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UNITED STATES NUCLEAR REGULATORY COMMISSION'S
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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623rd MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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FRIDAY

APRIL 10, 2015

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ROCKVILLE, MARYLAND

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The Advisory Committee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 10:30 a.m., John W. Stetkar, Chairman, presiding.

COMMITTEE MEMBERS:

JOHN W. STETKAR, Chairman

DENNIS C. BLEY, Vice Chairman

MICHAEL CORRADINI, Member-at-Large

RONALD G. BALLINGER, Member

SANJOY BANERJEE, Member

CHARLES H. BROWN, JR. Member

DANA A. POWERS, Member

JOY REMPE, Member

PETER C. RICCARDELLA, Member

MICHAEL T. RYAN, Member

STEPHEN P. SCHULTZ, Member

GORDON R. SKILLMAN, Member

DESIGNATED FEDERAL OFFICIAL:

EDWIN HACKETT

ALSO PRESENT:

PHIL AMWAY, Exelon Corporation

RANDY BUNT, Southern Nuclear Operating Company

JEFFREY GABOR, Erin Engineering

STEVEN KRAFT, NEI

JOHN MCHALE, NRR

*Present via telephone

C O N T E N T S

P R O C E E D I N G S

10:33 a.m.

CHAIRMAN STETKAR: The meeting will now come to order. This is the second day of the 623rd Meeting of the Advisory Committee on Reactor Safeguards.

During today's meeting, the Committee will consider the following: Development of Interim Staff Guidance in Support of Order EA-13-109, Reliable Hardened Vents and Preparation of ACRS Reports.

This meeting is being conducted in accordance with provisions of the Federal Advisory Committee Act. Dr. Edwin Hackett is the designated Federal Official for the initial portion of the meeting.

We have received no written comments or requests to make oral statements from members of the public regarding today's sessions. There will be a phone bridge line. To preclude interruption of the meeting, the phone will be placed in listen-in mode during the presentations and Committee discussion.

A transcript of the meetings is being kept. And it is requested that the speakers use one of the microphones located throughout the room, identify themselves and speak with sufficient clarity and volume so that they can be readily heard. And I ask everyone to please check and silence all of your little electronic devices.

By the way, I thought I heard the phone -- is the phone line open in the incoming direction? If it's not, it should be on mute. Unless you folks have someone out there.

Given the -- we're done with the administrative things, I'll turn the meeting over to Dr. Steve Schultz will guide us through the Interim Staff Guidance on the hardened vents. Steve?

MEMBER SCHULTZ: Thank you, Chairman Stetkar. What this meeting is discussing is the Phase Two of the Guidance in Support of Order EA-13-109.

The Committee provided a letter on Phase One of the Guidance in the fall of 2013. Phase Two involves providing additional protections for severe accident conditions to the installation of a reliable severe action capable drywell vent system, or the development of a reliable containment venting strategy that makes it unlikely that a licensee would need to vent from the containment drywell during severe accident conditions.

We had a Subcommittee meeting on this topic on March 20. There we reviewed the NEI document, NEI 13-02 Revision 0E2 and the draft ISG. Since then we've received other drafts of those documents.

And today we're going to hear from the industry and the staff relating to those documents, and the interactions that the industry has been having with the staff related to them. And so, we're please to have both the industry and the staff with us today to make those presentations.

To move forward with the discussions I'd like to call upon Jack McHale from the Japan Lessons Learned Directorate. He is the Associate Director of the JLD. Jack, welcome and please provide your introduction for the Committee.

MR. McHALE: Thank you, Dr. Schultz. Good morning and again, my name is Jack McHale. I'm an Associate Director in Japan Lessons Learned, a division of our Office of Nuclear Reactor Regulation.

Today we'll have the industry and staff discussion of the proposed Guidance in support of implementing Phase Two requirements of NRC Order EA-13-109 or BWRs with Mark I and II containments. As Dr. Schultz mentioned, we presented draft Guidance to the ACRS Fukushima Subcommittee on March 20 of this year.

And today we will plan to go through a similar, though shorter, presentation focusing on the issues that were highlighted at the Subcommittee meeting as needing additional discussions with the industry working group. And again, how those issues were resolved.

When the staff's presentation after the industry, we'll focus on seeking ACRS endorsement for issuance of the proposed Guidance. And I'll introduce the staff members at that time.

And again, before we start, I would like to thank the ACRS for its flexibility and patience in supporting the staff with our efforts to provide the materials to the Committee. As the ACRS knows, we're on an aggressive schedule which has been typical of our post-Fukushima actions.

And with that, I'll apologize for the earlier reliance on the preliminary draft type information. Which, actually, you know, making its way to a final state even this week.

So, I just wanted to acknowledge that. But that hopefully, the discussions will show that we've, you know, achieved a path forward from those open items which were previously discussed.

So again, very much appreciate the support of the Committee. And at this point I'll turn it back over for the industry presentation.

MEMBER SCHULTZ: All right. With that I would like to introduce Steve Kraft from NEI who would introduce the panel from the industry today.

MR. KRAFT: Thank you, Dr. Schultz. Steven Kraft, NEI, Senior Technical Advisor. A great pleasure once again to appear before the ACRS.

To my left is Phil Amway from Exelon. He is the Corporate Lead for FLEX and a bunch of other stuff post-Fukushima.

To my right is Jeff Gabor, Vice President of Erin Engineering. Erin Engineering is the key engineering support firm for both NEI and EPRI in this area and the related CPR rulemaking.

They're also accompanied by Randy Bunt in the audience. Randy was unable to join us on the 20th of March for the Subcommittee.

Randy, in addition to being southern company lead for all-Fukushima is also the Chairman of the BWR Owners' Group Fukushima Committee. So, brings a great wealth of understanding in this area. And if necessary will come to the mic to answer questions.

And with that, let me turn it over to Phil.

MR. AMWAY: Okay. Good morning. My name's Phil Amway, Exelon Corporation. I'll be leading you through the presentation that we have this morning. Focusing particularly on those topics of significance between the Subcommittee on March 20 and today's meeting.

At particular points throughout this presentation, I will ask my colleague Jeff Gabor to walk us through some of the slides. Particularly with the various plots and drawings that we'll see in the presentation.

I may actually ask Randy Bunt to provide input at particular time. Maybe to answer questions as well as we go through the presentation.

So start off with this slide of the general characterizations. We have revised NEI 13-02 to include Phase Two Guidance. We have the Rev 0 issued back in 2013 for Phase One Guidance.

And consistent with the approach that we took in Phase One, we are working towards common design elements for implementation of the Order. So we'll try to establish some consistency across the BWR fleet in implementing both Phases of the Order.

This version of NEI 13-02, which will ultimately become Rev 1, will be informed by ACRS insights. We certainly appreciate the valued feedback that we receive through these ACRS meetings.

As a result of the Subcommittee on March 20, we have made some modifications to the Guidance documents. Particularly with respect to HCVS out of service times and check valve testing. We'll see those slides later in this presentation.

We do expect limited exceptions and clarifications in the final ISG. In the Subcommittee, the drafted ISG that was issued had a number of items that we were still working with the staff to close out.

We have made substantial progress since the Subcommittee to close those items. And with that additional exchange of information and modifications to the Guidance documents, we expect that final ISG will be very closely aligned with, with limited exceptions and clarifications necessary in the final ISG.

MEMBER SKILLMAN: Phil, you said that you're working your way through Phase One. I can imagine it's very complex administratively because the different owners might approach this differently.

Could you comment on how well that is going or how difficult that is going, please?

MR. AMWAY: I would characterize it so far that it is going well. We have a number of workshops that we have done for Phase One to try to establish that alignment and consistency.

We are going to do that going forward with Phase Two as well. We'll have another series of workshops to work through design details and implementation for the Phase Two requirements.

Within our own particular fleet, Exelon having a number of boiling water reactors, we're looking to standardize across our fleet how we approach the Guidance and implement it. And we are well tied together as a working group with the other fleets and other BWR owners to try to make sure that we stay aligned through the process.

MR. KRAFT: Yes, and if I could comment. Just yesterday we had a meeting of our CNOs, the Fukushima -- what we call Fukushima Response Steering Committee.

And I did discuss with them, particularly with regard to Phase Two, the need to have an assist program in the industry. Probably a small group of people to look at line drawings and things like that simply because of the point you're making.

It's complicated. Plus, we don't want it to become so different at each plant it becomes difficult for NRC to review and endorse the different plans. As it is, we have a common template for the overall integrated plan. That's a good place to start.

And then we'd want to look a little more -- a little deeper then that. Randy?

MR. BUNT: Randy Bunt. We also have our -- with the BWR Owners Group, we're having periodic phone calls approximately every four weeks to cover this particular topic on Phase One implementation, to get all the owners involved with that.

And then we have a meeting roughly every half a year where we go in detail and talk about -- have talked about that. So we are staying aligned with that.

MEMBER SKILLMAN: Okay, Randy and Steve and Phil, thank you.

MR. AMWAY: Okay, so just to recap, it is a phased implementation of the Order. Phase One being the vent capability from the wetwell that is severe accident capable.

And Phase Two being either the vent capability from the drywell. Or the alternate venting strategy that we have since referred to as the

SAWA/SAWM approach.

High level water functional requirements. The objective is to limit the containment pressure within the primary containment pressure limit or the containment design pressure, whichever is lower.

The objective there is to make sure that we maintain the containment capability. To control the use of common systems within and between units.

And that's primarily there to address the concern with hydrogen migration to other systems and other units. And also to make sure that we address the vent usage during ELAP conditions and under -- so include severe accident conditions.

Some Phase One topics, just to touch on at the ACRS meeting. We read that letter coming out of Phase One and the recommendations that were in there. And the concern about combustible gas control.

We have since addressed that with endorsed industry White Paper, HCVS White Paper 03. And we have also had considerable information that's very closely aligned with the White Paper actually.

It's a -- there's a lot of close similarities between the two documents, to address the methods to control hydrogen. Or to prevent detonation -- detonable mixtures from occurring within the HCVS piping.

Those ML numbers that you see referenced here is the first one is the actual industry White Paper that was submitted for endorsement. The second ADAMS ascension number is the NRC endorsement letter. Appendix H being in 13-02.

To go along with that it's, you know, we've done analysis for the referenced plan of concern that we used to develop the Guidance. And that analysis shows that the combustible gasses are largely vented as part of the SAWM strategy within the first 24 hours, such that the concentrations remaining in the containment are very low.

Additionally, we addressed accessability due to radiation. We developed and issued an industry White Paper, HCVS 02. That again, was review by the staff and endorsed.

It does provide a methodology for calculating integrated dose to HCVS equipment qualification that would include instrumentation. It also provides methods for determinating dose rates from the HCVS piping so that we can assess operator actions and accessability for HCVS controls.

That as also extended, would include the SAWA components that need to be manipulated.

MEMBER CORRADINI: Can I ask you a question? I wasn't at the meeting on Friday when you guys did this.

For the vacuum breaker performance, what's assumed in the analysis for the range of performance for the vacuum breakers for leakage from drywell to wetwell? Because the leakage rate would affect this if I understand the system correctly.

MR. AMWAY: In terms of, you're talking about potential impacts to HCVS White Paper 02?

MEMBER CORRADINI: Oh, yes.

MR. AMWAY: Predom --

MEMBER CORRADINI: Because historically, again, I'm not very familiar. But historically this has always been a continuing issue. And that means -- so you have to assume sort of leakage during these sorts of accidents.

And I'm curious how if the accident proceeds into a severe accident, how the degreda -- if there's an effect on the leakage rate of the vacuum breakers?

MR. AMWAY: And just to be clear, we're talking about the vacuum breakers that go from the wetwell back to the drywell?

MEMBER CORRADINI: Right.

MR. AMWAY: Okay. Jeff, you might be able to help me. But I'll give a crack here. That under the initial sequence of the accidents, once you start core damage, you'll get a substantial gap release.

Most of that gap release should end up in the wetwell through the SRVs. When you implement the SAWA, you're putting water in the drywell.

The heat generation, steam production in the drywell should put positive pressure seating force on the check valves down through the suppression function of the containment. So that for most of the accident the pressure should be higher in the drywell side then it is in the wetwell side because you're going to vent from the wetwell.

Which should minimize --

MEMBER CORRADINI: Well that was my guess, but --

MR. AMWAY: Should minimize the leaking.

MEMBER CORRADINI: Again, I haven't seen the evolution of the accident. I would expect somewhere in there you're going to have a burping of the vacuum breakers. And I'm worried about resealing and leakage rates that are assumed in the analysis.

MR. AMWAY: Do you have --

MR. GABOR: Yes, I -- this is Jeff Gabor.

I guess we haven't specifically looked at what influence that leakage would have.

I know -- I can't say in the Mark -- in the radiation calculation because the -- from a radionuclide perspective and what the vent pipe, what kind of radiation levels the vent pipe itself are exposed to, that was considered.

We actually assumed a well mixed drywell/ wetwell compartment so that if there were for venting through the wetwell, and there was a large fraction of radionuclides in the drywell, the vent pipe doesn't necessarily see those. And if it does, it's after scrub.

So I know in the radiation analysis, I think that the topic that you're discussing was addressed. In our calculations on hydrogen distribution, that amount of leakage wasn't factored in.

And for the qualitative reasons that he gave.

MEMBER CORRADINI: But if you can point me to where it is, after the fact I'll read it. I just -- since I wasn't there, I didn't know if this was asked.

And to me, vacuum breaker performance

always tends to be a knotty issue with and when you're going into a severe accident regime chunk cares about sealing as I get to higher temperatures, et cetera, et cetera, et cetera.

MR. GABOR: Yes. And don't forget in our analysis, the scenarios we've adopted the water addition strategy. And in those scenarios, as you see, and in the NRC presentation, the temperatures are relatively mild in those cases, so.

MEMBER SKILLMAN: But we didn't discuss this in detail in the Subcommittee either.

MR. AMWAY: But the last Phase One, and it's really also a Phase Two topic, is the drywell vent design temperature 545. If you recall, that was originally proposed back when we developed the Phase One Guidance.

It was an open issue because it really impacted Phase Two. We have since confirmed through analysis that the water addition that we're proposing through the SAWA strategy provides us with the assurance that we should be able to maintain the containment temperature below -- at or below 545 degrees Fahrenheit.

The figures shown here, that was also included under the Phase One Guidance. But it's still, you know, applicable under Phase Two.

And just what I'd like to point here is that under point two, if you look at that dotted line, that envelopes the expected operating regime of the containment. With the implementation of the hard containment vent system and SAWA.

Yes, go ahead?

MR. GABOR: Yes, I'll -- this is Jeff Gabor again. I had a couple of comments.

This -- if you look at this curve, this is supposed to repre -- looks to represent the ultimate capacity of the containment. The red bar was actually taken from the original Chicago Bridge and Iron Work on the Mark I containment where they evaluated both pressure and temperature capability of the containment.

And as you can roughly see, that beyond a temperature of around 700 Fahrenheit, the pressure capability degrades to the point where it has essentially no capability beyond 900. And that's a typical representation that a plant, IPE or PRA would factor in.

The other areas, the darker blue in the center upper comes from the SOARCA analysis representing again, an upper bound. The green area on the right is a compilation of a lot of the Sandia and various penetration experiments that were done to look at, at what point would a penetration begin to degrade and potentially leak.

So we -- obviously we didn't want to pick a design temperature where the -- in this case, this is specific to the development or the design of the drywell vent. We didn't want to pick something where that valve would be the last thing standing and come up with a reasonable expectation for the design.

So that's what led to the -- it justifies a 545 limit.

MEMBER REMPE: During -- excuse me, the Subcommittee meeting at the end, I believe our consultant Bill Shack mentioned that he had read some of the background information on that temperature. And he said that there were some questions about it.

And I apologize, but I was busy with other things and I didn't follow up on his concern. Has anybody looked at what he said?

MEMBER BALLINGER: It had to do with the seal material. Whether it was silicone based or another material base. And there was a paper which he sent us related to the capability of that material -- those materials with respect to the 545.

MR. AMWAY: Yes. His concerns if I recall is in the report. It talks about silicone rubber and EPDM.

MEMBER BALLINGER: Yes.

MR. AMWAY: And at one point in that paper, that those materials were reversed in the report.

MEMBER BALLINGER: And that there was an error in it.

MR. AMWAY: So to be careful when we use that paper.

MEMBER BALLINGER: Yes. But I guess the concern is, have you checked that out?

MR. GABOR: Well, I know that if you go back, the green band on this chart addresses both types of penetrations. So there's experimental results for both silicone and EPDM.

MEMBER BALLINGER: Okay. Because I think there was some talk around the table of not knowing what seal material was used with what plant.

MR. GABOR: The next chart that we included as we did in the Subcommittee presentation, is just showing that if you recall the work that the industry is doing on the rulemaking, on the filter rulemaking, the CPRR.

We developed much like the NRC, a PRA framework to look at the ways in which we can get to a core damage event. And then we analyzed using an accident progression tree or a containment event tree, how that accident might progress to a potential containment breach or release of radionuclides.

And there was some 500 end states that are analyzed. All we've done here is to look at a compilation of those end states and their associated temperatures in the drywell that are assessed.

And we've looked at that on the left curve, we've looked at a probability that the maximum drywell gas temperature stays below whatever that limit is. And if you look at the blue line, those are just scenarios where we were successful in getting water into the containment post-core damage, post-vessel breach.

And you can see in those scenarios again, probabilistically weighted, probability weighted, we're able to demonstrate through a large number of calculations and uncertainties that the temperatures remained below the 545 type limit pretty consistently.

The red line in that first curve are the other scenarios where we assumed for different reasons that the water injection source did not function. So this is the kind of typical, kind of a SOARCA type analysis, where there wasn't severe accident water addition.

The core comes out. It's dry on the floor and the containment heats up. You can see those temperatures are well above 1,000 Fahrenheit.

MEMBER CORRADINI: So just to, again, just to clarify. It doesn't matter when the water comes in. It's essentially covered with water to some extent. And what was the extent? I forgot.

MR. GABOR: Yes. The calculations we did, we did cal -- we did -- obviously these are simulations. Best estimate simulations.

So prior to the debris entering the containment, obviously there is potential for condensation on the walls and some accumulation. There's also some nominal leakage through the recert pumps. Pretty standard 36 gpm kind of numbers.

All of those things might put water on the floor prior. But the real key success is to be able to inject in our simulations and these simulations, 500 gpm at or about the time of vessel breach, consistent with the NRC calculations as well.

So it's 500 -- and 500 gpm will fill the drywell up to the spillover point where water is now running down into the torus.

MEMBER CORRADINI: And then eventually you're going to get this management of the water. But that will take you --

MR. GABOR: Yes, that's no reflected here.

MEMBER CORRADINI: That will take you up to the spill level?

MR. GABOR: Yes. The 500 will give us --

MEMBER CORRADINI: But what is that typically? Because they vary in all these designs?

MR. GABOR: It does. I think in our Mark I surveyed, we surveyed all the plants and we provided that data to the NRC. We had a range from nine inches to I think 30 inches.

MR. AMWAY: 30 inches, yes.

MR. GABOR: Yes.

MEMBER CORRADINI: Okay. Thank you.

MR. GABOR: And then the right side is merely, these are both scenarios where we have water either into the RPV post-vessel breach or into the containment, into the drywell. And what you can see from this is a slight preference to RPV injection in terms of maintaining.

And the benefit we see from that is from putting the water in the RPV after the core is melted and after a large quantity has been discharged into containment. The RPV can either retain some of that core debris, can have fission products deposited on surfaces.

The water that goes in is able to have some benefit in cooling the internal structures of the RPV, making the radiation into containment slightly reduced in those scenarios. They both seem to be giving us successfully temperatures in the 545 or less range consistently.

But we do see by -- just simply by cooling the -- helping to cool the gas and the structures in the RPV, it kind of cuts down the thermal radiation off of that hot vessel long term.

MEMBER REMPE: But your model did consider radiation heat transfer off the outer surface of the vessel as a heat transfer removal mechanism along with the 185 control ride drives?

MR. GABOR: It did. It did and what -- and to the drywell head reason and to the cylindrical part, the more tightly compacted area next to the RPV. And then into the spherical part below.

MEMBER SCHULTZ: Jeff, if we could just go back briefly to the containment capability figure.

MR. GABOR: Um-hum.

MEMBER SCHULTZ: What Bill Shack, our consultant, brought up at the meeting, had to do with the Paper and other discussions that -- from our discussions at the Subcommittee, the industry had reviewed or at least was aware of, and the question really had to do with the boundary line that is from point three down and across the pressure curve.

That that's not a -- that's not a bright line.

MR. GABOR: Right.

MEMBER SCHULTZ: Rather it's an area -- there's an area around that sharp line of uncertainty. We didn't get into questions related to the point that has been chosen for the limit, the 545 degree Fahrenheit limit at point two.

Rather the discussion was around how well we understood or how well the evidence supported the containment integrity along that bright line that's between the --

MR. GABOR: Yes, and I wouldn't disagree with that line of thought. I mean, we're not trying to show that as a hard line.

MEMBER SCHULTZ: I understand.

MR. GABOR: Right. And in fact my attention is drawn more to the green box because that's where a lot of those uncertainties lie.

MEMBER SCHULTZ: Correct.

MR. GABOR: And we feel that the 545 number is sufficiently low within that region that it protects us.

MEMBER SCHULTZ: And that reflects what we discussed at the Subcommittee meeting. Thank you.

MR. GABOR: Okay.

MR. BUNT: This is Randy Bunt. I think you're straight on Dr. Schultz. What we're showing here is the relationship is from point one on that chart to point three is relatively the gap between them. And when you design, at the lower gray box, that you get some failure -- when you get ultimate failure out at point three.

So you expand that design element window to point two. Then you've got some margin that it would expect you to be somewhere out where four is. And four is not a strict distinct point. Four is somewhere in the red bar.

So that's why -- and we realized that the other colored bars are really shaded bars as they start having some failure when that color starts. And the failure will go further.

MEMBER SCHULTZ: Thank you.

MR. AMWAY: Okay, so moving on with the Phase Two terminology. The two terms, severe accident and water addition as a means of providing reliable water addition to either the reactor vessel or the drywell post-core damage. With a severe accident water management managing that same water addition in a manner which preserves the wetwell vent path.

If you look at the order in total, this is just an outline of all the different order elements. We are in Phase One right now, which is at the top green box.

Phase Two, drywell vent, a reliable alternative implementation. That's what's due in the 2017 to 2019 time frame. Our integrated plans are due at the end of this year.

The gray box off to the side is the Bravo 1 drywell vent option that would not include severe accident water addition. And as Jeff showed on the charts that would require that design boundary condition to be far in excess of 545 degrees.

And that would require some plant specific analysis. As we've mentioned, there's different seals. Some are silicone. Some are EPDM. So, you would have to look at that in context of what you defined as a boundary condition.

MEMBER CORRADINI: Can I ask another question?

MR. AMWAY: Yes.

MEMBER CORRADINI: Since I've been prompted and I've forgotten. So, we're all talking Mark I geometries. If I move into the world of Mark IIs, how many are we talking about? And how diverse they are geometrically?

MR. AMWAY: In the Mark IIs, there's seven total. And they are very dif -- well, I'll say --

MEMBER CORRADINI: Seven different designs is at a minimum.

MR. AMWAY: Because there are essentially seven different designs in terms of whether they have a sunken pedestal. Whether they have downcomers within the sunken pedestal region or not.

You know, there --

MEMBER CORRADINI: So let me push the point. So, are any of them such that they are such flushed that if you put water there it goes right down into the wetwell? Or are you going to build something up that keeps you nice and cool versus toasty?

MR. GABOR: Again, this is Jeff Gabor. I think the -- it's not correct to compare the two relative to the -- what you're referring to the spillover of water myth.

MEMBER CORRADINI: Well I was trying to get back to your curve about temperatures and pressures and --

MR. GABOR: Yes.

MEMBER CORRADINI: Okay.

MR. GABOR: So, the behavior in the Mark IIs is they have -- as you know, they have downcomers that will most likely transport the debris into the suppression pool. And -- or they have drain lines, which has been evaluated by Oak Ridge many years ago, to look at the possibility that the plates that -- under the vessel that hold the drain piping would melt and fail and also allow debris to be discharged.

So there's -- the Mark IIs have various ways for the debris to find the pool. Where in the Mark I, that doesn't happen. We have to put the pool or put the water on the debris.

VICE CHAIRMAN BLEY: Well, the trouble is if the debris finds the pool, it's also probably creating a wetwell bypass.

MR. GABOR: That's a true statement. And in our Mark II analysis we consider that bypass. But we don't see that bypass creating any kind of a variation on the thermal response of the containment.

And we also don't --

VICE CHAIRMAN BLEY: You don't have a containment.

MR. GABOR: With the bypass?

VICE CHAIRMAN BLEY: Yes. You're bypassing the wetwell then.

MR. GABOR: The wetwell, but the wetwell is there to -- as vapor suppression. Right? I mean, that's the point of it.

If I put the debris in the wetwell, I'm getting that vapor suppression.

MEMBER CORRADINI: But I thought Dana said -- oh, okay.

MR. GABOR: But my heat balance is the same. But I do have the bypass. And from a radionuclide transport, it's something that we did analyze.

VICE CHAIRMAN BLEY: Yes. You're just venting all your volatiles. Or you're --

MR. GABOR: Well, we can vent the volatiles. But what we see in our analysis and what we saw in our radiation analysis is that now that I've moved my pressure source into the wetwell and I'm venting the wetwell, you can tend to have the drywell stay at a lower pressure and not as effectively communicating with the wetwell air space.

So my heat source is in the wetwell. My vent's in the wetwell. I can vent that heat out without really involving the drywell. And we do see fairly significant deposition in the drywell long term, even with that bypass model.

MEMBER CORRADINI: I guess I'm really not as familiar as he is with the geometry. But when you say bypass, I would -- I interpret that to mean that you don't get any sort of scrubbing at all.

MR. GABOR: For radionuclides leaving a drywell going out the wetwell vent, you're correct. You're correct.

What you get is the passive deposition mechanisms in the drywell to function.

MEMBER CORRADINI: And that's it?

MR. GABOR: And that's it. But again, you have to analyze it integrally because we find that our wetwell, because that's where the debris is, that's where the pressure source is, stays at a slightly enough higher pressure then the drywell.

And we don't see a lot of flow from the drywell into the wetwell from through that bypass.

MEMBER CORRADINI: Okay.

MEMBER POWERS: It seems to me that that

would be a very strong function of how much of your core debris actually penetrated down. That if you have a substantial amount either in the vessel, hung up on the drives or on the diaphragm floor, that that could reverse that pressurization.

MR. GABOR: And we -- in our radiation calculation I believe we've -- I'm pretty certain it's documented in the White Paper 02. There is a sensitivity to try to address your concern.

And we looked at, what if, you know, our typical simulation would have let's say 90 percent of the core debris draining into the pool. Maybe 10 percent remaining behind. We varied that.

We found ways to increase how much we got -- we left behind. We didn't see a large variation because it's such a strong pressure source in the wetwell.

MEMBER POWERS: If I used an alternative model that didn't bring the core debris down at a very high temperature onto the diaphragm floor, would I get the same -- within your range of variability?

MEMBER CORRADINI: What he's asking is, what I assume you know is, instead of it being nice and liquidy, it's nice and mushy and it just sticks where you dump it.

MR. GABOR: I think that those original Oak Ridge studies looked at that. Because they were using the BWRSAR melt releases, which were more in line with the MELCOR or the current day MELCOR results, where it did come out pretty low temperature and more solid then liquid.

And in some of those scenarios, these plates, diaphragm plates for the penetrations for the drain lines did not even melt because of debris. But what they did see as soon as they had any kind of oblation of the concrete, the downcomer pipes themselves did give way and debris was able to flow.

MR. POWERS: Yes, I would suspect that. It doesn't take much of a thermal stress on the diaphragm concrete to pop it. Because it's only three feet thick or something like that.

MR. GABOR: But our Mark II strategy is similar to our Mark I strategy in that we are still relying on the addition of water to the containment post-vessel breach.

MEMBER POWERS: You can't get very much water in on the diaphragm floor can you?

MR. GABOR: Yes, but the downcomers are in the 18-inch range, if you look at the Mark IIs. One of the plants is very unique, Nine Mile 2. It has these downcomer pipes directly under the reactor vessel. So, there's a pretty much straight shot.

The other ones have a uniform floor and the downcomers are outside the door, the pedestal door.

VICE CHAIRMAN BLEY: I kind of missed a piece of your discussion there. When you did the sensitivity studies and left more behind, what did you say that did to the results?

MR. GABOR: The radiation results, we still found that there was a large amount of deposition of radionuclides in the drywell. And we still were not seeing a huge flow of radionuclides from the drywell to the wetwell because the majority of our heat source was still in the wetwell.

So wherever the heat source is, obviously it's going to generate the greatest pressure. And that's what we saw in those calcs.

Now we didn't take them to an extreme of keeping it all up on the floor.

VICE CHAIRMAN BLEY: This seems like a case where what's conservative from one point of view might not be from the other. And you don't treat it probabilistically. But do you think the sensitivity study has showed you enough to be --

MR. GABOR: I think it helps. And I never used the word conservative in level two parameters.

VICE CHAIRMAN BLEY: I know you didn't. But I did to work.

MR. GABOR: Because you picked something. Right. But we specifically for the rad calc, we wanted to see was there a way that we could increase the local doses in the wetwell, which would obviously increase the local doses going out the vent pipe and the shielding required.

And so that was the point of that calculation.

MR. AMWAY: Okay. With that I'll continue here. Working down this chart here, the gray box, this is something that, you know, we don't see really as a viable approach for the industry.

We talked about, you know, the need to be standard in how we're trying to implement Phase Two of the order. We are certainly not aware of anybody in the industry that's going to attempt to do that.

We will strongly discourage that approach in the workshops that we do. And in the various vehicles we have to make sure that we stay aligned across the fleet for implementation.

Our Guidance really is very restricted in terms of what we do. In fact, you know, we make the statement that the Guidance provided in section three of the Phase Two Guidance 13-02 really isn't right to address this. And anything that, you know, any plant that would want to try to do that, they would have to work that out specifically with the staff to figure out what they would have to do for that type of design.

So really what I'd like to do is turn my focus down to the bottom section of this chart, which is where the Guidance is written for Phase Two. And this is, if you look in the ISG, this is methods two and three, which both include reliable water addition, which is the SAWA.

Then down below that, then the options exist for either a severe accident drywell vent designed to 545 degrees Fahrenheit. Or the water management approach that doesn't need a drywell vent.

I expect that the box that includes the water management will be the dominant path that the industry follows. That's where we are all headed.

The only reason that we would have a plant that would go into the drywell vent option is if for some reason they can't follow the Guidance to implement a successful SAWM strategy. And then ultimately chooses to put in the severe accident capable drywell vent.

Now this next slide, I pretty much talked about on the previous slide. And again section three, you'll see that's very short in terms of saying, you know, the Guidance really isn't written for the drywell vent option that doesn't include water addition.

And that there is other long term impacts through the rulemaking. Which, you know, one of the biggest benefits we're seeing is the water addition with SAWA.

That controls the containment temperatures and preserves the containment function or capability, which would lead you to not select the option of ISG method 1. Then going into the ISG methods 2 and 3, that's where you get the breakdown between the 545 degree drywell vent and the SAWM approach.

The next big topic for Phase Two is how long do we have to preserve the wetwell vent to have a successful SAWM strategy? And we've broken that down as three options.

The first is if we can show seven days of sustained operation. That ability to preserve the wetwell vent path that there's no additional actions required to meet the order.

For those plants that can demonstrate successful SAWM strategies, but maybe not for the full seven day duration. If they can make it at least 72 hours, between 72 hours and seven days, then they actually have to provide a functional level description of the alternate reliable containment heat removals mechanisms that they can put in place to remove long term decay heat from the containment.

And they would have to describe that in the Phase Two OIP. The difference between that option and the third tier is for those plants that can do SAWM, but for less then 72 hours, they have to go rachet up that level of detail.

Now they have to have specific Guidance and procedures to tell you how to do it. And it would also include plant modifications that are readily available to be able to implement that alternate reliable containment heat removal.

MEMBER CORRADINI: So again, since I wasn't around. So is it the FLEX -- is it the FLEX --

CHAIRMAN STETKAR: This is by the way, was largely revamped in the latest revisions. So it didn't make any difference that you're not around --

weren't around.

MEMBER CORRADINI: Oh, okay.

CHAIRMAN STETKAR: This came in between then and now.

MEMBER CORRADINI: Okay. Fine. So my question really is about this, is, what is the equipment that this is the FLEX onsite equipment that's going to be used for this? That's my -- that was my starting question.

MR. AMWAY: They're equipped for the alternate decay of heat removal. It could be a combination of all installed equipment. It could be a combination of installed and portable equipment

It could be all portable. The portable equipment could be your onsite Phase Two that you're using to support FLEX. Or it could be offsite equipment.

We're trying to leave that open because of the timing involved. And the conditions that a plant might see at that particular point.

And that's why we're saying, we want them to provide two or three different options that would, you know, consider both, what if I have offsite power back, can I use the installed equipment to restore decay heat removal?

If they can do that, that would be their preferred option at that point.

If they don't have the offsite power and they have to rely on portable equipment, well maybe the equipment at the plant is fine, but they can power it up with either the FLEX generators they have onsite or something they bring in for the National Response Centers to provide, you know, the 4160 capability and the higher loading capability. And use the installed plant equipment.

And for conditions where they don't have either of those, they may have to establish an entirely external loop and means of what that alternate heat removal is.

So we're trying to leave that flexible. I mean they have to describe it in the OIP what their approaches are. But leave it flexible enough in consideration of not every event is going to follow the same path and you want to keep your options open in terms of what you're going to use.

CHAIRMAN STETKAR: The 72 hour to seven day time period, a few questions. There is Section C-72 now and Appendix C, sort of walks people through.

Well, you might think about this. You might think about that. Because in Section -- for that middle option, all you have to do is say, I might think about this. I might think about that.

Some of the things you might think about are saying, says the Emergency Response Organization will be at full staff at 24 ours.

MR. AMWAY: Um-hum.

CHAIRMAN STETKAR: Well, okay. That's pretty speculative for me in saying that. I can get stuff from the SAFER Center within 24 hours. It will start to arrive. Anything I need.

That's pretty speculative for me. My question is, I don't want to get into this discussion of what people might do. How many of the plants, and you've looked at them all, fall within that second bullet?

MR. AMWAY: And I'll tell you, I don't -- we don't know yet. Because we haven't done --

CHAIRMAN STETKAR: Aw, come on. You've looked at all of them. How many fall within the second bullet? There should be very few.

MR. AMWAY: I mean, if you look at --

CHAIRMAN STETKAR: I hope that there's very few.

MR. AMWAY: And there should be. Because there's really, I mean, if you look at what the SAWM strategy is, it's just a mass balance. I'm putting water in. I'm venting steam off.

CHAIRMAN STETKAR: If they all fall within that second bullet, I've got real problems.

MR. AMWAY: Right.

CHAIRMAN STETKAR: Because you're basing the entire fleet-wide strategy on speculation. If only a couple of them are in there, I don't have a problem.

MR. KRAFT: It's not meant to be complete speculation. It -- and we've had this discussion with the staff.

It -- I don't think it's about at the time, you'll figure out what to do. You've got to figure out what your options are in advance.

CHAIRMAN STETKAR: But you're only --

MR. KRAFT: So you have that understood and you're not trying to invent it at the time.

CHAIRMAN STETKAR: But the require -- the Guidance just says you have to have a general functional idea. It doesn't say -- it's not nearly as specific as that bottom bullet there.

The bottom bullet says, you've got to have some strategies in place. You have to have thought about this.

MR. AMWAY: That's right. And what this part --

CHAIRMAN STETKAR: The middle part just says, well, I can get some functional restoration of containment, you know, heat removal of some sort. But the examples, I mean, you -- there's a long example set.

There are things like, well you might account for the fact that the Emergency Response Organization will be there according to NEI 12-01 HCVS frequently asked question 06. That's why I can assume that everybody's going to be there.

Those kinds of things bother me if indeed the majority of the plants are going to fall into that bin. Because that says that all you're doing to tick off a box is saying, yes, oh, we've kind of thought about it. And well, everything will be okay because everything will be okay.

MR. AMWAY: And we certainly don't expect many plants, if any --

CHAIRMAN STETKAR: I hope not.

MR. AMWAY: To fall in there.

CHAIRMAN STETKAR: Okay. So that was my question.

MEMBER CORRADINI: Since he knows more

then I, why not?

MR. AMWAY: Why not?

MEMBER CORRADINI: Why not?

MR. AMWAY: Because you know, with the -- the Guidance that we have in place, there is enough time for the operators to take suf -- even if they were slow in cutting back the SAWA flow, there's enough wetwell volume in there that, you know, there's some flexibility there at the times that you actually cut back that SAWA flow and establish your long term flow rate that's preserved in that wetwell vent pad.

CHAIRMAN STETKAR: Your expecting the majority of plants to fall within the first --

MR. AMWAY: The first seven days.

CHAIRMAN STETKAR: The first seven days.

MR. AMWAY: They should be able --

CHAIRMAN STETKAR: That's good. That helps me a lot.

MR. AMWAY: Okay. Randy did you want --

MR. BUNT: Randy Bunt. Another thing is I think what we may have a little bit of misunderstanding.

We said that the ERO staff would be staffed within 24 hours. But again, we're saying this is at three days, not at that 24 hour period. And it's the whole window between three and seven.

So there is some speculation here. But there's also some margin to that time.

CHAIRMAN STETKAR: You know, why? I didn't -- Randy, I didn't get that impression reading through here. It's the entire just -- these are examples of the justification that people might use.

It doesn't say within 24 hours, after 72 hours. It just says they'll be there within 24 hours.

MR. BUNT: Right. That's our assumption based on other guidance. But again, that's why we --

CHAIRMAN STETKAR: I understand.

MR. BUNT: That's why we chose 72 hours instead of saying that middle block should be 24 to seven days.

CHAIRMAN STETKAR: I know.

MR. BUNT: So we gave some margin to some of those time lines in there. So, we said ERO staff would be avail -- would be fully staffed by 24 hours.

But we're not going to credit -- that's why we didn't want to say that middle box was 24 hours to seven days. We wanted to say it was 72 hours to seven days.

So that's some of that margin to help you with some of that speculation. And also, it was intended to be a fuller thought out strategy where the bottom one was modifications and plant changes that would be in the bottom one.

In the middle one, you would still know how you would do that. And it would be pre-thought out before you got there.

MEMBER CORRADINI: Can you help me Randy, about the last one then? What sort of modifications are you thinking of, might be necessary if they fell within the less then three days?

MR. BUNT: An example of what we see at -- talking about the second bullet and the third bullet, is in the third bullet you might go and use your suction or your test return line to your CST as your suction point back out for your heat exchanger.

You'd go ahead and make a modification to that line and put a T in and a valve and a flange so that you could go ahead and hook that up in a quicker time line. Because you wouldn't want to be so much speculative on getting extra staff in to be able to cut that line and put a clamp on it or something else.

In the middle version, you would go ahead and identify and say, I'm going to use that suction line out of the CST for the return line as my suction point. And I would have tooling to be able to cut it off and to be able to put a slip on clamp or something on.

And the reason you're out to three days or longer is you're going to have more resources available by the time you get there. In the bottom one you don't have those resources as guaranteed, as Mr. Stetkar mentioned as.

You are speculative on how many you will have. So you want to go ahead and have that pre-modified so you can go do a hook up with limited personnel and limited planning.

And that's the distinction between those two bottom ones. Does that help?

MEMBER CORRADINI: It does. I'm -- well, I guess it kind of does.

MR. BUNT: And again, we don't see anybody that's really -- we don't believe that anybody that's run their analysis so far is going to be in that second box.

CHAIRMAN STETKAR: That's the thing that helps me.

MR. BUNT: Yes.

CHAIRMAN STETKAR: No, I mean, really. It does.

MR. BUNT: And anybody that we've even

speculated, we expect that they won't be in that second box until day five or six at the earliest. Even if they were there. They wouldn't be in the 72 hour period.

MEMBER CORRADINI: But then -- let me ask the question that's going through my mind. Which is, why even have the second opportunity?

Why not just simply say, you're either going to have to do some sort of sustained operation in seven days or, if it's less then seven days, you're going to have to make some sort of up front fix to make sure you can get into the seven day.

Do you see what I'm asking?

MR. BUNT: Yes. And because -- the reason we choose the three tiered approach was because of the variability of the progression of the event. And making those predetermined cases, while they look good today based on the stylized scenario that we're building into it, that we want to be more symptom based as we go forward.

And so that middle block allows you that when you've got more time and you've got more resources. But if you're in the really short window that shouldn't be applicable.

You should go ahead and have something

totally predefined.

MEMBER CORRADINI: It's also -- may I fight back a little bit?

MR. BUNT: Sure.

MEMBER CORRADINI: So, that sounds good when everything is nice and rational and calm. But, I don't know how calm people will be in some sort of event that leads me to this sort of environment.

So it seems to me that if I could -- if your analysis is suggesting that you can do something to take you into seven days, you would do it if it's as you were giving the example of, what you said, adding a T so you could draw suction from the CST. Something that would be, at least in my simple mind, a nominal fix.

Do you know what I'm asking?

MR. BUNT: Right. It really would come down to evaluation of that when it's submitted in as to what the information would be. And how close you are to the 72 hour or the seven days I think.

MEMBER CORRADINI: Okay. Okay. Thank you.

MR. AMWAY: Okay now, if we can move on, I'm going to turn this over to Jeff Gabor to walk us through some of these plots.

MR. GABOR: Yes, so there's three plots. Three? Yes. Three plots here. The point of them is to just demonstrate that we can successfully get into that third block area where we can get out beyond the seven days.

And the scenario that we looked at was relatively simple where 500 gpm was initially injected into the containment. And that was done until, you can see from the chart here, it was done for something like eight hours.

The decision was made to cut that flow down to 100 gpm at that point. And for the remaining seven day period, we just kept it there.

The goal for the strategy is to maintain a slight upward trend in the torus level or in the wetwell level. If we're maintaining a slightly upward trend, it means we're putting more water on the debris then we likely need.

And there is water spilling over into the torus. So having that very slow upward trend, in the case of our reference plant, which was the most restrictive of all the plants, the operators would have to isolate that wetwell vent at 21 feet in the pool.

And you can see if we go well beyond seven days, we could get there, even at 100 gpm. But these are relatively modest. As Phil said, there's a lot of time.

You're talking about a huge mass of water, volume of water in the torus. So it's, you know, by simply monitoring the wetwell or torus water level on the Mark I, you can, we believe you can achieve the seven days.

And the --

MEMBER CORRADINI: So I have a couple of questions about this one just to help me. So, let's talk about instrumentation first.

So the instrumentation you would use to make sure that things are going the way you think they're going would be instrumentation of level indication out in the wetwell?

MR. GABOR: Correct. Right.

MEMBER CORRADINI: And it's not going to have any sort of challenges relative to its environment that would be outside of its current EQ range?

MR. AMWAY: That's one of the things we would check. Right, over the seven day period, we would have to look at that integrated radiation dose and make sure it falls within that instrument's equipment qualifications.

MEMBER CORRADINI: Okay. So, -- all right. So, the next question is, now I get the seven days and I hit 21 feet. Then what?

MR. GABOR: In the case of this plant, they would be told to isolate the wetwell vent. In this case, obviously another adjustment to the injection rate could be made anywhere from 24 hours to seven days to try to bring that trend back down to an almost stable point or a slight increase and buy even more then seven days.

And I was able to get seven days with these simple actions. You know, additional reduction, slight reduction in flow could maintain the torus level essentially forever below the 21 foot.

MEMBER CORRADINI: Okay. Just -- I don't want to take up too much time, but a whole bunch of questions popped in my head. So, you always want to maintain a positive slope so that you can get some sort of instrumentation, a reliable information response so that you know things are going where they're going? All right, I'll stop now.

MR. AMWAY: And we have also improved the Guidance between the Subcommittee and now for things that we want to do to make sure that the SAWA injection flow path is in tact. And you're not in fact diverting some of the flow from your pump to places that you don't want it to go.

You know, looking at logic. Making sure that valves are in the right position. Make sure there's no other diversionary paths that are going to defer that SAWA flow to someplace that you don't, you know, need it to go.

MR. GABOR: Done.

MR. AMWAY: Done?

MR. GABOR: Unless there's questions. It just shows that we're maintaining pressure and temperature acceptable in a containment.

MR. AMWAY: Okay. So moving on. SAWA equipment. We have to be able to demonstrate that we can actually connect it and maintain it for the sustained operational period.

That includes the mode of force that may be needed to power the instrumentation any valves in the SAWA flow path. And to make sure that were can do that in a time line that's needed to support the SAWM strategies or the 545 degree drywell vent.

To approve the assurance and reliability of those actions, for any actions that we need to do in less then 24 hours, we will be doing a validation of those actions similarly to what was done under NEI 12-06 for FLEX. To make sure that we do have those actions clear and well defined and implementable.

MEMBER SKILLMAN: Phil, how will the radiation levels be considered in that validation point?

MR. AMWAY: They'll be considered up front. We will, you know, before we even get to the validation point, we will have done the radiological analysis to make sure that we understand what we expect those dose rates to be, where they are taking those actions.

MEMBER SCHULTZ: And that's done on a design specific basis?

MR. AMWAY: Yes.

MEMBER SCHULTZ: I know there was a --

MR. AMWAY: It's a design specific basis. It's going to be a function of wherever those SAWA components have to be, you know, actually gotten to when, you know, whether it's connecting, monitoring, refueling, repowering, pneumatic supplies, anything that needs to be done within the radiological area.

MR. GABOR: The White Paper 02 provides the basis for that.

MR. AMWAY: Right.

MR. GABOR: That then it's scalable from that basis.

MEMBER SKILLMAN: Will that include preemptive placement of shielding?

MR. AMWAY: I would like to stay away from that. I mean, I think it's best if we can locate the controls and monitoring locations for either HCVS or SAWA, without predeploying any type of portable instrumentation.

Whether that's on the front ends that we put it in, you know, as part of the design effort, before we declare victory on implementation. Or the location is just far enough away that we would be able to get to it.

We don't want to have to have those actions done at the time of the event.

MR. KRAFT: There may be situations, I can imagine in the old boilers where you make the personal entry right where the CDRM hydraulics are. You look down the hallway, there's a door that used to just open up basically for guards which now secure the door. Right?

And the way FLEX is going to work, some plants will have -- would have an ability to overcome the security requirements, open that door, run a hose into a quick connect, to a standpipe that's right in that corner for the feed water system.

So I've seen that in a number of plants. You can't stand there during a serious accident because you're 20 feet from the core. Even though it's on other side of the, you know, the light bulb.

So some plants may decide, okay, I'll hard pipe that but not penetrate that outer wall. So I open that door up and maybe I'll erect a new shield wall that will be permanent, to have the new connection behind that shield wall.

MEMBER SKILLMAN: That was the question.

MR. KRAFT: One of the things -- I mean, so you're ask -- you asked about temporary. I was -- and that's what Phil was talking about.

MEMBER SKILLMAN: No, I said preemptive.

MR. KRAFT: Yes.

MEMBER SKILLMAN: What I'm saying is you've done your analysis.

MR. KRAFT: Right.

MEMBER SKILLMAN: Erin said hey, we believe it's going to be 5,000 RPR and shield it.

MR. KRAFT: Right.

MEMBER SKILLMAN: You say fine. Since I'm going to have to access that point, we will build the shield today.

MR. KRAFT: If it's necessary, yes.

MEMBER SKILLMAN: So that when we can get to that when we need to.

MR. KRAFT: If necessary, yes. There's a diagram in the Guidance that's really from Phil's plant that NRC has in their presentation we noticed, that shows that the FLEX connection as he currently has it, is a hose that snakes its way in from the truck bay into a location near the wall.

If that becomes a SAWA injection point, that will hard piped up further. So you're taking advantage of distance there and of some other shield walls that are there.

So yes, those considerations will be made. It's one of the reasons that we've been talking about this assist program. Because we want to make sure people are A, accomplishing what they need to accomplish.

We want to make sure we're taking advantage of knowing what the different geometries are in the Mark IIs. Make sure the water can get to where it has to go.

And also, those questions too. I can imagine, you know, some industry group looking at some design source, say wait a minute. You know, what about those levels at that point?

It's not a common thing to do in the industry. But we think this is important enough that we do it that way.

MEMBER SKILLMAN: Well, it seems to me that unless that evaluation and consideration has been incorporated, you've only achieved a portion of your objective.

MR. KRAFT: Um-hum.

MEMBER SKILLMAN: Because if we really are, we hope this will never happen. As you said in the last meeting, it's very rare.

MR. KRAFT: Right.

MEMBER SKILLMAN: But by golly, if it happens, we need to be able to fulfil what we say we're going to fulfil.

MR. KRAFT: Absolutely.

MEMBER SKILLMAN: And you can't be irradiating, heroically, your workers.

MR. KRAFT: Absolutely. But you and I were talking before the meeting about experiences at TMI. While you were with that crew pumping that water out of the aux building, I was receiving into the tanks that we had set up in the -- remember the old, we called it the cap gun system and then we had the Epicor system. What do we do with the water?

I was on that side of the problem. So, yes. We understand completely the need to avoid those heroic actions. And Fukushima was a great teaching event in that regard in terms of what heroic actions you need to avoid.

You know, as heroic as they were, we don't want to put people in those positions.

MEMBER SKILLMAN: Again. Yes.

MR. KRAFT: Again, yes.

MEMBER SKILLMAN: Thank you.

CHAIRMAN STETKAR: Phil, go back to your last slide. Every time I read these updates when they come in two or three days before a meeting, I learn things.

This innocuous looking little first sub-bullet there that says motive force for SAWA may include power and pneumatics for valves in the SAWA flow path and instrumentation.

And I read the Guidance. And the Guidance says, yes. We might have to get power to open valves in that flow path. But we'd run analysis in the minimum time that's available. And our analysis is eight hours.

And we can take credit for offsite help within six hours. So, we'll have everything we need to get that power.

I have a different question. So this pump, and I'm not going to call it -- it's a pump. It's a 500 gpm low pressure pump.

And it -- however we connect it up with a hose to wherever that connection is located, can pump water into the reactor vessel. To me that sounds like a good idea.

And let's say it's hooked up through two normally closed A/C motor operated valves that you say we don't need power for those valves in eight hours. And I say I'm in an event where RCIC fails at time t-zero.

And I'm an operator. Does the Guidance now tell me that I sit on my hands until the core melts and I just save the public?

MR. AMWAY: Absolutely not.

CHAIRMAN STETKAR: Because -- okay, how do I get power to those valves at t-zero?

MR. AMWAY: You're going to -- if you get in a situation where RCIC fails at t-zero, you start then deploying generators, pumps, whatever you need.

CHAIRMAN STETKAR: No, no. I'm sorry.

Your Guidance says I don't need to think about that for eight hours. So my generator that I'm going to take credit for is 250 miles away because I've done an analysis that says I can get it there in eight hours.

I'm saying, how does your Guidance help me to get low pressure injection into that reactor vessel at t-zero? Because your Guidance says, I don't have to think about that for eight hours.

MR. AMWAY: Well, if our Guidance says sit on -- sit and wait for eight hours, you don't have to worry about it, that's wrong. I mean the --

CHAIRMAN STETKAR: The Guidance tells me that. Because see FLEX, now I'll give things names. FLEX assumes RCIC works forever.

MR. AMWAY: Yes. I'm told that, right.

CHAIRMAN STETKAR: So that's FLEX. This assumes RCIC fails at t-zero. If I'm an operator, I'd be darn liking to get low pressure injection into that reactor vessel at zero.

And I'd not like to have A/C closed motor operated valves that I can't open. Because I can't get to them and I can't -- I don't -- and the Guidance says that I don't need power for them.

MEMBER SCHULTZ: You've indicated Phil, that the gap is going to be filled. That is the operator will have equipment to anticipate.

CHAIRMAN STETKAR: No, the FLEX Guidance doesn't require it.

MEMBER SCHULTZ: We're not seeing the requirement for it.

CHAIRMAN STETKAR: What I'm talking about is integration here. We're now -- this is another example of subdividing and parsing the problem so small that you guys are only worried on severe accident water addition for boiling water reactors with Mark I and Mark II containments for the venting requirement.

I'm worried about giving the operators guidance for not melting the fricking core of the plant. And I don't see that integration.

MR. BUNT: Okay, if I could help with this one. What we've done is we've done the analysis. And again, it's a stylized, particular analysis that says, if you get to eight hours, you won't challenge containment as much if you put the water in.

CHAIRMAN STETKAR: Yes.

MR. BUNT: We also say that if our analysis says that you can wait until this long because your batteries and your other functions will support you. But that's -- no where in there does it say, wait this long before you do it.

What we're doing is saying that if that happened to be the longest that you go, here is still a success path. And what we want to do is we're not writing our Guidance or anything else to say wait to hear.

I totally agree that what I would expect is if I don't have RCIC flow at time equals zero, I'm going to utilize almost everyone on my site to go get pumps and power hooked up. Not just the people that are in this one little Guidance that we stylized in our scenario.

CHAIRMAN STETKAR: FLEX Guidance doesn't say that.

MR. BUNT: That's correct.

CHAIRMAN STETKAR: If the FLEX Guidance is supposed to keep you out of this, the FLEX Guidance doesn't say that because the FLEX Guidance assumes that RCIC is working. And you have all of that time for RCIC to be working.

MR. BUNT: That's correct.

CHAIRMAN STETKAR: Okay.

MR. BUNT: What you would get into is you'd get into your severe action Guidance, which tells you that you have no flow injections. You would then go to your other Guidance documents, into your SFGs and your other documents which then have you go immediately, start doing that, because you have no injection.

And your operators would prioritize that based on their ability to not have flow.

CHAIRMAN STETKAR: I can make that all sound so good.

MR. AMWAY: Why don't we just take those facts. We'll look at it because it's certainly not the intent of our Guidance that they would wait.

CHAIRMAN STETKAR: Right. I sure hope -- the reason is that these words have implications on real designs. Because if the most expedient way for the guys to hook up the connection is to tie into let's say the RH/ROI, if those have the two closed valves, because it's the easiest to get the hose connections in there.

And they're saying that's the way I'm going to make my modification for this particular function because, you know, because according to this Guidance, I'm allowed that time window to get power back to those valves.

I don't need to worry about where they're powered from or, you know, in the short term. And I can have enough power and cables and all that stuff, to get those valves open.

That can have an implication on people making design decisions today. That's the real point of the rant here.

And a different design decision might be made if they wanted to pick a different water injection point. Or they might have a different integrated strategy for FLEX out into the SAMGs -- FSGs to SAMGs for different contingencies.

MR. AMWAY: The shorter we can get -- the shorter time we can get water flow, the better we're doing.

CHAIRMAN STETKAR: Sure.

VICE CHAIRMAN BLEY: I think, you know, one of the things we're saying is, we understand where you started from and why you started that way. And all the interim places you had to get by certain times.

We're at a point now, pulling it all together is the right thing.

MEMBER SCHULTZ: Right. And pull it all -- don't -- look at all the stove pipes that have been created and integrate those to ensure that both the equipment and the procedures and the overall Guidance does in fact pull it all together so the right decisions are made.

MR. GABOR: And I think the SAMGs do that. Because they are symptom based. They don't know that it took you one hour or 16 hours to get to the core uncovering.

But once you do get there, they're pretty clear on go find a pump. Hook it up and put water in the core. And they don't care what the time line is.

CHAIRMAN STETKAR: That's right. But again, all of this stuff would be under the SAMGs.

MR. GABOR: This stuff would get triggered by the SAMG. Yes.

CHAIRMAN STETKAR: Yes. Well, but I mean, yes. We're saying the same thing there.

MR. GABOR: Yes.

CHAIRMAN STETKAR: I'm talking about that interim period while things are not good, but you still have a chance of saving it before you need to invoke the SAMGs.

There are design decisions being made and people are developing strategies, you know, based on assumptions over in that part, assumptions over in this part. And it's not clear that they're well integrated yet.

MEMBER CORRADINI: I mean, my way of -- John's question or my interpretation of John's question is that at least in my mind, since I'm not an operator, and I'm never going to get close.

Is, I don't understand how one leaves the EOPs and what you enter next. And how all of these things are hooked together in a logical fashion so the operator doesn't go into a complete melt down. Him, in not knowing that to avail himself with.

MR. AMWAY: Um-hum. And I -- I mean, because I was an operator as late as 2012, anyway. But, the EOP Guidance is very clear on that transition point between the EOPs and the SAMGs.

And once they get out of those EOPs and I'm in the SAMGs, I won't go back to EOPs again. These other procedures that we have in place, whether they be EDMGs or FSGs, they are support procedures to the SAMGs.

So, I'm still on this -- it's not like I ever leave the SAMGs and go off to EDMGs or FSGs. They are support procedures that help me implement the Guidance that's provided in my SAMGs.

They're the -- this is how you connect this pump. This is how you tie in this electrical generator. My SAMGs tell me, get power from point A to point B. The FSGs tells me how to do it. So I'm still in those SAMGs.

MR. BUNT: And one thing that we -- I think we want to leave the thought here, is that while we've analyzed to be able to cope at this particular times, there's nothing in our Guidance or anything else that says wait until you get there to do these actions.

And that you are going to start in your EOPs. And you're going to quickly transition to your SAMGs because of your loss of injection flow.

And you're going to still have people trying to get that injection flow back. You're going to have people getting everything else back.

VICE CHAIRMAN BLEY: We understand it doesn't say wait. But, you guys have been sitting around thinking about how all this is going to work. And you've been giving it an awful lot of thought.

And you know what you'd do if you were there. But there's a lot of guys out there who aren't doing that. They're operators and they're going to walk into some of these and at least it's going to cause them pause.

Oh, I don't go to this until the core melts. You know, I -- whatever.

MR. AMWAY: And I got -- I got that feedback.

CHAIRMAN STETKAR: Or my plant is built on a flood plain that's, you know, two and a half inches above the river level. And to protect my portable equipment, I'm going to store it in a shed, you know, back up in the hills, which might be ten miles away.

But I can do that because I know for this purpose, I don't need it for eight hours. So I can do all kinds of analysis. Even if the water washes through. But I can get it in eight hours.

And that might be a strategy that I think about because, you know, if I don't think about that I might need it earlier, I don't think about that.

MEMBER SCHULTZ: But it's scenario based.

CHAIRMAN STETKAR: It could be scenario based. But it's also just function based. It's --

MR. AMWAY: Okay. This slide deals with instrumentation. It is a limited set that we're have in our Guidance as needed.

Obviously you need to know how much flow is coming from your pump to make sure you have the SAWA flow rate you need. The containment water level, which would be in the wetwell and containment pressure so you know when to vent.

The instruments that we are selecting are existing design basis instruments with the exception of the SAWA pump flow. But I'm talking about containment pressure, wetwell level here that are in our tech specs or TRM as post-accident instrumentation.

That instrumentation is for most plants, qualified to Reg Guide 1.97. For those plants that are pre-Reg Guide 1.97, they have similar post-accident qualifications.

To demonstrate that those instruments will function during severe accident conditions for use in the SAWA/SAWM strategies, we will do an evaluation of the radiological dose rates and the impact. Both the radiological and thermal impacts on those instruments to make sure that they would function through the seven day sustained operational period.

To make sure that we can provide them with the power that they need through the seven day period. And make sure that we have a success strategy to make sure that we can use our FLEX equipment to power up those instruments before their normal power source is depleted.

The closing comment on there is that, you know, particularly for wetwell level, we really don't need to have that powered up until it would be the time and the sequence where we actually need to cut that back to the 100 gallon per minute range. And to be able to do that wetwell monitoring as part of the severe accident water management strategy.

CHAIRMAN STETKAR: Phil, and I'm going to be short here because of the time constraints.

MR. AMWAY: Yes.

CHAIRMAN STETKAR: A comment. And write down the section number. It's 4.2.2.4.1.1. And let me just reads a quote. It says, verification of a functioning SAWA flow path can be obtained from indication of pump flow and changing containment pressure and/or suppression pool level find.

As an acceptable alternative approach, is local or remote valve position indications in the main control room, remote operating station or some other severe accident evaluated location for remote operated valves, can be used for validation of an open SAWA flow vent.

We have had events where the valve internals have separated from the operating mechanism. And therefore remote operation -- remote position indication or even locally looking at the stem does not give you positive indication that that flow path is open.

So, you may want to rethink that alternative and put higher priority on actual pump flow and level changes.

MR. AMWAY: I understand. Thank you.

CHAIRMAN STETKAR: That again, that's something that popped up in this version of the thing for some reason.

MR. AMWAY: Right. This one, and I don't want to go through this entire table. What I wanted to focus on was what's in the green sheeted text.

You know, we discussed in the Subcommittee, you know, why aren't we cycling HCVS check valves. We certainly agree. So we have added a requirement to the table to do that on a once every other operating cycle.

We do have some notes down here at the bottom which discuss that, you know, particularly for SAWA. I expect that SAWA backflow prevention will be provided by an existing installed valve.

Generally, we would be injecting through a flow path that already has containment IVs that are check valves that get leak rate tested per Appendix J. And that leak rate testing would suffice without doing additional testing for SAWA.

CHAIRMAN STETKAR: Phil, help on this real quick. Because I had a comment on this. Did the green thing change between the version of 0F4 that we have and this slide?

MR. AMWAY: Yes. We've been working with the staff on that to --

CHAIRMAN STETKAR: Okay. Okay, fine. Because this says what I wanted it to say. But the version of the report that I have is basically just checking reverse flow.

MR. AMWAY: Right. Right. Yes, we --

CHAIRMAN STETKAR: This has -- okay, thanks. That's all --

MR. AMWAY: This is all that Guidance will say.

MR. KRAFT: Which shows Dr. Stetkar, we listen to what you have to say.

(Laughter)

CHAIRMAN STETKAR: At least one person.

MR. KRAFT: At least once. At least I do and at least one.

CHAIRMAN STETKAR: No, thanks. I mean the group -- no.

MR. AMWAY: The other item deals with the out of service time compensatory action. The concern being there was no defined total out, out of service time. The concern being was it could go years and years without being corrected.

We have added it to the Guidance that that out of service time shouldn't exceed one full operating cycle. The reason why that's in there is just to make sure that, you know, you do timely repair. But acknowledge the fact it may take an outage to fix.

RPV depressurization. The concerns with that, you know, just to acknowledge that our procedure Guidance and that the procedure Guidance be in the EOPs, requires RPV depressurization anytime you exit the EOPs and before entry into the SAMGs.

And that we described the likelihood of success of those actions in India 1.3 of the Guidance. And that we do not credit failures such as SRV seizure or main steam line creep rupture to get those actions done.

Remaining steps, we are on a path to issue 13-02 Rev 1 and the final ISG by the end of this month. Our next steps after that will be to develop the industry template for Phase Two OIP, conduct the Phase Two workshop and to make the OIP submittals by the end of this year.

On conclusion, you know, we have achieved a successful SAWA strategy for meeting Phase Two of the Order. That's defined as ISG methods two and three using either the SAWM approach or the 545 design boundary condition for the drywell vent.

And the draft 02 of the ISG, there is a second draft of that ISG out. And there is, you know, very good alignment between that draft 02 of the ISG and NEI 13-02, which will become Rev 1.

MEMBER SCHULTZ: Any other questions from the Committee?

MEMBER CORRADINI: So, I have one that I'm sure you thought of, and you'll tell me that I've got my engineering wrong.

But, if I come into something which is potentially a loss of offsite power, that's it's extended. And I'm concerned that I can't risk covering in time, you have anticipatory venting allowed?

MR. AMWAY: Yes.

MEMBER CORRADINI: Has the set point for that been determined? Or is that still being evaluated relative to certain plants? Or at least sample pilot plants?

MR. AMWAY: You could -- the EOPs say that you can start the anticipatory venting as early as two psig, which is above the rps SCRAM set point.

The time in which a plant will actually do that, you know, most of the majority of the plants, at least the ones that I'm aware of throughout the Exelon fleet, have done analysis to show that at the time they plan to open that vent, it's successful in preserving the RCIC system for the time they need to be able to transition to the portable pump.

So it's somewhat of a function of what their vent size is and what their venting capability is, in being able to hold the suppression pool water temperature below 250 degrees.

MEMBER CORRADINI: So let me -- okay, so I'm sure this sounds wrong, so you tell me where it's wrong.

So, have any thoughts of an accident scenario where I start down that path, I open the vent. I now successfully get back power, but I start leaking and I transition from an ELAP to a loss of cooling accident, such that I need low pressure injection.

And now, I'm at a CAP plant and I don't get it any more because I required the operation at essentially a saturated pool to have a positive pressure and a wetwell.

MR. AMWAY: Well once you get to a state where you have the power back and you have alternate means of core cooling, you no longer have the provision to have that vent open.

MEMBER CORRADINI: Close it?

MR. AMWAY: So it would have to be closed at that point.

VICE CHAIRMAN BLEY: And could damage the pumps before that, I guess would be --

MEMBER CORRADINI: Well, I'm not sure, but I'll stop for the moment. I'll -- let me think a little more. But thank you for that.

MR. AMWAY: You're welcome.

MEMBER SCHULTZ: Other questions? All right, I'd like to move now to the staff presentation.

Jack, I'll turn it to you for introductions and any other comments you'd like to make after the industry presentation here.

MR. McHALE: Thank you, Dr. Schultz. And I'll just to get moving with the presentation, I'll introduce the staff that will be making the presentation over on the table.

First, you have Bill Reckley, who is a Special Advisor of the Japan Lessons Learned Division.

You have Rao Karipineni, a Senior Reactor Systems Engineer in the Containment and Ventilation Branch in NRR.

And joining them will also be Raj Auluck, who is also with the Japan Lessons Learned Division as a Senior Project Manager. And in the room we also have staff members from NRR and the Office of Research to assist.

So the next thing is to turn it over to Raj when he gets here for the --

CHAIRMAN STETKAR: While we're waiting for Raj, let me just, you know, we're obviously going to run over long. We are not strongly constrained on the amount of time to run over.

We have another activity scheduled through our lunch hour. But I'm informed that that doesn't have a particular back end constraint on it.

So, I'm not saying just, you know, talk at leisure. But don't rush through the presentation or Members, don't feel to constrained about asking questions of the staff, because we do have some time flexibility.

MR. AULUCK: Good afternoon. I'm Raj Auluck. I'm a Senior Project Manager in the Japan Lessons Learned Division within the Office of Nuclear

Regulation.

In addition to at the table, I have Mr. Nageswara Karipineni and Bill Reckley. There are other staff members in the audience from the Office of NRR and Research who participated in developing this Interim Staff Guidance or the ISG. And they are prepared to answer your questions.

Before we begin our presentation on the proposed ISG for Phase Two of the Order, I'll briefly go over the level background.

The accident at the Fukushima Daiichi Nuclear Plant reinforced the importance of reliable operation of containment events for BWR plants with Mark I and Mark II containments.

As part of its response to and lessons learned from the accident, the NRC issued Order EA-12-050 in March 2012, requiring licensees to upgrade or install a reliable hardened containment venting system for Mark I and Mark II BWR containments.

While directing the requirements of Order 12-050, the NRC staff acknowledged that questions remained about maintaining containment integrity if licensees used the venting system during severe accident conditions.

In November 2012, the staff presented

options to address these issues for Commission consideration in SECY 12-0157. It incorporated comments from the nuclear industry, the stakeholders and the ACRS.

In the supplement SECY issued in March 2013, the Commission directed the staff to take certain actions, including requiring the licensees to upgrade or replace the reliable hardened vent required under EA-12-050 with containment venting system designed and installed to remain functional in severe accident conditions.

And also, they will have technical basis and rulemaking for filtering strategies, drywell filtration and severe accident management of containments.

The NRC subsequently issued Order EA-13-109 in June 2013, which supersedes the requirements imposed under EA-12-050 and replaces them with new requirements. And also allows implementation in two phases.

Under Phase One, upgrade the venting capabilities from the containment model to provide operation under severe accident conditions. And 2 -- under Phase Two, install a reliable severe accident action capable drywell vent system or develop a reliable containment venting strategy that makes it unlikely that the licensee would need to vent from the containment drywell before alternate reliable heat removal and pressure control is reestablished.

Implementation for Phase One is no later then the start of from the refueling outage that begins after June 30, 2014 or June 30, 2018, whichever comes first. And for Phase Two, no later then start up from first refueling outage after June 30, 2017 or June 30, 2019, whichever comes first.

For Phase One, all operating integrated plans will be submitted by June 30, 2014. And I believe the staff has issued all interim staff evaluations ahead of schedule, which was the date of June 30 of this year.

Next slide, please. This slide shows the schedules for issuing the ISG for Phase Two of the Order. As directed in the staff comments memorandum, the staff engaged external stakeholders throughout the development process.

There were 12 public meetings held since issuance of the Guidance for Phase One. Six of these have been since August 2014, related to Guidance development specifically for Phase Two.

The staff briefed the Subcommittee last

month on March 20. The staff's presentation will include responses to the questions raised at the Subcommittee meeting.

Once we receive the Committee's letter of endorsement, we will revise the ISG to include the Committee's recommendation and any other public comments. As you can see, the public comment period ended yesterday.

We plan to issue the Phase Two ISG by April 30, 2015, which will endorse the latest version of the Guidance document with exceptions and clarifications as needed. This will provide the needed time for licensees to prepare and submit their Phase Two overall integrated plans by December 31, 2015, as required by the Order.

And now with that, I will ask Rao Karipineni to begin the staff presentation on the ISG -- proposed ISG.

MR. KARIPINENI: Thanks Raj.

MR. KARIPINENI: Thanks, Raj.

Basically, you already know that we are talking about three matters of compliance, one of which is very questionable. Hopefully, nobody will go that path, which is the capable severe accident drywell vent with no provisions for water addition.

The second one is severe accident capable drywell event with water addition, SAWA, called Severe Accident Water Addition, at a high flow rate, the idea being if you are putting it at a high flow rate, at some point you will get the wetwell vent submerged and you will need a drywell vent. Therefore, there is a drywell vent available for that.

The third part is preserving the wetwell vent, and it is achieved by the management of the severe accident water addition. At somewhat of a later point, reduce the flow from 500 gallons to approximately, say, 100 gallons, and may reduce even further as time goes further. That is the idea here.

Next slide.

There is work done on the Guidance since most of the members have seen the Phase 1 items. There was somewhat required by comments that industry folks during the implementation made and asked for clarifications. Therefore, the NEI and the industry have decided to add some differently-asked questions than what the staff has told them about answers to those questions.

There are also some White Papers developed. The doses and source terms is White Paper No. 2, and the flammable gases was White Paper No. 3.

The appendices referred to in the slide were already there in the Phase 1 Guidance.

Glossary of Terms, Appendix A, has been revised extensively to suit the Phase 2 application. Also, some changes were made regarding instrumentation capabilities.

The major focus of the Phase 2, which is the SAWA and SAWM are covered in Appendix I for SAWA and Appendix C for SAWM.

Combustible Gas Control. We had some identification of issues in Phase 1 that ACRS has made in a letter to the EDO. I just want to explain quickly about what we had done, what we had thought we had done by then and, also, what else we have done since then.

There are two issues with combustible gas control. One is the possibility of any detonations within the pipe itself, or the pipe, is it properly designed for this? Second, is leakages into the reactor building, et cetera, gas migration and ingress, et cetera.

The first issue was covered by, the pipe itself is covered by WP-03, White Paper No. 3, to a large extent. They gave several options for the individual licensees to take. They include both passive and active approaches.

The active approaches are, you know, they would enter the pipe. They would then install a check pipe and a check valve at the end of the vent lane to prevent any ingress back into the system. They would provide a control valve beyond the two containment isolation valves, somewhat close to the exit point, and the control valve would close. It would prevent any of it to come back into the pipe. And the sections beyond the control valve, they would either design for detonations or make any other provisions, design provisions, that they feel are needed to prevent any detonations there. Those are the active issues.

The second issue, the passive issues that were mentioned are they would design these systems to take deflagration and a detonation or they would consider some operational experience, et cetera, to help them reduce the possibility or eliminate the possibility as much as they can with the design.

So, what an individual licensee would actually do is something we really don't know at this point until all of them come in and clearly tell them what they are doing. I think in some cases we have that information. And I talked to some of the folks that are working on these issues. They said quite a few of them are coming up with the check valve approach at the end of the pipe.

The other issue about the possibility to have leakage into the reactor building, et cetera, those were handled by two approaches. One is design the entire pipe to be leak-tight. There is testing included, leakage testing, et cetera, from the pipes. Design the interfaces into the other system to close at the initiation of the HCVS. And the closure mechanisms, whether they are valves or dampers, would also be tested for leak tightness, both initially before we place the system into operation and, also, periodically afterwards, as you saw in the testing and testing table.

MEMBER CORRADINI: So, can I ask --

MR. KARIPINENI: Go ahead.

MEMBER CORRADINI: So, do you know which of these two possibilities most plants are going to choose or is it still up to them in terms of --

MR. KARIPINENI: It is still up to them.

MEMBER CORRADINI: Because the question I guess -- I think you are eventually going to show a calculation -- the question I guess I am curious about is, if they chose the path, the top one -- or, I'm sorry, the bottom one, for -- well, I guess whichever one it is, that I am not going to have to worry about hydrogen combustion within the path because I fell well below the detonation limit. How would they know that going into this? It is purely based on bounding calculation to the design, and that is the end?

MR. KARIPINENI: You are talking about the top one, which I said there were some active approaches? You are talking about the active approaches?

MEMBER CORRADINI: The active approaches.

MR. KARIPINENI: When you are venting, you have another control valve, let's say, past the containment isolation valves. That valve also needs to be open. When you initially open, you've got steam and inertia basically --

MEMBER CORRADINI: So, it is just the inerting of it that essentially eliminates any concern?

MR. KARIPINENI: Right. Initially, it is the inerting, the nitrogen steam inerting. Some people may come back and say at the time that nitrogen is pretty much gone from there, if they feel there is a need, they may actually inert the pipe before they open the back-end flow valve.

MEMBER CORRADINI: Okay.

MR. KARIPINENI: That is what we are told in the White Paper.

MEMBER SCHULTZ: So, the staff has endorsed the White Paper. And as we have just discussed, that includes a number of different options and approaches and design and operation, and so forth.

MR. KARIPINENI: Right.

MEMBER SCHULTZ: And now, you are saying, well, we'll see what the licensees come back with in terms of the design.

MR. KARIPINENI: That is correct.

MEMBER SCHULTZ: What is planned for that review of those designs?

MR. KARIPINENI: The staff reviewing those plants that come in, they would write an Interim Staff Evaluation about how they concluded that it is an acceptable approach for that plant. That is how it is done.

MEMBER SCHULTZ: Okay.

MR. KARIPINENI: They will review those.

MEMBER SCHULTZ: And when does that happen? That comes after the --

MR. RECKLEY: Well, actually, keep in mind that the hydrogen part is applicable to Phase 1 as well.

MEMBER SCHULTZ: Yes.

MR. RECKLEY: And so, when licensees have submitted the Phase 1, they have left this open as an open item, as to which of the options in the White Paper they are going to pursue. Again, as was mentioned, we think many of them will take the check valve at the end of the pipe approach.

But, as they pick it and update to the integrated plan, which they are required to do every six months, one of these will capture which approach the licensee plans to take. At that point, we would review the plant-specific aspects.

Now the general idea that a check valve at the end of the pipe is good enough we have accepted through the White Paper. The plant-specific how they do that, we would do as part of that review of the integrated plant.

MEMBER SCHULTZ: Good. That is what I was looking for. Thank you.

MR. RECKLEY: Yes.

MR. KARIPINENI: As far as leaking into the reactor building, I already talked about what we are doing on the vent pipe itself. Any interfaces from the vent pipe to ducts or other piping into the rest of the reactor building, they will be isolated immediately.

The possibility of leakages directly from the containment into the reactor building, there are two aspects. One, is the water addition is reducing the temperatures, encasing the potential sections of the drywell head seals and, then, other penetrations. Also reducing the pressure from always staying at PCPL; rather, you maintain the pressure somewhere around, as you saw some of the curves that the industry has put up, somewhere around 20 psi. That is well below the containment design pressure.

So, these factors would also help reduce the leakage into the reactor building. So, as far as the vent is concerned and how the vent is operated, these factors that are there that address the hydrogen part to the extent they can, and the way the staff is approaching it is further evaluations will be done under Tier 3, under Recommendation 6, in consideration of what has been already done up to now and, then, what else may need to be done or may not need to be done for Mark Is and Mark IIs.

This graph was put up there. We did just the left side of the graph before in the Subcommittee meeting. We added a couple of other graphs here to show what the concentration levels of hydrogen would be in the containment for the cases that were analyzed.

That shows both the drywell and wetwell. You can see the average in the summary, around 5 percent in those levels, pretty much after 14 hours or so except for the small spike in between. So, the idea being here that most of the hydrogen is actually getting vented out. A very small amount is remaining in the containment.

Method 1, you already heard from the industry. Basically, we don't see it as a workable method at all, and we have added some language into the Guidance about how it would conflict with potential requirements in the CPRR rulemaking. Also, you know, it raises possible concerns with increased release of hydrogen into the reactor building.

And just like the industry is planning to reinforce those points in these workshops, if staff gets invited, we will mention them also in those meetings. They have invited staff during Phase 1 meetings, Phase 1 workshops. We kind of think they would do that again. We can certainly reinforce those points again at that time.

The graph is, again, the temperatures that you have seen from the analysis the industry has done. These are the MELCOR results. You can see the temperatures are pretty high in the pedestal region. That would be almost up to 2500 degrees Celsius, going down to the low regions of the drywell, and you are still up somewhere around 1800 and 1500 most of the time during the 72 hours.

Another tool, actually, provides a severe accident drywell vent that complies with all the Guidance requirements as they are being written for Phase 1. It also has a water addition component to it. The industry felt it is a strategy. We thought it was a hybrid approach. It is all just a matter of words, I guess, you know. It basically does what we want. The fact you have water addition plus a severe accident drywell vent is the best thing that you can do.

If you go slide on 13, the temperature --

MEMBER CORRADINI: Can I ask a question?

MR. KARIPINENI: Sure. So, I think I have got the right report. What Mark II was used for the analysis of temperatures and water addition? Was it LaSalle for the staff's calculation?

MR. KARIPINENI: Yes.

MEMBER CORRADINI: So, is this a -- I

don't know if the right word is "limiting" -- but is this the least peculiar, most peculiar, or they are all peculiar in terms of their behavior?

(Laughter.)

MR. RECKLEY: They're different enough that I think you would use your last term; they're all peculiar.

(Laughter.)

There is a small number and they are all somewhat unique.

MEMBER CORRADINI: But the reason I am asking is that, going back to what Dr. Powers was asking about, the range of things that he was asking the industry, has staff thought about these sorts of things and have checked it out, such that the analysis here is -- and again, I will use bounds, limits -- what you expect of the behavior in terms of that it satisfies your needs?

MR. ESMAILI: This is Hossein Esmaili.

MEMBER CORRADINI: Hello, Hossein.

MR. ESMAILI: Yes. So, yes, for the base-case calculation, we assume the dry cavity, the dry lower, you know, that it is a concrete plant, but we did sensitivity by just removing that one and filling up with water, so what happens, you know, and then, looking into the timing when a drain clog or a downcomer would fail and the debris would clog.

Based on some of the analysis that was done previously, they estimated, for example, 20 minutes. You know, when the debris comes into the lower part, it takes 20 minutes for it to fail the drain clog and the debris gets moved to the lower cavity.

We played sensitivity. We assumed, you know, it just like takes maybe one hour or we assume that it just stays there long enough for the concrete, separating the lower and upper cavity, to complete ablate and go there.

So, we look at a whole bunch of -- we started with a base model that had a dry lower cavity, but we did a whole bunch of sensitivity calculations based on that base model.

MEMBER CORRADINI: Okay. Okay.

MEMBER REMPE: Hossein, while you are up there, could I ask a question? I looked through the MELCOR report. What was your assumption for heat transfer off the lower head and the control rod drives? Did you consider radiation and convection for heat transfer from the vessel?

MR. ESMAILI: You mean as an integral part of the vessel? Because it is --

MEMBER REMPE: The lower head and the control rod drives. I am looking at timing of vessel failure and what the assumption was for heat loss from the vessel and how that affected your results.

MR. ESMAILI: From the upper head or the lower head?

MEMBER REMPE: The lower head.

MR. ESMAILI: Well, the lower head, it gets really, really hot once the debris gets in there.

MEMBER REMPE: Right. And what was your assumption for heat loss off the vessel? Did you consider radiation in the calculation?

MR. ESMAILI: No, we just assumed a very low convective heat transfer. And that is why the temperatures that you are seeing, once the debris gets in there, you have temperatures of the order of a couple of thousand Fahrenheit. But that is in the pedestal.

MEMBER REMPE: Uh-hum.

MR. ESMAILI: The other part of the driver stays cooler.

MEMBER REMPE: Okay.

MR. ESMAILI: But when you add water -- I mean, this is the case that you add water -- you do get a temperature, even in the pedestal, reaching about 500, but that one, you know, that is the maximum temperature that you are going to get because you keep adding water and you are going to cool the atmosphere, the lower pedestal, and the entire driver. Okay?

And one thing I didn't mention is that all of these cases assume there is a preexisting -- because I think it was explained during the industry that there is some leakage. So, you would have some preexisting water level at this time of the lower head failure.

MEMBER REMPE: Thank you.

MR. KARIPINENI: Those temperatures, as you can see, for the past 24 hours or so, somewhere around there, the maximum is about 400 degrees. And it gives you some idea how important the water addition is.

In fact, I may as well add that this is not a revelation, you know. This is something people knew from the very beginning, since the GL 89-16 event times, that the feed-and-bleed system is the way to go in severe accidents, and this is all really confirming what has been already there a pretty long time.

Go to slide 12. Yes.

The severe accident water addition, this is the slide I think Steve Kraft and they were mentioning, the industry. We have that slide here.

This is where the deflection of the connection point is done, you know, what was very close to the line. It would be what was a flexible pipe originally under the FLEX system, FLEX strategies. It will be made a hard pipe, and it will be moved to a location where they may already have some shielding or where they may add some shielding, which is where the operators will have to go in and make the connection for a severe accident.

CHAIRMAN STETKAR: Let me ask, you don't have the slide out. So, I will take the opportunity. Bring the bottom back up again.

One of the changes to the Guidance, indeed, does include this issue of providing motive power to the valves that aren't shown as operated valves, but between the drywell wall and the reactor vessel there, whatever we are showing on the righthand side, the vertical gray thing there.

And the staff endorses this notion that we don't need to have power for at least eight hours to be able to make sure that we can maintain containment function. Did you think at all about this notion of the inability to get power to it until eight hours and how that might implicate the integrated response to these events? Or did you just look at this containment issue?

MR. RECKLEY: No, I think --

CHAIRMAN STETKAR: Because the staff reproduces it. This is one of the areas where it just doesn't say we endorse NEI 13-02. It explicitly reproduces all of that verbiage.

MR. RECKLEY: I think the way we look at it is back the way Randy was describing it, a slightly different characterization. The supporting work shows you have up to eight hours in order to accomplish some of these tasks. We never assumed that that was being taken as a permission to take up to eight hours, but if licensees were going to do an analysis, a time-sensitive analysis, to show how much time they had in order to accomplish all the tasks that they would have underway, some of these could take as long as eight hours, and you could still meet the success that was laid out for this.

But, again, it is a slightly different twist in that we would assume they are trying to do it as quickly as they can possibly do it. But, in prioritizing what they need to do in response, if that valve was up to eight hours, the conditions being such that they could still do the manipulation because of the environment, and so forth, that would be an acceptable approach as they laid out the timeline.

But, again, depending on how you want to go. We didn't look at it as a case where we were giving them permission to just wait around for eight hours. It was they had up to eight hours and they could still successfully meet the success criteria that was being laid out for the venting and SAWA operations.

CHAIRMAN STETKAR: Right. But not for saving the core?

MR. RECKLEY: No.

MR. KARIPINENI: The order was issued; you know, it was only for the vent. The water addition was not anywhere there in the order.

CHAIRMAN STETKAR: I understand that, but --

MR. RECKLEY: The SAMGs and other things would be pushing them to try to get that water in as quickly as they could possibly get it in. So, we are not with --

CHAIRMAN STETKAR: SAMGs are impending core damage; FLEX is to prevent core damage. FLEX doesn't get you into this situation.

I have already made the point.

MR. RECKLEY: Yes.

CHAIRMAN STETKAR: I just want to poll the staff whether you had thought in that kind of integrated manner or were you just simply thinking about your particular little part.

MR. RECKLEY: Well, the thought in this particular case -- and we thought this all along, even in the initial discussions -- that severe accident water addition would most likely build off of the FLEX. It did bind these things together. And again, we weren't surprised by that.

From the very beginning of the discussions, when we started to talk about severe accident water addition, the most logical way to do that was to build off of FLEX.

CHAIRMAN STETKAR: But, see, FLEX doesn't need to get the power back, either, because by definition for FLEX, my FSGs, that turbine-driven pump is running. Do you see my point?

MR. RECKLEY: A way to look at this, the way I look at this is that, when you are looking at Fukushima, you can say, but for the availability of a few extra tools, a few extra gallons of water, however you want to put it, that licensee stood a chance of saving those units.

And so, FLEX and this order as well is basically saying the NRC sees fit that licensees should give those operators a couple of extra tools to try to do those functions. And that is why FLEX is written the way it is, I mean the mitigating strategy order is written the way it is. That is why this order is written the way it is. It is driven towards give licensees a few extra tools to try to address failures that weren't originally foreseen or accounted for in setting up the design basis events.

And so, in both cases the expectation is that, as systems fail or are unavailable to them, licensees are going to go to this extra tool and try to use it in order to save the day.

If you are going to say how successful this capability is, you have to get into the analysis of the assumptions of how quickly they can set it up and what additional things might fail or what the human performance is going to be. And all of that is useful to say how much we are getting out of this extra capability. But, in the end, the requirements are for the capabilities to be added, and the assumption is it gives, again, the operators just another tool to try to use to save the day, either to save the containment in this case for the Mark Is or IIs or to save the core and the containment and the spent fuel pool in the case of the mitigating strategies order.

MEMBER CORRADINI: So, Bill, taking that discussion, then we would have to go look at the integration of this with SAMGs because, as industry suggested, once I leave the EOPs, if somehow we are having a bad day and I don't have AC power, and I don't have diesels that are starting, and I am on the road to damage, I would leave the EOPs and I would go into SAMGs.

MEMBER SCHULTZ: No, you go to FSGs.

CHAIRMAN STETKAR: No, that's not what they said.

MEMBER SCHULTZ: That's not what they said?

MR. AMWAY: No. When you leave the EOPs, you enter the SAMGs. The SAMGs may --

CHAIRMAN STETKAR: That is contrary to NEI's guidance that shows entry conditions to FSGs and triggers for EOPs.

MEMBER CORRADINI: So, I am asking the question for this clarification, because you said it one way, and I want to make sure I am not misinterpreting. So, what I heard you say, in another meeting you had pretty, little color charts this way. It is that EOPs send me to SAMGs, and then, all these things spiral off of that. Is that correct or incorrect?

MR. AMWAY: That's correct. There are supporting procedures for either the EOPs, if they are still in the EOPs, but once you leave the EOPs, enter the SAMGs, those same support procedures still exist.

MEMBER CORRADINI: Okay. So, my question goes like this: with your explanation/logic, one would expect the staff to say -- well, now I am putting words in your mouth, but that is what I am trying to get. I am trying to sneak it in, but let's just say it.

It would seem to me that you would look at the SAMGs to make sure that, if I had a very bad day, and if Plan A didn't work and we went to John's characterization of Plan B, there is a way to attack it, so that I would not lead myself into core damage. I would actually lead myself into mitigation strategy, that I have a Plan B, not just a Plan A.

MR. AMWAY: Yes, and if I could clarify that, in your SAMGs, across the top, you are constantly evaluating your actual conditions, such that, as you recover things, like in the example you get AC power back, and now I have my RHR systems available to me, you can go back and forth with those various SAMGs legs as conditions improve and back yourself up to conditions where you are in a better overall state for either the RPV or the containment.

VICE CHAIRMAN BLEY: That is something new, right?

MR. AMWAY: That's not new. That has always been in the SAMGs. When you get in the SAMGs and you look across the top of the SAMGs, the first question you come in, you know, are you above top of active fuel? You know, do I have enough to keep above top of active fuel? If the answer to that is yes, it gives you a defined set of actions. If the answer is no, can I stay above bottom of active fuel? Then, a yes or no, and there's a series of sequences.

You evaluate those conditions continually while you are in the SAMGs. Even though I may be in these FSGs for hooking up FLEX pumps, I still am required to constantly evaluate my current plant state and containment state and what's available, and I can change paths depending on what comes back to me.

MEMBER CORRADINI: Okay.

MR. BUNT: Additionally, for the FLEX

scenario, you still stay in your EOPs as your governance document and the FSGs are where you go get the tools to accomplish the EOP task. So, the EOP is still your governing document or the severe accident guidance are your governing documents, depending on where you are in the accident scenario. The others are just support procedures that give you the tools to cope with the symptoms that you are seeing in those two governing procedures.

MEMBER CORRADINI: So, you would make the claim that everything is integrated already? We just probably didn't catch it?

MR. BUNT: That is our intent, is to have everything all integrated when we are done with all these. And we are adding, as Bill mentioned, we are adding additional tools and capabilities to the operators to be able to cope with the various conditions that may apply.

And we have designed those tools using a certain set of assumptions to set up the design parameters to design them to. So, there is no intent to go use it at that particular application, depending on however the scenario applies. The symptoms of the plant will tell you when to apply that tool at the appropriate time. We are just ensuring that, if you followed the scenario that our analysis shows, that you would still be successful.

MEMBER CORRADINI: Okay. Thank you.

MR. KARIPINENI: Yes, I also want to add that the eight hours, I believe, actually, what they all looked at came from some of the SOARCA work that was done for us. I believe the RCIC was assumed to fail maybe within two hours or so in that particular case. And the remaining water in the vessel at that time will take you to eight hours, approximately, when the actual vessel melts, the core melt happens, and you are exiting the vessel. I think that is where it came from.

MEMBER CORRADINI: Okay.

MR. KARIPINENI: So, it was never meant to say that you have eight hours to provide water. It was only a scenario that they looked at. If RCIC did conk out in two hours, when does the core actually exit the vessel, and I think that is the time that actually came from.

You can correct me, if I am wrong in that. Correct me? It must be right.

MR. RECKLEY: Okay, that's fine.

MR. KARIPINENI: Okay, it's okay. It's okay.

I just wanted to say that because I was told when we looked at that, this is how the eight hours was looked at, but not necessarily, it doesn't mean that we are accepting that you can start working at eight hours or somewhere before eight hours. We always thought that the 049 strategies would take you to quickly get there to make some connections work.

MR. AMWAY: If I could just -- this is Phil Amway -- just to make a clarification. For that eight-hour sequence of events, RCIC never operates.

MR. KARIPINENI: RCIC never operates? Okay.

CHAIRMAN STETKAR: That's my whole point, that if RCIC fails -- and I know how you got to the eight hours -- if RCIC fails at T-zero, you say, I've got up to eight hours to save the containment. I'm an operator. RCIC fails at T-zero. I would really like to try to save the core. I would like to get pressure down and I would like to get water in there. If I have got a couple of series of AC motor-operated valves that are closed, I would really like to get those suckers open sometime between T-zero and less than eight hours.

MR. RECKLEY: We don't really see the gap because we think that SAMGs are going to be telling the operators to do exactly that.

MEMBER SCHULTZ: But what is being discussed here is the potential of different types of design changes and additional equipment that can be provided, hard-piped in, that will protect the core, if the core melts. And I have got eight hours to provide that capability. Is there a slight change that one could make to that design change in equipment to --

CHAIRMAN STETKAR: Poor storage --

MEMBER SCHULTZ: -- get the water in earlier and save the core?

CHAIRMAN STETKAR: I will take you back to my flood plain that is 2 feet above the river, and your FLEX equipment location strategy is to put the shed up in the hills. You have got the portable generators with the plug-in things that you can get power to open my two little valves with. But it is up in the hills because that was the most expedient place and I don't need it for hours. And I don't need it for eight hours because the only reason I need power to those valves is for this particular function. That is the kind of thing I am worried about.

MR. BUNT: This is Randy Bunt again.

I think we have heard you here. We have

got some information. If we put something in the Guidance, in our programmatic element or back in the general one, that basically says: ensure procedures and designs consider early deployment of equipment to facilitate expedited water addition and repowering, such that no unnecessary delays are done, so that you can address the accident response, that is what I am hearing you saying.

So, we want to make sure that people are thinking about not putting delays in and not putting things in that, even though I am allowed eight hours, that I am not going to utilize that eight hours if I don't have to.

CHAIRMAN STETKAR: How you do it is -- the point I am trying to make is that we are not getting too pigeonholed --

MR. BUNT: Right.

CHAIRMAN STETKAR: -- into each one of these functions --

MR. BUNT: Right.

CHAIRMAN STETKAR: -- and losing the big picture.

MR. BUNT: Right.

CHAIRMAN STETKAR: Because we do have people making decisions about how were we going to protect that equipment --

MR. BUNT: Right.

CHAIRMAN STETKAR: -- what equipment do we need, how are we going to protect it if we have got equipment, for the entire variety of challenges, hazards, floods, seismic events, and things like that.

MR. BUNT: Right.

CHAIRMAN STETKAR: And all of those decisions are actually integrated in my little example about where do you put the shed --

MR. BUNT: Right.

CHAIRMAN STETKAR: -- as some criteria.

MR. BUNT: So, we could add some guidance that gives some enhancements to make sure people consider that they don't create anything that creates an unnecessary burden when they are doing that.

CHAIRMAN STETKAR: And I am just trying to challenge the little bits, you know, the various players here to say how much has the industry been talking when you developed the various guidance documents and how much has the staff been thinking as they develop the different -- whether it is a Draft Guidance for the beyond-design-basis rulemaking or whether it is this particular Interim Staff Guidance for venting requirements for these levels.

MR. RECKLEY: And that is a good point. I think we have talked and we have interfaces between all of this.

But I also don't want to leave the impression too much that we don't -- because of the way these regulations and orders and specific regulatory actions are set up, that there is not some lines that we're not likely to cross because we can.

And I will give you the example that in this particular case, severe accident water addition is being set up as a containment function, right? We are saying there is a preference for it to go into the reactor vessel and you get this preference, but it is a preference, because the requirement we are under is that it is a containment function. And therefore, if a licensee were to choose to put it to the drywell, that is okay with this action.

CHAIRMAN STETKAR: Right.

MR. RECKLEY: So, just what we are trying to do, but there are constraints based on what order and what the order was intended to do.

CHAIRMAN STETKAR: Yes, I got it.

MR. RECKLEY: Okay?

CHAIRMAN STETKAR: Thanks.

MR. KARIPINENI: Slide 14.

Method 2 is where you have a drywell vent, like I said before, and, of course, this severe accident water addition. What you have seen in the Guidance the last time we had the meeting, that is when the discussions were going on, what functional requirements apply to the severe accident water addition.

Initially, there were some differences. Some of it is just a pure strategy that doesn't require any NRC review. Or does it require some NRC review? And we are finally all agreed that there are some functional requirements for a SAWA that need to be addressed under this order and guidance. And the sections were properly revised to include what those functional requirements are for a SAWA. At this point, we don't have any more questions or disagreements between the Guidance and what NRC thinks it should be.

Water management. We will preserve the wetwell vent. Basically, if it preserves the wetwell vent for the entire seven-day sustained period of operation, it is like you do have a vent; you have a vent. So, you can almost say it meets the basic Guidance because you do have a severe accident wetwell vent for the entire seven days in a sense. So, that is the greatest option.

The second option would be preservation about three days and below seven days, in that period of time. You heard about the discussion with the industry, and we also thought a little bit about that part. Is it reasonable to allow them not to make any modifications? But the intent there is, if a licensee could preserve it for more than seven days, is it a reasonable amount of time for him to do whatever is necessary to put the alternate heat removal system in place?

And they would provide some functional requirements, descriptions, and what the system is. That is when the staff would determine, yes, it looks reasonable; they can do this. It is not like a real design that you have to look in how each hour is going there. It is like a very broad sense review that you would do.

When it comes to below three days operation is when they elevated that a little bit and said we will actually have some connections made to reduce the work that will be needed to put the heat removal system in place, and we are comfortable with that, too. And that is where we are. At this point, we don't have any further issues left to be resolved.

MEMBER REMPE: I have a question about some of the information added to Appendix C. I know earlier industry mentioned that they were looking at the instrumentation, and the water level in the wetwell is clearly important, and they are looking at it for dose. They said it is going to be bounded by design basis accident conditions, which is what Reg Guide 1.97 requires.

What about the initiating events? What if it is a beyond-design-basis earthquake, for example, or something? Is that not going to affect the validity of that water level to function?

MR. KARIPINENI: These are the instruments that are, basically, already safe. They have looked at for their seismic --

MEMBER REMPE: But if it is a beyond-design-basis accident?

MR. KARIPINENI: Well, when you say if it is a beyond-design-basis seismic part of it, that is being handled separately within this seismic, et cetera. The plants have been looking at, they have to look at the higher capability than what they have. And that is going on concurrently. If there is a need for that to be done for a particular plant, licensees will do that. It is how we resolve it in Phase 1.

MEMBER REMPE: Okay. So, even though this is a beyond-design-basis accident situation, you are going to just go with what is in the design basis for the qualification of the equipment?

MEMBER BROWN: At this point.

MR. KARIPINENI: At this point. At this point, yes.

MEMBER BROWN: But a separate seismic evaluation is going to be done to determine --

MR. KARIPINENI: Yes, they will be doing it.

MEMBER BROWN: -- if anything additional needs to be done. Is that --

MR. KARIPINENI: That's correct.

MEMBER RICCARDELLA: But that is kind of an overall plant PRA type of seismic evaluation. It is not clear that it is going to cover qualification of this --

MR. RECKLEY: But they will look at the fragility of individual components and instruments.

MEMBER REMPE: But the result will be something that is within the design basis? You would qualify the design basis or you are going to go to beyond-design basis --

MR. KARIPINENI: The newly-defined

hazards, I think.

MR. RECKLEY: But they will look at the new spectrum, the high-frequency changes. That is one of the areas that changes the most. And so, it will be looked at in that context.

MR. KARIPINENI: But it is not looked at right now for this Guidance is what we are saying.

CHAIRMAN STETKAR: We are still working out what is robust with respect to what the evaluated seismic hazard means quantitatively.

MEMBER REMPE: But I guess right now we don't require people to go beyond design basis. So, even if you put it in the design basis, if this is a beyond-design-basis --

CHAIRMAN STETKAR: People are still working out what "robust" with respect to the reevaluated seismic hazard means.

MEMBER SCHULTZ: For this order.

MR. KARIPINENI: We have, from the last meeting, we followed up. That Technical Analysis was provided to the ACRS.

We have already discussed the programmatic controls and the corrective actions and the surveillance frequencies from the industry.

The revised Guidance for that part of it only came in like the day before yesterday. We have one small, minor issue that we think we can easily resolve with them, and I don't see the need to bring it up here, unless you all want to.

Remaining exceptions and qualifications in the document are pretty consistent with what we did in Phase 1, but we are not specifically endorsing EOPs/SAMGs of this Guidance.

The reference to the EPRI Technical Report that the Subcommittee has asked for, you know, the Summary Report will not be ready until the end of April. I believe the Final Report would not be available until October or so, is what we were told. And if you want to see it, it can be made available to you. Most possibly, it may be put in ADAMS also; we don't know.

Appendix A, Glossary of Terms, we have an exception there, basically, talking about how certain terms used in the Guidance are not consistent in the regulatory part of the NRC work. And we just wanted to make sure that people understand that. And therefore, there was an exception there regarding that.

MEMBER SCHULTZ: It looked like there were changes made to try to correct that. It didn't go far enough? The changes did not go far enough?

MR. KARIPINENI: Well, I think they look okay right now. There may be one more little tidbit we wanted to see. But, yes, as far as it seems like the depressurization of the vessel, et cetera, that were discussed, it is a good thing, you know, to make this --

MEMBER SCHULTZ: It seems it would be good to make sure that, in fact --

MR. KARIPINENI: Yes, we will make sure of that.

MEMBER SCHULTZ: -- we do get to the point where it is clear.

MR. KARIPINENI: Right.

MR. RECKLEY: But this is an exception we even had in Phase 1. The distinction is, just whenever you have a glossary for one report, the staff, unless we are going to spend a lot of time to make sure there's consistency across every regulatory arena, we just put in the exception to say the definitions are good for this report, but we don't want it to be taken outside of the context of this report.

MEMBER SCHULTZ: I understand, yes.

MR. KARIPINENI: That's the end of my

presentation. Any questions?

MEMBER SCHULTZ: Are there questions from the staff? John? Oh, I see where you are pointing.

(Laughter.)

At this time, I would like to ask for public comments. We will open the phone line. But are there any members of the public who would like to make a comment to the Committee at this point.

(No response.)

We hear none from the room.

I think the phone line is open, but we find out whether anyone is listening-in by asking someone to say "hello". Is anyone there? I hear someone speaking.

Is there any member of the public who would like to make a comment for the benefit of the Committee? If so, please state your name and make the comment.

(No response.)

Hearing none, I will close the public comment session.

I want to thank the staff and the industry for the presentations this morning, and then, turn it back over to you, John.

CHAIRMAN STETKAR: Thanks, Steven.

Again, I would also like to thank the industry and the staff. This is obviously part of a really complex topic, and it is finally coming together, which is why I think you hear a lot more of focused questions from us. We appreciate all of the effort that everyone has put in there.

With that, we are, in fact, adjourned.

(Whereupon, at 12:51 p.m., the meeting was adjourned.)

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Advisory Committee on Reactor Safeguards

Mark I and Mark II BWRs
Containment Venting Systems Guidance
for Phase 2 of Order EA-13-109
and ISG JLD-ISG-2015-01 (Revised NEI-13-02)
April 10, 2015

Japan Lessons Learned

Order EA-13-109 Background

- EA-12-050
  - Issued March 12, 2012 requiring reliable hardened containment vents for boiling water reactors (BWRs) with Mark I and II containments
- SECY-12-0157
  - Response to Commission direction to provide analyses to inform a decision on whether filtered vents should be required
  - SRM directed modification of EA-12-050 to require venting system remain functional under severe accident conditions and consider additional requirements using rulemaking process
- Order EA-13-109
  - Issued June 6, 2013
- Containment Protection and Release Reduction Rulemaking

Order EA-13-109 Background

- Phased approach to minimize delays in implementing the requirements originally imposed by EA-12-050.

<u>Phase 1</u>

Upgrade venting capabilities from the containment wetwell to provide reliable, severe accident capable hardened vents to assist in preventing core damage and, if necessary, to provide venting capability during severe accident conditions (JLD-ISG-2013-02).

<u>Phase 2</u>

Additional protections for severe accident conditions through installation of a reliable, severe accident capable drywell vent system or the development of a reliable containment venting strategy that makes it unlikely that a licensee would need to vent from the containment drywell during severe accident conditions

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Order EA-13-109
Phase 2 ISG Schedule

- Public and industry interactions – August 2014 to March 2015
  - 6 public meetings/webinars
- Draft ISG issued for public comment – March 10, 2015
- ACRS subcommittee meeting – March 20, 2015
- Public comment period ended – April 9, 2015
- ACRS full committee meeting – April 10, 2015
- Phase 2 ISG issued – April 30, 2015
- Phase 2 Overall Integrated Plan Submittals – Dec 31, 2015

Order EA-13-109
Phase 2

- Revisions to Industry Guidance Document
  - NEI-13-02, Rev. 0F4
- Draft Interim Staff Guidance JLD-ISG-2015-01
  - Three Methods of Compliance Identified
    1) Severe accident capable drywell vent with no provision for water addition
    2) Severe accident capable drywell vent with severe accident water addition (SAWA)
    3) SAWA with severe accident water management (SAWM) to prevent loss of wetwell vent obviating need for severe accident capable drywell vent

Order EA-13-109 Revisions to NEI-13-02

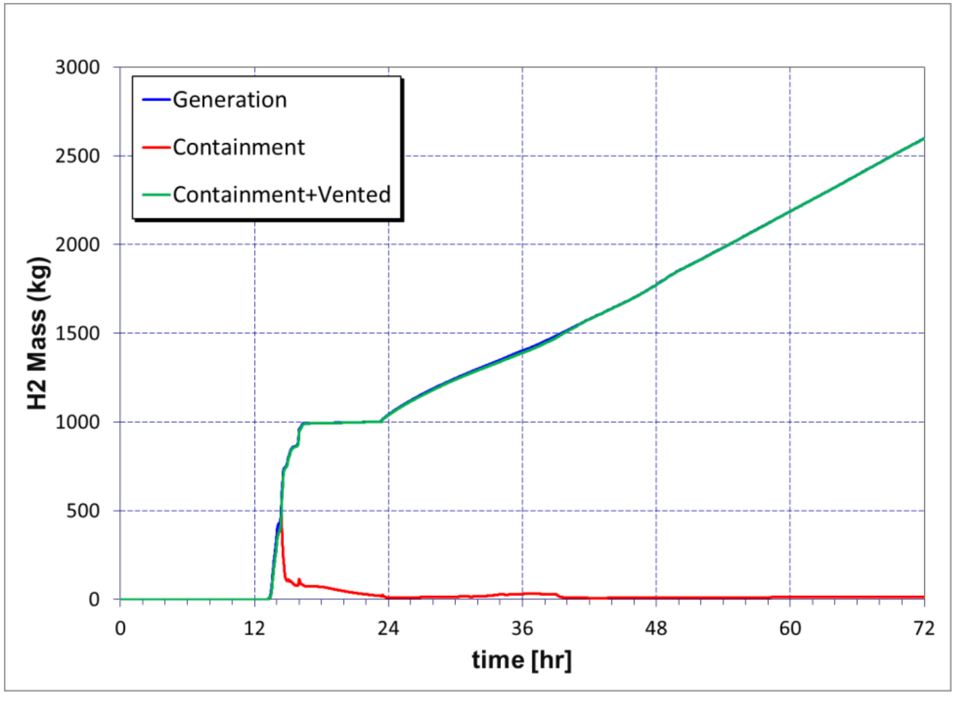
- Updates
  - Flammable Gases (App H & HCVS-WP-03)
  - Evaluation of Doses and Source Terms (APP F & G, HCVS-WP-02)
  - Appendix A (Glossary of Terms)
  - Instrumentation Capabilities

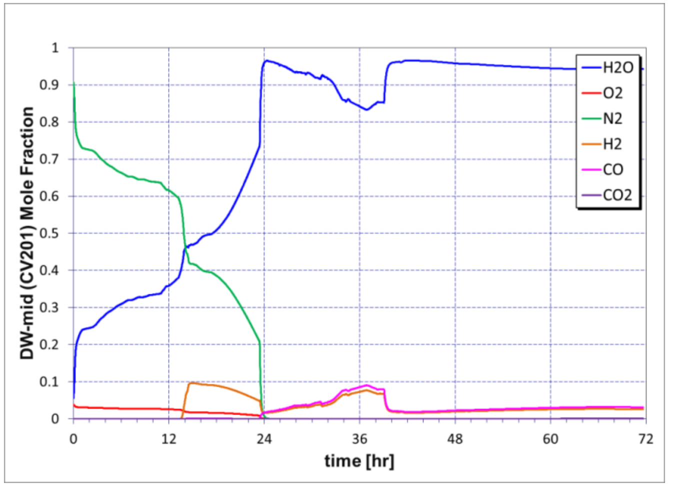
- Phase 2 Focus
  - Severe accident water addition (SAWA)
    - Appendix I
  - Severe accident water management (SAWM)
    - Appendix C

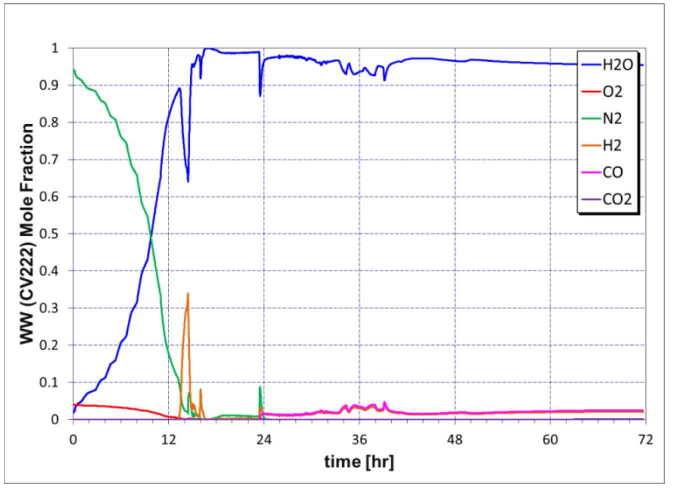
Combustible Gas Control

- Order EA-13-109
  - The HCVS shall be designed and operated to ensure the flammability limits of gases passing through the system are not reached; otherwise, the system shall be designed to withstand dynamic loading resulting from hydrogen deflagration and detonation.
  - The HCVS shall be designed to minimize the potential for hydrogen gas migration and ingress into the reactor building or other buildings.
- Related guidance is provided in Appendix H to NEI 13-02 and White Paper HCVS-WP-03, "Hydrogen/Carbon Monoxide Control Measures"
- Further evaluation of possible measures to address hydrogen control and mitigation inside containments or other buildings to be addressed under separate Tier 3 item (Recommendation 6)

Hydrogen Generation and Transport







Mark I Hydrogen Generation and Transport for SAWA

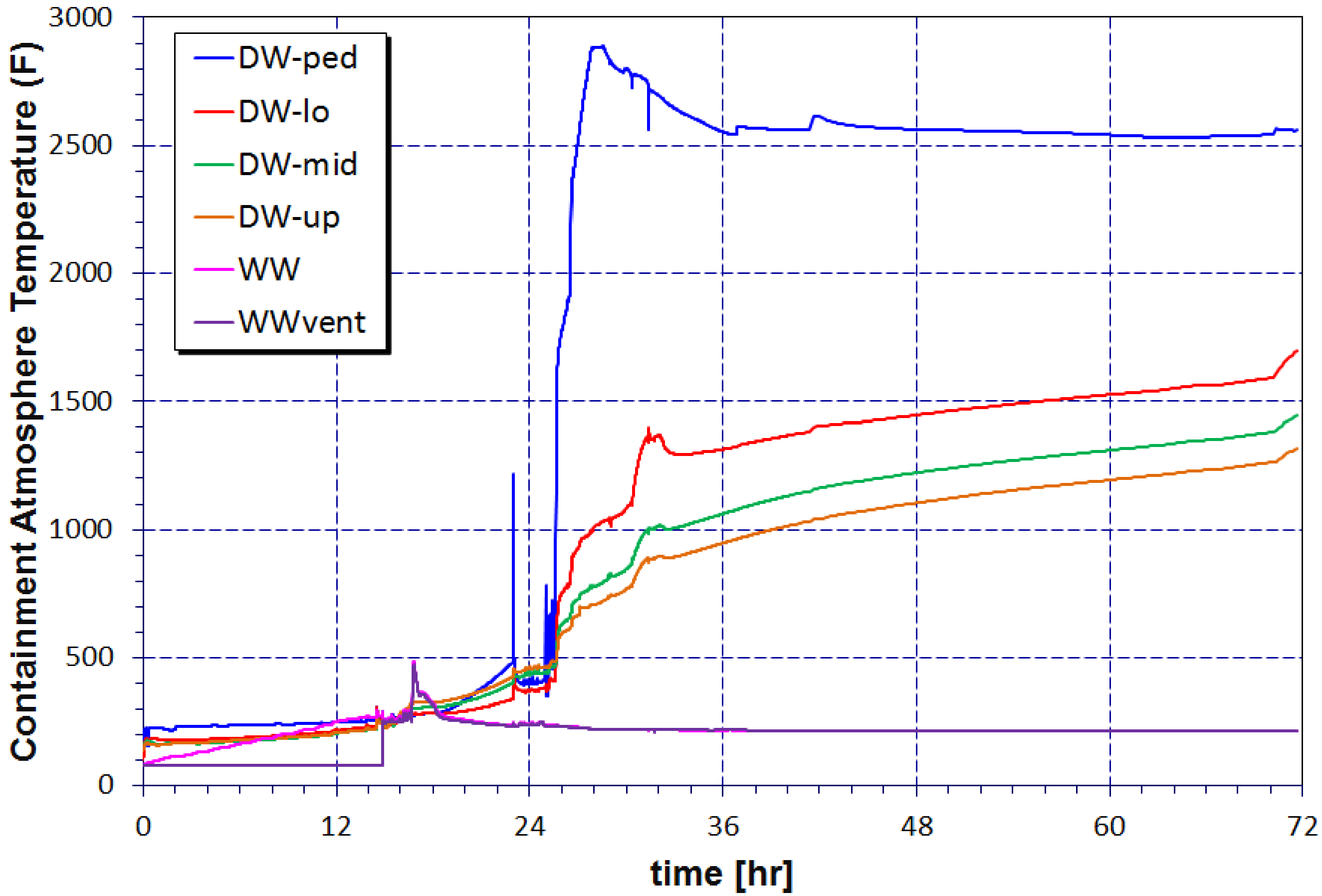
Japan Lessons Learned

INTERIM STAFF GUIDANCE JLD-ISG-2015-01

<u>Method 1</u>

- Severe accident drywell vent (SADV) with no provisions for water addition
  - drywell temperatures could exceed 1000°F
- No guidance provided in NEI 13-02, Rev. 0F4. Plant specific analysis by individual licensees is required
- JLD-ISG-2015-01 cautions that approach could conflict with potential requirements in CPRR rulemaking; also raises possible concerns with increased release of hydrogen into reactor building
- Plan to reinforce challenges posed by this method during workshops and other interactions

Evaluation of Drywell Temperatures



Mark I Containment Gas Temperature with no water addition

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

INTERIM STAFF GUIDANCE JLD-ISG-2015-01

Method 2

- Severe accident drywell vent (SADV)
- Additional provisions for severe accident water addition (SAWA)
  - Limits drywell temperatures to justify 545°F design specification
- Hybrid approach to implementing Order involving a strategy for SAWA but includes SADV (545°F design specification) for pressure control following loss of the wetwell vent
- Guidance provided in Appendix I to NEI-13-02 (Draft 0F4)

Severe Accident Water Addition

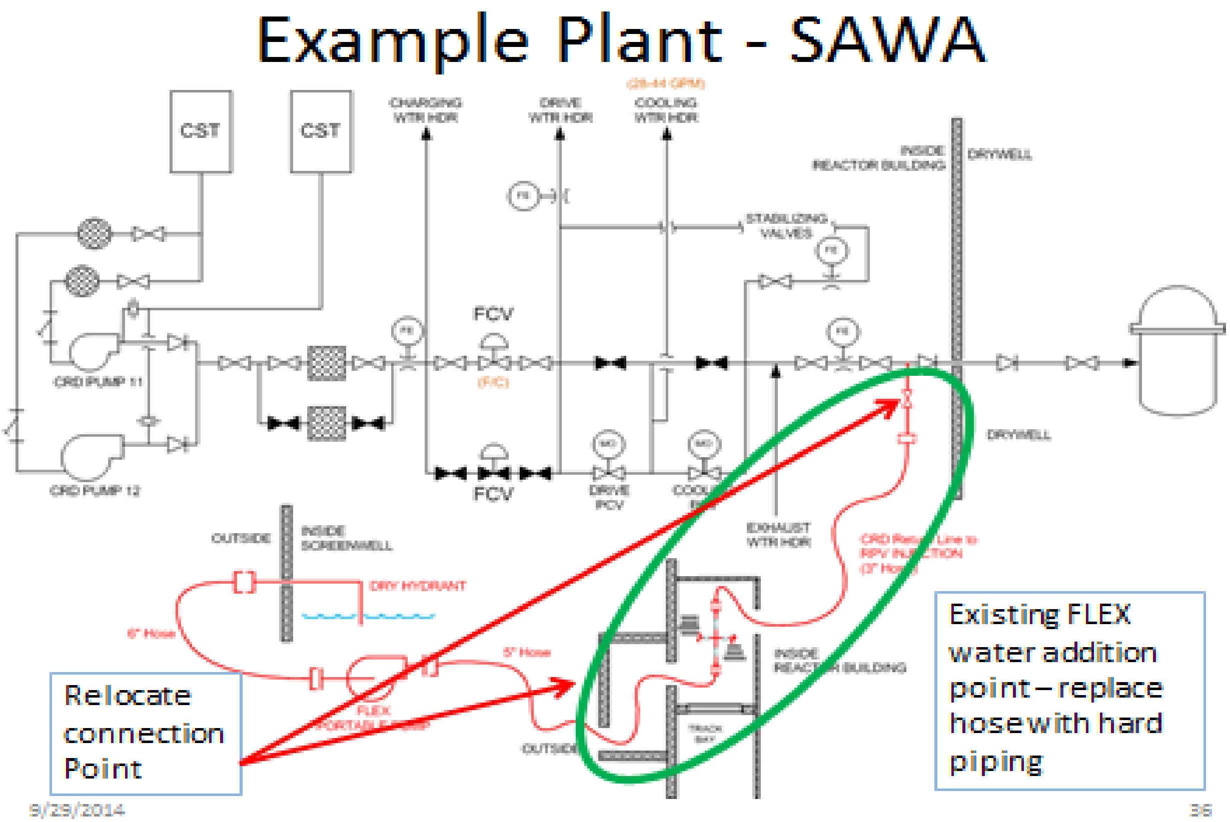
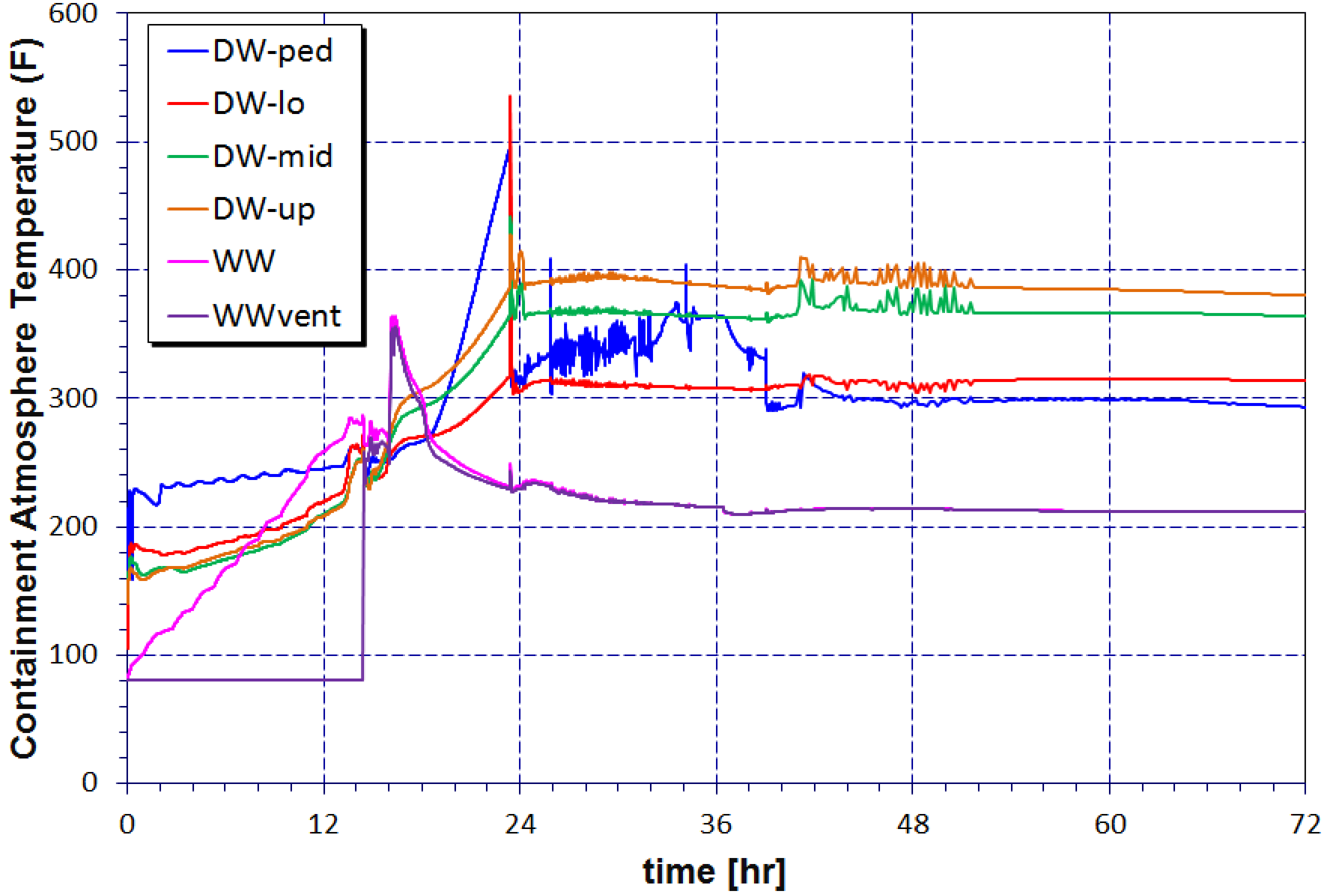


Figure from NEI 13-02 (Draft 0F4)

Evaluation of Drywell Temperatures



Mark I Containment Gas Temperature with water addition

(SAWA/SAWM - SAWA only shows similar behavior/temperatures)

INTERIM STAFF GUIDANCE JLD-ISG-2015-01

Resolution of Issues in Draft ISG – Method 2

- Issues in Draft ISG
  - Clarify functional requirements for SAWA provisions

- Resolution: Industry added discussion to NEI 13-02, Rev. 0F4 regarding functional requirements for SAWA to address time sensitive actions and equipment capabilities
  - Section 4, “Design Considerations”
  - Section 5, “Programmatic Controls”
  - Section 6, “Operational Considerations”
  - Appendix I, “Severe Accident Water Addition (SAWA)”

- Issues in final ISG
  - None

INTERIM STAFF GUIDANCE JLD-ISG-2015-01

Method 3

- Additional provisions for severe accident water management (SAWM)
  - Sustained operations using severe accident wetwell vent and/or alternate reliable heat removal capabilities

- Guidance provided in Appendix C to NEI-13-02, Rev. 0F4

INTERIM STAFF GUIDANCE JLD-ISG-2015-01

Resolution of Issues in Draft ISG – Method 3

- Issues in Draft ISG
  - Clarify functional requirements for various SAWM approaches and coping times
- Resolution: Industry added discussion to NEI 13-02 regarding functional requirements for SAWM to address:
  - Sustained Operations (> 7 days) With Wetwell Vent
  - Sustained Operations (> 7 days) With Wetwell Vent for > 3 days with functional level description of alternate heat removal capabilities
  - Sustained Operations (> 7 days) With Wetwell Vent for < 3 days with detailed description of alternate heat removal capabilities
- Issues in final ISG
  - None

INTERIM STAFF GUIDANCE JLD-ISG-2015-01

Subcommittee Meeting Issues/Follow-up

- Supporting analyses (MELCOR, EPRI)
    - Draft Technical Analysis Provided
- Programmatic Controls (Corrective Actions)
    - Revised NEI 13-02 to clarify programmatic controls
- Surveillance Frequencies
    - Revised surveillance table to resolve staff questions

INTERIM STAFF GUIDANCE JLD-ISG-2015-01

<u>Remaining Exceptions and Clarifications</u>

- Did Not Review/Approve :
  - EOPs/SAMGs
  - References in NEI 13-02, Rev. 0F4
    - Including Reference 27 (EPRI Technical Report)
  - Appendix A – Glossary of Terms

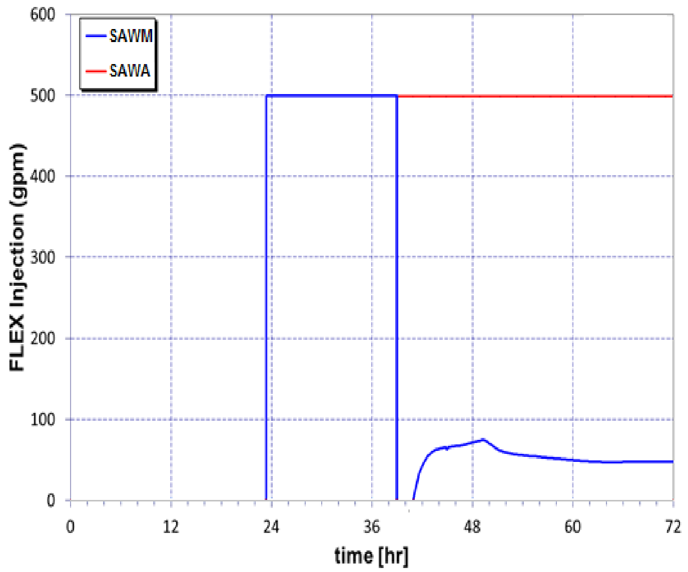
Questions & Discussion

BACKUPS

MELCOR Results for Mark I

(Timing of key events for selected scenarios)

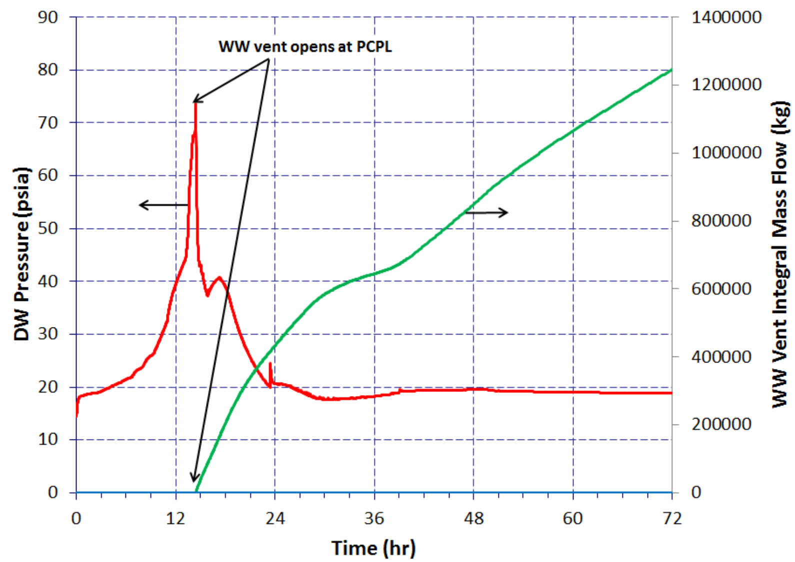
Event Timing (hr)	Case 1 (no water)	Case 9 (SAWM)	Case 10 (SAWA)
Start of ELAP	0.0	0.0	0.0
Operators first open SRV to control pressure	0.17	0.17	0.17
Low-level 2 and RCIC actuation signal	0.18	0.18	0.18
Operators open SRV to control pressure (200-400 psig)	1.0	1.0	1.0
RCIC flow terminates	9.6	9.6	9.6
SRV sticks open or operators open SRV after RCIC fails	16.0	9.6	16.0
Water level reaches TAF	12.4	11.9	11.9
First hydrogen production	13.7	13.2	13.7
First fuel cladding gap release	13.7	13.2	13.7
Start of containment venting at 60 psig	14.9	14.4	16.3
Relocation of core debris to lower plenum	15.6	15.5	15.5
RPV lower head dries out	18.1	18.2	18.9
RPV lower head fails	23.0	23.4	23.1
Drywell head flange leakage	27.1	-	-
Hydrogen burn in reactor building refueling bay	28.8	-	-
Drywell liner melt-through	31.4	-	-
Calculation terminated	72	72	72
Selected MELCOR Results	**Case 1**	**Case 9**	**Case 10**
Debris mass ejected (kg)	292,000	280,000	287,000
In-vessel hydrogen generated (kg)	1,195	1,032	1,232
Iodine release fraction at 72 hr	2.28E-01	7.86E-02	8.10E-02
Cesium release fraction at 72 hr	1.94E-02	6.12E-03	7.26E-03

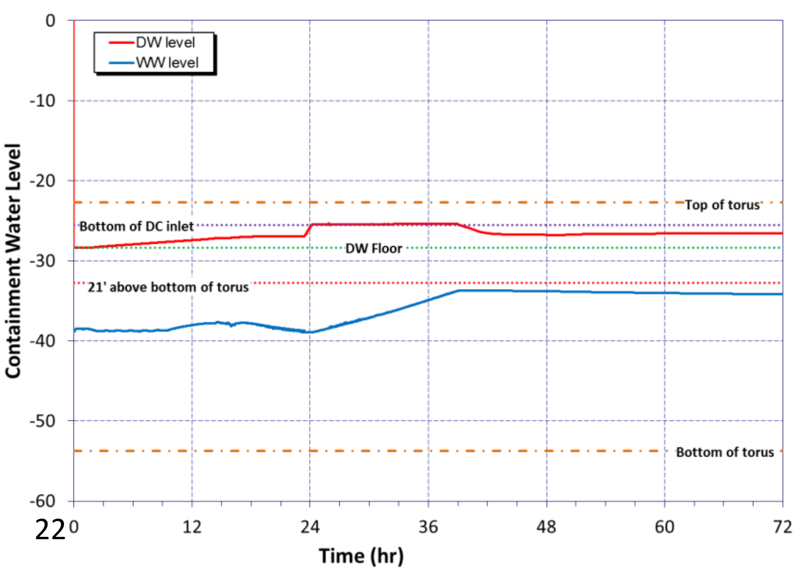


MELCOR Results for Mark I

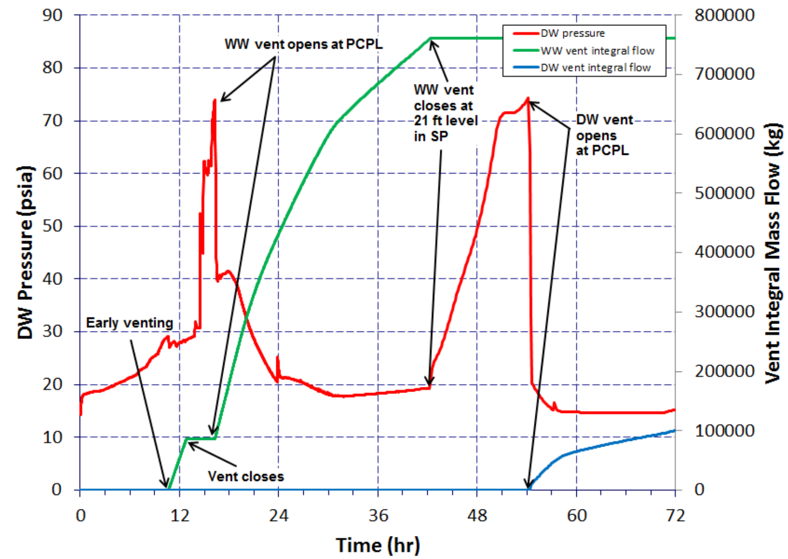
(containment pressure & water level)

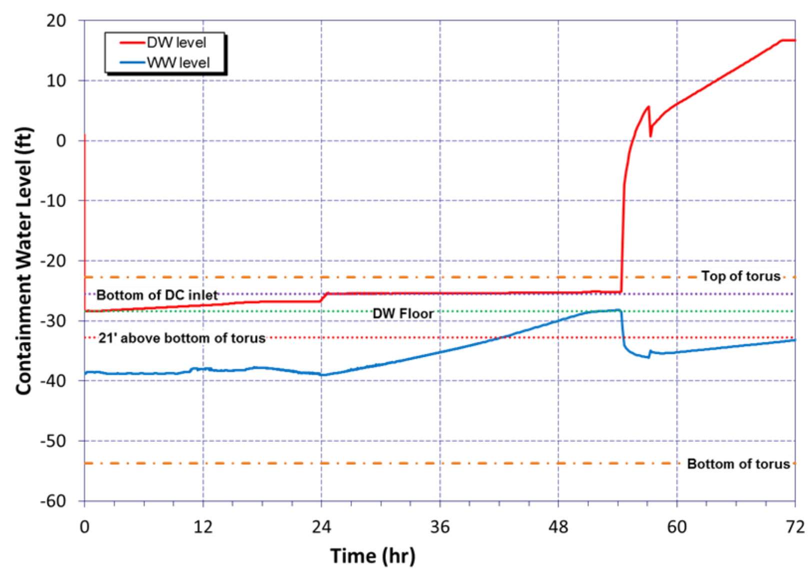
Case 9: SAWM





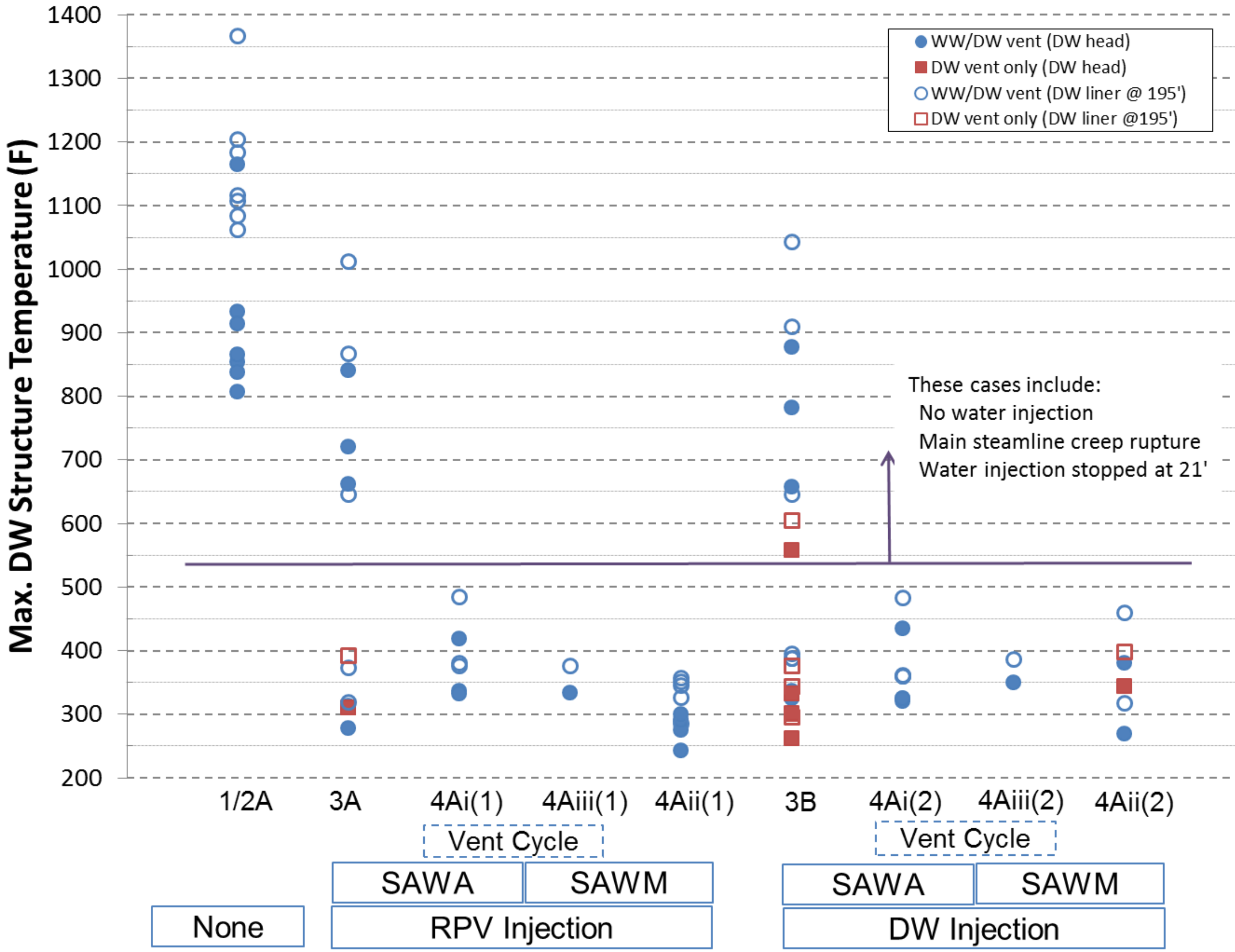
Case 10: SAWA





MELCOR Results for Mark I

(containment structure temperature)



Testing and Inspection Requirements

Description	Frequency
Cycle the HCVS and installed SAWA valves[1] and the interfacing system boundary valves not used to maintain containment integrity during Mode 1, 2 and 3 ~~unit operations~~. For HCVS valves, this test may be performed concurrently with the control logic test described below.	Once per every[2] operating cycle
Cycle the HCVS and installed SAWA check valves not used to maintain containment integrity during unit operations[3]	Once per every other[4] operating cycle
Perform visual inspections and a walkdown of HCVS and installed SAWA components.	Once per operating cycle
Functionally test the HCVS radiation monitors.	Once per operating cycle
Leak test the HCVS.	(1) Prior to first declaring the system functional; (2) Once every three operating cycles thereafter; and, (3) After restoration of any breach of system boundary within buildings.
Validate the HCVS operating procedures by conducting an open/close test of the HCVS control function ~~logic~~ from its control location ~~panel~~ and ensuring that all HCVS vent path and interfacing system boundary valves[5] move to their proper (intended) positions.	Once per every other operating cycle

~~* Not required for HCVS and SAWA check valves if integrity of check function is demonstrated every 4 cycles~~

[1] Not required for HCVS and SAWA check valves.
[2] After two consecutive successful performances, the frequency may be increased to a maximum of once per every other operating cycle.
[3] Not required if integrity of check function (open and closed) is demonstrated by other plant testing requirements.
[4] After two consecutive successful performances, the frequency may be increased by one operating cycle to a maximum of once per every fourth operating cycle.
[5] Interfacing system boundary valves that are normally closed and fail closed under ELAP conditions (loss of power and/or air) do not require control function testing under this section. Performing existing plant design basis function testing or system operation that reposition the valve(s) to the HCVS required position will meet this requirement without the need for additional testing.

NEI 13-02 Rev 1
Industry Guidance to Implement
EA-13-109

Advisory Committee on Reactor Safeguards

Full Committee Meeting

April 10, 2015

BWR OWNERS' GROUP

NUCLEAR ENERGY INSTITUTE

General Characterization

- Revised NEI 13-02 to include Phase 2 guidance
  - Industry is working toward common design elements for implementation of the order
  - Final version will be informed by ACRS insights
  - Expect limited exceptions and clarifications in final ISG
- Phased implementation
  - Phase 1 - Vent capability from wetwell
  - Phase 2 - Vent capability from drywell or alternate venting strategy

Order Functional Requirements

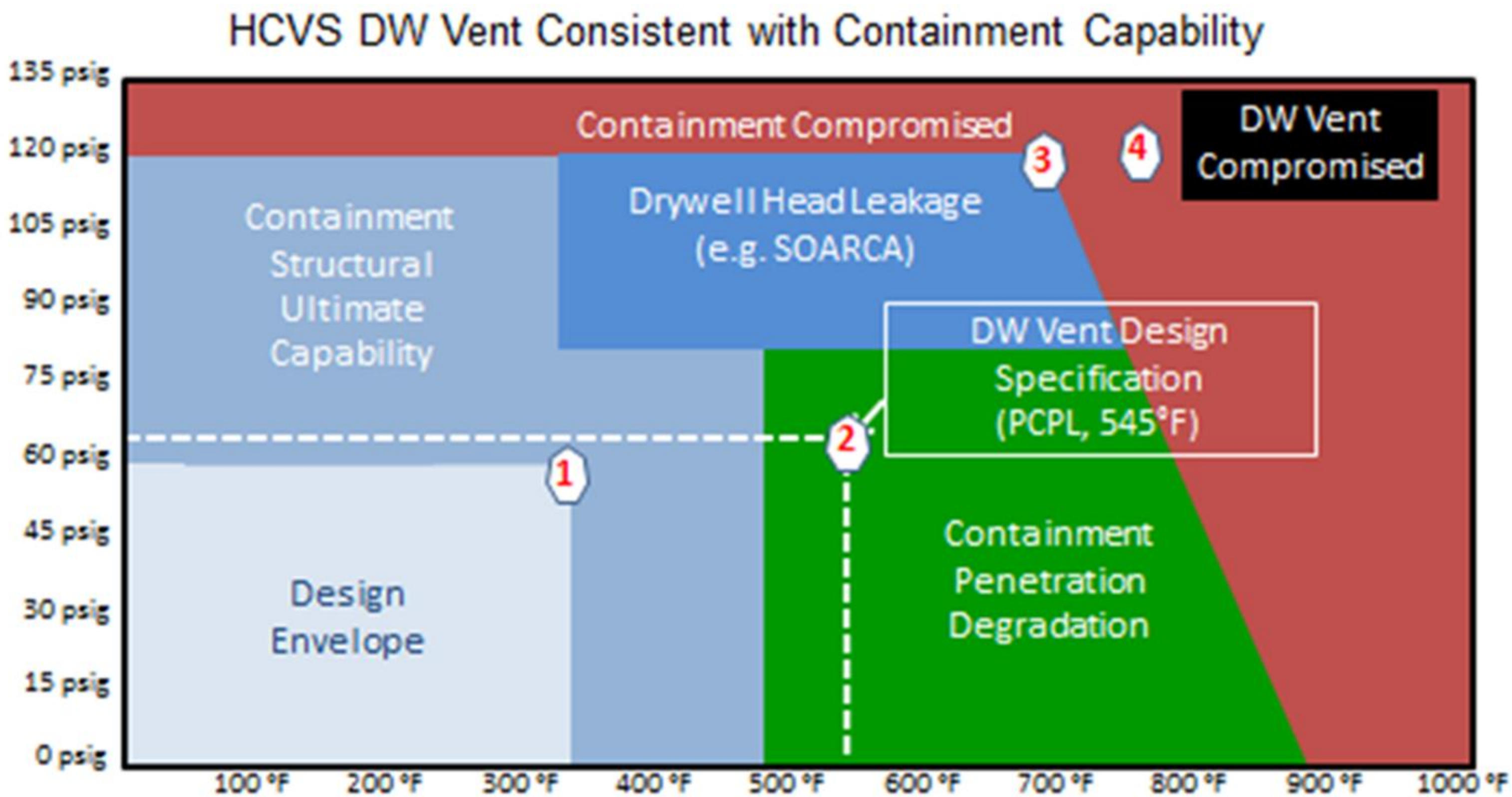
- Limit containment pressure
- Control the use of common systems within and between units
- Vent usage with ELAP and severe accident conditions

Phase 1 Topics

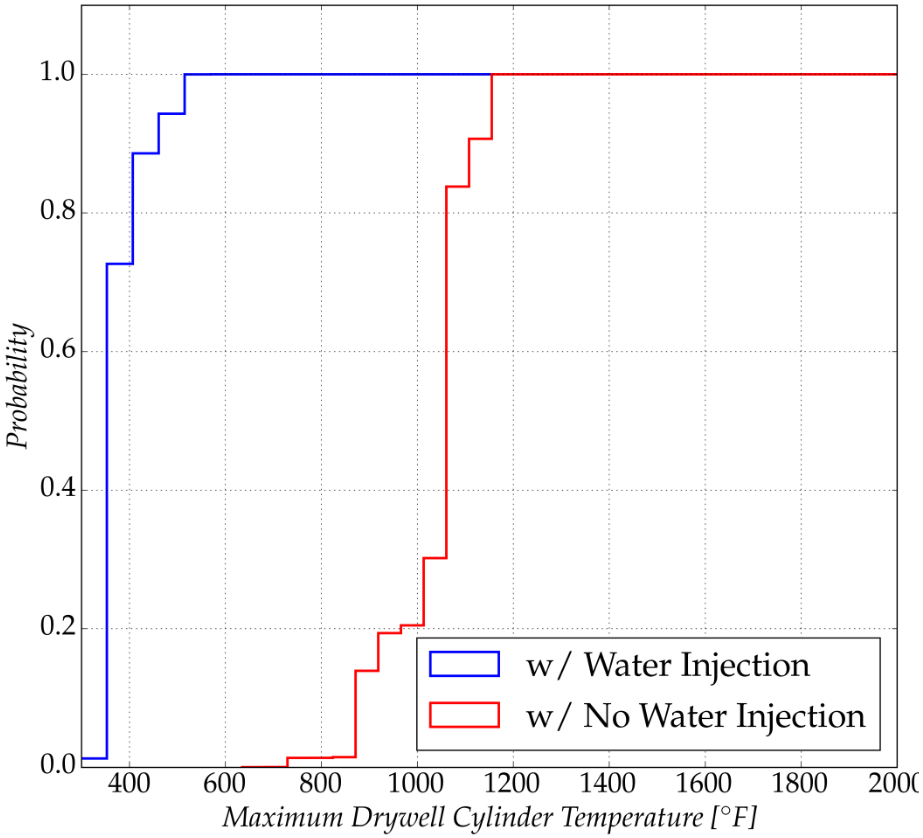
- Combustible gas control addressed by HCVS-WP-03 and NEI 13-02 Appendix H (ML14302A066/ ML15040A038)
  - Analysis shows combustible gases are vented as part of the SAWM strategy within 24 hours
- Accessibility due to radiation – resolved by endorsed HCVS-WP-02 (ML14358A038/ML14358A040)
  - Method for calculating integrated dose for HCVS equipment qualification
  - Method for determining dose rates from HCVS piping during venting for assessment of operator action feasibility

Phase 1 and 2 Topic

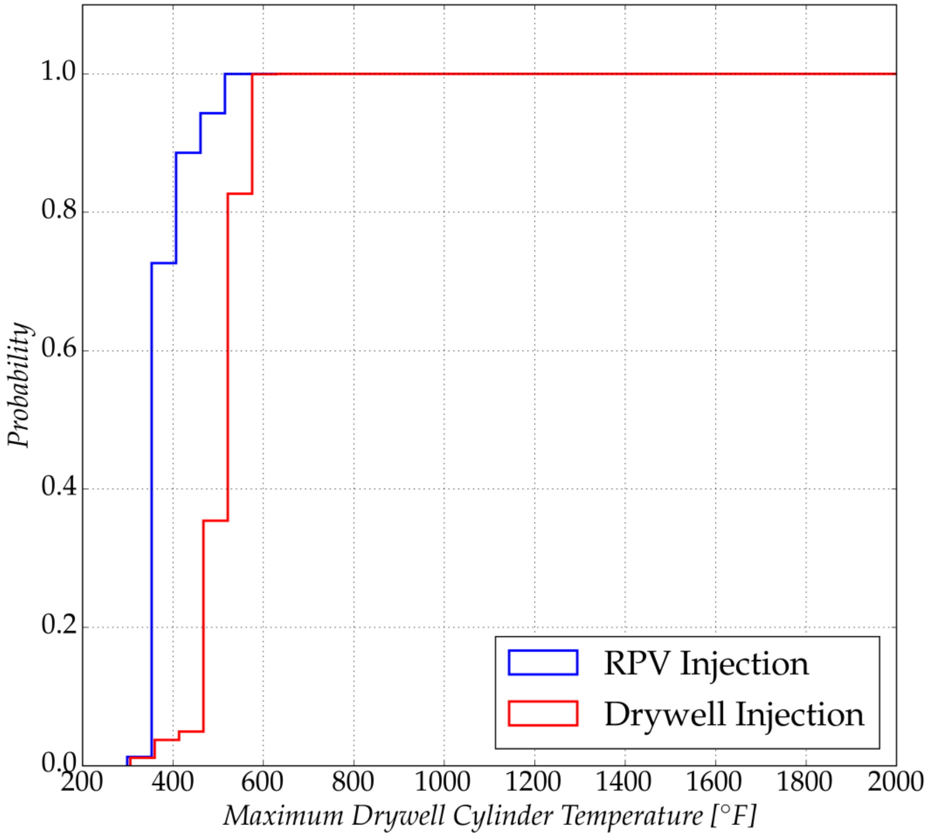
- Drywell vent design temperature of 545°F is confirmed by analysis if water addition is included



Phase 1 and 2 Topic



Probability that the Maximum Drywell Gas Temperature is below the indicated value under Various Severe Accident Sequences, Water Addition vs. No Water Addition



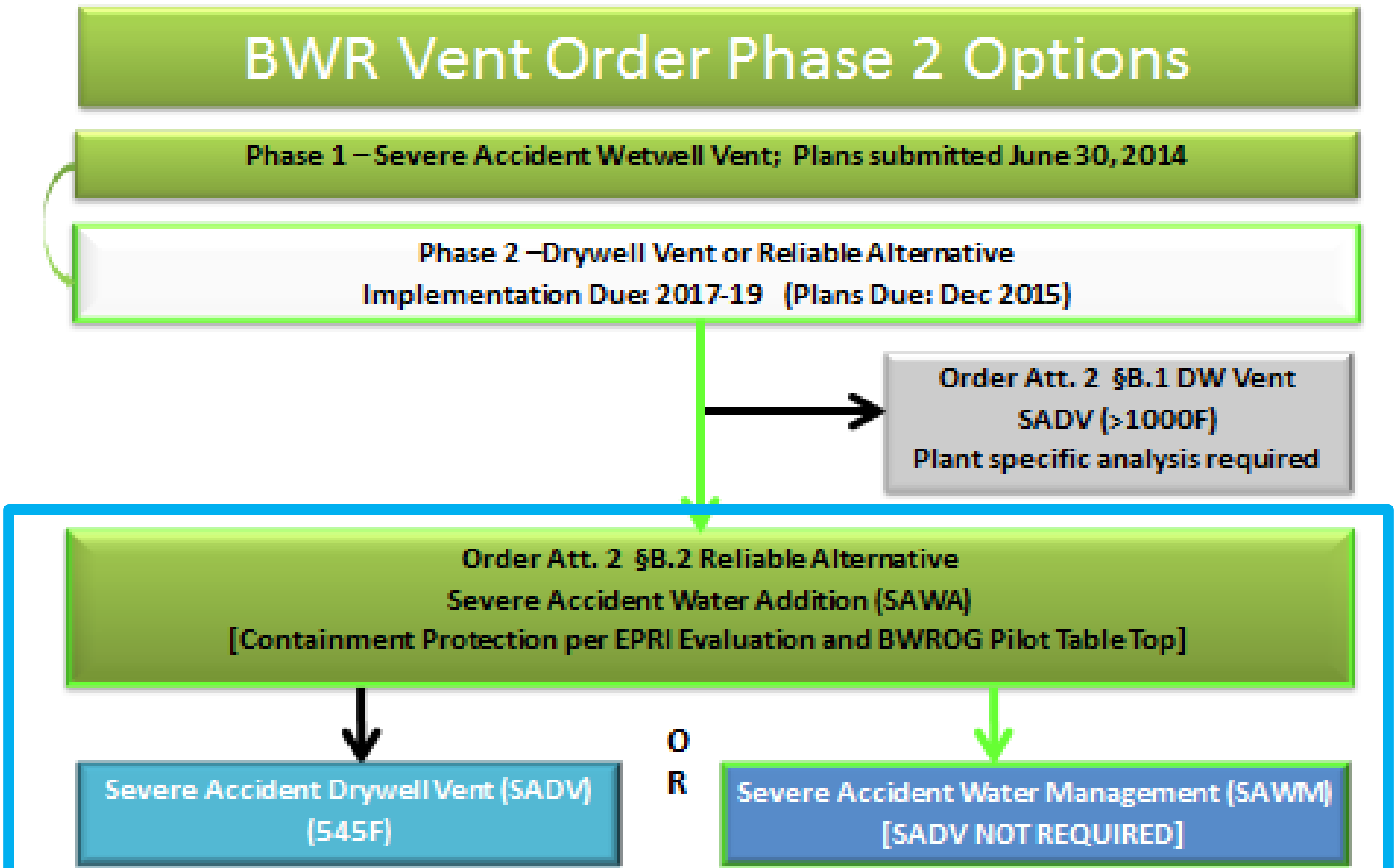
Probability that the Maximum Drywell Gas Temperature is below the indicated value under Various Severe Accident Sequences, water addition to RPV vs. water addition to Drywell

Phase 2 Terminology

- Severe Accident Water Addition (SAWA)
  – Providing water to reactor vessel or drywell post-core damage.

- Severe Accident Water Management (SAWM)
  – Preserve wetwell vent path.

Phase 2 Guidance



Phase 2 guidance applies to bottom three boxes

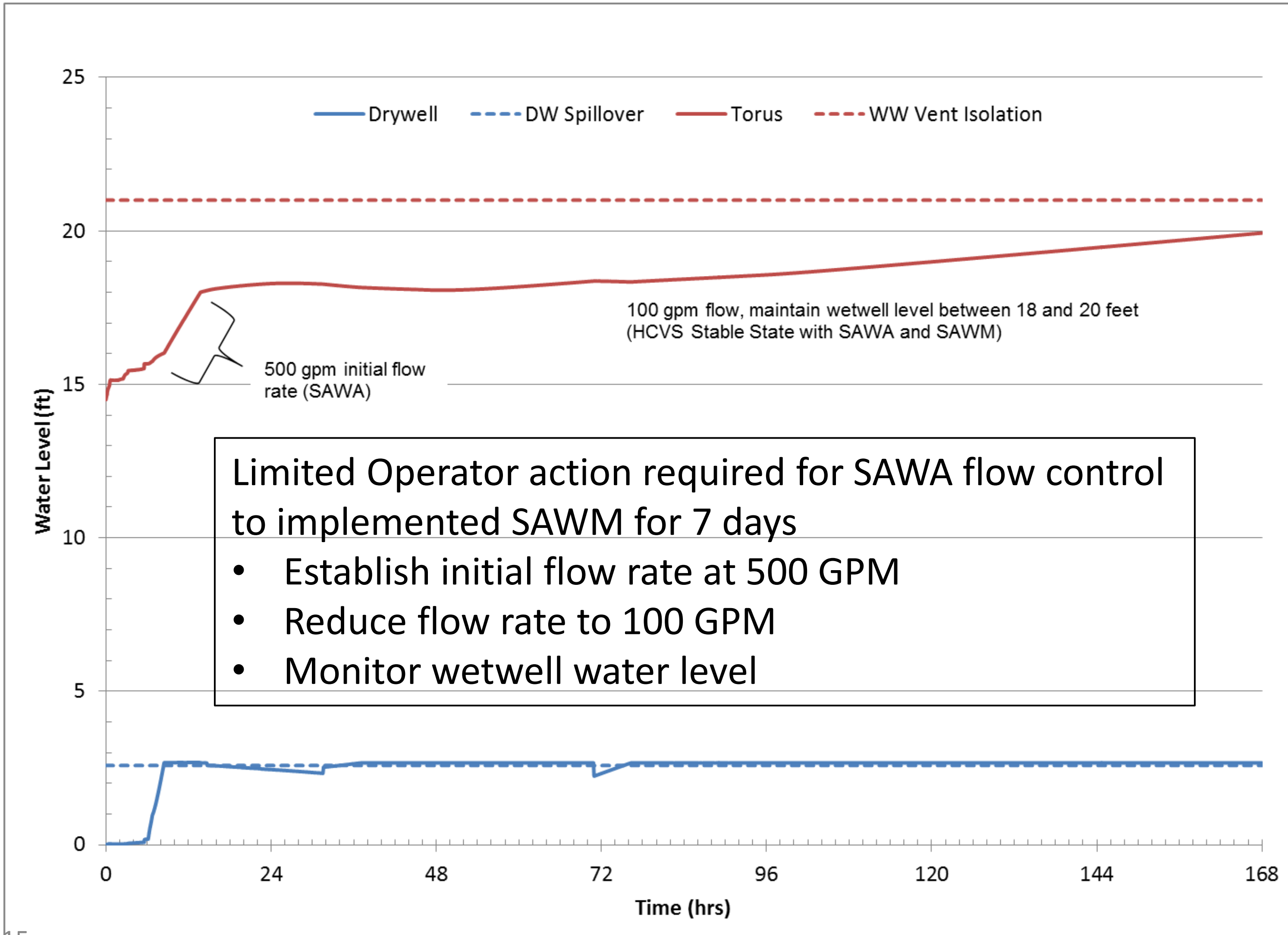
Phase 2 Guidance

- Section 3 (ISG Method 1):
  - Provide no specific guidance for the high temperature drywell vent option
  - State there are potential longer-term issues related to the CPRR rulemaking should a licensee decide to pursue this option
- NEI 13-02 guidance is written to require SAWA for B.2 options for either:
  - 545°F SADV option with functional requirements from Order Section A (ISG Method 2), or
  - SAWM approach for Phase 2 alternate venting strategy (ISG Method 3)

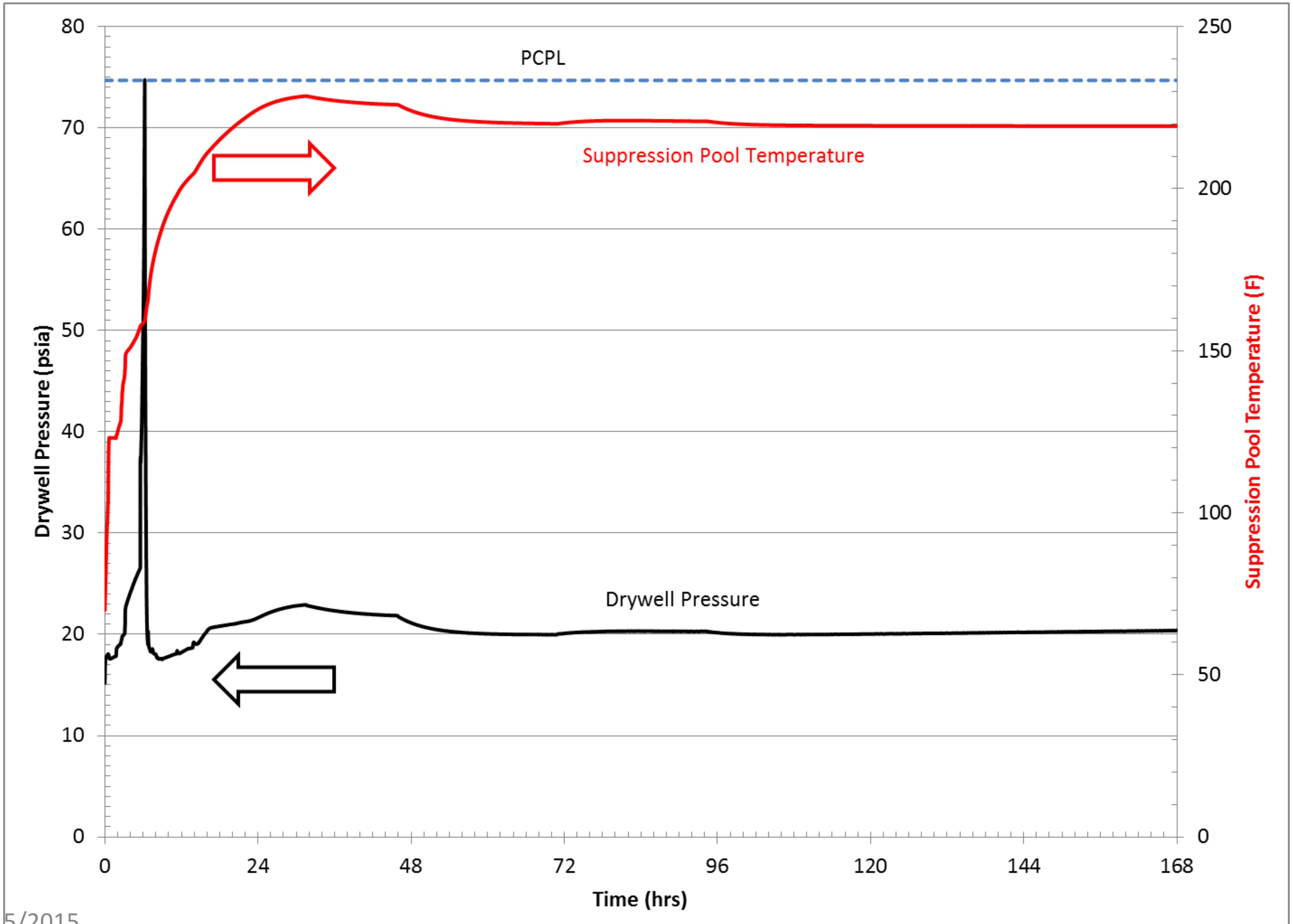
Wetwell Vent Preservation Time

- Three tier approach for SAWM:
  - 7 days of Sustained Operation – no additional actions are required to meet Order EA-13-109
  - 72 hours to 7 days of Sustained Operation – a functional description of alternate reliable containment heat removal will be included in Phase 2 OIP (similar to S/D Refueling Modes guidance under Order EA-12-049)
  - <72 hours of Sustained Operation – an evaluation of alternate reliable containment removal that includes equipment to be used including plant modifications will be described in the Phase 2 OIP (Similar to Phase 2 action under Order EA-12-049)

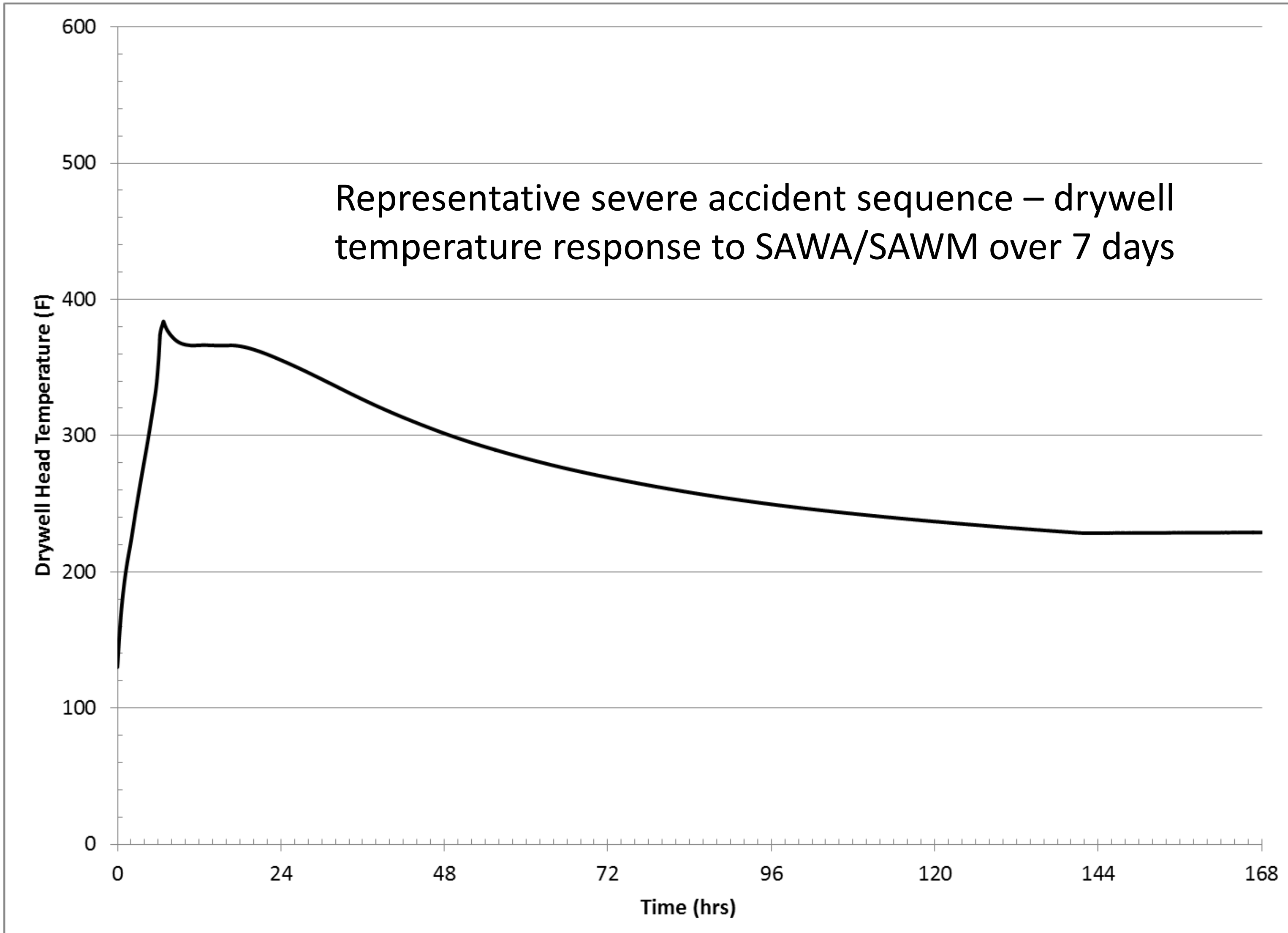
MAAP 5.02 SAWM Simulation



MAAP 5.02 SAWM Simulation



MAAP 5.02 SAWM Simulation



SAWA Equipment

- NEI 13 – 02 contains guidance for Phase 2 OIPs to describe how SAWA components will be powered including a timeline that shows that components are available to support SAWA in support of 545°F SADV or SAWM
  - Motive force for SAWA may include power or pneumatics for valves in the SAWA flow path and instrumentation
  - For actions less than 24 hours, NEI 12-06 Level "A" validation under severe accident conditions will be used to demonstrate acceptability (treated similar to a "Time Sensitive Action" (TSA))

SAWM Installed Instruments

- Installed SAWM instruments are the same is those discussed in the Phase 1 guidance
  - Design basis instruments with Technical Specification post accident functions
  - Designed to meet Regulatory Guide (RG) 1.97 requirements or similar qualification for pre-RG 1.97 plants
  - Evaluations performed per HCVS-WP-02 will demonstrate HCVS integrated dose will be bounded by design basis accident integrated dose
  - Post ELAP initial power provided by plant DC or AC through inverters
  - Powered by FLEX equipment before battery power is depleted as part of FLEX mitigation strategy (already evaluated)
  - Not necessary until SAWA flow needs to be controlled to implement the SAWM strategy

Maintenance and Testing – Check Valves

Description	Frequency
Cycle the HCVS and installed SAWA valves[1] and the interfacing system boundary valves not used to maintain containment integrity during Mode 1, 2 and 3. For HCVS valves, this test may be performed concurrently with the control logic test described below.	Once per every[2] operating cycle
Cycle the HCVS and installed SAWA check valves not used to maintain containment integrity during unit operations[3]	Once per every other[4] operating cycle
Perform visual inspections and a walkdown of HCVS and installed SAWA components.	Once per operating cycle
Functionally test the HCVS radiation monitors.	Once per operating cycle
Leak test the HCVS.	(1) Prior to first declaring the system functional; (2) Once every three operating cycles thereafter; and, (3) After restoration of any breach of system boundary within buildings.
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[1] Not required for HCVS and SAWA check valves.

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[3] Not required if integrity of check function (open and closed) is demonstrated by other plant testing requirements.

[4] After two consecutive successful performances, the frequency may be increased by one operating cycle to a maximum of once per every fourth operating cycle.

[5] Interfacing system boundary valves that are normally closed and fail closed under ELAP conditions (loss of power and/or air) do not require control function testing under this section. Performing existing plant design basis function testing or system operation that reposition the valve(s) to the HCVS required position will meet this requirement without the need for additional testing.

Out of Service Time – Compensatory Actions

- Revised NEI 13-02 Section 6.3.1.3.3
  - Limits out of service time to a reasonable period of time, not to exceed one full operating cycle
    - Allows for outage related repairs without forcing a plant outage
    - System functionality basis is for coping with beyond design basis events and therefore plant shutdown to address non-functional conditions is not warranted (no change from NEI 13-02 Rev 0 guidance)

SAWA Flow – RPV Depressurization

- Procedure guidance requires RPV depressurization prior to entry into SAGs
  - RPV depressurization likelihood of success is discussed in I.1.3
  - Failures not assumed to obtain depressurization (e.g., SRV seizure, MSL creep rupture)

Remaining Steps

- NEI 13-02 Rev 1 (Phase 2)
- JLD-ISG-2015-01 (Phase 2)
- Phase 2 OIP template
- Phase 2 workshop
- Phase 2 OIP submittal

Conclusion

- SAWA is a viable strategy for meeting Phase 2 of EA-13-109 (ISG Methods 2 and 3)
  - SAWM is a viable strategy for preserving the wetwell vent
  - 545°F design boundary condition for SADV confirmed acceptable with SAWA
- Draft 2 ISG indicates resolution of issues during April public meetings resulting in expected good alignment between final ISG and NEI 13-02 Rev 1