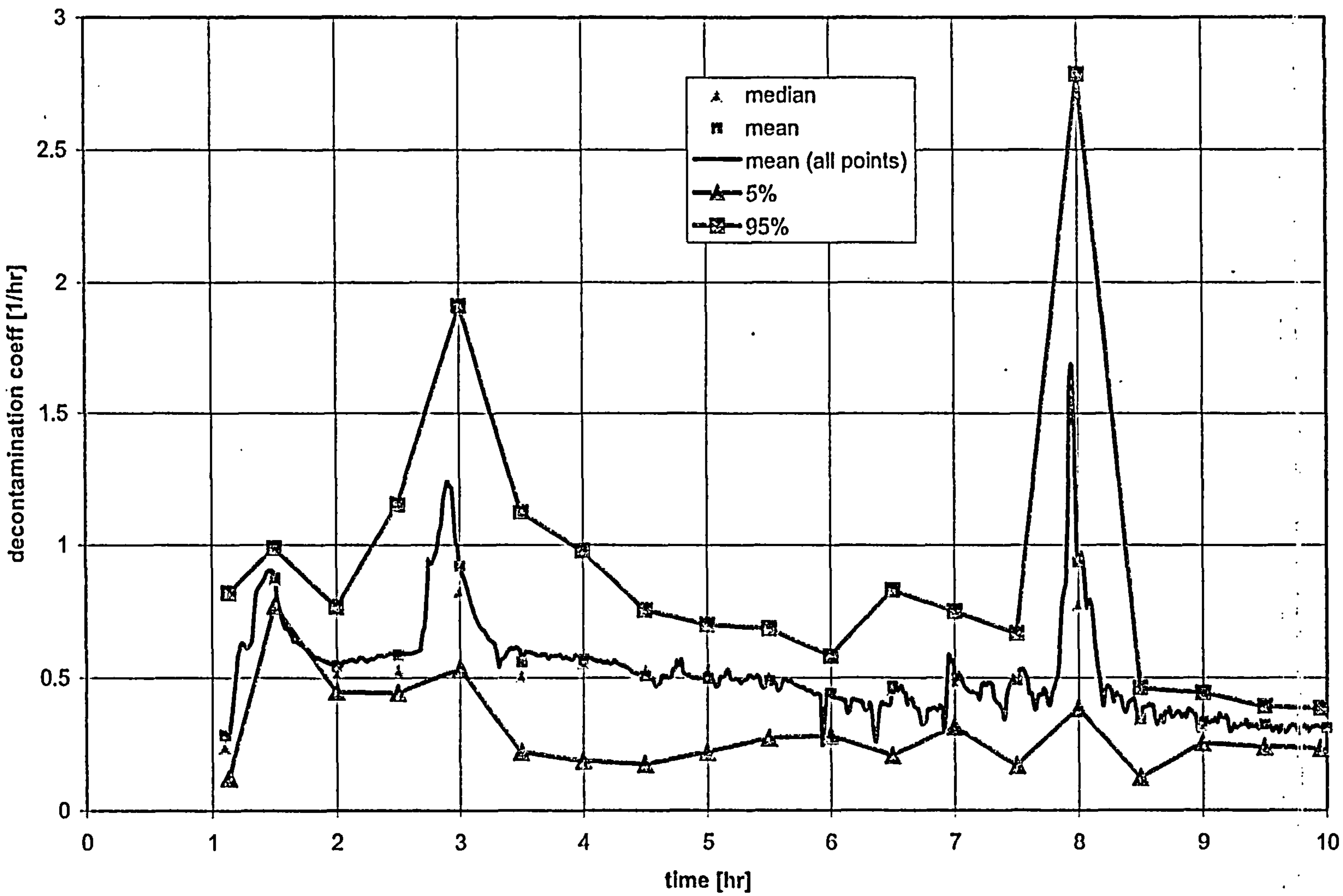


Figure 1: Uncertainty bands of aerosol removal rates (lambdas)


Cs Decontamination Coefficient
MAAP Thermal Hydraulics
median
mean
mean (all points)
decontamination coeff [1/hr]
time [hr]
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
1
2
3
4
5
6
7
8
9
10

Cs Decontamination Coefficient
MAAP Thermal Hydraulics



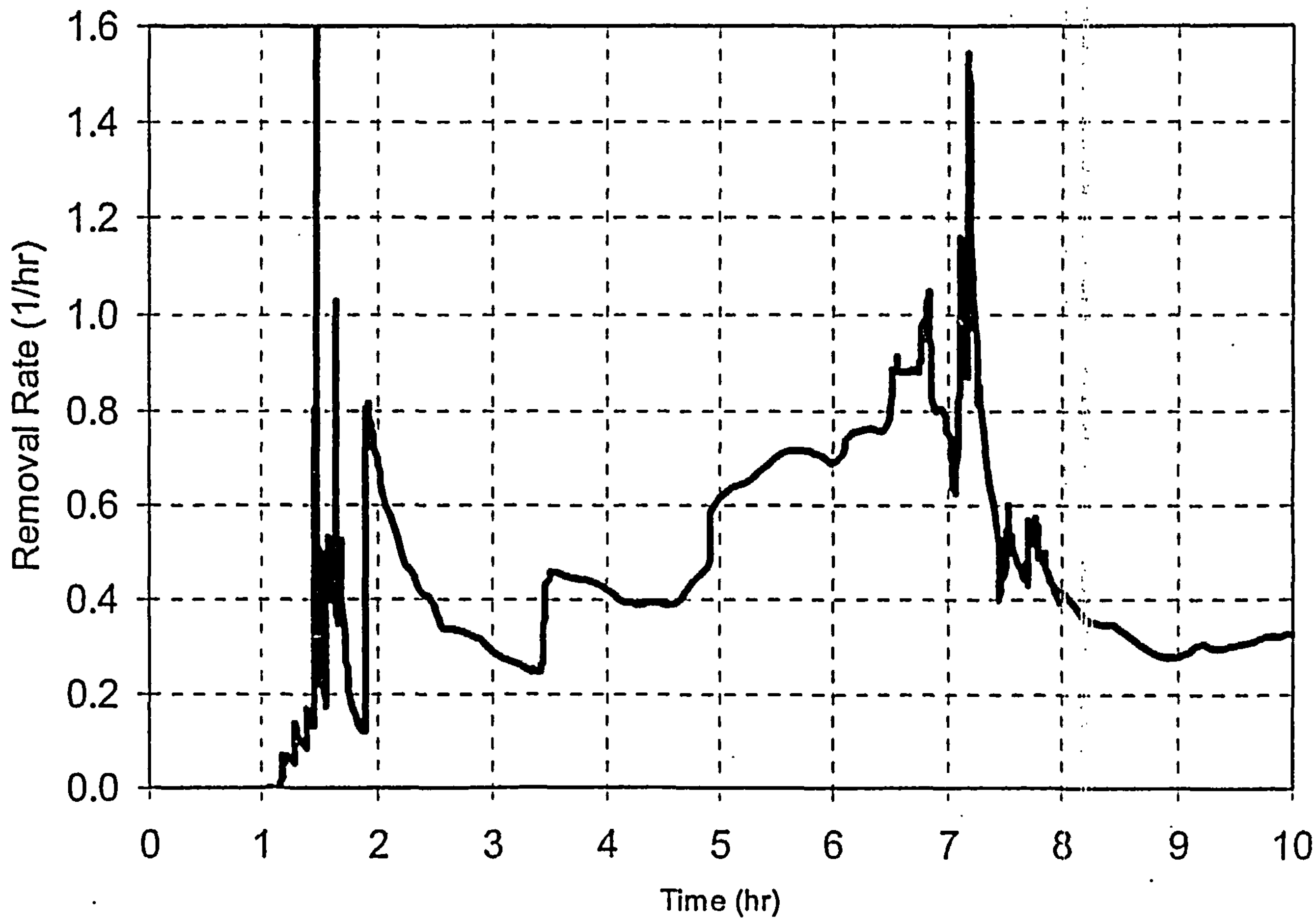
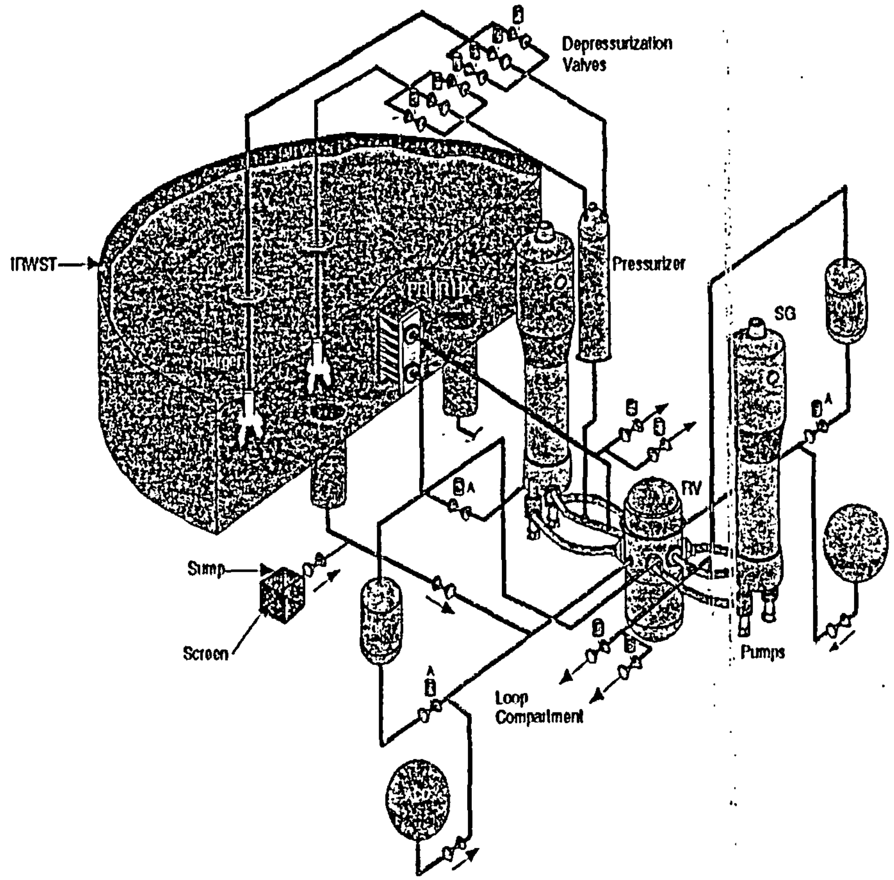


Figure 3 Average Aerosol Rate Removal Constant in Containment, MELCOI Scenario 3BE with Vessel Reflood Through Broken DVI Line

AP1000 Passive Core Cooling System

- AP600 System Configuration Retained
- Capacities Increased to Accommodate Higher Power
  - CMT Increased 25%
  - IRWST Injection Increased 80%
  - Sump Injection Increased 110%
  - ADS 4 Increased 90%
  - PRHR HX Capacity Increased 72%
- System Performance Maintained
  - No core uncovery for SBLOCA
    - DVI line break
  - Large margin to PCT limit



Standard Review Plan Update Process

Presentation to the Advisory Committee on Reactor Safeguards

Rob Kuntz
Aida Rivera

Organizational Effectiveness Branch
Program Management, Policy Development and Planning Staff
Office of Nuclear Reactor Regulation

June 3, 2004

Purpose

- Present summary of changes to SRP sections 5.2.3, 5.3.1, and 5.3.3 and request a waiver of ACRS review of the revised sections
- Inform the ACRS of NRR's process and plan to update SRP sections during FY05 and FY06.
- Obtain ACRS agreement on the potential work load, and the schedule established for SRP updates during FY05.

Agenda

- Summary of changes
- Background
  - October 31, 2003 SRM
- SRP development process
- Plan
- Summary

Summary of changes

SRP Section	Technical changes	Editorial changes	Added /revised references	Total number of changes
5.2.3 REACTOR COOLANT PRESSURE BOUNDARY MATERIALS	0	5	17	22
5.3.1 REACTOR VESSEL MATERIALS	0	12	22	34
5.3.3 REACTOR VESSEL INTEGRITY	0	4	7	11

- Since technical changes were not required to update these Standard Review Plan sections, ACRS review is not considered to be necessary. The technology for light water reactor applications in the areas covered by these sections has remained essentially unchanged.

Background

- October 31, 2003 SRM - SRM in response to October 2, 2003 ACRS meeting.

- SRM asked staff to provide the Commission the status, approach and plans for maintaining a current and effective set of guidance documents (including SRP).

Background

- Prior to the issuance of the SRM, NRR staff had begun preliminary work on an SRP update plan.
- Included:
  - Scoping process
  - Prioritization process
  - Scheduling

Scoping Process

- Purpose- determine the extent of the update and estimate the resources required to complete the update.
- Questions asked during the scoping:
  - What version is currently used for reviews of license amendments?
  - Is there guidance that has superceded the version used?
  - Does updating the SRP Section require public comment, ACRS comment, and/or CRGR comment?
  - Does updating the SRP section require updating of other guidance?
  - Estimated number of hours required to complete the revision.
- Updating the entire SRP will require approximately 35 FTE.

Prioritization Process

- Purpose – create a prioritized list of SRP sections that will be used to determine which SRP sections are scheduled to be updated each fiscal year.
- 3 criteria used to prioritize the sections:
  - Safety Significance
  - Recent Industry Activities
  - Stakeholders/Commission Interest
- As resources are allocated in the budget for updating the SRP, the highest priority SRP sections will be updated.

Plan

- Updates to the SRP will be accomplished according to NRR Office Instruction (OI) LIC-200, "Standard Review Plan (SRP) Process."
- The budget proposed for SRP work for FY05 and FY06 is approximately 6 FTE for each fiscal year.
- NRR's plan is to update around 35 SRP sections in FY05 and FY06.

Bundling

- Purpose - create groups (bundles) of SRP sections in order to make the SRP update process easier on both NRR staff and ACRS.
- Examples of topics for bundles:
  - Reactor Vessel – materials and internals
  - Containment
  - Instrumentation and control systems
- Results -
  - FY05 - 35 sections divided in 13 bundles
  - FY06 - 35 sections divided in 11 bundles

Scheduling

- Intermediate milestones were established to distribute resources for review of SRP sections throughout the year.
- Each bundle for fiscal year 2005 (FY05) will be completed within a specified quarter.
- The quarter was assigned based on the estimated hours the staff provided during the scoping process and resource availability.

Summary

- The update of the SRP will be accomplished according to NRR OI LIC-200, "Standard Review Plan (SRP) Process."
- During FY05, ACRS will be receiving 13 bundles of SRP updates, approximately 3 bundles per quarter.

Objectives

- ACRS response to waiver request for review of revised SRP sections 5.2.3, 5.3.1, and 5.3.3
- ACRS agreement on the potential work load, and the schedule established for SRP updates during FY05.

ISSUE 5: IN-VESSEL RETENTION/FUEL COOLANT INTERACTIONS

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Rockville, Maryland

June 3, 2004

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ACRS CONCERNS

- "The assessment of in-vessel retention has not included exothermic intermetallic reactions which have been shown by some prototypic experiments to be important. If these factors are properly accounted for, the associated energetics of any resulting ex-vessel steam explosions are likely to be greater than has been currently evaluated. We would like to review the FCI models used and see additional justification that the initial conditions related to intermetallic reactions will not give rise to an energetic FCI that could fail containment."

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June 3, 2004

IVR/FCI ANALYSIS

- Used a simple mechanistic model based on the existing constitutive relations & a synthesis of severe core damage phenomena, to arrive at a likelihood of vessel failure for AP1000 (presented to ACRS during meeting on July 17, 2003).
- Focus on thermal effects – Recognized that intermetallic (e.g., melt-vessel) interaction effects potentially important. Therefore, also conjectured LH failure at bottom location leading to discharge of denser metals at higher temperature.
- Approach & analyses subjected to peer review (by Dhir, Corradini & Moody).

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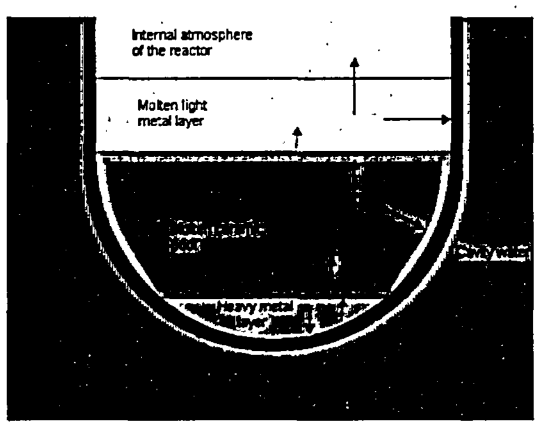
MELT CONFIGURATION

- Two Configurations Considered



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U. S. Nuclear Regulatory Commission
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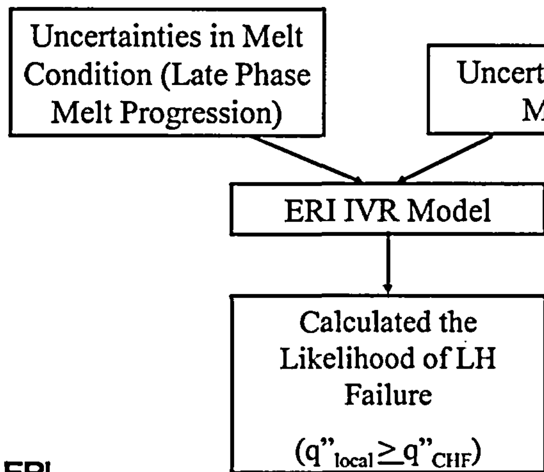
IVR Analysis



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IVR ANALYSIS RESULTS

- Likelihood of lower head failure in the region of the "light metallic layer" (due to "focusing" effect) ranges from ~0.05 to 0.30

Case	Description	Ceramic Layer CFP	Metal Layer CFP
	Without Decay Heat in the Light Metal Layer		
1	Base Case	0	0.15
2	DOE heat transfer correlations	0	0.20
3	INEEL heat transfer correlations	0	0.30
4	Material Properties	0	0.16
5	Reduce probability level of low UO_2 range	0	0.04
6	Impact of "tails" of uncertainty distributions	0	0.16
7	Impact of assumed ±10% uncertainty in CHF	0	0.08-0.25
8	Impact of 25% increase in HTC (Ceramic to Light Metal Layer)	0	0.17
	With Decay Heat in the Light Metal Layer		
1D	Base Case	0	0.27
2D	DOE heat transfer correlations	0	0.30
3D	INEEL heat transfer correlations	0	0.31
5D	Reduce probability level of low UO_2 range	0	0.07
6D	Impact of "tails" of uncertainty distributions	0	0.30
7D	Impact of assumed ±10% uncertainty in CHF	0	0.20-0.31
8D	Impact of 25% increase in HTC (Ceramic to Light Metal Layer)	0	0.29

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PARAMETRIC RESULTS FOR CONFIGURATION II

- Results show that thermal failure of lower head at the bottom location not likely

Fraction of U in Oxide Form	0.95	0.9	0.85
m_U(kg) [bottom layer]	2,921	5,841	8,762
m_{UO2} (kg) [oxide layer]	62,853	59,639	56,326
Decay Heat			
Q_b (MW/m³) [bottom layer]	1.126	1.084	1.071
Q_o (MW/m³) [oxide layer]	2.127	2.112	2.096
Q/Q_{CHF}	0.22	0.30	0.36

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EX-VESSEL FCI ANALYSES

- Considered two RPV failure scenarios:
  - At the side wall (near the cavity wall) – non-negligible likelihood even in the absence of any chemical reactions
  - At the bottom – To address the potential for LH failure due to inter-metallic (melt-vessel) interactions

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FACTORS IMPACTING FCI LOADS

- Melt Composition (Metallic vs. Ceramic)
- Melt Temperature (Superheat)
- Water Temperature (Subcooling)
- Melt Pour Rate (Quantity)
- Location of Explosion (Center vs. Side)
- Debris Particle Size & Fragmentation Rate
- Chemical Energy Augmentation (Not Considered)

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FCI CALCULATION MATRIX

- Variability in:
  - Melt progression (melt pour composition and the RPV failure size)
  - Modeling of fuel coolant interactions (within the PM-ALPHA/ ESPROSE [2D version] framework)

Case	Variation from the base case	Comments
1	Base case scenario	Metallic pour at 2060 K, lower head failure size of 0.4 m, melt particle diameter of 0.01 m, and the maximum fragmentation rate per particle of 4 kg/s
2	Ceramic composition at 3150K	Pour involves ceramic material
3	Failure size of 0.6 m	Larger hole size
4	Particle diameter of 0.10 m and maximum fragmentation rate per particle of 400 kg/s	Larger particle diameter and fragmentation rate
5	Bottom failure of the lower head	Metallic pour (U+Fe+Zr) at 2300 K, lower head failure size of 0.4 m, melt particle diameter of 0.01 m, and the maximum fragmentation rate per particle of 4 kg/s

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FCI RESULTS

Case	Impulse Load on the Cavity Wall (kPa-s)
Metallic Melt, 2060K, 0.4 m, D_p=0.01m, R_f=4 kg/s/particle (Side) (Base Case)	~85
Ceramic Melt (3150K, 0.4 m, D_p=0.01m, R_f=4 kg/s/particle (Side)	~300 [500 – 600]*
Metallic Melt, 2060K, 0.6 m, D_p=0.01m, R_f=4 kg/s/particle (Side)	~150
Metallic Melt, 2060K, 0.4 m, D_p=0.1m, R_f=400 kg/s/particle (Side)	~12
Heavy Metallic Melt, 2300K, 0.4 m, D_p=0.01m, R_f=4 kg/s/particle (Bottom)	~10

* Loads estimated for AP600

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CONCLUSIONS

- Inter-metallic reactions could potentially result in LH failure at the bottom location
- FCI loads following LH failure at bottom location are significantly lower than cases involving side failure of LH:
  - Smaller mass of melt participating in the fuel coolant interaction
  - Mitigation effect due to dampen pressure propagation as a result of distance from the explosion zone (in the cavity center) to the cavity wall

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FCI MODELING USING PM-ALPHA/ESPROSE.m

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PM-ALPHA/ESPROSE.m

- 2D version released to ERI in mid-1990s by NRC
- Developed by UCSB (Theofanous, et al.)
- Newer version also made available to ERI but not used in the present analyses
- Numerical approach based on the KFIX code
- Models have some experimental validation basis

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PM-ALPHA

- PM-ALPHA simulates the premixing phase
- Uses multifield Eulerian formulation
  - Fuel melt
  - Liquid coolant
  - Vapor
- Constitutive laws provide interfacial heat & mass transfer, phase change, fuel breakup through a number of correlations
  - Breakup model solves an interfacial area transport equation:

$$\frac{\partial A_f}{\partial t}+\nabla\cdot\left(A_f\overline{u_f}\right)=S_{fr}+S_b$$

A_f is fuel surface area, u_f is fuel velocity,S is the source term representing fragmentation & breakup

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PM-ALPHA (Cont)

- The breakup mechanism is given by:

$$S_b=-\frac{6\theta_f}{D_f^2}\left(\frac{dD_f}{dt}\right)=-\frac{6\theta_f}{D_f^2}\left[\max\left(\frac{|u_f|}{\beta_b},\frac{D_f}{L}|u_f|\right)\right]$$

D_f = melt diameter
θ_f = melt volume fraction
β_b = User specified paramter
L = Total available fall distance

Breakup process is terminated once particle diamefer reaches capillary size:

$$\sqrt{\sigma / g(\rho_f-\rho_l)}$$

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ESPROSE.m

- ESPROSE.m simulates the propagation phase of the explosion once it is triggered.
- Uses multi-field Eulerian formulation
  - Fuel melt
  - Liquid coolant
  - m-field (vapor field ahead of the explosion front – denotes a homogeneous mixture of fragmented debris and coolant behind the explosion from where fragmentation occurs)
- Fuel fragmentation is principal mechanism that drives the propagation phase of the steam explosion

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ESPROSE.m (Cont.)

- Rate of fragmentation for a single melt particle:

$$\frac{dm_f}{dt} = \frac{\rho_f \pi D_f^3}{6 t_{fr}}$$

- Where

  D_f = fuel particle diameter

  ρ_f = particle density

  t_{fr} = characteristic time for fragmentation

- The dimensionless fragmentation time is defined by:

$$t_{fr}^{+} = \frac{|\overline{u_f} - \overline{u_i}| t_{fr}}{D_f} \left(\rho_f / \rho_i \right)^{-1/2} = \beta_f / Bo^{1/4} = \frac{\beta_f}{\{3 C_d \rho_i D_f |\overline{u_f} - \overline{u_i}|^2 / 16\sigma\}^{1/4}}$$

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ESPROSE.m (Cont.)

- Therefore:

$$\frac{dm_f}{dt} = \frac{\pi D_f^2 \left| \vec{u}_f - \vec{u}_c \right|}{6 t_{fl}^*} (\rho_f - \rho_c)^{1/2}$$
$$= (\frac{3}{6})^{1/4} (\frac{\pi}{6\beta_f}) C_d (\frac{1}{\sigma})^{1/4} D_f^{9/4} \left| \vec{u}_f - \vec{u}_c \right|^{3/2} \rho_c^{3/4} \rho_f^{1/2}$$

However, if $\frac{dm_f}{dt}$ ¡ÝUser specified rate then,

$$\frac{dm_f}{dt} = \text{User specified rate}$$

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ESPROSE.m (Cont.)

- Total rate of fragmentation per unit volume is:

$$F_r = n_p \frac{dm_f}{dt} = \frac{6\theta_f}{\pi D_f^3} \frac{dm_f}{dt} = \frac{\rho_f'}{t_{fl}}$$

Where

n_p = number of particles per unit volume
θ_f = volume fraction of the melt
ρ'_f = macroscopic density of the melt

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ESPROSE.m (Cont.)

- To account for presence of both vapor and liquid in the mixture:

$$F_r = \dot{\rho}_f \left(\frac{\alpha}{t_{fl}} + \frac{1-\alpha}{t_{fm}} \right)$$

F_r is introduced as the source term in the fuel and debris continuity equations. It also appears in the fuel and m-field energy equation

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ESPROSE.m (Cont.)

- The rate of energy addition to the m-field is

$$E_f = F_r I_f = F_r \{ C_{pf}(T_f - T_{ref}) + I_f^* \}$$

I_f = Internal enegy of the melt
I_f^* = heat of fusion of the melt
C_{pf} = heat capacity of the melt
T_f = temperature of the melt
T_{ref} = reference temperature

Therefore, explosive load is a function of melt quantity, temperature, particle size and rate of fragmentation

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AP1000 Design Certification Review

June 3, 2004
ACRS Full Committee Meeting

John Segala, Senior Project Manager
Office of Nuclear Reactor Regulation

Overview

- Purpose
  - Provide status of the staff's review
  - Discuss major schedule milestones
  - Provide overview of the ACRS interim letter issues

AP1000 Review Status

- March 2002 - Completed pre-application review
- March 28, 2002 - Westinghouse (W) submitted DC application
- June 25, 2002 - NRC accepted the application for docketing
- June 16, 2003 - NRC issued Draft SER with 174 Open Items
- May 18, 2004 – NRC provided responses to the issues in the ACRS's Interim Letter
- Processing Final SER

Upcoming Schedule Milestones

- June 25, 2004 - ACRS Future Plant Design Subcommittee Meeting
- July 7-9, 2004 - Full ACRS Committee Meeting
- September 13, 2004 - Final SER and FDA issued
- December 2005 – Final Design Certification Rule issued

Issue 1 - Automatic Depressurization System (ADS)-4 Squib Valve Function

- Issue:
  - Agreed with the staff that ITAAC assures the valves meet the design basis specifications
- Response:
  - Simple design - ASME Code Section III Class 1
  - Redundant and Diverse Actuation
  - PRA Sensitivity Study
  - ITAAC

U.S. Nuclear Regulatory Commission Slide 5 June 3, 2004

Issue 2 - Assurance of Long-Term Cooling (Strainer Blockage)

- Issue:
  - AP1000 is a robust design to prevent screen blockage.
  - Recommended ITAAC to ensure compliance with GSI 191
- Response:
  - ITAAC
  - COL Action Items
  - Containment recirculation screens redesign

U.S. Nuclear Regulatory Commission Slide 6 June 3, 2004

Issue 3 - Code Deficiencies

- Issue:
  - When deficiencies are identified in codes, the weaknesses should be corrected.
- Response:
  - TRACE code is being assessed using APEX AP1000, ATLATS, and UPTF data.
  - If desired, the staff can describes the results to the ACRS when completed.

Issue 4 - Range of Pi-Group Values

- Issue:
  - The staff should verify that a Pi group range of 0.5 to 2 is appropriate.
- Response:
  - This range has been used as a de facto standard in scaling analyses.
  - This issue is generic, not an issue specific only to AP1000.
  - Staff plans to develop and document procedures to define appropriate Pi group range.

Issue 5 - In-Vessel Retention/Fuel-Coolant Interactions

- Issue:
  - IVR assessment needs to consider the effects of exothermic intermetallic reactions.
  - Would like to review the FCI models and justification that intermetallic reactions will not result in energetic FCI that could fail the containment.
- Response:
  - Staff provided the ACRS a copy of their contractors IVR and FCI report for AP1000

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Issue 6 - Organic Iodine Production

- Issue:
  - Acidification of water film on the inside of the containment wall (as a result of radiolysis of organic material) could result in re-evolution of iodine in the gaseous organic form.
- Response:
  - W first presented their sensitivity study during a public meeting yesterday.
  - The staff plans to perform an audit of the sensitivity study within the next week.
  - The staff may perform independent evaluations.
  - If desired, the staff can describes its evaluation to the ACRS on June 25, 2004.

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Issue 7 - Catastrophic Failure of the Steel Containment

- Issue:
  - A free-standing steel containment can fail in a catastrophic manner when its failure pressure is exceeded. This failure mode can lead to rapid depressurization and resuspension of deposited fission products.
  - Like to see a sensitivity study on the fission product source term to assess the effect on the risk of latent fatalities as compared to the Safety Goal.
- Response:
  - Frequency of catastrophic containment failures are small
  - Resuspension would not have a noticeable impact on the Commission's safety goals.

Additional ACRS Comments

- Materials
  - Comment:
    - Ongoing and future studies may suggest material and environmental changes that will be addressed at the COL stage.
  - Response:
    - Clarified the Part 52 change process
- Aerosol Removal Coefficient (lambda)
  - Comment:
    - The ACRS looks forward to reviewing the staff's aerosol removal analysis using the MELCOR code.
  - Response:
    - Provided staff evaluation

Conclusion

- On schedule to issue Final SER by September 13, 2004
- Questions/Comments?

AP1000

AP1000 Design Certification Review

Westinghouse Electric Company

Presentation to

Advisory Committee on Reactor Safeguards

June 3, 2004

BNFL Westinghouse

AP1000

Safety Goal Risk Measures

- NRC Safety Goal Policy Statement
  - no significant additional risk to life and health
- Quantitative Health Objectives - metrics for Safety Goal
  - fatality and cancer risks < 0.1% of sum from other causes
- Quantitative Health Objectives - numerics
  - risk of prompt fatality < 5E-07 per reactor year
  - risk of latent cancer fatality < 2E-06 per reactor year
- AP1000 PRA Results
  - risk of prompt fatality 8.4E-11 per reactor year
  - risk of latent cancer fatality 8.6E-10 per reactor year

AP1000 Risk Quantification

AP1000

- The AP1000 comparison to Safety Goal shows that additional uncertainties associated with severe accident analysis, such as those discussed today, can readily be tolerated without challenging the Safety Goal measures.

Summary of Issue 5

AP1000

- Exothermic intermetallic reactions could lead to a vessel failure and produce a fuel-coolant interaction (FCI) greater than currently evaluated.
- ACRS would like to review FCI models and see justification that such a FCI does not fail containment.

Ex-Vessel FCI in AP1000

AP1000

- **FCI Analysis submitted for AP600**
  - TEXAS code used to determine FCI loads
  - Side, hinged failure is limiting case
  - Upper bound containment vessel strain is 3.8%
  - Tests on vessel material show 22 to 32% strain for ultimate load
  - FCI does not fail containment
- **AP600 analysis applied to AP1000**
  - Similar vessel lower head geometry
  - Similar lower plenum debris characteristics
    - materials
    - temperatures
  - Same vessel failure modes
  - AP1000 vessel closer to containment floor
- **This is consistent with NRC staff findings**

FCI in AP1000

AP1000

- **Lower metal layer exothermic reaction scenario would challenge vessel bottom.**
- **Vessel bottom failure not the limiting case**
  - Bottom of vessel close to floor
  - Limited pre-mixing volume
  - Limited debris participating in the FCI
- **The lower metal layer exothermic reaction failure scenario is bounded by side, hinged failure scenario – containment does not fail.**

AP1000

Summary of Issue 6

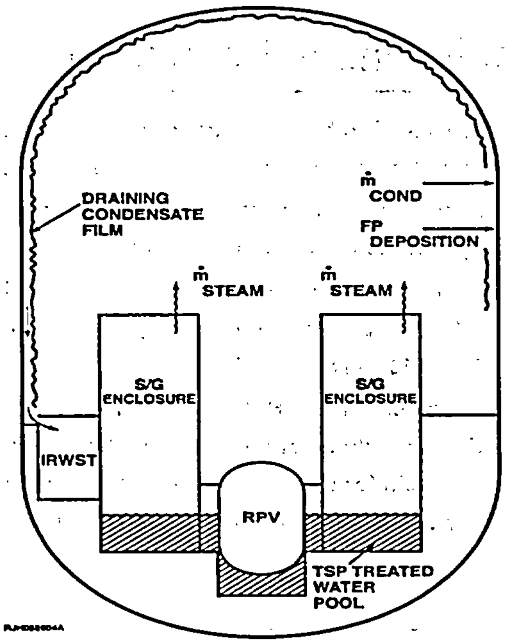
Organic Iodine Production: The acidification of containment water as a result of radiolysis of organic material could give rise to significant airborne fission product iodine in gaseous organic form. We need to review how Westinghouse and the staff have dealt with this potential.

AP1000

Issue 6: Organic Iodine Production

- Formation of organic iodine as a result of radiolysis or organic materials involves the availability of elemental iodine (I_2).
- Elemental iodine can be produced from iodide (I^-) in water pools or films where pH is not controlled to be 7 or greater.
- AP1000 containment design includes TSP to control the pH of the water pool that collects in the lower compartment and reactor cavity following an accident.
- However, no specific pH control treatment for the condensate film draining down the containment dome and shell is provided.
- Cesium iodide can be deposited on the draining film and provide a source of I^- that could potentially be converted in the film to I_2 given the film was acidified.
- Film residence time depends on the steam condensation rate and limits the amount of film acidification and CsI deposition. A range of 40 to 260 seconds has been estimated for condensation rates of 29 to 2.3 kg/s.

AP1000



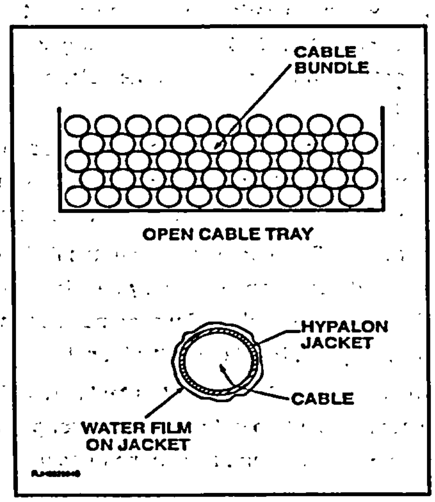
BNFL

Westinghouse

AP1000

Issue 6: Organic Iodine Production

- Radiolytic decomposition of electric cable jacket material can produce HCl. If the HCl could escape the uncovered and covered cable trays, it could eventually mix with the containment atmosphere and be delivered to the draining film with the condensing steam.



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AP1000

Issue 6: Organic Iodine Production

- Draining film could be acidified by radiolytic formation of nitric acid or possibly deposition of other acids generated in containment.
- The radiation field in containment varies as the FPs are released and then removed by various deposition mechanisms.
- The estimated range of film pH due to nitric acid generation is 5.6 to 6.5 and 4.8 to 6.7 due to HCl deposition during the first 10 hr of the accident when $[I^-] \geq \sim 10^6$ g-mole/liter.
- A very small integral amount of CsOH (270 gram) from deposited aerosol fission products would be sufficient to neutralize all this nitric and hydrochloric acid for this 10 hour interval. Less than 0.1% of the potentially available CsOH in the core would completely neutralize the film.

AP1000

Issue 6: Organic Iodine Production

- It is known that a variety of fission product chemical species constitute the source term (ST). CsOH has been judged to be a dominant specie and used as a surrogate chemical specie for the balance of Cs available following CsI formation.
- If the balance of the core Cs is considered to be CsOH, an initial core inventory of approximately 373 kg of CsOH would be available for release. This is several orders of magnitude larger than that estimated to neutralize the draining film.
- Continuing ST research such as in the PHEBUS facility suggests multiple Cs compounds are formed and may be released as aggomerated aerosols of multiple fission product species. Thus, some uncertainty exists regarding the dominant chemical specie but it doesn't eliminate the existence of CsOH as one specie.
- Interestingly, the PHEBUS FTP1 test results indicate that the aerosols injected into containment do not possess a strong acidic character. A small increase in sump pH was measured when the deposited fission products were washed into the sump.

Issue 6: Organic Iodine Production

AP1000

- The limited inventory of CsOH required to neutralize the film leads to the expectation that the draining condensate film pH will be 7 or greater.
- Significant conversion of the deposited iodide (I^-) would not be expected nor would the formation of additional organic iodine.

Issue 6: Organic Iodine Production

AP1000

- As a sensitivity study, it can be assumed that no CsOH is deposited on the draining film.
- Regulatory design basis source term (ST) definition considers that 3% of the *elemental iodine that is released from RCS is converted to organic iodine in* containment. (Note: 5% of iodine released from RCS is taken as elemental so 0.03 x 0.05 = 0.15% of released iodine is in organic form per the ST definition.) This source term has been used in the AP1000 design basis dose assessments.
- Models have been formulated (NUREG/CR-5950) for estimating the fraction of I^- converted to I_2 in water as a function of the water's pH and the I^- concentration.
- *Experimental studies indicate that when a threshold radiation dose to water is* exceeded, the conversion will reach the steady-state value. Specifically, NUREG/CR-5950 states that for this model:
  - "Experimentally, it has been observed that at dose rates > ~0.3 Mrad/hr, steady state would be reached within a few hours."
- The draining film residence times are much shorter than an hour, which suggests that the steady-state conversion fractions would not be obtained.

AP1000

Issue 6: Organic Iodine Production

- To estimate the potential dose impact of additional organic iodine generation due to the lack of specific pH control of these draining films, it will be assumed that the conversion model applies and conversion of iodine form occurs instantaneously.
- Based on the estimated ranges of film pH for either HNO_3 formation or HCl deposition and the range of iodide concentrations due to CsI deposition, the conversion fraction is estimated to vary between 0 and 0.5 over the 10 hour interval.
- As a conservatism, a conversion fraction of 1.0 is assumed to assess the potential dose impact – not pH dependent.
- All the I^- in the deposited CsI, is assumed to be converted to elemental iodine in the draining film and also assumed to be in the equilibrium distribution of the aqueous, $(I_2)_{aq}$, and the gaseous, $(I_2)_{gas}$, molar concentrations.

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Issue 6: Organic Iodine Production

- An expression for the iodine partition coefficient, PC (I_2), defined as the ratio of aqueous to gaseous concentrations is provided in NUREG/CR-5950 to be given as a function of the water temperature:

  $\log_{10} PC(I_2) = 6.29 - 0.0149\,T$

  where T is in °K
- The draining condensate film temperature is used to determine the iodine partition coefficient over the 10 hr interval. The fraction of $(I_2)_{gas}$ in the film is assumed to all be released as elemental iodine into the containment gas space. This corresponds to approximately 6.4% of the iodine aerosol released per the design basis ST.
- With the assumed 3% conversion to the organic form for the elemental iodine released to the containment atmosphere, the impact on the organic iodine source term is to increase it from 0.15% to 0.33%.
- The fraction of $(I_2)_{aq}$ that remains in the film is not expected to produce organic iodine since the containment dome and shell are coated with inorganic zinc that does not contain organic material.

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Issue 6: Organic Iodine Production

AP1000

- This sensitivity study includes several significant conservatisms:
  - core melt,
  - conservative source that includes 3% conversion of elemental to organic iodine,
  - conservative containment leak rate,
  - conservative weather (χ/Q quantification),
  - zero CsOH release,
  - for control room no operation of HVAC nor re-supply of compressed air until 7 days.
- The impact on the doses of the additional organic iodine is:
  - Site Boundary 24.7 rem increases to 24.71 rem
  - LPZ 22.8 rem increases to 23.16 rem
  - Control Room 4.8 rem increases to 5.07 rem
- The sensitivity study results indicate that sufficient margin exists in the design basis dose assessment to accommodate these postulated consequences of no explicit pH control for the draining condensate films even if no CsOH deposition is considered.

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Summary of Issue 7

AP1000

There is experimental evidence that a free-standing steel containment can fail in a catastrophic manner when its failure pressure is exceeded. Such a failure mode can lead to very rapid depressurization and, potentially, to resuspension of fission products that have been previously deposited or settled out. While the surrounding concrete structure of the AP1000 design may impede such a catastrophic depressurization, we would, nevertheless, like to see a sensitivity study on the fission product source term to assess the potential maximum effect on the risk of latent fatalities as compared to the Safety Goal.

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Issue 7: Catastrophic Containment Failure

- Failure of water cooling of containment vessel is 1E-06/demand
- Even with loss of water cooling, likelihood of catastrophic failure of the AP1000 steel containment due to overpressure is low, approximately 0.02, given failure of PCS cooling and no corrective operator actions.
- At least 24 hours are available for operators to take preventive actions. Any of the following actions could prevent the possibility of containment failure:
  - Climb up to the PCS valves and manually crank open one of the PCS drain valves that failed to open remotely.
  - Align another water supply to the outside surface of the containment; connections are provided for PCS Ancillary Water, Fire Water and Demin water.
  - Vent the containment to relieve the excess pressure.
- SAMG procedures guide operators to take these actions.

Issue 7: Catastrophic Containment Failure

- The potential for rapid containment depressurization causing resuspension of deposited fission products for a set of LWR reference plants was evaluated as part of the IDCOR program.
- The range of containment volumes and catastrophic break sizes include the applicable AP1000 characteristics.
- The IDCOR report concludes that resuspension due to dispersion following catastrophic containment failure would be insignificant even for large failure areas (10 m^2) and dry particle deposits.
- Wetted deposits are harder to disperse than dry deposits (deposited and settled aerosols).
- The conditions inside the AP1000 containment with or without failure of the PCS to remove decay would remain wet with steam.

Issue 7: Catastrophic Containment Failure

- The expected wet physical state of the deposited fission products greatly reduces the potential for resuspension.
- Thus, it is also concluded for AP1000 that catastrophic containment failure would not significantly enhance the fission product source term.
- The risk significance of any source term increase due to resuspension would be very small since the frequency of catastrophic failure induced releases is very low.
- This low frequency and the availability of preventive operator actions to potential catastrophic containment failure would prevent any discernible impact on compliance with the Safety Goal.

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Safety Goal Risk Measures

- NRC Safety Goal Policy Statement
  - no significant additional risk to life and health
- Quantitative Health Objectives - metrics for Safety Goal
  - fatality and cancer risks < 0.1% of sum from other causes
- Quantitative Health Objectives - numerics
  - risk of prompt fatality < 5E-07 per reactor year
  - risk of latent cancer fatality < 2E-06 per reactor year
- AP1000 PRA Results
  - risk of prompt fatality 8.4E-11 per reactor year
  - risk of latent cancer fatality 8.6E-10 per reactor year

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AP1000

AP1000 Risk Quantification

- The AP1000 comparison to Safety Goal shows that additional uncertainties associated with severe accident analysis, such as those discussed today, can readily be tolerated without challenging the Safety Goal measures.