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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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FUKUSHIMA SUBCOMMITTEE

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FRIDAY, MARCH 20, 2015

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ROCKVILLE, MARYLAND

The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., Stephen P. Schultz, Chairman, presiding.

COMMITTEE MEMBERS:

STEPHEN P. SCHULTZ, Subcommittee Chairman

RONALD G. BALLINGER, Member

DENNIS C. BLEY, Member

CHARLES H. BROWN, JR., Member

DANA A. POWERS, Member

JOY REMPE, Member

PETER RICCARDELLA, Member*

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

ACRS CONSULTANT:

WILLIAM SHACK

DESIGNATED FEDERAL OFFICIAL:

WEIDONG WANG

ALSO PRESENT:

EDWIN M. HACKETT, Executive Director

PHIL AMWAY, Exelon

RAJENDER AULUCK, NRR

SUDHAMAY BASU, RES

HOSSEIN ESMAILI, RES

MICHAEL FRANOVICH, NRR

JEFFERY GABOR, Erin Engineering

NAGESWARA KARIPINENI, NRR

STEVEN KRAFT, NEI

WILLIAM RECKLEY, NRR

*Present via telephone

AGENDA

P R O C E E D I N G S

(8:30 a.m.)

CHAIRMAN SCHULTZ: Good morning. This meeting will now come to order. This is a meeting of the Advisory Committee on Reactor Safeguards, Subcommittee on Fukushima. I'm Steve Schultz, Chairman of the Subcommittee. Members in attendance today are Dick Skillman, Dana Powers, Dennis Bley, John Stetkar, Ron Ballinger and Joy Rempe.

On the telephone -- is Pete on the telephone? Pete Riccardello's going to join us on the phone. He may be joining us later. We also have former ACRS chairman Dr. Bill Shack at this meeting as our consultant on this matter. So today's meeting is to review the development of the second phase interim staff guidance, and the associated industry guidance document, NEI-13-02, which are designed to achieve compliance with Order EA-13-109, an order modifying licenses with regard to reliable hardened containment vents, capable of operation under severe accident conditions.

We'll hear presentations from the NRC staff and the representatives from the NEI Working Group. This meeting is open to the public. The meeting is conducted in accordance with the provisions of the

Federal Advisory Committee Act. Rules for the conduct of and participation in the meeting have been published in the *Federal Register*, as part of the notice for this meeting.

The Subcommittee intends to gather information, analyze relevant issues and facts, and formulate proposed positions and actions as appropriate for deliberation by the full Committee. Mr. Weidong Wang is the Designated Federal Official for this meeting. The transcript of the meeting is being kept and will be made available, as stated in the *Federal Register Notice*.

Therefore, we request that participants in this meeting use the microphones located throughout the meeting room when addressing the Subcommittee. All participants should first identify themselves and speak with sufficient clarity and volume, so that they may be readily heard.

We have received no written comments or requests for a specific time to make oral statements from members of the public regarding today's meeting. I understand that there are individuals on the bridge line today who are listening in on today's proceedings, to effectively coordinate their participation in this meeting.

We will be placing the incoming bridge line on mute so that these individuals may listen in. At the appropriate time later in the meeting, we will provide the opportunity for public comments from the bridge line and from members of the public in attendance.

I remind us all to turn off our cell phones or communication devices so there is no interruptions during the meeting. We'll now proceed with the meeting and I'll call on Michael Franovich of the Office of Nuclear Reactor Regulation to open the presentation today. Michael.

MR. FRANOVICH: Thank you, Dr. Schultz. Good morning ACRS members. My name is Mike Franovich. I am the deputy director of the Japan Lessons Learned Division in the Office of Nuclear Reactor Regulation. Today we will discuss the proposed draft guidance to support implementation of Phase 2 regarding NRC Order EA-13-109, for BWR Mark I and II type containments.

More specifically, the staff will discuss the technical and regulatory guidance for containment drywell venting capability, that make it unlikely that plant operators would need to vent during a severe accident.

By my count, the staff was last before the

Committee in October of 2013. So it's been some time since we last discussed guidance for EA-13-109, although there have been ACRS briefings on the related technical and regulatory analysis for the containment protection and release reduction rulemaking.

We are here today to engage the ACRS Fukushima Subcommittee in support of your review of the proposed guidance. We are seeking the Committee's endorsement of the guidance. To support this presentation, I have several members of the NRR today here at the table.

With me today is Raj Auluck. He is the senior project manager for EA-13-109. Raj will lead us through a discussion regarding the background of the orders, the activities and schedules to support full implementation of the order, and also refresh our memory, since it has been some time since we were last here before the Committee.

Also with me is Rao Karipineni. He is our senior containment systems engineer and our technical expert for this topic. Rao will focus on the size and engineering behind the Phase 2 guidance. He will also address some of the remaining technical guidance issues, and update the Committee on the progress of those items since the time we provided the Committee with the supporting material for today's meeting.

I'll also note with us today is Bill Reckley. Bill is a senior advisor in the JLD, and he is here in the support discussions on the context of the guidance and the order itself. We also have several members of the staff in the room to answer questions from the Committee, in particular from the Office of Nuclear Reactor Regulation, and the Office of Nuclear Regulatory Research.

I want to thank the ACRS for its flexibility and patience in supporting the staff, regarding the materials today under review. As typical of any of our post-Fukushima actions, we are on an aggressive schedule. We are doing quite a bit in parallel as we are doing other activities in parallel.

So there are places where we do have some gaps and we do need to update the Committee regarding those gaps, and how we plan to address those. With that said, I will now turn the meeting over to Raj, to lead us through a discussion on the background.

MR. AULUCK: Good morning. As Mike just mentioned, my name is Raj Auluck, and I'm the senior project manager in the Japan Lessons Learned project within the Office of Nuclear Reactor Regulation. As also mentioned, you know, the senior staff members will be supporting us in today's meeting from NRR, as well as Research.

Next agenda. This is the agenda we're going to follow in today's meeting, before our presentation on the draft interim staff guidance on Phase 2 requirements of the Order EA-13-109. I will briefly go over the background and schedule of the Subcommittee.

The accident at the Fukushima Daiichi nuclear power station reinforced the importance of reliable operation of containment vents for BWR Mark I and Mark II containments.

As part of its response to the 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 I BWR containments.

While delivering the requirements for Order EA-12-050, 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

stakeholders, the nuclear industry and the ACRS. The SECY paper provided options to address questions about maintaining containment integrity and limiting the release of radioactive materials, if venting systems were used during severe accident conditions.

In the staff requirements memorandum on the SECY, issued in March 2013, the Commission directed the staff to take certain actions. These included requiring licensees to upgrade or replace the reliable hardened vents required under Order EA-12-050, with a containment venting system designed and installed to remain functional during severe accident conditions, and develop technical basis and rulemaking for venting strategies with drywell filtration in severe accident management conditions.

The staff subsequently issued Order EA-13-109 in June 2013, which supersedes the requirements imposed by the Order EA-12-050, and replaces them with new requirements for licensees with BWR Mark I and II containments, and also allowed implementation in two phases.

Under Phase 1, it was upgrade the venting capabilities with the containment wetwell to provide reliable severe accident capable hardened vent, to assist in preventing core damage and, if necessary, to provide venting capability during severe accident conditions. Under Phase 2, install a reliable severe accident capable drywell vent system or develop a reliable containment venting strategy that makes it unlikely that a licensee would need to vent from the containment drywell before alternate, reliable containment heat removal and pressure control is established.

As you can see on this slide, this provides the implementation time line for two phases. Our implementation for Phase 1 is no later than startup from second refueling outage that begins after June 30th, 2014 or June 30th, 2018, whichever comes first, and for Phase 2, no later than startup from the first refueling outage after June 30, 2017 and June 30th, 2019, whichever comes first.

Next please. The staff's last briefed ACRS full Committee in October 2013, as Michael mentioned earlier. Since that time, certain activities have been completed. These include the staff issued the interim staff guidance, JLD-ISG-2013-02 in November 2013, which endorsed the industry guidance document NEI-13-02, Revision 0, a template to assist licensees in preparing their overall integrated plans.

The staff participated in development of this template, and held six public meetings between December 2013 and March 2014, in support of this activity. Third, as required by the Order, all integrated plans for Phase 1 were submitted by June 30th, 2014. Fourth, the staff has completed and issued interim staff evaluations for nine plants, and will complete all evaluations by June 2015.

As I mentioned earlier, the staff briefed the full Committee on October 2013 on interim staff guidance for Phase 1 of the Order. In the ACRS letter dated October 18th, 2013, the Committee's conclusions and recommendations included the interim staff guidance 2013-02 should be issued. As I mentioned, we did issue the guidance in November 2013.

Second, the staff should better define accident scenarios during drywell venting, with the necessary (telephonic interference) drywell venting.

Next. The venting procedure must be developed that do not compromise (telephonic interference), which depends on the containment accident pressure. The letter noted that the industry proposed value of 545 degrees Fahrenheit temperature for the drywell vent design needs to confirmed by analysis. The staff will address these recommendations in the presentation today.

This slide shows the schedule for issuing the ISG for complying with Phase 2 of the requirements of the Order. As directed by -- in the SRM, the staff included external stakeholders throughout the development process. There were 12 public meetings since issuance of the ISG for Phase 1.

Six of these meetings have been held since August 2014, related to guidance development for Phase 2 of the Order. The last one was earlier this week. As you can see, the schedule is really tight. We plan to meet with the full Committee on April 10th, and plan to issue the first two ISG by April 30th, 2015, which will endorse the latest revision of the guidance document with exceptions and clarifications as needed.

This will provide the needed time for the licensees to prepare and submit their Phase 2 overall integrated plans by December 31, 2015, as required by the Order. With this, unless there are any questions, I will introduce Rao Karipineni, who will -- who's the senior systems engineer, as Mike mentioned, in the Containment and Regulation Branch of the NRR, and will lead the staff's presentation on the ISG.

MEMBER STETKAR: Before you do that, I do have a question. You've noted that now the schedule is very tight suddenly. As I read through this ISG, I was surprised by the number of places where you use the terms like oh, resolution of this is subject to ongoing discussions, or these issues remain under further discussion, or this requires further discussion.

This is really unusual for interim, even interim staff guidance. If I'm an NRC reviewer or I'm a member of the industry and I come across those, I don't know what to do. So how is this valid guidance?

MR. RECKLEY: This is Bill Reckley. If I can, this is where, as Mike mentioned, we're doing some things in parallel.

MEMBER STETKAR: Yeah. Well, we're reviewing this guidance.

MR. RECKLEY: But what happened to our schedule was we were hoping that by the time we were at this point, it would be cleaner. So we issued the draft with the plans to meet with the industry a few weeks ago, and then that meeting was snow-delayed, and we weren't able to have it until Monday. So as we go -- one of the things we'll be doing today is as we go through the presentation that Rao's going to give, we're going to say how those issues are being resolved, and what we'll have to coordinate with y'all is between now and the full Committee meeting --

MEMBER STETKAR: Two weeks from now.

MR. RECKLEY: Two weeks from now, that --

MEMBER STETKAR: Already noticed on the *Federal Register*, less than the 30 days we normally require for final finality of materials sent to the Committee for their deliberation.

MR. RECKLEY: Right.

MEMBER STETKAR: I want that on the record.

MR. RECKLEY: Right, and we apologize, but that's --

MEMBER STETKAR: And as Chairman of the ACRS, I was not aware of this.

MR. RECKLEY: There are, as Dr. Stetkar mentioned, about three or four major issues that were identified in the draft guidance and again, as we go through the presentations today by the staff and the industry, we'll be explaining how those were largely resolved at the public meeting we held earlier in the week.

MEMBER BLEY: Have you actually written some of that into the guidance?

MR. RECKLEY: We will be doing that to give to you as soon as we can.

MEMBER BLEY: How far before our meeting?

MR. RECKLEY: Right now, our plan -- the

industry's schedule is to have it by the end of the month, and that would be also the staff's plan.

MEMBER STETKAR: Well, I think we'll have to rethink this, because this is not acceptable behavior for providing material for final deliberation, and this is final deliberation by the ACRS.

CHAIRMAN SCHULTZ: What was provided for support of the public comment period, in terms of the documentation?

MR. RECKLEY: The same thing that you received.

MEMBER STETKAR: We can certainly comment on this document.

MP Sure.

MR. AULUCK: Yeah. Bill, although it was published for public comment on March 10th, it was available in ADAMS a week earlier to the public.

MEMBER STETKAR: We received this in enough time to read it. My comment is that this is an incomplete set of guidance. That's my own personal opinion as a Subcommittee member, and I'm saying that the staff is not allowing us sufficient time to deliberate on a final document as a full Committee.

MR. RECKLEY: Yes. I'm not going to argue, because what you got was a work in progress, and what we're going to do today is to update you on the progress that's been made.

MR. KARIPINENI: Thanks, Ray. Again, my name is Rao Karipineni. I'm from NRR. I deal with safety systems, Containment Ventilation Branch. I've been involved in the overall venting issue very much from the very beginning. Even though I'm not in the JLD, I've been basically assisting JLD on this issue.

Since we had the last meeting in October 2013, we had done a little bit of work both on Phase 1, and of course a lot of work on Phase 2. After that meeting, we developed this overall integrated template for the submittals from the licensees to the staff, the purpose of which is to get some consistency in those submittals, and exactly relay what the kind of information the staff would be looking in their reviews.

For that reason, we had a bunch of meetings that took place with the public meetings that took place with the industry, and it took about five or six meetings to generate those overall integrated templates. I believe that the idea here is a similar to what will be undertaken on Phase 2 also, after issuing the guidance, after issuing the interim staff guidance.

After the development of the overall integrated templates, we also had some meetings with the industry. Basically they're called industry workshops that basically rolled out the guidance to the licensees.

In those meetings, some questions came up from the licensees about some final issues about interpretation of some of the language in the guidance, etcetera, and the industry has -- NEI and the supporting cast have determined that additional information needs to be provided.

Therefore, some questions were asked and we gave them the answers. We gave them the document in what they called Frequently Asked Questions, FAQs, and also another kind of papers that were called white papers, which are a little bit higher level than a small question in FAQ.

Those were all -- the FAQs were made part of this guidance also in Phase 2. The documents we sent you contained those FAQs, Frequently Asked Questions. Additionally, some more appendices were added that related to those determinations, source terms and flammable gases, you know, what measures they're undertaking in implementing the requirements of the model in that regard.

The Phase 2 focus itself is the two appendices. Appendix I, which is on severe accident water addition, called a SAWA, S-A-W-A, and the Appendix C, which is a severe accident water management, which is a continuing aspect of SAWA, by controlling the amount of water that they were injecting into the vessel that eventually will go down the path into the vessel, into suppression pool.

Slide 11. During the last meeting, there were some questions from the ACRS Subcommittee as well as the full Committee on the combustible gases, how the issue of hydrogen control is being taken care of. We have done some work on that since then. The Order requires the licensees to follow -- two ways they can manage this situation.

One is to operate and ensure flammability of gases passing through the system will not breach, and the other way to design the piping to withstand the deflagration and detonation. These two concepts are kind of in the Order itself. The licensees have given an Appendix H into the document, into the NEI guidance, as well as a white paper letter that's called White Paper No. 3, about how they will ensure the requirements of the Order.

There are three aspects when you look at it, when you look at the hydrogen ratio. One is possibility of hydrogen leaking into the surrounding parts of the plant, basically the reactor building, and the other is how do you ensure that the hydrogen is properly vented out through the vent pipe itself and ensure there are no detonations, or detonations that might be designed for the requirement itself, okay.

So in that regard, what we did is -- go to the next slide --

Oh, part of the CPRR work we have done, there are several sequences that were analyzed, severe accident sequences, and one of them is presented here, which is pretty much representative of the different sequences when you have the vent operating at different times through the severe accident.

This was produced by our Research group. It shows that you have basically vented a lot of hydrogen out through the vent pipe into the -- out into the external parts of the plant, outside of the plant basically. If you look at the green line, that's the overall hydrogen that was generated, basically as well as vented also, because the red line represents what is left in containment.

And as you can see after the accident, initially there is a little bit of hydrogen in containment. But within an hour, hour and a half, basically it goes down quite a bit and everything else goes up. So based on this, you can basically conclude that around the -- somewhere around 24 hours, you have reduced the existence of hydrogen in the containment quite a bit.

By doing that, you also basically would be reducing the potential for leakage from containment into the surrounding buildings through or to components that other than the vent pipe itself. By that, I mean the drywell head, the other containment inefficiencies, etcetera.

The second issue is that the fact that you have this vent itself and you have brought the pressure down will also help the situation, by reducing the -- any amount of hydrogen that potentially could leak into the buildings.

The third aspect is we have made the severe accident water addition as part of this guidance, and the licensees for the most part are following this severe accident water addition part, and that itself will use the temperatures in the drywell, even given the severe accident when the core has become X-vessel, to reasonable temperatures written in Order, 500, 550 around.

Which means the vent pipe will only work okay, and the guidance contains some discussion about the seals, etcetera, what will happen at those temperatures and the conclusion is there is -- you can basically say that yeah, I know, the seals should not be really compromised in any way, other than some small issues at all, if anything at all.

So these two, these two things combined with reduce the potential for hydrogen to be leaking into the buildings. As far as the vent piping's concerned, I think last time or so we told you that when the -- when vent system gets started, the design is such all the interfaces with the CVRs, with the other stand-by gas treatment system and any of the other -- any other pipes that join these containment purge lines.

All those routes would be isolated, closed, and the requirements in the guidance also states that all these leakage paths will be tested for potential leakages, and ensure that any small amount of leakage, if anything, will be the acceptance criteria.

So between these two, we believe the work that has been done uses with confidence that whatever the vent part can do in regards to hydrogen, is ensure that it can happen.

MEMBER STETKAR: And this presumes the

hydrogen is fully mixed and all is drawn to the wetwell; correct?

MR. KARIPINENI: That's correct.

MEMBER STETKAR: Okay.

MEMBER REMPE: So in the analysis, do you have concentrations at certain locations? I mean this is a total mass. The issue is obviously concentration, as he's inferring.

MR. KARIPINENI: As far as I know, our MELCOR did not show that. I'm not too sure that the industry presentation would show that.

MEMBER REMPE: But you have numbers from MELCOR. Surely they can get this --

MR. KARIPINENI: But different levels were used, I think.

(Simultaneous speaking.)

CHAIRMAN SCHULTZ: Hossein.

MR. ESMAILI: Okay, yes. We do have --

CHAIRMAN SCHULTZ: Go ahead and introduce yourself.

MR. ESMAILI: Yeah. This is Hossein Esmaili. Yes, we do have the concentrations if you want that. I actually have copies. The concentration inside the drywell can reach up to about ten percent. Inside the wetwell can be higher, but it is still noted.

There's a loss of steam.

MR. KARIPINENI: Sorry, I misunderstood your question. I thought you were asking for concentration at different levels.

(Simultaneous speaking.)

MR. KARIPINENI: They're not at different levels.

MEMBER BALLINGER: What about the concentrations of where it's vented to?

MR. KARIPINENI: Vented outside of the building --

MEMBER BALLINGER: So there's no way you can get locally -- high local concentrations?

(Simultaneous speaking.)

MR. KARIPINENI: The interfaces being all the -- if there were any. They have like two or three interfaces. Those dampers or valves would close at that time when you open the vent, and they're tested for leakage also on a periodic basis.

MEMBER STETKAR: The stuff that I -- the problem is that there are apparently two fundamental reports that look at the thermal hydraulics of all of this, neither one of which are available. I looked for them, I couldn't find them. There's some reference in the ISG to a NUREG that will be published.

There's reference in the NUREG, in the ISG and NEI-13-02 to an EPRI report, which is EPRI 300200, 3301, which is a basis for all the temperatures and the analyses. That hasn't been published. That's --

(Simultaneous speaking.)

MEMBER STETKAR: --why I can't find that. So it's really difficult for me to, for example, look at any of this stuff, because all of the background is not available.

MR. RECKLEY: Yeah. Those two reports, both the NUREG and the EPRI report, are the MELCOR and MAAP work that was done in support of the CPRR rulemaking. So the graphs you're seeing are from those reports. It's just that the actual documentation and finalization of the reports is not completed yet.

MEMBER REMPE: And when will that be done?

MR. RECKLEY: For the NUREG, both of those activities are largely supporting the rulemaking. So the NUREG is on a schedule for like next year or some time, and to be published. But again, y'all have seen the -- you've seen the technical work, the EPRI report sooner than that, I believe.

But again, the primary focus of those analyses is to support the rulemaking activity, and it just also supported an assessment of compliance with this Order.

MEMBER STETKAR: When I'm reviewing something, I often find it useful to then read the entire supporting document, because it tends to describe assumptions, it tends to describe limits, it tends to describe boundary conditions that don't come through when you only see a graph of results and say trust me, we did this okay.

So it's really difficult to draw any kind of meaningful conclusion without that supporting documentation in its entirety.

CHAIRMAN SCHULTZ: Is this being presented as a typical case or representative case? How would it be characterized?

(Simultaneous speaking.)

MR. KARIPINENI: It is one case, with the drywell vent siphoned a little bit.

MEMBER STETKAR: This has a drywell vent in it?

MR. KARIPINENI: I'm sorry, wetwell vent. A wetwell vent siphoned water on a 10 psi delta, which means that as soon as the temperature goes up a little, you would be opening the wetwell vent again, and that process will get a lot of hydrogen out of there.

MEMBER STETKAR: So the vent is cycling.

It's not opening the vent and leaving it open? When is the cycling --

MR. KARIPINENI: There were so many cases done, different ones than this.

MEMBER STETKAR: That's why I'm asking if this is typical?

MR. ESMAILI: This Hossein Esmaili again. We have done about 50 runs, and this has been -- as Rao was saying, this has been presented at various public meetings, at EPRI. So this is just one case to show how hot behaves. In terms of the containment temperatures, structure temperatures, upper head temperatures, etcetera, we have actually, you know, looked at, you know, vent cycling, everything.

What we have seen is that as long as we inject water, okay, all the cases that you have water injection, both the drywell temperature and the upper head temperature, you know, where you think a failure will occur, both remain below about 500 or, you know, 550 Fahrenheit. And then if you don't have water, it can be much higher, you know, 1,000, etcetera.

In terms of hydrogen, as I said, you have lots of steam. So everything just becomes steam-filled, steam inert very, very soon. Even inside the vent line, as soon as you open the vent, you are pushing all the steam in the hydrogen, you know. So there is not that much time before everything gets outside of the containment, and once again --

And then you start injecting water and then steam keeps going. So in the long term, what we see is a steam-filled environment, both in the vent line and inside the containments.

MR. RECKLEY: And this is Bill Reckley again. Go back to the previous slide. Just I can do little else but apologize by how the different part of the Fukushima activities support each other, but they're on different time lines. So when we come here, I know it sounds discombobulated sometimes.

But for the purpose of this assessment and this Order, we're really looking in terms of hydrogen, to make sure that the vent system either can survive the hydrogen explosion or prevent a hydrogen explosion within the vent, all right.

The last bullet, in terms -- and where I was going into this, based on the comment from the last ACRS meeting about overall concerns about hydrogen, that we see some preliminary results here that are likely to inform us on another activity, which is Recommendation 6 within the NTTF world, on whether hydrogen -- measures to address hydrogen in the reactor buildings or other areas outside of the vent system should be undertaken.

So we're offering a little bit of an insight in regards to that. But looking narrowly of what we are trying to address for the sake of Order 13-109, it's only in regards to hydrogen and the vent system itself, and whether the vent system is either able to survive the hydrogen deflagration or detonation, or is able to prevent it, such that the vent system is not taken out by a hydrogen issue.

MEMBER STETKAR: So looking narrowly sub-one at the particular issue in this particular ISG, and narrowly sub-one being the issue of hydrogen only in the vent line, yeah, maybe.

Looking narrowly sub-two at another issue in this ISG, which you'll get to in three more slides, which is what's the basis for the 545 degree Fahrenheit design criterion for a drywell vent, if one decides to install that, that 545 degrees is my understanding, is also justified by the analyses in those nebulous reports that we haven't seen.

So if you want to start partitioning things, I'll then ask the same question about how come we don't have the basis for the 545, which is an issue that pertains to this ISG.

MR. RECKLEY: And yes, and I don't disagree with that.

MEMBER STETKAR: Don't try to partition it into too many small Excel little files, because --

MR. RECKLEY: No, this is all -- it's all interrelated unfortunately, and again they're on different time lines. So I can't say we've been totally successful in making sure that all of pieces fit together.

MEMBER STETKAR: Bill, put yourself in our seats. You're asking the Advisory Committee on Reactor Safeguards to make a final determination on the acceptability of this guidance, based on the totality of information we have available to us, and the totality of that information is sparse.

MEMBER REMPE: A compromise could have been to take some subset of the report that you think's relevant to justify this action and writeups, and if this were a different type of interaction with an EPU, we'd have questions saying provide and describe the analysis and assumptions and the results that support this and give us some sort of document that we should use. I mean there is a way to do this if you can't issue the big report for a while.

MEMBER BLEY: The EPRI report, you guys must have a draft of it.

MR. RECKLEY: Right.

MEMBER BLEY: So you're making determinations based on it without having all the information?

MR. KARIPINENI: The results have been, you know, shown in the public meetings.

MEMBER BLEY: Yeah, but as John said, it's your code; it doesn't really tell you the basis for it all.

MEMBER STETKAR: I've seen results from PRAs that once you looked at the PRA models, the results changed a lot after you ask questions, for example. Please do it.

MR. BASU: Thank you. Sud Basu from the Office of Research. Bill, I'm assuming the ACRS members got the regulatory basis report.

CHAIRMAN SCHULTZ: Not yet.

MR. BASU: Not? The draft, whatever the version is.

MEMBER BLEY: I'm getting a little bit.

MR. BASU: Maybe I preempted somebody. So in that regulatory basis report, there is a technical analysis portion, which is really a condensed version of the entire analysis that we performed and documented. That's the report that Bill is talking about, was talking about in relation to the CPR rulemaking effort.

The report has not been finalized, but maybe I already, you know, sort of preempted something. The regulatory basis report should have enough information there in condensed form, to give the ACRS members some sense of, you know, what the technical analysis, what sort of technical analysis was done and how we sort of reached whatever technical conclusions that we did. I don't know if that's good enough.

MEMBER STETKAR: Okay. Well, I understand that there must be a basis coming, but the difficulty is, as John expressed and I'll just say it one more time, perhaps in a slightly different way, and then we should move on. But the ISG that we received would appear to have been formulated at the time at which you did have sufficient information, such that you had to write the draft, put it out for public comment with a lot of statements in fundamental areas saying well, we don't have sufficient information.

We're going to have to interact to get additional information, in order to draw conclusions and provide the final guidance. So there's different things that need to come together in a very short time, and that is a final guidance, which provides this, what we discussed before, guidance that in fact would be implementable, and the technical information that supports that.

In other words, it seems as if what we're dealing with here is technical information supporting a document that is -- both of which are incomplete, and we need additional final information, or at least information that supports a final ISG that is in fact giving the guidance that would be required to implement this on the schedule that's proposed.

MR. RECKLEY: Yes. I think as we go through the discussions, the amount of change in regards to the industry guidance document is probably not as significant as what might first appear, based on the issues that we identified.

It is largely that the staff had not reached final conclusions yet. So we said in the draft ISG that it was subject to ongoing discussions. In large part as we've aligned on that guidance to make those issues go away, and we're going to get into that as Rao speaks, I don't believe when you see the difference between what we sent you in the draft industry guidance and ultimately what is the final version of that, is as dramatic as what might first appear. So but as we go through it, we'll talk about how we were able to align on those issues.

MEMBER STETKAR: But again Bill, the draft industry guidance, NEI-13-02, is based on the analyses that were performed in that EPRI report, documented in that EPRI report. I read the NEI guidance first. I always do that.

MR. RECKLEY: Yes.

MEMBER STETKAR: Now I had a question about gee, where are these analyses supporting these temperatures and timing and things like that? So I dutifully went to go find that EPRI report; I couldn't find it anywhere. So a fundamental question I had on the NEI guidance was where are the analyses to support the bases for that guidance? Granted, it hasn't changed. But we have yet to see those supporting analyses.

MEMBER BLEY: I have one related question, I suppose based on some of our conversation. In your guidance, you endorse NEI-13-02. Sometimes endorsements don't include appendices or facts. We run into that very often. I take it your endorsement includes the appendices, which includes the facts, which include the references to the white papers. Is that true or not?

MR. RECKLEY: We'll get in later. We have some specific exceptions --

MEMBER BLEY: I know you have exceptions, but despite -- those exceptions are the only ones. Otherwise, you are endorsing the facts as well as the related white papers? And we don't have the white papers either, right?

MEMBER STETKAR: We have -- we have them now.

MEMBER BLEY: All of them?

MEMBER STETKAR: I think we have them all now.

MEMBER BLEY: Oh, okay.

MR. AULUCK: I think we have endorsed three white papers --

MEMBER STETKAR: I think we have all three of those now.

MEMBER BLEY: Okay.

MEMBER STETKAR: I got one yesterday.

MEMBER BLEY: Yeah. I didn't catch up with it.

MR. KARIPINENI: Again, just before I close that one, the hydrogen issue, what I'm trying to say here is at the last meeting, when you said -- when the Committee said has all, all things that the event can do to take care of the hydrogen to the best it can, has it all been done by you guys.

We were kind of -- didn't give you probably an acceptable response, or give you exactly what we're doing. Now I'm saying that yeah, all this analysis of what we have done, as well as how the event gets operated, all the requirements in the guidance, about all the interface locations and the leakage testing of all those.

So the vent is doing all it can. It depends on how the strategies and what they do in a severe accident, how they operate the vent, that's a different issue. That procedures haven't been developed yet and they will come later from the industry to us.

So the vent is doing all it can, and that leads us to what Bill said, about the Recommendation 6, and that stuff that comes later. If it was determined after all these procedures were finished and everything, there is some aspect here that has not been addressed that has to be looked at at that time, along with the rest of procedures, et cetera.

MEMBER STETKAR: There seems to be a presumption here among everyone that the -- by definition, everyone's going to proceed with the option of a wetwell vent, no drywell vent, severe water addition and severe accident water management. A lot of this stuff hangs together fairly well for that.

There are other options that are available that are described both in the ISG and in the NEI guidance, one of which is a drywell vent with absolutely no water addition. Another one is a drywell vent with water addition into the drywell flooding up.

And the guidance covers all of those things, and that's why I had questions, for example, about the 500. Everybody buys into this 545 degree temperature. But nobody's paying much attention to that, because that only applies if I have a drywell vent. Everybody seems to be heading down the presumed path of a wetwell vent with water addition and water management.

If that's the case, then the guidance should just say this is guidance for a wetwell vent with water addition and water management, and nobody can install a drywell vent.

MEMBER BLEY: Without justification.

MEMBER STETKAR: Without justification of all of the technical bases for it. We don't endorse any of the NEI guidance for a drywell vent.

MR. RECKLEY: That's actually the slide we're on, so Rao, if you want to pick up there, that's basically what this slide says.

MEMBER STETKAR: Okay. Well, it doesn't -- it's not as direct.

MR. RECKLEY: It's not as direct.

MP That's what I just said.

MR. KARIPINENI: Slide No. 13. Oh, you got that. Okay. Like Dr. Stetkar said, there were three methods in the NEI guidance of how to approach Phase 2. One of them is a strictly severe accident drywell vent that doesn't include any kind of water addition at all. The analysis work that was done for that case indicated that the temperatures in drywell can get pretty high, you know, exceeding 1,000 degrees, 1,100 degrees even.

Therefore, the industry also said that we are not providing guidance for this particular matter. If an individual licensee wants to do that, he will have to come and approach you, and give you the guidance. So basically, it's a situation -- a situation where we don't have a guidance.

They don't want to even propose a guidance, and you would like to think that nobody would do that, no agency would want to come and do a severe accident drywell vent with no water addition. But 100 percent guarantee?

I don't know if it is there, but I don't know why any licensee would come and try to propose himself something different from what the NEI guidance is talking about, and want to go into a very difficult situation of reviews with staff, potential likelihood of which -- outcome of which is questionable. So that's all I can say about Method 1 at this point.

MEMBER STETKAR: So but is there some expectation that there is a way in which to have a system, such that the drywell vent is severe accident capable?

MR. KARIPINENI: We don't have any expectations in that regard. Actually, it would be very hard to accept --

MEMBER STETKAR: Without water addition.

MR. KARIPINENI: Without water addition. It would be very hard to accept that because at that temperatures, you know pretty well these head seals and other containment seals, you know, pretty much everything will be compromised and, you know, the whole purpose of the vent arteries to vent and retain the containment function back, and that would all be lost if you have that kind of event. So it's very hard to say.

MEMBER STETKAR: And your previous one slide regarding hydrogen was set up with water addition, wetwell. Has hydrogen been evaluated for this case, drywell without water addition?

MR. KARIPINENI: No. But in this case, we haven't done any analysis like that.

MEMBER BLEY: Let me take you back to the ISG. You have exceptions in there, and in the exceptions you kind of, at least to me, dance around this a little bit and say it would be hard to show that this can work. You don't say this doesn't apply.

MR. RECKLEY: This is Bill Reckley again. The difficulty we were having is that the Order, as it's written, does not specifically preclude this as an option. So it was identified as an option. The more work that was done, the harder this option was found to be a practical solution.

MEMBER BLEY: That makes sense to me. But what I'm getting at is the ISG, it seems to me, should be a little more clear on this in saying we haven't developed good guidance for doing this.

MR. RECKLEY: Okay, and maybe we can clarify. We thought we were pretty clear that the industry chose not to try to develop guidance. The staff acknowledges that and says if any licensees wants to do this, you're on your own to try to make an application, and then we included a caution --

MEMBER BLEY: That's the caution that seems a little --

MR. RECKLEY: Even if you were to try to successfully do this, you need to worry that the CPRR rulemaking may require water addition, in which case you've just double-spent.

MEMBER BLEY: It needs to be as clear somewhere else than where I was looking. Where I was looking it seems --

MR. RECKLEY: We'll look at the work.

MEMBER BLEY: It's better, but it seemed a little light.

MR. RECKLEY: A little. So, okay. Let's do this one.

MR. KARIPINENI: Yes. Slide 14. This is the case for the containment temperature, with no water addition in a drywall vent, evaluation of the drywell temperature, not a drywell vent. I'm sorry. This indicates that you can see that 900 K is the equivalent to somewhere around 1,160 degrees. So that is about the area where most of the drywell mid-level, et cetera, would be.

You can see that that temperature's extremely high, even after an extended number of hours after the core has become X-vessel.

Method 2 is actually installing a severe accident drywell vent, and in addition they would have the severe accident water addition. The severe action water addition is basically gets the drywell temperatures to justify the 545 degrees we had in Method 1.

So in a sense, you are getting a severe accident drywell vent that the Order has originally asked for, except that in this case you would have water also to justify the 545. So we are calling it a hybrid approach for implementing the Order, and the licensees have given the guidance for this in Appendix I to NEI-13-02.

And the severe accident drywell vent, we were told they would follow the guidance that was developed for Phase 1, for all the aspects of the directives of the Order, that were included in Section A of the Order. Let's go 17.

MR. RECKLEY: The original?

MR. KARIPINENI: 17, next slide.

MR. RECKLEY: Okay.

MR. KARIPINENI: This is the -- this is the containment temperatures with the severe accident water addition. We said severe accident water management also. It's not a whole lot of difference in temperatures between the two really. So this case you can see that the temperatures within let's say 24 hours past and the core melt in this case is somewhere around that time.

Go down to 440 degrees, to somewhere between 350 and 440 degrees Fahrenheit, which is a pretty reasonable number. I did not think in the beginning that a severe accident --

MEMBER STETKAR: But it's Fahrenheit and not K?

MR. KARIPINENI: Fahrenheit, you know. They give Kelvins on the left. I have my numbers on the right here so I can put it in Fahrenheits. That's why I'm reading my numbers here. 540 is equivalent to about 440 degrees F. 350 is equivalent to -- I'm sorry. 450 is equivalent to 350 degrees F. So we are somewhere between 350 and 450 there.

MEMBER BLEY: It would be nice if it was on the graph.

MEMBER BROWN: Yeah. I just love going from Kelvin to Fahrenheit. We can all do the conversions, but this is --

MEMBER BLEY: But then we slip up and we talk degrees and we get sloppy.

MEMBER BROWN: Yeah, I know. Degrees what?

MEMBER BLEY: It's just whining, but I'm a thick one, so I can stay with it.

CHAIRMAN SCHULTZ: Can you describe why in this case we have severe accident water addition, slash, severe accident water management? What does that mean?

MR. KARIPINENI: Like Basu was saying, there was almost like 15-20 different system, major cases that were run, and there was so many different radiations in those cases. But this represents a very -- it will represent a case for any severe accident water addition and management, with the vent venting out through the wetwell or the drywell.

CHAIRMAN SCHULTZ: Is this the same Case 9 we saw with the display of hydrogen generation and transport?

MR. KARIPINENI: That's right, that's right.

CHAIRMAN SCHULTZ: And that just talked about water addition. This has water management does it?

MR. KARIPINENI: Right, right.

MEMBER STETKAR: I thought their option. I mean the difference is that if you want to use just the wetwell vent, you have to manage the water. You can't flood up?

MR. KARIPINENI: Yeah, that's right. Flood up, yeah.

MEMBER STETKAR: To the vent. But the idea is I thought, you know, why would one put a drywell vent with severe accident water addition, no water management? Well because all you then do is tell the operators to turn the darn water on and forget about level. Just let it go and it takes care of itself.

Now the question is what assumptions are built into these -- when you start talking about well, it doesn't make much difference if they manage the water or not manage water. Do you have analyses that strictly show only water addition?

MR. KARIPINENI: Right.

MEMBER STETKAR: Okay.

MR. KARIPINENI: There are analyses for water addition.

MEMBER BLEY: And that assumes flooding.

MEMBER STETKAR: That assumes flooding.

MEMBER BLEY: Right.

MEMBER STETKAR: All the way up.

MR. ESMAILI: This is Hossein Esmaili again. I just want to clarify something that there is difference between severe accident water addition and severe accident water management in this case. What you see here you have -- at 24 hours you have lower head failure. At that time, you start injecting. That's why the temperature goes down.

So for the next 15 hours, from 24 hours to about, you know, you start injecting at 500 GPM. So there's no difference between management and addition.

MP In the front part --

MR. ESMAILI: It takes that much amount of time for the water level to get to the point where you get to the, you know, to the hot level inside the vent. At that point, then you switch, you know. The switchover occurs not at this point but at about 38 hours or so. By that time, it doesn't matter whether it's water addition/water management. You're moving it up to K heat, so there's no difference between the two cases.

CHAIRMAN SCHULTZ: I'm just confused. When we discussed the earlier slide on hydrogen, we talked about wetwell venting, and here we're talking about a case focusing on drywell.

MR. KARIPINENI: This is giving the temperatures in different parts of the --

CHAIRMAN SCHULTZ: Drywell, but this is a case where venting occurs from the wetwell --

(Simultaneous speaking.)

MR. KARIPINENI: --is working at that time.

CONSULTANT SHACK: Yeah. But does the venting stop when you reach the flood-up? I guess that's the question.

MR. KARIPINENI: Right.

MR. ESMAILI: This is not a drywell vent.

MEMBER STETKAR: For this graph. This is not a drywell vent?

MR. KARIPINENI: This is not a drywell vent.

MR. ESMAILI: This is not a drywell vent.

(Simultaneous speaking.)

MR. KARIPINENI: This a temperature value. There is water addition and there is a vent. What happens to the temperature?

MEMBER STETKAR: I thought we're seeing all of these nice pretty curves as justification for what you introduced, and that's Method 2, which is drywell venting with water addition. It didn't say anything about wetwell venting. It doesn't say anything about water management. It says drywell venting with water addition.

That was Slide 15, and then we're on this pretty picture here. But now I'm hearing it's wetwell venting with probably some water management, but it doesn't make any difference.

MR. RECKLEY: In all cases, it's initially venting from the wetwell.

MEMBER STETKAR: Okay.

MR. RECKLEY: What this plot is trying to show is in either case, well I shouldn't say, that the addition of water into the drywell controls the temperature in the drywell, such that if you vent from the drywell, this is the kind of temperature that the piping and the valves associated with the vent would have to be able to see.

We're trying to say what is an appropriate design specification for Method 2, which is idle water and venting from the drywell. If you're going to have that vent for the purpose of the Order, what kind of specification are you going to set for that hardware? So this run, and while I was saying that it doesn't in this particular case confirm to the MELCOR run, whether it's water management or water addition is not particularly important to us.

What was important was what is the temperatures in the drywell, such that setting a design specification for the drywell vent, and all other runs that we've seen would support that the 545 degree Fahrenheit number that we did for Phase 1, for the shared piping, can actually be used and extended back all the way to the pure drywell portion of the piping.

CHAIRMAN SCHULTZ: Where I'm confused is that for Method 2, it prescribed only water addition.

MR. RECKLEY: Yes.

CHAIRMAN SCHULTZ: But here you're justifying the drywell vent capability in a case where you have water addition and water management. I don't know enough, I haven't -- I don't know whether you need both to drive these temperatures would protect the drywell vent? Do you need water management for it?

MEMBER STETKAR: Let me just ask, did anyone ever run a run that would replicate what Method 2 is supposed to do, which says you open a wetwell vent. You turn on water, you fill it up. The wetwell vent floods. It then becomes ineffective, and you have to open the drywell vent and you flood-up into the plenum. Did anyone ever run a case that did that?

MR. ESMAILI: Yes.

MEMBER STETKAR: What are the results of that case?

MR. ESMAILI: Yes. We ran two cases, one assuming that at 24 hours, you start injecting water and you continue for the next two days or 72 hours. That's 500 GPM.

MEMBER STETKAR: Okay.

MR. ESMAILI: If you -- unfortunately, you know, but you're -- I sympathize because you haven't seen all the other graphs that shows how the containment water level, how the containment pressure is.

MEMBER STETKAR: We don't need to repeat my rants. You're right. We haven't seen it.

MR. ESMAILI: So I'm trying to -- yeah. So what happens is that if you continue adding water for the next two days, in this case at about 50 hours, okay, when you talk about water addition, about 50 hours you have built up enough water. You have compressed that thing enough that you need to go to open the drywell, because at that point you have reached the 21 feet. You have reached the hot level inside the wetwell.

At that point you isolate the wetwell vent, okay. You let it pressurized, and then once you get back to that 60 psig, then you open the drywell vent. In the case of the water management, what you do is that you just control the water. You never go to the drywell vent.

MEMBER STETKAR: That I get. That's Method 3.

MR. ESMAILI: Yes.

MEMBER STETKAR: We're talking about Method 2 here. So I don't want to talk about Method 3.

MEMBER BLEY: What was in Method 2, did that case get actually run?

MR. KARIPINENI: That would be slightly less temperature than this, because this would be a conservative case for Method 2 really because --

MEMBER BLEY: So the answer's no?

MR. ESMAILI: What is Method 2?

MR. KARIPINENI: Method 2 is the drywell vent.

MEMBER STETKAR: Method 2 is what you described in terms --

(Simultaneous speaking.)

MR. ESMAILI: Right.

MR. KARIPINENI: It was run. Yes, it was run.

MR. ESMAILI: So we --

MEMBER STETKAR: And what does it look like since --

MR. KARIPINENI: That's the one I --

MR. ESMAILI: As soon as you start injecting water at the time of lower head failure, which is this case, this is the type of temperatures you're going to see.

CONSULTANT SHACK: So you're saying these temperatures look like this even in that case?

MR. KARIPINENI: Yes.

MR. ESMAILI: Even if you do drywell venting, yes.

MR. KARIPINENI: Yes.

MEMBER REMPE: So what you do, the operator needs to know what the water level is?

MR. RECKLEY: Not until they get to the next one, Method 3.

MEMBER REMPE: Okay. Is there any sort of instrumentation required for this method?

MR. RECKLEY: Yes.

MEMBER REMPE: Okay, and you talked about the qualification of the equipment. Is there any issue with the pressure instrumentation? Is it rated for all these conditions, and is there specific guidance and will the staff be reviewing any of that guidance for it?

MR. RECKLEY: Yes. There's within the guidance, and then in the ISG, we took up on the instrumentation requirements for pressure and level. The accident qualifications of that instrumentation and all of that would be described for each licensee, in terms of what equipment they have and how they will use it within the integrated plans that they'll submit. But I don't know. Phil, did you want to --

MR. AMWAY: Yes. My name's Phil Amway

representing the industry this morning. We will talk about, in our presentation, more detail about the different methods and particularly the instrumentation that would be necessary for the SAWA-SAWM strategies.

MEMBER REMPE: Okay.

MEMBER BALLINGER: You're trying to meet the 545 degree limit, right? You don't want to go above that.

MR. RECKLEY: It's trying to show that the 545 degrees is a reasonable number for the design specification of the -- of a drywell vent, should anyone choose to do a drywell vent.

MEMBER BALLINGER: Okay. So just the drywell vent, period?

MR. RECKLEY: Right.

MEMBER STETKAR: The idea being that if you get a lot warmer than that, other penetrations in the drywell head seals are going to start failing. So why qualify it to higher than that?

MEMBER BROWN: But it's not just the drywell. There's also a wetwell vent in this also. I mean this all assumes there's a wetwell vent system installed.

MR. RECKLEY: Both cases.

MEMBER BROWN: Until it gets filled with

water --

(Simultaneous speaking.)

MEMBER STETKAR: Oh, I understand that. Once you fill it up, it's useless. But I mean --

MEMBER BALLINGER: But since nobody's going to do a drywell vent without water addition, the 545 is not important.

MALE PARTICIPANT: No, it is important.

MEMBER STETKAR: It's important. It is important to show that you don't need to qualify the thing for more than that temperature of this picture. Or that you might need to open it earlier, for example. You know, there was some assumptions about when you needed to open it.

CHAIRMAN SCHULTZ: But what's so confusing me is what part of this picture, this sequence is associated with water management? When does that come in?

(Simultaneous speaking.)

CHAIRMAN SCHULTZ: But when does it happen? After the -- 36 hours on, right?

MR. RECKLEY: Yeah.

MEMBER STETKAR: So about 39 hours I think.

CHAIRMAN SCHULTZ: 39? Okay.

MR. KARIPINENI: At the peak temperatures, you can see that it's --

(Simultaneous speaking.)

MEMBER STETKAR: That's fine.

MR. KARIPINENI: For example, they're all temperatures --

MEMBER STETKAR: But now I can differentiate and --

(Simultaneous speaking.)

MEMBER STETKAR: --as to why this case is good for what you presented previously, and what you're presenting now. I got it. Thank you.

MR. AMWAY: This is Phil Amway again. I'd just like to have one more comment. When we get to the industry presentation, we have some plots that will show the sequence of SAWM, when you initially establish the SAWA flow rate of 500 GPM, when you throttle it back and what the plots look like in terms of the wetwell level response through, all the way out through the seven days --

MEMBER STETKAR: But again that's Method 3. We haven't got to Method 3 yet. We're still talking about Method 2, which indeed is possible under the NEI guidance.

MR. AMWAY: Yes, and we have the -- we can show the results for Method 2 as well. So when we get to the industry presentation, we'll have that. We're good to go.

MR. RECKLEY: Did you want show this one?

MR. KARIPINENI: Yeah, yeah. The slide before that. The water addition, where is the water addition connection point to inject and to deal with the vessel and the drywell? What the industry has done is basically run the point that they have provided for 049 mitigating strategies. They have half-piped that out to a point where they can have some shielding, etcetera.

It could be sometimes right at the edge of the reactor building, or maybe a little bit farther out. That's where they would bring in the FLEX connections or whatever to make the injection point connection. So that's the -- that's what the severe accident water addition, hardware-wise, the change is.

The pumps, etcetera, are same as in the 049, the same pump, and if one pump fails they would have to use another pump. But the connection point is what got moved out to the place where that can be achieved, the injection.

MEMBER STETKAR: I was little surprised when I looked at the ISG discussion of Method 2. There's a statement that says Appendix I of NEI-13-02 discusses reactor pressure vessel pressure control in the realm of the emergency procedure guidelines and severe accident guidelines. "This discussion is informational on how the equipment would be used, but has no direct bearing on the implementation of Phase 2. Therefore, the NRC did not review and is not endorsing this discussion."

Is that because you're presuming that the vessel failure by itself is enough to depressurize you sufficiently? So it's that the FLEX injection would give you 500 GPM? Because otherwise, I mean you know how they -- that whole Appendix I talks about actuating ADS and leaving ADS open, and that regardless of how you get into trouble, the operators would eventually be instructed to do that.

So it's that pressure is then low enough for you to get adequate flow. So it seemed to me as kind of a critical element, regardless of whether you're doing Method 2 or Method 3 to get pressure down. You're saying well, you didn't care about it. Maybe I misinterpreted that paragraph but --

MR. RECKLEY: This is Bill Reckley again. But the difficulty we have in realms like this is what's covered by what requirement that's in play. All we were trying to say by that statement is that as important as it is, that aspect is not addressed by the vent order.

Although the SAMGs and EOPs are calling for that action, we didn't look at that separately in regards to the vent.

MEMBER STETKAR: But for the vent to succeed, I need some amount of water flow. I mean the analyses are based on 500 GPM under just water addition, throttled back to some, I forgot what it was, throttled back under the severe accident water management. But if I just look at the water addition, it's based on a presumption of 500 GPM and if it's something less than that, you'd succeed.

But I still have to have pressure low enough to get that water in, for the -- now I'm partitioning it for the venting function to work, right?

MR. RECKLEY: Yes.

MEMBER STETKAR: So I don't know why it's not important to the vent function. I understand it's important for other things also.

MR. KARIPINENI: By the time the water addition and everything comes into play, you would have basically the situation with X-vessel, and you have already depressurized in that sense. You're only talking about --

MEMBER STETKAR: You absolutely know that the vessel is going to depressurize sufficiently that if I'm -- by taking the option of severe water accident SAWA, the water addition to the vessel, you know absolutely that regardless of how the melt progresses, that by that time it will be low enough so that I can get 500 GPM out of my low pressure pump? You know that.

I don't know. I'm not a thermal hydraulist guy. Under any of these melt scenarios.

MR. ESMAILI: This is Hossein Esmaili again. I tried as best as I can. We get both water addition into the drywell. This is we're talking about still structures, right, what's happening inside the containment. We did do water addition inside the containment into the drywell and into the RPV.

We didn't -- in terms of temperature differences, we didn't see much difference. So as long as you have water, it doesn't matter.

MEMBER STETKAR: Okay. Let me stop you right there. I got it. Into the drywell, I know that the pressure is going to be low. If it gets really high, we have a bad day. I'm talking about water addition into the vessel. How do I get pressure low enough in the vessel so that I get 500 gallons a minute of water going into the vessel? How do I do that?

You just assumed it was low enough, right? I'm asking how do I get it low enough?

MR. KARIPINENI: Well, even if you cannot get water --

CONSULTANT SHACK: If you've set the system up to inject into the RPV, then you darn well better be able to get the pressure down.

MEMBER STETKAR: This little drawing here doesn't show any injection, I don't think, into the drywell. It looks like it's going into the RPV, doesn't it?

MR. ESMAILI: It's going straight into the RPVs.

MEMBER STETKAR: Yeah, okay. So if I pipe it up this way, I'd better have pressure in that little sort of circly-looking thing to the right. I'd better have pressure low enough so I can get enough flow. Now how do I get that pressure low enough? It is presumed that the vessel always blows down sufficiently to get that pressure low by itself, because of the melt?

CHAIRMAN SCHULTZ: Or is there some other way?

MEMBER STETKAR: Is there some other way, which Appendix I in NEI-13-02 says it will always be that low, even before melt, because the operators will always open the ADS valves and leave them open. You're saying that's irrelevant to the ISG.

MR. RECKLEY: It's an assumption through your water injection to save containment, that either the licensee will have used ADS to depressurize, as the procedure calls for, or ultimately that the core will melt through the bottom of the reactor vessel.

In either case, the severe accident water addition being added to the Order to support improved containment performance would serve its purpose.

MEMBER STETKAR: What I'm questioning is the second part of that statement, where you said either they're going to blow down through ADS, which you're not looking at or --

CHAIRMAN SCHULTZ: It's going to melt through.

MEMBER STETKAR: Or the melt will sufficiently depressurize the vessel under all of the possible scenarios, such that that water -- you will get enough water in. I'm not a thermal hydraulist guy. I don't know. I just don't. I'm not trying to be coy here. I just don't know whether or not the vessel will depressurize sufficiently to get the types of water injection at the timing that you're assuming here, and I don't know if people have run those analyses. Or you just assumed that it will depressurized.

MR. ESMAILI: This is Hossein Esmaili again. We do different analysis. We assume that at the time the RCIC's operational for a while, once you lose RCIC you try to depressurize, because you want to get low pressure injections that come in.

We did calculation where we did not depressurize. Even if you do not depressurize, shortly after core damage, the temperatures are high enough that it's going to cause the SRV to get stuck open. So that's one way, that there's a high power leak and the SRV gets stuck open and you depressurize.

CHAIRMAN SCHULTZ: That's not depressurizing.

MEMBER STETKAR: That's not depressurizing. That's -- all it's doing is opening up enough to relieve that amount of energy. I mean it's not going to -- it's not going to blow itself all the way open fully.

MR. ESMAILI: If one SRV gets stuck open, it's going to depressurize the vessel.

MEMBER STETKAR: If you assume it is stuck open. But the world doesn't necessarily work that way.

CHAIRMAN SCHULTZ: Don't always stick.

MEMBER STETKAR: Don't always go fully open and stick open.

MEMBER BLEY: So it can sit there and cook and hold that -- the set pressure for a very long time.

MEMBER STETKAR: In its normal SRV mode, a spring-loaded valve, not something that's actively open.

CONSULTANT SHACK: But you do assume that the 500 GPM starts at lower head failure. You're really making an assumption that John is making, that lower head failure is sufficient to depressurize the reactor. Then you get your 500 GPM there either because --

MEMBER STETKAR: That sounds like what they're assuming, and I don't know whether --

MEMBER REMPE: If it's a MELCOR analysis --

(Simultaneous speaking.)

MR. ESMAILI: The assumption --

MEMBER REMPE: --line failing rather than lower head fail?

MR. ESMAILI: The assumption is that water injection, either into the vessel or into the containment, starts at the time of lower head failure. So whatever you saw before, hydrogen and temperatures, etcetera, that assumes here.

MEMBER STETKAR: But I'm an engineer. So I piped up my plant according to this drawing here. So

I don't have any connection into the drywell. I didn't do it that way, because I can't see why I'd want to do that. I piped it up this way because there's a lot of reasons I'd like to get water into that vessel.

So I did this. So your Or is not operable. I can't inject into the drywell. I can only inject into the vessel, and you're claiming that under that condition, you're okay.

MALE PARTICIPANT: You get 500 GPM.

MEMBER STETKAR: You get 500 GPM out of the low pressure pump.

MR. ESMAILI: At vessel failure.

MEMBER STETKAR: And you're assuming that the vessel failure is sufficient enough to depressurize you, such that you get 500 GPM out of your low pressure pump, because you only have a low pressure pump. You don't have a high pressure pump.

MR. ESMAILI: Yeah. We think --

MEMBER STETKAR: I'm not a severe accident person.

MEMBER REMPE: So again with MELCOR, would you get lower head failure or would you get another type of piping failure that would depressurize the vessel at the main steam line failure that they often predict with --

MR. ESMAILI: Depends -- depends on what your assumption is. If you do -- if you actually do, I think maybe -- if you actually do cycle the SRV during the time that, you know, the pressure is low and then you continue the cycling the SRV at low pressure, even though we get to the high temperature cases, okay, this is during the core damage.

You then get main steam line failure. You get SRV failure. Regardless, what I'm trying to say is that even if you wait until the lower head fails, and the lower head -- even if you -- even if the original lower head failure size is small, it's going to -- you're going to depressurize the vessel at the time of lower head failure.

So if you are going to -- so the question is that you're either going to be able to inject into the vessel, okay, or into the containment. If the containment is not available, you can inject into the vessel. If you cannot inject, then this is what happens. You are going to have a containment failure.

So we have analyzed all the cases. So you either have SRV sticking open. If that doesn't happen, our assumption that we start injecting at the time of lower head failure.

CONSULTANT SHACK: This is MELCOR analysis, not a pipe guide for putting in pipe.

CHAIRMAN SCHULTZ: I guess at some point we would like to see, without iterating, it would be helpful to have not only temperature plots but the pressure plots and other things that would indicate what's really happening and demonstrating the functionality of the overall system. But I think we should go ahead to Method -- have you finished Method 2 at this point?

MR. RECKLEY: Well, except for the issues --

(Simultaneous speaking.)

MR. RECKLEY: --that basically say how we resolved.

MR. KARIPINENI: Yeah. We didn't get to that slide yet.

MR. RECKLEY: Is that Slide 18?

MR. KARIPINENI: Slide 18, yeah. This is where the issues that we talked about in our draft ISG comes. From the very beginning, our thought was that under the severe accident water addition, even though the industry calls it a strategy, we felt like there were some requirements, functional requirements that they will have to show us.

There was discussions in that regard, and by the time we did the draft ISG, we didn't come to complete alignment yet. That's why it was shown as an item in the ISG. What we felt was that the functional requirements that were provided in the Order, Section A, the high level functional requirements, would also apply to a severe accident water addition.

But if you read them, some of them are not applicable to your water addition type issue that's related to your vent issue. But from the aspect of showing that this is all workable, we felt like these are the requirements you still would have to look at, and show us, you know, that you're meeting them and that you show us how the -- any instruments that are required for severe accident water addition will get the power, things like these that we're addressing in the Order itself.

We said you need to go there and come back and show that everything works. Which is where the meeting in the last week or early this week on Monday, we were headed in the right direction. Industry's proposing to have that discussion of functional requirements for SAWA, to address all the time-sensitive actions and equipment capabilities, and also the accessibility required to get there, to take these actions.

So these are all being addressed in the

revised document that will be coming into us within a week or ten days or whatever, that could give all that, and then we'll --

MEMBER STETKAR: And then the draft ISG will be amended to reflect that?

MR. KARIPINENI: Amended, yes sir.

MEMBER REMPE: You said ten days before you even see what industry will give you? Is that what I heard?

MR. KARIPINENI: I don't remember the exact date, but it was like 10 business days.

MR. AULUCK: -- the revised guidance document by March 31st.

MR. RECKLEY: But the reason we have confidence in this is that this particular issue was a level of detail kind of issue. It wasn't a strong technical disagreement on any really philosophical point. It was a level of detail. We wanted more discussion of what the functional requirements were, the water addition components of the strategy were. The discussions we had on Monday gives us confidence that we're basically on the same page in terms of what that level of detailed discussion will be in the submittal that we'll be getting.

So again, this is what I was saying. It's not fundamentally an issue, and what you will see with the revisions not a dramatic change from A to B. It's just further explaining what A is.

MEMBER STETKAR: But this indicates that there will also be a revision, you know, OE-3 or something or other to NEI-13-02 issued in parallel with that, right?

MR. RECKLEY: Yeah. That's what we're talking about getting by the end of the month, and then the ISG would be changed to eliminate, assuming that everything works. We see what we're expecting to see.

MEMBER STETKAR: I was going to say. You're going to have to read the words in that. Yes.

MEMBER REMPE: And you really can't get it done before our next meeting, that revised ISG. You think you're going to do something like that in less than six days?

MR. AULUCK: We plan to.

MR. RECKLEY: Yes, assuming -- and here we go to Method 3.

CONSULTANT SHACK: Just in time documentation.

(Laughter.)

MR. KARIPINENI: Slide No. 19. Method 3 is a severe accident water addition with severe accident water management. The underlying reason for that is there would be no drywell vent at all, severe accident drywell vent. The wetwell vent will be preserved for as long as they can, managing the water level, and that's how they would show there's no need for a drywell vent.

Okay, that's what basically the Method 3 is. The sustained operations of the severe accident wetwell vent, it will be required until an ultimate reliable heat removal capability is established. Those are the words from the Order itself.

The issue is somewhat similar to what we talked about in Method 2. The concept is if you have an alternate heat removal capability, what are the functional requirements for that alternate heat removal capability. Provide us a success path with what we are asking them, and basically the guidance establish the time for 72 hours of coping, coping period. It's what they call coping time concept.

Beyond 72 hours, you know, the wetwell vent may start getting flooded. If the wetwell vent is preserved all the way up to seven day sustained period, let me explain what the sustained operation concept is. It came about in Phase One.

I mean we have to establish some time until which under the Order requirements the vent would have to operate, and at that time we said either seven days, or until you have an alternate heat removal system established, and that is the concept.

So to preserve the wetwell vent all the way up to seven days, it's pretty clear to us that you don't have to show us an alternate heat removal system instead, because that's a lot of time, by which time we agree that you can go do many things and potentially establish some kind of a system.

But if you are preserving it for less than that period, we felt that the alternate heat removal system does come under some kind of review from us, which you show us what it is. Show us the success path you can do it within this time period. They established basically three variations in that time period.

One is operational 72 hours, preserve it for less than 72 hours, and one is between 72 hours and seven days, and one is about seven days. Those are the three tier approach in phase -- in 21, Slide 21. I just talked about it. Let's go to 22.

MR. RECKLEY: So just go back again. So just to be clear, what the delta is between what we gave you and what we think the final product is is that in the I guidance, we'll -- it's another question of level of detail, largely of what will be in the guidance. So the level of discussion varies, depending on your confidence in maintaining the wetwell vent.

Do you have confidence that licensees will show that it can be maintained for at least seven days. There's really no expectation that that licensee would provide additional information on hooking up an alternate heat removal system.

If it's between three days and seven days, they would provide a little more -- they would provide information on how they would be able to do it, and if it's less than 72 hours that they would be able to show wetwell venting, then they have to show even more, and provide a higher level of confidence by showing actual connections and so forth.

CHAIRMAN SCHULTZ: So okay. But even more has not been defined. In other words, you still feel -- you still feel that less than 72 hours could be acceptable, a sufficient connection?

MR. RECKLEY: Yes, but the rigor that the licensee would have to go through to show that that alternate heat removal could be hooked up goes up a notch, you know. If Method 2 -- if Option 2 here is we can cut a pipe and we can put in a line, then the third one is no, it already exists. There's a plan there and it's not cutting and welding. It's actually in place. So that's the distinction.

MR. KARIPINENI: So here being that the staff would review those proposed approaches that they would give all the three tiers, and ask for any questions on anything, and finally agree it can be done, or we think there's something more that needs to be done. That would take place at the time of the actual reviews by the -- when the individual licensees provide their implementation plans, and what exactly they're doing in this case.

CONSULTANT SHACK: Sometimes I have a hard time matching up what happens in the FLEX situation with this world. But you know, I'm using my FLEX pump. Well, if my FLEX pump works, I'm probably not going to melt the core unless, you know, unless I failed ADS, in which case I'm back to John's question.

I've got to make sure that the lower head failure is enough to get my 500 GPM in. Have people thought about -- I know they're sort of doing this on a boundary condition thing, without looking at specific scenarios.

But does it all kind of hang together, you know. Would I get into this because my FLEX equipment worked, but the RCIC didn't last long enough for me to do the full FLEX? And then now I'm in a severe accident, because I've melted the core, because I lost RCIC a lot sooner than I thought?

MR. RECKLEY: Any of those. I mean the way I look at these Orders is we're trying to put in a requirement that licensees have additional capabilities, and FLEX is I've lost power, I've lost heat sink. I have additional capabilities through installed equipment, RCIC and portable pumps, to try to prevent the core from melting.

There's some chance that won't work. Either RCIC won't last as long as I thought, or it will fail. Or when I transition to portable pump, there's some other issue, right. This for Mark I and II containments, because of the specifics of those containment designs, and the sensitivity of the containment failure to core melt, an additional capability is being added for the venting and now for the severe accident water addition as part of that, an additional capability.

So yes. If FLEX works, you don't need this. You don't need the severe accident portions of this. You still need the venting part, because that's supporting maintaining RCIC as part of FLEX. So you still vent, but in terms of the severe accident portions of this Order and particularly Phase 2 that we're talking about now, you shouldn't need this if FLEX works.

But in case FLEX doesn't work, this is an additional capability, because of the particular sensitivity to Mark I and II containments.

MR. KARIPINENI: For instance, if for FLEX the connection point we showed in our slide, it was in the reactor building, goes to a pipe there, and the assumption is that the FLEX did not come in time, and severe accident process is already in play, can you even go into the reactor building to make this connection?

So in SOARCA I would move that pipe out to a point with shielding and everything, and it could eventually be the same FLEX pump and the same pre-core melt strategy that we're just starting to develop the severe accident already. Okay.

MR. RECKLEY: The last issue.

MR. KARIPINENI: The last issue is the alternate to containment pressure control. The Order states that alternate heat removal system and alternate pressure control. The guidance is somewhat inconsistent in places, that refer to the need for an alternate pressure control after you've flooded the wetwell vent, and if there is something like that needed, we felt well, then you're really needing to vent the drywell vent.

So there are some functional requirements you will have to go in and address, just like the way you're addressing the alternate heat removal for us. The response we got was after the wetwell is flooded, they would not need a drywell vent at all in the flood-up process, after you've flooded the wetwell and your level is going up.

We'll be waiting for the revised guidance there. Any requirement for alternate pressure control after the -- for the long-term, that would be taken care of from basically the same procedure interfaces at that time.

MR. RECKLEY: A key point here is pressure control, in order to protect the containment from overpressure conditions, versus a need to vent the containment for other purposes, such as flood-up or whatever other purpose might be later in accident recovery or management, in order to vent the containment.

So really here what we agreed to was to kind of define the scope of the Order, and that long-term need to vent or other than overpressure protection of the containment, we agreed that will be addressed under the existing -- or to be developed programs in terms of SANGs and other aspects of accident management, and not addressed specifically by this Order.

MR. RECKLEY: The last slide.

MR. KARIPINENI: Yes. These are some of the other exceptions clarifications that we have done in page one. These are pretty consistent with what we are done then.

For instance, we're not reviewing the EOP-SANGs. In fact, there was another revised EOP-SANGs available I believe. Plus there is a rulemaking going on, whether we have any -- whether we'll be going to the reload at all on that is going to be addressed in that time.

So at this point, whatever references you made to EOP-SANGs, okay they're for information. But we are not -- staff is not endorsing any of those. We do want operating procedures for the vent, that is the wetwell or drywell vent, and they will be there. They're submitting that. We'll be reviewing those. But how they interface with the EOP-SANGs also we'll look at.

But in what context they're actually using the SANGs, etcetera, that we felt like at this point it's not under our --

MEMBER STETKAR: Rao, you said you're not going -- you said you haven't. But you're not planning to review that EPRI technical report, which is the basis for all of this. Is that because you're performing independent MELCOR analyses on your own to provide that information or that's because, you know, it's a fundamental reference in the NEI guidance.

MR. RECKLEY: It is, but I look at it is as a body of knowledge, if you will. The purpose of this Order, what decision we need to make is whether 545 degrees as a design specification for the vent is a reasonable number.

And what we've seen from the EPRI work and the work our own Research people have done, and other work from the broader body of knowledge on severe accidents for these things, SOARCA and other things, are showing that 545 degrees is a reasonable --

(Automated message.)

MR. RECKLEY: Then and I noticed in the industry slide deck they have a slide that we used in Phase 1. The 545's not a magical number, in that you need to look at it within the overall scope of protecting a containment and when penetrations are going to fail and when other things are going to fail, and how much margin is built between a design specification and when you actually expect equipment to begin to fail.

All of that makes this not a number that if the EPRI analysis had shown 550 degrees, you know, it's not that Order. It's really to a reasonable value for the design specification. That's what we were trying to get out of this. So the level of rigor that we need for the analysis of any of this is not really the same as when you get into a regulatory analysis and using those numbers in terms of cost-benefit assessments and so forth.

So that's the reason we don't feel we need to review. We're being informed by, but we don't feel we need to actually review and approve those reports.

MEMBER BALLINGER: So you're satisfied -- excuse me. You're satisfied that any uncertainties in these analysis and these calculations and stuff like that, when you consider all those things, you're far enough away from whatever limit there is, and you've done the analysis to satisfy yourself that that's the case?

MR. RECKLEY: Yes.

(Simultaneous speaking.)

MR. RECKLEY: That it's a reasonable number, and that's the trouble that you get in the severe accident space, is it's separate from like design basis space, where you're saying there's a 95-95, you know, probability and confidence level that something's going to work the way you think it's going to work.

You know you're not in that space in this particular realm, that when you look at the history and what few experiments have been done on the performance of equipment at these conditions, yeah, we're reasonably -- 545 is a reasonable number, and basically keep in mind that we had accepted that number in Phase 1 for the connected piping.

Really, the decision that we're making now is yeah, that initial assumption we made on Phase 1 in terms of connected equipment, connected meaning drywell and wetwell vent, that the portion of the piping between the drywell and the connected piping can also be to that 545 degree temperature.

CHAIRMAN SCHULTZ: But what you've described is in support of Method 2. With respect to Method 3, the review of the EPRI documentation and so forth is not required?

MR. RECKLEY: Well, it is the --

MR. KARIPINENI: Leave it to me.

MR. RECKLEY: Yeah, go ahead please.

MR. KARIPINENI: With Method 3, until the wetwell vent gets flooded, the calculations still show with the wetwell vent and the water addition and water management, that 545 degrees is still achievable. It will remain there. There's no -- the MELCOR and the MAAP analysis they have done do agree on that.

MEMBER STETKAR: But in that case, you're relying -- if I understand what you're saying, you're relying on the MELCOR analyses that you've done?

MEMBER BLEY: And they confirm what you saw from EPRI?

MR. RECKLEY: Right. But the importance of that is not in designing a particular piece of equipment like a drywell vent. The importance of that is in showing like these numbers show, that the conditions within the drywell are basically keeping the containment function intact.

The temperatures and pressures are being controlled, such that you're not failing other penetrations or lifting the drywell head, such that you're leaking the hydrogen and radioactive materials out from another place. So it's a different use of the numbers. So yes, we're using them, but it's not to the same purpose.

MEMBER STETKAR: Just on the 545, I mean when

I -- I'm looking at Klaus containment seal paper from the Sandia, back there in the good old 90's, and 545 looks pretty reasonable for an EPDM seal. It doesn't look so reasonable for a silicon seal.

And then I read Harao, who says that they use silicon seals in Japanese BWRs. Who do we use in our BWRs?

MEMBER POWERS: And they use silicon seals.

MEMBER STETKAR: They use silicon seals?

MEMBER POWERS: Yeah.

MEMBER STETKAR: 545 doesn't look so good for silicon seals.

MEMBER POWERS: Yeah. We did -- in the course of NUREG-1150, we did test the seal and it held pretty well up to about 700 degrees.

CONSULTANT SHACK: Well I'm looking at the Klaus paper.

MEMBER POWERS: What it did not do is that if you vented it, it wouldn't reseal. In fact, they degraded .

MEMBER STETKAR: Push the microphone towards you.

MEMBER REMPE: Could you repeat what you said Dana?

MEMBER POWERS: In the course of doing the

LaSalle and the NUREG-1150 analyses, the question of the head seal venting came up, and the good people at Idaho offered a facility that we could run a test, and in fact the test was run up at Idaho, where they put in the seal material that was reputed to be used in I believe it was actually Brown's Ferry and not Peach Bottom. They ran it up for a substantial amount of time, up to about 700 degrees.

CONSULTANT SHACK: Was that steam or air? Because it makes a difference.

MEMBER POWERS: Yeah, it surely does, and you've got me. I think they pressurized it probably with nitrogen. But you know you've got me.

CONSULTANT SHACK: The steam results are different from the nitrogen results.

MEMBER POWERS: Yeah. Well, there's another issue too. It's also different if you have a radiation --

CONSULTANT SHACK: Radiation helps.

MEMBER POWERS: It brings the hell out of a seal.

CONSULTANT SHACK: Yeah, but if you're extruding the seal, hardening is good. Again, the Klaus and Harao just do better with the radiation.

MEMBER POWERS: What they observed in the experiments was that the seal held. Now when they opened the seal, it was badly degraded, and it would not reseal. So after venting, it would not come back and squeeze back up, and that was the issue that they were really --

Well, the issue that had come up was that the bolting on the drywell head seal was different in Brown's Ferry and Peach Bottom, that it was possible by thermal expansion for Peach Bottom's head seal to lose tension and it would vent, much like we think we observed at the Fukushima reactor accident.

The question is would it, and like I said, they ran the experiment and it held pressure for hours at 700 degrees. But had it ever vent, it would never hold. It wouldn't, it just wouldn't reseal. The seal was badly degraded.

MEMBER STETKAR: But again, I mean the 545 is just, you know, the design -- what do I design the vent valve and the piping up to, so that I have assurance that it's going to work up to that temperature? If I need to open it to provide --

(Simultaneous speaking.)

MEMBER STETKAR: Yeah. I mean the criteria for when I open that had better be pretty clear.

MR. KARIPINENI: The guidance references to the seal material level looked at when they wrote the guidance, and that gave some temperatures et cetera in NEI-13-02.

MEMBER STETKAR: All right. Other questions for the staff from the Committee? Pete, are you out there?

(No response.)

MEMBER STETKAR: Not at this time.

MEMBER RICCARDELLA: Yeah, I am. I'm here. I was on mute.

MEMBER STETKAR: Any questions, Pete at this time? We're going to move to the industry --

MEMBER RICCARDELLA: I'm following it as best I can.

MEMBER STETKAR: All right, after the break. So we'll recess now until 10:35.

(Whereupon, the above-entitled matter went off the record at 10:18 a.m. and resumed at 10:35 a.m.)

CHAIRMAN SCHULTZ: We will come into session and on the record.

Before we start, Steve, you had some discussions with the staff regarding information that can be provided to provide additional technical basis.

John, do you want to --

MEMBER STETKAR: Yes, I just want it on the record, because of the discussion we have had earlier about supporting information, it is my understanding that the staff does have the analyses available or some analyses available to support the CPRR rulemaking that may answer some of our technical questions regarding thermal hydraulic analyses.

I would like to formally request that the Subcommittee members be provided with those analyses very soon, meaning very early next week at the latest. Can the staff do that?

MR. RECKLEY: Yes, the staff will provide early next week the material that we have compiled to support the CPRR rulemaking. Now it is still in the concurrence process --

MEMBER STETKAR: Yes.

MR. RECKLEY: -- so it will be draft.

MEMBER STETKAR: Yes.

MR. RECKLEY: But we will get it to you early next week.

MEMBER STETKAR: Yes, we will treat it that way.

CHAIRMAN SCHULTZ: You can provide it to Weidong.

MR. RECKLEY: Yes.

CHAIRMAN SCHULTZ: And we will have that

circulated to the Committee.

Thank you very much.

MEMBER STETKAR: Thank you.

CHAIRMAN SCHULTZ: With that, we will turn it to the industry presentation and introduce and welcome Steve Kraft from NEI.

MR. KRAFT: Thank you, Mr. Chairman.

I am Steven Kraft from the Nuclear Energy Institute. My colleagues here with me today, Phil Amway from Exelon and Jeff Gabor from Erin Engineering. These are two gentlemen you have seen before in other discussions and have lead responsibilities in the industry for not only the vent water, but for the CPRR rulemaking.

To the point Dr. Stetkar just made on the record, I am glad to know that the staff can be accommodated. We are very sensitive to the fact of these references, particularly our own, but from EPRI, not yet available. And I just offer an explanation. It is that the rulemaking and the vent are operating on parallel but offset pathways, obviously.

Frankly, when you read the water, and not only read the water, but study the structure of the water, what is now being referred to, conveniently, as Method 1 was the primary idea that the staff is interested in. Put in a drywell vent; call it done. And that was basically going to be a set of mechanical and electrical kind of engineering requirements, and not terribly more challenging than that.

But we really delved into the rulemaking analysis on both the NRC and industry side, that we realized the value of this water management strategy, water management addition. Now I am sure you will be the first to tell me that injecting water into a reactor to prevent core damage and control of melting core is not news, and it is not.

What is new is having to do so reliably -- and I stress the word "reliably" -- under ELAP conditions. That was the main learning in this context from Fukushima. And that is where all the complications begin.

And then, as first we did the wetwell vent because that was the first thing in the order schedule-wise, and it is also the thing that was easier for the utilities to do. A lot of the plants have some sort of wetwell vent. Certainly, the MARK Is in response to Generic Letter 89-16. It is a matter of making that meet the new water requirements. And while it was not a simple thing to do, the guide is a lot easier to put together.

We began to face up to Phase 2, and we were trying to figure out what we could do with that allowance in Phase 2 of the order that said, you know, you could have strategies to avoid going to a drywell vent, which has implications for the rulemaking as well.

We began looking into the rulemaking results. I think the NRC was trying to do the same thing in parallel. And surely we had this "aha" moment in April of this year where we said, you know what? The real issue here is injecting water because the real thing we are trying to do is control containment.

If you go back to our tabletop studies done in November of 2012, when we were dealing with the development of what turned into SECY-12-0157, we concluded that the issue was protecting the payment, management payment during accident, not necessarily any one specific function, such as filtering or what have you. That is where the reliable water part came in.

And then, it occurred to us that what we should do, and what we did do, is approach NRC management and say, "Look, what we are contemplating here is taking what would have been a requirement under a projected rulemaking for water addition and water management and moving, the one addition anyway, and moving it into our compliance for the water, our compliance guidance for the water.

That answered a heck of a lot of questions and gave people a lot of comfort that we were planning on protecting the payment. Because the point that Rao made was a very good one, and we have told the industry any number of times at all levels that, if you should select what is now called Method 1, which is not really covered in our guidance at all, you will have not only tell NRC how are you going to do it, they are going to ask you how you are going to protect containment and where is water addition, anyway. So, you will like that part. So, you might as well do it in the first place. And everyone has that understanding.

But, because it still lives in the order, it is kind of an obligation on our part to at least mention it in the guidance. We are aware of no plant that is contemplating electing Method 1. But we are following it very, very closely, and we will make sure we understand compliance.

With regard to who might be electing Method 2 versus Method 3, we don't know yet. There is a desire in the industry for everyone to go to Method 3, but there may be geometric problems in the plant that prevent that. There may be one or two that can't. We don't know just yet.

But the BWR Owners' Group, in fact, is -- one of the reasons we are the only three industry folks here is there is a big meeting out in California. Again, that one snow day that hit us on March 5th just threw everyone's schedule off. It is amazing how interconnected that turned out to be.

The feedback from that meeting is that everyone is trying to figure out how to do Method 3, and we will probably try to go in that direction. We won't know, of course, until we see the integrated plans at the end of the year.

So, with that background, let me turn it over to Phil for the bulk of the presentation.

MEMBER BROWN: Method 3 has no drywells in it?

MR. KRAFT: Not a severe accident drywell vent. Plants may have drywell vents.

MEMBER BROWN: Okay, but not the severe accident --

MR. AMWAY: It is not credited for use for meeting the order, is probably the best way to describe it.

MEMBER BROWN: Okay. The temperature,

pressure, whatever those conditions may be?

MEMBER STETKAR: It is something that has already happened.

MR. AMWAY: Right.

MEMBER BROWN: I am not a big BWR-type guy. I just wanted to make sure I understood the nuance on the severe accident vis whatever just an installed drywell --

MR. KRAFT: It is just the recommendations under the water more than anything else.

MEMBER BROWN: All the actions come back to managing water or whatever you do in the wetwell?

MR. KRAFT: Correct.

MEMBER BROWN: And its vent?

MR. KRAFT: Yes.

MEMBER BROWN: Okay.

MR. KRAFT: And managing water in the drywell, I mean as the water flows.

MEMBER BROWN: Yes, okay.

MR. KRAFT: To your point, Dr. Stetkar, one -- I will not name the site -- contacted us and said, "Well, we've got this connection. Do we have to severe it."

(Laughter.)

MEMBER BALLINGER: Cap it off?

MR. KRAFT: Cap it off, right, avoid it, take the valve out.

We said, "Why would you do more work than you have to do?"

MR. AMWAY: Okay. With that, I have got to get into this. The way I have got to get through this presentation is I will leave through it. At particular portions, particularly with some of the analyses and charts and graphs, I will turn it over to my colleague Jeff Gabor to discuss those items.

MEMBER BLEY: Phil?

MR. AMWAY: Yes?

MEMBER BLEY: Just to give me a heads-up on what is coming -- I haven't looked through your slides yet -- are there any points on which you folks are in disagreement with what the staff has put out?

MR. AMWAY: No, I think we are very well-aligned. I think what really remains to be seen yet -- and we had the public meeting on Monday where we went through those, I'll call them, open items, for lack of a better term, where we proposed how we were going to respond to those.

What really remains to be seen is, okay, they have seen it in a presentation format. They need to see it in what it actually looks like in writing in the guidance document. We are going to be able to deliver that to them to be able to review and to make sure that what is actually written there conforms to what we told them we would do this past Monday, but I think we are in very good alignment with the outstanding items that remain.

MEMBER BLEY: And I think what they told us is they are expecting your draft the first of next month?

MR. AMWAY: By March 31st.

MEMBER BLEY: March 31st?

MR. AMWAY: The reason not sooner is because, for the things that I talk about in this presentation, it has already been incorporated between 0E2 that you have --

MEMBER BLEY: Right.

MR. AMWAY: -- and the Draft F that we will deliver on the 31st.

But the BWROG is meeting this week for the express purpose of looking at those deltas between 0E2 and 0F drafts to make sure that the rest of industry, beyond the working group, is also aligned and understanding what those changes are and what they mean, and that they really do think that they can use that to implement Phase 3.

And so, I want that feedback and be able to look at that before I deliver that to the staff and say, "This is our final product," with the intention they look at 0F, they look at those changes, make sure they are aligned with what we said we would do on Monday.

If there are any tweaks here or there, I would expect it will be 90 to 95 percent. They may want to change a word or two or move something from one location to another, but, then, there would be very minor editorial-type stuff between the 0F that they get on 331 and Rev 1 that they would actually use and reference in the Final ISG.

CHAIRMAN SCHULTZ: Phil, you have heard our schedule. We talked about it this morning. Is there a way that you can provide us with a concise description of any changes that may be coming out of this week's meeting and affecting your document?

You said you are going to present today what is in the document, essentially.

MR. AMWAY: Right.

CHAIRMAN SCHULTZ: So, if there are any significant, if there are any changes that you --

MR. AMWAY: What we have done --

CHAIRMAN SCHULTZ: Yes.

MR. AMWAY: -- and I certainly think we can provide you as well -- is when we send 0F, we are going to send a crosswalk document that is a table format that outlines the changes between 0E2 and 0F to facilitate their review, and it would also facilitate yours as well.

CHAIRMAN SCHULTZ: That will be good. And if there are any changes from today's presentation --

MR. AMWAY: That is included in the matrix as well.

CHAIRMAN SCHULTZ: Yes, I would appreciate that.

MR. AMWAY: The way I have structured that --

CHAIRMAN SCHULTZ: To flag those, not to include them in the matrix, but also to flag them --

MR. AMWAY: Yes.

CHAIRMAN SCHULTZ: -- so we know what is different between what you are presenting today and what is in this.

MR. AMWAY: Ideally, to send the table, I would say here are the deltas between 0E2 and 0F for everything up-to-date and here is additional changes that may have come out from either the feedback we got from the BWROG meeting this week and today's meeting.

CHAIRMAN SCHULTZ: That will be very

helpful. Thank you.

MEMBER BLEY: Last question on this for me. In what you go through in the next few slides, I assume, one, that is consistent with your current draft of 0F. And, two, does it show all the substantive changes from the previous draft, not minor things, but substantive changes? Or are there substantive changes that are going to be in the new draft that you are not going to show us today?

MR. AMWAY: The current draft of 0F does show all substantive changes.

MEMBER BLEY: Okay.

MR. KRAFT: Like if you saw it today, that is what you would see, yes.

MEMBER BLEY: Right.

MR. KRAFT: And then, those will be held in --

MEMBER BLEY: What I asking you is, when you go through your presentation, will you be able to show us all those substantive changes that are there? Or are there too many to cover?

MR. AMWAY: The big ones are all here.

MEMBER BLEY: Okay. Go ahead.

MR. AMWAY: There are other lower-level ones that don't really rise to -- and there are examples of editorial-type things.

CHAIRMAN SCHULTZ: So, those would be you have seen this before or here's something new and it is going to be in 0F?

MR. AMWAY: Right.

CHAIRMAN SCHULTZ: That would be helpful.

MR. AMWAY: Right. Okay. We can certainly do that.

All right. So, if we can just start off here, the general characterization slides, and I think I can get through these first couple fairly simply because the staff has gone through some of these already.

We have revised 13-02, include the Phase 2 guidance. We have had numerous public meetings. I think the number was six since last August. We in the industry have been working closely together to work towards common design elements. Similarly, like we did in Phase 1, we did that very methodically, looking for common approaches to the designs, making sure that we developed the OIP consistently, and that when we submitted the OIPs, they contained consistent information, level of detail which facilitated the reviews for both the industry side going into it and the audit of those OIPs that the staff did.

We will continue that practice throughout Phase 2. Currently, I would say that we have a limited number of open items between the ISG and the guidance.

In terms of the functional requirements, the goal is to limit containment pressure and prevent overpressure failure modes, divide it into the two phases, the Phase 1 being the wetwell vent that we are currently implementing and Phase 2, vent capability from the drywell or the alternate venting strategy. And that is where we are going to spend most of our time today, is with the alternate venting strategy.

Control the use of common systems within and between units. That addresses the hydrogen issue with either interconnected systems or between units that could create problems with excessive leakage.

And it is important to note that the vents that we are putting in, the wetwell vent, and drywell vent, should a licensee choose that path, not only has to address the order, but it does share systems with the normal containment vent-and-purge system. And so, we have to be careful when we do the severe accident changes to make those vents useful under those scenarios, that we are not adversely impacting the normal day-to-day use of that vent. Every outage we use the vent-and-purge to inert the containment. We use the common isolation valves in most cases. And so, we have to preserve that design-basis function.

Phase 1 status. I am not going to go over the first bullet. We have already seen that. We did go through the endorsement process for the industry template on Phase 1. I bring that out because we would want to do something very similar in Phase 2 to make sure that we had a common template that the industry was going to use that would provide that consistent level of detail.

We used a pilot plant project to go through those OIPs and had a number of --

MEMBER BROWN: What is an OIP?

MR. AMWAY: Oh, Overall Integrated Plan. Sorry.

MEMBER BROWN: Okay. Thank you.

MR. AMWAY: Yes.

We used two pilot plants that walked through the Phase 1 OIP during a series of public meetings, used those as a template for the rest of the industry, and all the OIPs were submitted by 6/30/14.

The staff has conducted their initial audits of the OIPs and has issued some of the ISEs, Interim Staff Evaluations, for the OIPs.

Detailed engineering is in progress. That varies from site to site, depending on the implementation dates.

CHAIRMAN SCHULTZ: So, it would look feasible to move forward on a similar approach for Phase 2?

MR. AMWAY: Yes.

CHAIRMAN SCHULTZ: You would have to work out the details on schedule, but I am thinking more in terms of the technical approach and the process interaction with the staff.

MR. AMWAY: That's correct.

CHAIRMAN SCHULTZ: And that is what is being planned?

MR. KRAFT: I think so, Mr. Chairman, but I believe -- and, Jeff, you can chime-in -- that it will be somewhat more complicated because you will see in some of the aspects of 13.2 and some of the work that Jeff has done there may have to be some analytical work done, either on a generic basis and, then, show plants are bounding or individual site evaluations to figure out flow rates and setpoints and everything else, whether those are map runs or hand calcs or geometry, or whatever it is.

And so, it is not going to be quite as straightforward has what we will vent, because what we will vent was simply based upon what we already had.

MR. AMWAY: And where we can help out in a working group is we don't want 29 plants to go out and figure out how to do their own analysis for it. To the extent practical, we want to use the generic analysis. We want to be able to demonstrate how each plant falls within that generic analysis. But, if there are circumstances that would require any type of site-specific, we would want to identify upfront how to do that analysis, what assumptions do you use, but make sure that it is consistently being done from site to site.

CHAIRMAN SCHULTZ: So, from what you said, that would just broaden the scope of what needs to be done in Phase 2 --

MR. KRAFT: Yes.

CHAIRMAN SCHULTZ: -- that wasn't required in Phase 1?

MR. KRAFT: Yes, and in talking to our senior executives in the industry, I think we will probably, more than any other order, I think we will probably have engagement from the BWR Owners' Group and NEI helping the individual sites to the extent they need assistance.

Exelon commands so much resources; they

probably don't need industry help. But a one-unit company or a two-unit site probably could use some additional assistance. So, we will have to see how that goes, but we want to make sure this goes as smoothly as possible.

MR. AMWAY: Just like we had workshops in Phase 1, you know, we will establish a schedule and do similar workshops in Phase 2. If you recall, I mean, the workshops we did on Phase 1, that is where the topics for the FAQs and the White Papers originally came from.

CHAIRMAN SCHULTZ: Are you considering the use of pilot plants?

MR. AMWAY: Yes, we are.

CHAIRMAN SCHULTZ: Okay.

MR. AMWAY: Yes.

CHAIRMAN SCHULTZ: Thank you.

MR. AMWAY: Now the next story I wanted to address was some of the open items from Phase 1, particularly talking about -- there was a concern with the anticipatory venting, particularly how that may impact the positive suction head, particularly with plants that kept containment accident pressure in their analysis.

We have since gone through the White Paper process and endorsement for anticipatory venting. I have those ADAMS ascension numbers on here for both the letter we submitted for endorsement and the endorsement letter.

But it goes a little bit beyond just containment accident pressure because we are operating the RCIC systems with suction temperatures above their normal design-basis value. And so, that does have an impact on NPSH. Since the method in which we are using the RCIC is undersaturated or nearly saturated conditions, the fact that you are raising containment pressure and helping NPSH is negated by the fact that the temperatures that got you there are elevated. So, those functions pretty much negate each other.

But what you can look at and credit is the flow rates that you need aren't to design 600 gallons a minute. They are substantially reduced. When you do the anticipatory venting and you terminate the blowdown of 200 to 300 pounds to preserve the steam-driven systems, you, in effect, reduce the speed at which that pump can operate, and you don't need 600 gpm. You can be down to the 200-to-300-gpm range. And it is the line losses. So, the line loss term to your NPSH term goes down. And the fact that you are at a lower speed, your requirements go down. So, the fact that you have got reduced availability is also offset by the fact that you have got reduced requirements for NPSH.

The paper requires that each site that uses RCIC as part of their strategy, you evaluate the impact on RCIC performance, particularly doing an NPSH evaluation to make sure it is sufficient.

MEMBER STETKAR: So, do the supporting analyses -- because I haven't seen any of them -- assume that RCIC is aligned to the suppression pool at time T0?

MR. AMWAY: Most of them do. By and large, you will find that most plants can't credit the CST and FLEX because it is either not wind-protected or it is not seismic. It doesn't prevent them from using it in the case where --

MEMBER STETKAR: Well, the timing, obviously, is a lot different if they do.

MR. AMWAY: Right.

MEMBER STETKAR: That's my only question.

MR. AMWAY: Right. And we have done checks to see what happens in the suppression pool temperature response if you have the CST available versus lined up to the suppression pool at time zero.

And Jeff can chime-in here, but we didn't see a whole lot of difference in the end in the results of suppression pool temperature.

MEMBER STETKAR: You didn't.

MR. GABOR: Well, timing.

MEMBER STETKAR: Timing. But that was the genesis of my question, is timing, because people have to do this.

MR. AMWAY: Right.

MR. GABOR: Yes, but Phil is right, most of the assumptions, all the ones I have been a part of have not taken credit for the CSTs.

MEMBER STETKAR: Okay.

MR. GABOR: So, they start and stick with the pool.

MEMBER STETKAR: So, you get the minimum time --

MR. GABOR: Yes, yes.

MEMBER STETKAR: Okay. Right. Okay. Thanks.

MR. AMWAY: Moving on to combustible gas control, and I have characterized this in terms of the White Paper and, also, Appendix H of NEI-13-02, results at issue in part. And the point of it is the global context of combustible gas control, not the vent. You know, Appendix H and the White Paper fully address the combustible gas requirements for the hard vent order.

But, if you look at the analysis -- and we will have that in the next slide -- but it is fairly consistent with what the staff presented; it is the fact that, by this order, you are maintaining your containment pressure below design values, you are protecting the HCVS system integrity such that you can continue to vent, and the gases vent out with the steam.

The process we are using with the SAWA, where you have continued vent capability, reduces the hydrogen concentration to substantially low values within the first 24 to 48 hours of the accident, depending on your assumptions.

So, the impart is we fully addressed it for HCVS. There is the broader concern of what happens with the leakage out of the containment into the reactor buildings and the inner-system leakages. The order addresses the inner-system leakages. We do leak rates. We are going to be doing leak testing of any boundary valves to other systems.

The integration of that would tell you that we substantially addressed the hydrogen and combustible gas considerations of the Mark I and Mark II containments simply by implementing both phases of this order.

MEMBER REMPE: In the containments, they

have got igniters and recombiners, but do they have any real-time capabilities for monitoring the concentrations?

MR. AMWAY: In an ELAP they would not because the hydrogen monitors require AC power to run.

MEMBER REMPE: Uh-hum.,

MR. AMWAY: I mean, you could do rep samples. I don't know why you would want to do it under severe accident conditions, but that would be the only other way you would know, other than through analysis, what is going on. We don't have the igniters in the containment.

It is important to recognize that in the BWR Mark I and Mark IIs that they would remain inerted. So, even though you had high hydrogen fractions, that it would not create a combustible gas concern because it is in a steam-inerted environment.

MR. KRAFT: But the Mark III is not covered by this order. Those igniters have to be powered during ELAP conditions by one of your FLEX capabilities. So, they did maintain that there. It is not covered here, but they did maintain that in that containment design.

MR. AMWAY: But I think this is what the staff was mentioning, that the insights we gained from what we did in implementing this order should help us when we look at Recommendation 6 in terms of at least the Mark I and Mark II containments that have implemented the order.

MR. GABOR: Much like the staff provided, we also included on the next slide a couple of scenarios to look at what was asked of the staff, what the local concentrations within the containment might look like. What I didn't put on here is the cumulative hydrogen generation, like the NRC did.

But if you look at the left side, for our best estimate on ex-vessel cooling, so we look at the scenario where we have no ejection, the core melts, the vessel breaches. At that time, we get severe accident water addition to either be directed directly to the drywell or through the failed RPV.

MEMBER STETKAR: And your analyses presumed that it always blows down --

MR. GABOR: And I am going to make that comment next.

MEMBER STETKAR: Okay.

MR. GABOR: So, we kind of beat around the bush on that subject. I think the first thing during a pre-core-damage period, everything that the plant looks at is to depressurize the RPV. And FLEX provides yet another layer of capability, reliability I'll say, to do that.

Obviously, in the PRA space that all can fail. We move on into core damage. Now we look at studies like SOARCA. And SOARCA took great pains to look at the details of what high temperatures do within the upper head, what they do in the steamline. SOARCA came up with a relatively-high likelihood that an SRV would be stuck open, maybe partially, maybe not partially, maybe fully due to a seizing of the stem.

One thing to keep in mind during the core damage phase of the accident, a lot of the energy could be going into the melt, into melting fuel. I know it had the high steam release. I probably have some hydrogen release, which I don't need as much leak capacity to get rid of the hydrogen.

So, a small leak path or an SRV partially sticking open will go a long way to bring the pressure down in the RPV. But let's move on.

If that doesn't occur, if the pressure remains somewhat elevated -- and again, SOARCA looked at the possibility that -- and this came out mostly in their uncertainty analysis -- that perhaps the main steamline could rupture. Much like the PWR hotline creep rupture, it would be a failure of the steamline, another mechanism I think that was brought up in the early discussion.

Let's take it even further. Let's say those things don't occur. Everything I have been privy to relative to vessel breach and core material either coming out of the vessel via a CRD penetration where you melt around the CRD opening, which is 10 inches, I think, causing the CRD to basically be ejected, opening a pretty substantial hole; instrument tubes, again, smaller, maybe an inch or so diameter.

Again, also, work that was done, I think, to support both MAAP and MELCOR, I recall some things that Mike Epstein had done at Argonne looking at the ablation of a hole. So, you create this hole, and now you are going to pass some marked debris through it, marked debris that has got a couple thousand degree super-heat on the steel that it is passing through. It is just the hole grows.

So, if I walk down that path, I get to a place where I believe that, as a result of vessel breach, I will be depressurized. Putting water into the RPV will actually follow the debris. So, if there are questions on how does the water find its way to the debris, putting it in the RPV is, I think, a good strategy.

In fact, a couple of slides later, we show that putting it in the RPV has the added benefit of helping to reduce some of the temperatures inside the RPV. Keep in mind, during the core melt phase -- I'm sorry.

MEMBER POWERS: Coming back to your scenario a little bit, you had for a boiler core debris with a couple of a thousand degrees super-heat --

MR. GABOR: Yes.

MEMBER POWERS: -- over the melting point of the steel. How does that happen? You have 500,000 pounds of steel, cooling fins sticking up through the lower pressure vessel head. You have maybe a core volume or two of water in there. If you drop core debris into that mixture, how does it stay molten?

MR. GABOR: Well, this is a good question. We have spent a lot of time with -- this was a topic, a key topic, in the recent crosswalk where we took MAAP and MELCOR and we looked at those kinds of details. We tried to rationalize the different abstractions that these codes look at.

MEMBER POWERS: I am not interested in abstractions.

MR. GABOR: Yes.

MEMBER POWERS: I am interested in heat transfer.

MR. GABOR: I think if a large mass of debris either comes through the core through the core build and exits radially through the core where, like TMI, it could be suspended in the core region by a crust that forms in the bottom. And above that crust you can form a molten pool. That is what a lot of the modeling for TMI would lead you down, to see that created.

MEMBER POWERS: Well, in fact, the TMI is a PWR, and we are talking about a BWR. It is an interesting sidelight to that. But I want to go on. I will stipulate your TMI-like crucible of molten material.

Now you are going to drop it into a lower head with all these very robust structures spaced at 1-foot intervals -- so, there is very little gap between them -- filled with water. And you are going to keep that material molten when it is sitting essentially right at its melting point up in your crucible because it is pretty kind of in thermal equilibrium with the crustal boundary, so it can't have a lot of super-heat up there; some. I will concede as much as you think you need. And you are going to drop it down in there. It is going to stay molten, and I don't understand how.

MR. GABOR: Yes. The debris that is being held up, we believe it formed as a result of material --

MEMBER POWERS: I'm not interested. Drop it now.

MR. GABOR: Okay. So, a large mass dropped. There is going to be some interaction with the water, some interaction with the structures below. But some amount of that debris could stay coherent and still super-heated.

I think the water that is there will boil away. The structures will absorb some of the heat and melt. And then, longer term, it could reheat, refill a molten pool.

MEMBER POWERS: So, you're going to quench it? That is what you said?

MR. GABOR: Yes.

MEMBER POWERS: Okay. Now you are going to reheat it. What melts first?

MR. GABOR: The analysis that we do typically for us would show us that we could expect a penetration failure.

MEMBER POWERS: What in the core debris melts first?

MR. GABOR: The metals, the --

MEMBER POWERS: Okay, so the metals.

MR. GABOR: The mixture of the metals and the oxide.

MEMBER POWERS: And then, what do they do? They drain out of this mixture, right?

MR. GABOR: Well, they have to have a place to go. So, again, if a crucible can form in the lower head as well where --

MEMBER POWERS: How do you do that? I mean, this seems all fantasyland. I am going to drop this stuff down into a forest of big, heavy steel structures at one-fourth spacings on them. So, the gap that is in between them is very tiny. Okay? And there's a bunch of water in there, and you concede it will quench. Okay. Now, when it quenches, I presume it doesn't remain a coherent block. I assume it is all broken up if it quenches. How would it do otherwise?

MR. GABOR: As it remelts, as it heats up, there is going to be heat losses off of the RPV, the lower head, some heat losses off the top. I think there is potential -- I would agree with you there is uncertainty here.

MEMBER POWERS: That is what I was getting to.

MR. GABOR: I will agree.

MEMBER POWERS: We will leave the discussion at what it looks like.

MR. GABOR: Okay.

MEMBER POWERS: Now, because there is uncertainty, did you consider the possibility that maybe you got a very tiny penetration with very episodic flows through it as things melt and dribble down through it, and you don't have this high-velocity flow of very high super-heat material coming through?

MR. GABOR: I think we are all hoping to get better visuals on Fukushima to look at that exact type of scenario.

MEMBER POWERS: Well, I mean, it seems that, if that is a possibility, you can't pin all of your hopes on this outcome that at this juncture in life seems to be desirable. Why don't we pin our hopes on the outcome that says, no, there's not going to be a big hole; there's going to be a little hole, and it is not going to lead to depressurization in the scenario?

MR. GABOR: Our first strategy is in the early response.

MR. AMWAY: The SRVs.

MR. GABOR: They allow for both options, either directly to the injection, to the RPV or into the drywell. So, we are currently keeping both of those strategies as viable strategies. I understand your position.

MEMBER STETKAR: But, Jeff, I will tell you, if you read the guidance, it says that injection into both places is a viable strategy. But, if I was flipping a coin and making decisions about where I was going to pipe things up to, there is a lot of -- you already said it somewhere in the introduction -- you said there is a lot of benefit toward ejecting to the vessel.

So, if I am welding pipe and creating different ways of getting water in, which direction am I headed?

MR. GABOR: The piece that we all kind of ignored -- and I can test to the uncertainties in core melt progression. But I don't want to give up the fact that I have designed and built and, through other evaluations, I have ways to depressurize the RPV.

So, if I had another reliable injection source, and I think the NRC calculations have borne this out as well, if I can get that started, even after the onset of core damage, I have a chance to keep this inside the RPV. So, that skews it a little bit more towards the RPV side.

MEMBER STETKAR: I am not arguing with -- yes, I would really like to make that ability to open the ADVs really reliable, for a variety of reasons.

MR. GABOR: Sure.

MEMBER STETKAR: And that is the reason I was asking the staff why in this particularly pigeonholed, narrow focus of their ISG, why they are not interested in looking at the reliability of that function, because they said, well, it is for other things; I don't care about that for venting.

CONSULTANT SHACK: Well, I think what he said was that you are worried about the ADV. That capability is what you do count on to prevent core damage in the first place. And you have really focused on that. You are trying to defend that with your FLEX equipment, if you have to. So, you know, you have done everything you can for that purpose to prevent core damage.

MEMBER STETKAR: Okay.

CONSULTANT SHACK: Now something else went wrong. You know, the RCIC failed sooner than you thought.

MEMBER STETKAR: But I can get power hooked up to the ADVs and not at time TX, but I can get them hooked up at TY. It is a matter of the transition from no core damage to core damage in many cases is time.

CONSULTANT SHACK: Right.

MEMBER STETKAR: So, I don't understand

even, okay, you know, I don't know how I got core damage here in the first place. They are already saying that you can take credit for the pumps to pump water in there for severe accident water addition, the same pumps that should have saved you in the first place, but, for some reason, they didn't.

CONSULTANT SHACK: Well, we can think of reasons why they didn't.

MEMBER STETKAR: Yes. Okay. Part of it could have been timing.

CONSULTANT SHACK: Yes.

MR. AMWAY: You know, we put the discussion on RPV pressure control for the purpose of assuring ourselves that the RPV would be depressurized by the time we got to water addition.

MEMBER STETKAR: I like the arguments of Appendix I. I was just questioning why the staff was completely dismissing them from their consideration in this Interim Staff Guidance.

MEMBER BLEY: And this is really part of a broader issue that some of us have been talking about that affects -- you know, it is a part of the FLEX and all of this approach. As we go forward, we seem to be giving up some of the flexibility to do, attack fixed points of survival and knowing a bit of the uncertainties involved in maybe not having as broadly flexible a set of systems and responses as we could.

MR. GABOR: The hydrogen plot, I will just say we are just showing concentrations in the containment. I scored a line at 8 percent. It doesn't mean much in containment because there is no oxygen in there.

And I think we have brought up earlier, we typically find that we are steam-inerted in the containment. Again, it doesn't mean a lot because there is no oxygen in there.

But you can see that early on in the wetwell you can get 20-25 percent -- this is by volume mole fraction; I always talk by volume -- in the wetwell. And then, vessel breach occurs. That is the spike. And we see increased hydrogen throughout. And then, over time, as Phil said, over some period of time of 24 hours, obviously, that all trickles out and is vented out through the wetwell.

As I put on here, that is our best estimate ex-vessel core debris cooling. It somewhat mimics the kinds of heat transfer that we are seeing come out of Mitch Farmer's work at Argonne.

If I even assume more pessimistic where, even with the addition of this severe accident water addition, and I keep water on the debris, if I am pessimistic about the success of actually being able to quench the core and cool the core, that draws out to another 48 hours or so.

But, again, we have dealt with hydrogen in the vent system itself through the White Paper and the options that you have read there. This is just trying to give you some indication that hydrogen is going to dissipate once the vent is open.

In this case at the six-hour time period or so, we have opened the wetwell vent. So, our pressure and containment is fairly low; I think for these scenarios around 20 pounds absolute. So, it is relatively low for this plant.

Leakage through the normal design leakage-type pathways are going to be reduced from what it would have been if you evaluated it at 60 pounds, at the design pressure.

And I have looked at some of the details of this, again, in another project that I can't discuss. But, looking at would those leak rates actually contribute to local hotspots or local concentrations in a reactor building, and I, so far, haven't seen that to occur. Because I am at low pressure; I am venting it away from the containment. So, there is not a lot left to leak out of the containment.

CONSULTANT SHACK: But you are getting head failure a lot earlier than the NRC plots that we saw before. Is that a difference in the modeling of the failure or that is --

MR. GABOR: Drywell head or?

CONSULTANT SHACK: The lower head.

MR. GABOR: I think SOARCA has vessel breach around eight hours. I think in some of our MAAP analyses that is more in the five-hour range.

CONSULTANT SHACK: Well, I thought they had like 24 hours in the plot we saw.

MR. GABOR: Not for vessel breach, I don't think. Oh, it was for vessel?

MR. ESMAILI: Yes, it was.

MR. GABOR: He had RCIC up.

CONSULTANT SHACK: Oh, he had RCIC up?

MR. GABOR: Yes.

CONSULTANT SHACK: Okay.

MR. GABOR: There is no RCIC in this case.

CONSULTANT SHACK: Okay. Yes, that makes a difference.

MR. GABOR: Yes.

MEMBER REMPE: But, in general, there are differences due to just the way that they hold up the core material and --

MR. GABOR: But some of the reasons --

CONSULTANT SHACK: But 24 and 5 was sort of getting to me. Eight and five, yes, that I can --

MR. GABOR: Again, I won't harp on this, but, since Dr. Powers brought it up, it is a good subject. Our crosswalk between MAAP and MELCOR would tend to feed the argument that Dr. Powers provided, saying that the melt would be cooler in the lower head, and the perhaps the vessel failure mechanisms could be more localized. That does, indeed, come out of the comparisons we have made between MAAP and MELCOR, where MAAP does tend to have the higher super-heat in the lower head; MELCOR has the lower super-heat.

When I look at these things, I try to factor that in as an uncertainty and I try to ask myself, could that variation in the uncertainty of core melt progression affect the strategies that we are going to recommend? And so far, these are symptom-based strategies. We vent on pressure. You will see in a couple more slides how we work and how we implement severe accident water management.

I don't see even what would appear to be a relatively-broad spectrum in uncertainty in some of the details of, quote, "progression" being something that would change the way I would implement any of these strategies.

I don't have any more on that, unless there is a question.

MR. AMWAY: Okay. Just to summarize, I mean, our goal in this guidance isn't to address Recommendation 6. It is to implement the vent order. But, you know, we are just looking at it in terms of our analysis shows that the vast majority of the hydrogen is vented from the containment within about 24 to 36 hours.

Getting on to the next item, concern area, the ACRS paper or letter, it was the accessibility due to radiation. The industry has developed a guidance document for performing those accessibility evaluations, and it has two purposes.

One is it provides the methods of calculating the integrated dose that your equipment would see during seven days of sustained operation, that equipment including instrumentation.

And it also provides a method for determining the dose rates that the operators would be expected to receive for performing various manual actions to get the SAWA equipment connected and operational.

You know, the purpose of it, it is the HCVS components. There is a primary and a remote operating station for the HCVS, but there are also going to be manual actions associated with connecting SAWA.

This paper would take care of that radiological assessment and evaluation of those particular actions for the equipment and personnel.

MEMBER STETKAR: Phil, a couple of things on that. First, the local operating state, we have gone away, apparently, from the idea that the operators have the ability to mechanically operate these valves. And so, we presume certain failure modes won't exist because we say, you admit, if the solenoid supply, operator supply to this air-operated valve hangs up, it is called heroic actions. It means somebody has got to go in and die.

So, I thought originally that the idea was the ultimate fallback position is the guys would be able to mechanically open these things with reach rods and appropriate shielding, simple radiation shielding, and, apparently, we have gone away from that.

But you have also said things like, well, for thermal environmental conditions -- and these are in the facts; they are back buried in Appendix J -- we don't have to consider a core offload in the spent fuel flow. Apparently, your strategy, as best as I can read between the lines, is you're going to send people out near the spent fuel pool for these remote stations. So, I don't know.

MR. AMWAY: I have a correction for that. It just says we don't assume that our FLEX strategy in general fails. To get to the core damage stage --

MEMBER STETKAR: I mean, there are two things I am going to get to here.

MR. AMWAY: Okay.

MEMBER STETKAR: So, let me get to the two things. The first thing is thermal load. It says that total impact to the spent fuel pool area caused by the ELAP condition, I don't have to consider -- let's see. The proposed answer notes, "Thermal conditions for control stations outside the main control room include thermal impact to the spent fuel pool area caused by the ELAP condition, but for at least one unit per site, full core offload need not be considered since HCVS operation is not required when the reactor core is offloaded into the spent fuel pool."

It is okay if I have a plant that is one, and only one, reactor and only one spent fuel pool. If I have a site that has two reactors that share a spent fuel pool, why can't I have a full core offload into that spent fuel pool when the event hits the site? Why can't it?

MR. AMWAY: We would have one offload, but not two full core offloads.

MEMBER STETKAR: It says, "But, for at least one unit per site, full core offload need not be considered." I don't know what that means logically.

MR. AMWAY: What that means, so if I have a dual-unit site, two reactors and a combined pool, I don't have to assume I have both cores offloaded in the pool at the same time.

MEMBER STETKAR: Oh, well, that's not clear. Okay. If that is the way that -- I'll grant you that, but that is certainly not the way I read it.

MR. AMWAY: Okay, let me make a note here.

MEMBER STETKAR: Now the second one, though, for the unit you are trying to get to is that you don't have to consider source terms for radiation dose now from possible damage in the fuel pool. And you are going to lead me down the path that says, well, I don't have to assume that I have failed to restore fuel pool cooling because that is a separate part of the order. Okay, well, lawyers wrote those words.

If I'm in a plant and I have a core in the reactor vessel, I am probably going to try to save that core in the reactor vessel, everything that I try to do. I am also interested in the spent fuel pool. But I also know that I have more time for that.

The only reason I get severe core damage is that I didn't make it. For some reason, all that wonderful equipment that is being provided with hoses and stuff didn't work. That same equipment with the wonderful hoses is preventing the spent fuel pool from getting damaged.

Why, under conditions where I know it did not work for the reactor vessel, is it always guaranteed to have worked for the spent fuel pool? Why is that, except for lawyers?

MR. AMWAY: The reason that we give is the timing. I mean, if --

MEMBER STETKAR: These things go for seven days.

MR. AMWAY: I understand. The strategies for FLEX assume initial coping with installed equipment, which in most cases for BWRs that is RCIC. If RCIC fails at T0, you get core damage within an hour. There is no way I can hook up a FLEX pump -- well, I won't say "no way" -- highly improbable that you can get the FLEX pump hooked up in that hour and prevent the core damage.

MEMBER STETKAR: Okay.

MR. AMWAY: In the pool in an hour I am not even 140 degrees. My time to get to a point where we would cause a significant radiological source term in the spent fuel pool is going out in the 24-to-48-hour range. I have plenty of time in there, if it was strictly a timing thing, and the action and sequence worked such that I caused core damage, and I didn't have time to hook up my FLEX pump, it is so significantly much longer in the spent fuel pool case than it is in the RPV case.

You know, we are not saying that FLEX has a systematic failures, and the pumps that we have, I mean, you've got multiple pumps, multiple ways to do it. You have the time to make that happen. Whereas, in the RPV case, all I need is RCIC not to start.

MEMBER STETKAR: Phil, this gets back to a little bit of what Dennis mentioned earlier. It is that we are very carefully going from something that had a lot of good ideas in terms of providing us a lot of flexibility to provide core containment, fuel pool protection, to a bunch of presumed scenarios and timelines and guidance that is based on those presumed scenarios and timelines.

So it is that, when the next event occurs and Mother Nature and thermal hydraulics and physics don't recognize those presumed timelines, we will, then, be surprised that our flexibility wasn't as flexible as we thought it was going to be.

So, my whole point is, why not put in adequate shielding, such that if I get problems in this fuel pool, we are not cook the guys who are doing this work? Why not do that? Because that would give them more flexibility, wouldn't it? With the manual control stations in a place there where they wouldn't be exposed to possible damage in the spent fuel pool?

MR. AMWAY: Yes, putting more shielding in would potentially solve that.

CHAIRMAN SCHULTZ: Well, I would be more interested in looking at location.

MEMBER STETKAR: Locations, right. I have seen people who have done this over in Europe and they have carefully thought about that stuff, and they have got them in locations where, you know, they are kind of away from things.

MR. AMWAY: Right.

MEMBER STETKAR: They didn't have to put more shielding in because they put the hookups in locations where there was a lot of distance and shielding already. They had to run some pipe, but, for the thermal reasons --

MR. AMWAY: You're not going to put things like that up anywhere near the spent fuel pool anyway. So, I think that is inherently addressed by the fact that, while we are not saying you have to consider the radiological source term, the things that you are going to do for the thermal concerns are going to drive you to the same conclusions. Don't put stuff that you need to operate the vent on the refuel floor or the level below the refuel floor. It is going to be too out, anyway. You know, most of the installations I have seen are down in the lower levels of the building away from that area.

CHAIRMAN SCHULTZ: But the point is it appears as if you have made an argument as to why you could put it there. And yet --

MEMBER STETKAR: If somebody, for whatever reason, wanted to do that because of expedience, the guidance sort of says, well, here's some excuses about why you couldn't.

MEMBER BLEY: Or they didn't think about the very things that you are talking about.

MR. RECKLEY: Phil, if I can -- Bill Reckley from the NRC staff -- when you get into the severe accident portions of the order, a thing to keep in mind, and we had this discussion yesterday in regards to the rulemaking activity, the severe accident portions of this order were made as a substantial cost-justified change to the requirements.

And I remember the discussions we were having as we agreed to this level of the guidance. If your assumptions are that the pool is a radiological hazard, addressing the requirements for the containment, the cost of doing that, if you are assuming a concurrent spent fuel pool accident as a radiological source term, dramatically drives up the cost.

Yes, you can add more shielding; you can relocate these stations, but that assumption that you are making is going to drive up the cost of the ventilation modifications. And you can reach a point, as we are always going through the cost justifications of these things, that if you run the cost up too much, then you end up with no requirement. So, you always are trying to balance in these particular cases what is reasonable, and sometimes that also gets reflected in what assumptions you are going to make.

In this particular case, it was a conscious decision -- and the staff was involved in its insertion into that guidance -- that you need not assume a concurrent spent fuel co-accident as a radiological hazard. As Phil mentioned, you do assume that it is going to heat up the local environment and there may be steam and other things, but not for a radiological hazard.

MR. AMWAY: More questions on that topic?

(No response.)

Okay. Then, the final one deals with the drywell vent designed temperature of 545, and that is, again, with the water addition included, which is SAWA. We have had good discussion about that.

We have just a little bit more detail. I will start off on this. This was a figure out of the Phase 1 guidance. That was the basis for why 545 degrees Fahrenheit was acceptable.

Jeff, I will let you take this over here.

MR. GABOR: Yes. We talked about this earlier.

So, there are two pieces of this, right. It is, why does 545 make sense as a design criterion and do we satisfy that limit or that criteria if we simply just put water on the debris ex-vessel?

This plot, which I think you have seen, is a compilation of a lot of different things. We listed in the references all the different NUREGs and sources of information that went to kind of drawing this cartoon.

But the idea was to see if setting a goal of 545 is reasonable. The first thing, we have shown the design envelope. That is pretty clear there.

We look at severe accident studies like SOARCA. At around 80-pound gauge, the model that was in SOARCA had the drywell head lifting. So, that kind of sets a pressure bound for us.

The green area is kind of the key area because that is where all these NUREGs and all the information on penetrations comes into play. Typically -- and again, there are some exceptions -- but most of what we see in the references we cited show us that, perhaps around 500 Fahrenheit, we can start to see certain penetrations, certain material degrade.

Some of the tests that are run may have only been run for a single penetration, not realizing that it sealed both inside and outside of containment. By the time you get to 900 Fahrenheit, most of the sealant material is gone away and isn't going to provide a lot of leak tightness.

The red part of the curve is really the Chicago Bridge & Iron work that was done back in the late eighties and early nineties to support the Mark I IPEs. They did a finite element analysis. They looked at different temperature regimes. They had a regime less than 500. I think they had one intermediate, 500 to 700, and then, one 700 to 900. And they basically calculated the pressure. You can see just the line 3 there, or whatever, the red area. By the time you get to 900, the CB&I work basically said you don't have any ability to withhold pressure within a containment.

So, we looked at all these sources. Obviously, we don't want the drywell vent to be the last thing standing. That doesn't do us any good, to set a criteria that is that far out in the failure space.

So, 545 was somewhat convenient because it was a temperature, I think, that was the basis for calculating the primary containment pressure limit. And that number I think comes from assuming loss of drywell coolers, the RPVs at 550 degrees, and 1,000 pounds saturated, and reasonable over some period of time you could conceivably heat up the drywell to some temperature around that. Again, that was what was used for PCPL, and that was what was used. It seems like a reasonable limit.

The next slide, if you jump ahead, provides the results, and I think you saw this before when we presented the CPRR results. This has been presented at numerous public meetings, again, with the NRC staff on the rulemaking, the vent filter rulemaking, now called CPRR.

So, the one on the left shows us the influence that just putting water in the debris has. It is kind of a no-brainer. Everybody gets that.

The red line, if I just don't put water on the debris ex-vessel and let it radiate and core concrete attack continue, I can easily see temperatures in the thousand Fahrenheit range in containment.

If I do put water, the blue line, in this case I have added water to the RPV in that case. Again, I was depressurized, so it was able to follow the debris out of the hole.

You can see this is a probability distribution or cumulative probability chart where, if you remember the material that we presented to you on the CPRR, we had our core damage event trees, some -- what was it? -- 13 unique core damage end-states coupled with 39 containment event states. And all that resulted in over 500 unique scenarios.

Those scenarios look at high-pressure cases, low-pressure cases. They look at cases where the wetwell vent works as it should. It included, if you go back to those fault trees or the event trees, it included cases where the wetwell vent didn't work and the operator switched over to the drywell vent. So, it is all of that put into the probabilistic framework, frequencies assigned to each of those end-states and plotted against the peak temperatures we saw. In this case, it is in the cylindrical area adjacent to the RPV, up in the upper part of the drywell. We actually see that that region gets hotter than even the drywell head because of the heat transfer off of the RPV.

But you can see there what we are demonstrating is, in the case of the blue line, 100 percent of those instances or those scenarios resulted in temperatures below 550, I'll say. I can't read any better than that. My eyes aren't that good.

The plot on the right, all that one tries to do is to break out the difference between putting it in the RPV -- again, you have to give me that for these scenarios, either due to the operator actions to depressurize the RPV, due to SRV seizure, due to main steamline rupture, or due to the core melt coming through and opening up --

(Interruption by automated phone message.)

CHAIRMAN SCHULTZ: Okay. Go ahead.

MR. GABOR: Okay. Sorry.

Given all of those, the water in the RPV will find, in our calculations, will find its way to the debris.

And you can see a slight difference in both cases, either direct injection to the RPV or to the drywell. No credit for drywell sprays here. If they use the drywell spray as the delivery mode, I am taking no credit for any atomization or particles or anything. The water just appears kind of magically on the floor.

There is a little benefit, and the benefit comes from my ability to cool some of the maybe debris left behind in the RPV, some of the structures in the RPV that had heated up during the core damage phase. So, that is why you see a little bit of an advantage in the blue line there for RPV injection.

But, really, in both cases, by 90 percent of the instances, and it looks like for sure 80 percent, a little over 80 percent of the kind of probabilistic arena of scenarios we had temperatures below the 545.

And this is a different way of looking at the information that the NRC presented earlier, but does basically reach the same conclusion, that the 545 criteria is acceptable, is reasonable I guess was the word that was used.

MEMBER BLEY: Jeff, just a minor comment on your presentation.

MR. GABOR: Yes.

MEMBER BLEY: If you use these pictures somewhere else, it is not the probability. It is an accumulator. So, it is not the probability of temperature. It is the probability the temperature is equal to or less than --

MR. GABOR: Or less than, yes, you're right. I always have that trouble. I will try to fix the labels.

MR. AMWAY: Okay. Now, moving on to the Phase 2 guidance, from here on out, that is what we will be focusing on. The Phase 2 terminology -- and we have heard the term severe accident water addition, or SAWA; severe accident water management, SAWM. The SAWA is just the means to provide the water to the RPV or to the drywell post-core-damage. It is equipment. The SAWM is managing that water addition flow rate in such a way that the wetwell vent is preserved, and that gives us our Phase 2 strategy under B.2 of the order.

This figure comes right from the 13-02. We are trying to give an overview look at the various options within the order. Phase 1 we have gone through in quite detail already. That is in progress.

Phase 2 gives the option of either a drywell vent or a reliable alternative venting strategy. Under B.1, you will see the gray box there. That is for use of a drywell vent that does not include water addition, and we will talk about that further on the presentation on how our guidance addresses that and how we have addressed the draft ISG comment with respect to Method 1. So, that is Method 1 now.

The guidance is really written for these bottom three boxes that include severe accident water addition for both options. And to be explicitly clear -- and we are making sure the guidance reflects this -- that to use either of these two options requires severe accident water addition. That is the only way you get to a point where you can justify a 545-degree designed drywell vent. And you have to have a means of water addition in order to manage the water, do the water management strategy.

The next level of detail down from that for the severe accident water addition, as we have stated, it could be one of two paths, either to the RPV or the drywell. You have to be able to provide in the guidance some means of mode of force and instrumentation to make that happen, and you have to be able to do it under severe accident conditions, particularly the temperature and humidity concerns that may exist during a severe accident and, also, the radiological conditions.

In the practical terms of what we plan to do, we would want to use the connection point that has already been established in the Order 49, which is FLEX, and the equipment to do that, the delta being -- and the FLEX order does not assume core damage. And so, we would have to make modifications or at least evaluate that connection point to make sure that all the actions we need to do for that SAWA connection point through the sustained operation is accessible under severe accident conditions.

The severe accident water management, again, requires SAWA to be implemented. It requires the use of the Phase 1 wetwell vent. That is our means of pressure control for the containment through the period of sustained operation. And it is designed to preserve the wetwell vent for the sustained operation period. We will get into later the strategies, you know, the seven days, the 72 hours, the seven days, in a future slide. So, I don't want to dwell on that right now. This is just a high-level overview.

The severe accident drywell vent option, again, requires the implementation of SAWA. You use a 545-degree drywell vent. So, here you are not managing the water, so at some time you are going to flood out your wetwell vent, and at some time you are going to need a severe accident drywell vent for containment over pressure. So, that is what this option is.

Again, it requires utilization of mode of force, and I am talking about the drywell vent now, and instrumentation. And that is governed by the existing requirements in the order.

You would also have to consider the severe accident deployment considerations. That is already part of the vent order for the drywell vent, and it would also apply to the SAWA connection point.

Now, moving on to the Phase 2 guidance in terms of the next series of slides are going to address the specific ISG open items. I am going to use the term "open items," but we have all been through the staff slides now of what those areas of concern are remaining.

Section 3, which is Method 1, that is use of the drywell vent, but does not include water addition. We are making changes to Section 3 to make it explicitly clear that our guidance really isn't written to address that method of compliance, and to make sure that there is note in there that the ongoing work with the CPRR or rulemaking may impose additional requirements. One of those may be the severe accident water addition. So, if you are going to try to put in a drywell vent now without water addition, most likely, you are going to do it later anyway under the rulemaking effort.

So, that is how we plan to address it. You know, we are going to retain Section 3 in there, but make that clear distinction.

The next item -- yes?

MEMBER POWERS: Question on this drywell vent. When you do a drywell vent, of course, you are giving up the benefit of the suppression pool. But you have available, particularly in the Mark Is, I believe, a really formidable mitigation system, mitigation capability in the form of the drywell sprays.

Are you silent on use of the drywell sprays prior to or coincident with a drywell vent?

MR. AMWAY: As far as our guidance, we are because we are assuming we are doing these under ELAP conditions and those pumps would not have power.

MR. GABOR: Well, the other would be, if we are using a 500-gpm pump, we haven't done the analysis to know if we get the right spray patterns and all that.

MEMBER POWERS: Well, really it depends on the plant. Some of the plants have changed out their spray nozzles in the drywell spray, and you might get the atomization with those smaller spray nozzles. About half the plants haven't, and it wouldn't be a waste of time. You wouldn't get any spray activity with a 500-gallon vent.

MR. GABOR: Yes, we had some credit for that, if you remember the CPRR work. The Nine Mile 1 pilot that we did, we gave some limited credit to sprays and, then, did some sensitivities. Our current analysis we are not crediting the sprays for either thermal or radionuclide removal.

MEMBER POWERS: That's unfortunate because those sprays are truthfully impressive in there.

MR. GABOR: Yes, some of the plants are actually talking about bigger pumps. Obviously, the pumps that might come in from regional response centers could be bigger pumps and be much more effective in that mode.

MEMBER POWERS: Yes, I mean, it isn't a myth. It is an amazing capability. When you are thinking of such a drastic step as to lose the mitigation capability of the suppression pool, it is such a juicy thing and it already exists. It was not at all designed for source term mitigation. So, clearly, a modification might have to be made, but it is not a formidable modification. It is actually a pretty simple modification. It is a choice of the spray head or spray nozzles. That really is a margin that we have available there as a low-cost option.

MR. GABOR: I think use of those sprays, if again we had the power and we had the pump, it is part of our severe accident guidelines. So, it is already addressed in there as an option.

MEMBER POWERS: Well, I am glad to hear that because, I mean, when we try to -- we have difficulty analyzing the negation of those sprays because the water flow is so high that it overwhelms the computer codes.

MR. AMWAY: Okay. The next major bullet on here, our guidance is written to require severe accident water addition for either the B.2 options, either the 545 severe accident drywell vent, which is ISG Method 2, or the SAWM approach, which is the alternate venting strategy, which is ISG Method 3.

We are considering both the drywell vent and we understand the way the order is constructed and B.1 was intended to be drywell vent, B.2 was intended to be some alternate venting strategy. But, in consideration of we are writing Section 3 as pretty much stating that the original intent of B.1 we are not recommending that we do without water addition, but leave that under B.1; everything else under B.2. Because to make that 545 drywell vent operationally-relevant, you also have to include the water addition as part of that.

And then, I will have a discussion here in a minute as far as, okay, so now what functional requirements do you invoke for that? Should it be Section A or B.1? But give me a minute on that. I have a slide coming up on it.

Here it defines more and addresses the functional requirements aspect. As I said, under B.2, that is where we are fitting both of these options. In recognition of what the ISG says, and we agree with, that B.1 provides a logical starting point for defining those functional requirements. If you look at B.1 and what that says, it really says put in a drywell vent, go back and look at Section A to make sure you meet all those same functional requirements that you did in Section A for the wetwell vent and apply that to your drywell vent.

So, when we look at that, what we are doing with the guidance, it was already in there in the E.2 version, the same Section A requirements that were written and applicable to the wetwell vent are also applicable to the drywell vent at 545.

And we also recognize that most of the Section A requirements would also be applicable to the

SAWA because that addresses things like, you know, you want to make sure that it is accessible under severe accident conditions. So, if you go point-by-point -- and I think are 11 or 12 separate functional requirements under Section A -- it is easier to go look at those and say, yes, this was written for the drywell vent, but it would also be applicable. Because it is equipment and systems, it would be applicable to SAWA also.

So, it addressed that going back through Section 4.1, 4.2, 5, and 6, and identified all those functional requirements, quality controls, training, maintenance applicable under Phase 1 of the order, to figure out how those applied to SAWA as well. So, we make that connection clear in those sections.

Just a slide here on operator action. I think what is important to acknowledge, that operator actions are going to be required for both the HCVS, you know, knowing when to initiate it, knowing when to close it again. The same is also applicable to SAWA. It is going to take manual action to connect the pumps that are used, any flexible hoses to the connection point, and to make that flow path available to either the RPV or the drywell.

It is also going to take action to connect your portable electrical power to provide things such as instrumentation that you would use to either implement SAWA or SAWM and any of the valves that may be in sequence between the connection point and your ultimate destination, which is the RPV or the drywell, depending on which path you choose. And you are going to have to have power and indication available, so that the operator can know that they do have a flow path established.

MEMBER SKILLMAN: Phil, where do the procedures for that activity reside?

MR. AMWAY: Where?

MEMBER SKILLMAN: They are not EOPs. They are not --

MR. AMWAY: They are not EOPs.

MEMBER SKILLMAN: Are they going to be SAMGs?

MR. AMWAY: I would expect what they would do is they would be directed -- I mean, you've got realize under severe accident conditions EOPs are pretty much out of the picture now.

MEMBER SKILLMAN: I see.

MR. AMWAY: I would expect these procedures would take the form similar to the Functional Support Guidelines, the FSGs, where the SAMGs would kick you out to an FSG that would tell you the "how to's" of actually connecting the equipment and establishing the flow path.

MEMBER STETKAR: So, it is another set of procedures?

MR. AMWAY: Yes. Guidance.

MEMBER STETKAR: Okay, whatever you want to call them.

MR. KRAFT: They all have different qualities to them.

MR. AMWAY: Yes, they have to be. I mean, it is similar to like we established FSGs for hooking up the FLEX pump. It will look very similar, but it is under a different set of conditions.

MEMBER REMPE: Depending on what happens at the rulemaking, there won't be any sort of regulatory review of those procedures, right?

MR. KRAFT: You mean the rulemaking we talked about yesterday?

MEMBER REMPE: Yes, right.

MR. KRAFT: Yes.

MEMBER REMPE: That's true?

MR. KRAFT: It depends upon that willingness to accept this compliance commitment or commitment letter. I mean, we went through that discussion yesterday.

MEMBER REMPE: Right.

MR. AMWAY: The actual procedures, though, that we would use to physically connect the --

MEMBER REMPE: I am talking about the monitoring type of, the operator's monitoring. For example, maybe I missed it, but back in Section 4.-whatever, I would have thought there would have been a water-level indicator, if they are worried about covering up the wetwell zone. Maybe I missed it.

MR. GABOR: The force level was part of FLEX, though, right? It is powered as part of our FLEX strategy.

MR. AMWAY: Right, and I have got slides on instrumentation --

MEMBER REMPE: Oh, okay. I'm sorry. I will be patient.

MR. AMWAY: -- which is salient to that point, and then, we can do that.

MEMBER REMPE: Okay, okay.

MR. AMWAY: But, to address the concern, yes, obviously, we are going to have to have some kind of written procedure in place that tells us how to get at this pump in position and connected.

The thought was it would be reviewed as part of the audit process for implementing Phase 2. So, we would have to describe those procedures at a functional level in the Phase 2 OIP. Then, when it came time to actually do the audits, you know, that would be part of that process, to make sure we are fully compliant with the order.

MEMBER STETKAR: I am not thinking --

MR. AMWAY: At least that is how I would expect that to work.

MEMBER STETKAR: I'm not thinking like an attorney. I am thinking like an ex-operator who is now is faced with EOPs, SAMGs, FSGs, EDMGs, new vent G's, and I have got to understand all of these "G's" and how they fall fit together when the lights are off and the ceiling is falling down.

MR. AMWAY: Right.

MEMBER STETKAR: And the integration that I hear of all of those "G's" is "Gee whiz, we're going to link these things somehow to the EOPs, and it is all going to fit together," and I am going to understand which of the "G's" I've got to be in at any given time when the lights are off and the ceiling is falling.

MR. AMWAY: And you already have procedures that tell you how to actually go and establish a vent. So, instead of that procedure describing how you do it today, it is going to have to be changed to describe how you do it now that there is an HCVS.

I am going to tell you right now the procedure I'm familiar with is 125 pages. To use the HCVS, you are going to be able to do that in six or seven pages. I mean, we have greatly improved the reliability of the vent capability. And so, it is not like it is a different family of procedures. It is going to changing the procedure I have today to vent the drywell or the wetwell and updating it with my new HCVS capability.

Now my EOPs and SAMGs are going to dictate when that happens, but the actual "how to's," we already have procedures for "how to's," and those "how to" procedures will be reflecting the HCVS capability.

MEMBER STETKAR: I am just glad I am not operating anymore. I had to say that.

(Laughter.)

Even when I was younger, I had a good memory, but --

MR. KRAFT: It is a concern. One of the concerns our CNOs have is that we not overtrain for rare events and not train enough for more likely events.

MEMBER STETKAR: Yes, but, as an operator, I would kind of like to have -- I am familiar with

EOPs -- and I would like to have a coherent other procedure, clear guidance, the other guidance, not books of other guidance, so that I have to figure out which book to pick up, but something coherent that says here are the things that I need to think about when I am outside of the EOPs, integrated, not FSGs and SAMGs.

But we are getting short on time and I will stop ranting.

MR. AMWAY: But I appreciate your concern, and I was an operator myself. So, I mean, to the extent that we can, we are going to put this guidance in the existing family of procedures that we have, and not try to create some -- I don't know what you would call it, but to try to use the structure that exists, but it has to be modified to reflect what we are trying to do.

The last item on here, the actions that we do for venting and SAWA have to be achievable under the radiological temperature and humidity conditions.

Here is where I want to get into the three-tiered approach discussion a little bit on the next several slides. This was one of the open areas in the ISG.

The way we are revising our guidance document is just as was described this morning. If we can demonstrate a successful SAWM strategy, meaning for a full seven days we don't need a drywell vent to maintain containment within design pressure limits, we're done.

MEMBER BROWN: A severe drywell event?

MR. AMWAY: Right. If we could establish a severe accident water management strategy, but we can't get out to the full seven days before we need a drywell vent, then the alternative is that we have to be able to have a functional-level description of alternate reliable containment heat removal and include that discussion in the Phase 2 OIP.

And I have got slides for what that functional-level description looks like. So, let's just leave it there, and then, when we get into those slides, we can talk about that a little bit more. But it is a written-down description of alternatives that could be available to put in service.

It ratchets up if you get under 72 hours in terms of that level of detail and the actual physical mods that would have to be made to make that a viable option, if you will, less than 72 hours.

To get into a little bit of the SAWM, what it looks like from a simulation perspective, I will turn this over to Jeff to go through the next couple of slides.

MR. GABOR: Yes, and I will do this quickly.

The question is, can we feasibly -- this is Method 3 -- so, can we implement Method 3 in any feasible manner? So, we looked at a scenario, a relatively-straightforward scenario where we had no injection, at the time of this breach we're able to get water additions started. It is 500 gpm.

The red line is plotting the torus water levels. So, I am starting off a little below 15 feet. For this plant, our reference plant, it turns out they have the narrowest, we call it freeboard, the narrowest freeboard volume because, for Peach Bottom, they have a limitation on their instrumentation that says that, once they get the torus to 21 feet, they don't have indication; they have to isolate the wetwell vent.

And what we want to do for success of Option 3 is to prevent us from getting that far. So, the actions I invoked were starting the 500 gpm at vessel breach and, then, I simply changed that flow, dropped it from 500 to 100 when I hit 18 feet in the pool. Because I know I am starting at 15; I don't want to get to 21. I kind of split the difference. I said I am getting to 18 feet; I am going to start paying attention to water levels. Actually, all I did was to reduce the flow to 100 gpm. That is the only other operator action I did.

And you can see for seven days, with that simple, fairly-simple action, I was able to sustain this configuration without needing to isolate the wetwell vent in that seven-day period. Obviously, I am going to want to monitor the water level in the torus. There is additional information I can get from containment pressure because that gives me an indication of how much steam I am generating versus how much steam is going out the vent.

At the bottom, the blue line was just a way to show you that, once I started injecting either to the drywell or the RPV in this case, I quickly get up, in the case of Peach Bottom it is a little over 2 feet in the drywell, and then, water spills over and runs down into the torus.

So, it wasn't difficult. It didn't require a lot of manipulations in order to successfully get out to 7 feet.

And you will see in Appendix C I put a little writeup in there which I think is in their version, maybe not. I might be wrong. The Argonne discussion --

MR. AMWAY: That is in there, yes.

MR. GABOR: I tried to equate flow rates in this range to the experimental observations that are documented in the OECD core/concrete interaction experiments at Argonne. And you can read this on your leisure. But it seemed like the initial period where they see the so-called bulk cooling, where the heat transfers from the debris to the water is maybe a megawatt per square meter. Sorry about the units. That is the only way I know that number. And then, that drops down by almost a factor of four long-term. That kind of mimics what Mitch Farmer has seen in the experiments.

And again, it gave us some confidence that initially hitting it at 500, and then, being able to back it off to something in the range of 100, satisfies decay heat, keeps a nice crust over the debris, so I am not thoroughly challenging the drywell in any way.

The next chart, again, just shows a couple of parameters, the pool temperature in red and a drywell pressure in black. Again, you can see that I am able to have this kind of -- I call this, and I know I will get criticized, I call it a "safe, stable state". I will call it just a "stable state," but where the key parameters in the plan aren't changing.

And then, the last plot --

MEMBER SKILLMAN: Jeff --

MR. GABOR: Sorry?

MEMBER SKILLMAN: -- before you go further --

MR. GABOR: Yes.

MEMBER SKILLMAN: Is there in the requirements document a requirement to have flow instrumentation that would let you know that you have throttled to 100?

MR. AMWAY: Yes, and it is not in the version that you have, E2, but in the 0F version I've beefed-up that instrumentation discussion a little bit to include what would be able, hopefully. And there are a couple of different options available there.

Most of the pump skids we have have flow indication built in as part of the pump skid instrumentation. But in the case where you might use one pump to provide the SAWA flow, and it is also providing spent fuel pool makeup flow, you really need to know what is going to the RPV or the drywell for SAWA. In that case, there is available inline flow instruments that you put right in the length of hose, so it is the same connections as the hose, everything. You put it right in, and you can have flow monitoring capability of that single line that is being used for SAWA.

MEMBER SKILLMAN: Thank you.

MR. GABOR: And then, the last chart just shows the --

MEMBER BLEY: And those things are going to be available?

MR. AMWAY: Yes, they will be stored in the -- if it is part of the skid, it is protected with the skid.

MEMBER BLEY: Yes.

MR. AMWAY: And if it is a flow instrument, portable, that you put inline, that would be stored and protected as well.

MEMBER BLEY: Would that be local indication or would it have some kind of signal sending off to the control --

MR. AMWAY: They make them different ways. I mean, there is no --

MEMBER BLEY: You haven't specified?

MR. AMWAY: No, I haven't tried to specify. I have actually seen them.

MR. KRAFT: But every time you get into wireless signals, even during these situations, your security people take notice. And that has caused problems. It caused problems with the spent fuel pool limitation. So, everyone had to go to hardwired. So, I would just make that point, that we may be stuck with local indication.

MEMBER BLEY: And the other guy talking on the radio, which is wireless.

But go ahead.

MR. KRAFT: Actually, there is a requirement in the SFPI that, when you hit the button to energize, right, you can't be on a radio at the same time.

MEMBER BLEY: Okay.

MR. KRAFT: So, I mean, those kinds of complications sort of seep into these requirements.

MR. GABOR: The last chart just confirms that the SAWA, the water addition, and then, the strategy, which is the management of that, a fairly-simple strategy, 500 reduced to 100, still maintains the drywell head below the 545-type criteria.

MEMBER BROWN: I guess I didn't realize that the wireless communications create that big a problem with your instrumentation. Is that true?

MR. KRAFT: It could. In the spent fuel pool implementation order there is a requirement to demonstrate that there was no radio interference.

MEMBER BROWN: Right. I remembered some of that stuff, but I just didn't realize there was that much difficulty with it. That is just kind of a learning experience.

MR. KRAFT: Well, interestingly enough, one of the vendors literally placed a cell phone on top of the test rig and got no interference at all. Another vendor had it in their shop and they were doing remote radio communications. Still and all, NRC was very concerned that there was going to be some and you would get a false reading on that instrument.

Because you can imagine, with the power out, the operator is going to go to that remote location. It could be in the control room or it could be just outside the control room. And it is going to be a momentarily-powered system to keep your loads down. And you know they are going to stand there on the radio, telling the TSC --

MEMBER BROWN: Sure.

MR. KRAFT: -- what is going on.

So, I even suggested to people they actually put a placard, a little placard, right on that box saying, "Turn the radio off. Don't key the radio while you're pushing the button," or something like that.

So, there is that concern. No one actually saw that occur in testing.

MEMBER BROWN: It boggled me because I know that for operators, Navy aircraft carriers, the engine rooms and machinery are extremely noisy, very high dB level. And they started probably 20 years ago with wireless. The guys wear headsets. They have still got sound-fired phones and they have got the other types, but they are running the machinery spaces with little wireless communications. And you just run a little antenna wire up through the spaces.

MR. KRAFT: Right.

MEMBER BROWN: It works beautifully, and we have got very sensitive source range instruments, intermediate, all kinds. We do startups, and it just doesn't seem to --

MEMBER BLEY: And that stuff is pretty touchy.

MEMBER BROWN: Well, it used to be, yes. Well, it is better now. We learned to do a lot of things with microprocessors that you couldn't do with the old analog stuff.

But that is why I was little surprised. I am not trying to change anything. I am just getting educated here.

MR. KRAFT: I have to tell you that the vendors, the three -- the SFPI order required something really simplistic. I remember a comment from --

MEMBER BROWN: And we agree with that, by the way.

(Laughter.)

MR. KRAFT: But I remember a time with this Committee questioning the way they did it and saying there's all kinds of additional new technology out there. Well, no one -- no one -- got simple on this. I mean, you are using radar systems. Those are the systems everyone is using. There is no one on water who would attach anything to the pool wall. And each one of those systems is highly capable, much capable to be way beyond what this requirement is, but that is what was available.

And so, all of this modern electronics is shielded/protected. As you say, microprocessors work better. Yet, the requirement is there.

CHAIRMAN SCHULTZ: Let's go forward.

MEMBER BROWN: Why don't we go on? I'm sorry. I didn't mean to -- it is educational for me.

MR. AMWAY: Okay. Thank you.

Okay. So, the next couple of slides I want to spend some time talking about the functional descriptions that would be required under the 72 to seven-day scenario or the less-than-72 hours.

First of all, it would have to be a pre-thought-out, written plan that is going to address multiple meanings of alternate containment heat removal. The multiple approaches could use a combination of all installed, a combination of installed and portable, or entirely portable equipment. You want to have that flexibility because this is an event. We don't know how we got there. There could be a lot of different avenues in terms of plant stabilization and recovery. Maybe you will get electric power back before you get your alternate heat sink back.

So, you would a high degree of flexibility in being able to establish alternate containment heat removal. But you would identify that, you know, two or three ways of how you could do it using a combination of that equipment.

You want to identify what equipment is available for use, where to make electrical/mechanical connections. And so, make sure that you could make those connections under severe accident conditions.

What is important is, under the ERO -- and the ERO is going to be in place at that time governing that activity -- but in the 72-to-seven-day timeframe we are not looking at establishing detailed procedures or making any plant modifications to support that.

The examples I have got at the bottom, you know, might select the RCIC or HPCI, or High Pressure Coolant Injection, test return line as your means out of the containment and have a cold loop established using portable equipment, going back into the RPV or to the drywell through the same point as you did SAWA anyway. And that would form your closed loop.

MEMBER SKILLMAN: How would you address the radiological considerations for that closed loop?

MR. AMWAY: Well, for example, if you were going into the RCIC or HPCI test line, that is located outside the reactor building. It is inside your condensate storage tank. So, you have got sealing in between the source term and where the actions are, and you have got a considerable distance from that source term.

MEMBER BLEY: Phil, just a comment. I can see this maybe getting pretty complex in terms of what the procedures look like. I wanted to mention that one of the plants by a specific vendor that is not in the country has a different set of EOPs, and it is one that has like eight basic EOPs. And if you are in any one of those cases, you use it. If you have any complications beyond that, they have another, more complex thing that the shift engineer and the SRO sit down and tailor for that situation. Then, the operators have kind of a simplified new procedure to carry out in this case. You might look at those and consider that sort of thing as you go forward, because this could be pretty tricky to hand do and operate.

MR. AMWAY: And the whole reason why we are looking at these different tiered approach is on paper and in theory there is no reason why every plant that is subject to the order couldn't demonstrate SAWM for a full seven days. It is a math balance.

But knowing things are what they are, there are things they will discover during detailed design and engineering, that plants might fall into I can get out to six days, but I can't make seven. And so, what does that plant do? And then, they would fall into this guidance classification.

The third and final being less than 72 hours, the first four, that is all the same. You know, it is your functional-level descriptions, different means to be able to do it. What is really different is now, because the timeframe is so short, and detailed procedures, whether we call them procedures or guidelines, but you need something more here in this case with more detail that outlines the specific actions you need to take for at least one of those methods, and develop permanent modifications to the plant that would help you implement that means of alternate reliable heat removal.

The example is where in the previous slide maybe you would have to cut into the RCIC or HPCI test return, in this one you would want to pre-engineer and put a flange connection, so it is readily available for you to use. You know, the return, the second sub-bullet there is the same as before.

The alternate pressure control to address that ISG concern, what was really at issue there was the way we had written the guidance would lead some licensees to believe that they could use a drywell vent that wasn't fully compliant with the order before either the end of the seven-day sustained operation or the alternate reliable heat removal.

We took that concern away by taking it out of that Section 1.2 and revising it such that we make it clear that, if you need a drywell vent within that sustained operation period or before you had alternate reliable heat removal in service, i.e., you satisfied the order requirements, that it has to be severe-accident-capable, per the order.

And then, any further discussion really talks about the long-term venting capability that might be directed by the SAMGs after you have achieved the goals of the order, which would either be beyond the seven days or you have had alternate reliable heat removal established.

The next slide, it is a level-of-detail slide in terms of making sure that we have information through OIPs that describe how the SAWA components will get power, to make sure that they are available to support the strategies, either through the use of the 545 drywell vent or SAWM. Particularly important is that we have to make sure that mode of force is available and any power or pneumatics for valves in the SAWA flow path.

Again, we plan to do that. We already have timelines established for how we do that on the FLEX. We would have to go back and reevaluate those points under SAWA to address the severe accident considerations.

The mode-of-force requirements for SAWA are not within the scope of the installed 24-hour dedicated equipment requirement of the order. If you recall, the order specifically for HCVS components requires minimal, very minimal to no operator actions for the first 24 hours to provide the power and pneumatics to HCVS valves.

By the very function of SAWA is, you have to be able to move the equipment out of the storage location, connect it up, which is actions beyond what that 24 hours was intended to do for HCVS. That is why we are proposing to provide that additional level of certainty in terms of the reasonableness of those actions, that we perform some level of validation that those actions could be completed within the time constraints required to satisfy the order.

Now there is a process already established for that under FLEX. We are looking at adapting that established guidance for FLEX, applying it to those actions that are required in the first 24 hours, and determine a Level A validation. The next slide will describe what that Level A validation is. And we would do that for any installed, dedicated, 24-hour mode of force.

Now that last bullet is, as an alternative to that, if the licensee chose to put in an installed dedicated source for 24 hours, it would also be an acceptable option.

This next slide deals with the validation itself. This comes right out of -- yes?

CONSULTANT SHACK: I just found it. I couldn't find it last night.

MR. AMWAY: We can provide that to you. That is part, it was done under FLEX.

CONSULTANT SHACK: It's not in the NEI document.

MR. KRAFT: In our document, in this

document, no, it is not.

MR. AMWAY: Put it in 12-06.

MR. KRAFT: No, there is, it must be a White Paper because there was a V&V plan, validation and verification plan that I read through at one point. It was a separate document. I couldn't tell you what White Paper or number it was or anything like that. And I believe NRC endorsed it. Is that right?

MR. RECKLEY: We will get that to you.

MR. AMWAY: I believe it is, but it is something we can provide.

MR. RECKLEY: No, we'll do that.

MR. AMWAY: Okay.

MR. KRAFT: Staff has indicated they will do that.

MR. RECKLEY: It is a separate document on the validation process, and we will get it to you.

MR. AMWAY: So, it is a validation document. What it does is establish a graded approach for doing validations. The long and short of that being the shorter the time period you have to take an action, the more rigorous the validation has to be, where the most rigorous is this Level A. And to support FLEX, that was used for any time-sensitive actions starting within the first six hours.

And the adaptation of that is we would use that Level A validation standard performing any manual actions that are required to support SAWA, not only for six hours, but through the full 24-hour period.

MEMBER REMPE: Who oversees the validation of this? Or is it just you follow that process that is endorsed by NRC, and then, it is --

MR. AMWAY: You follow the process. You document the results. And those results are available for auditor inspection.

MR. KRAFT: And inspection, right.

MEMBER REMPE: Okay. So, regional inspection, and that's how it is done?

MR. KRAFT: Everything under FLEX because FLEX was -- first of all, these orders become part of your license. So, you are required to do them and, then, FLEX because it was added protection, it kind of gets a higher view.

And there is a temporary inspection order or temporary instruction for inspection that has been developed that will describe to the inspectors how they are supposed to carry out inspection under these.

MEMBER REMPE: Okay.

MR. KRAFT: And then, I think there is a provision in the new rulemaking we discussed yesterday that will codify that inspection requirement.

MEMBER REMPE: Okay. Thank you.

MR. AMWAY: The next item deals with required instruments for SAWM. They are defined in Appendices C and I. And that includes guidance regarding the functional requirements and show how power is provided those instruments. It will include both portable and installed. We already talked about the pump skid and local instrumentation that determine that you are actually getting the flow you need for SAWA.

But it also includes installed instrumentation. That is particularly important for the SAWM phase, where initially SAWA is you are just putting water in at a certain flow rate. At some point you need to control that flow rate and throttle it back, such that you don't flood out your wetwell vent for that 72-hour period.

Those instruments are really quite simple in terms of what you really need is to see what containment pressure is. You are going to know when to operate the vent. In our analysis it appears as if we should be able to open the vent and leave it open. We had talked, when we did the tabletops, about cycling the vent as a means to improve the efficiency. What we found out is cycling the vent really doesn't help the overall strategy. Open the vent, leave-open strategy, as long as you don't challenge, go on negative pressure in your containment, is an acceptable option and would certainly minimize the amount of operator actions.

But you want to be able to see your containment pressure, and you are going to want to be able to see your wetwell level, so that you know that your strategy is effective.

MEMBER REMPE: And so, Jeff mentioned that there is new information in Appendix C. But, again, how will this be demonstrated to -- is it, again, part of a regional inspection following the temporary order inspections that are provided to the regional folks to say, yes, they've done something to ensure that you don't have problems with your water level because the pressure has changed, or something like that?

MR. KRAFT: I'm anticipating, Dr. Rempe, that it will be -- what is in FLEX will, then, be mirrored in what will go on in this order. This order runs a year or two behind FLEX. So, we are not just talking about the temporary inspection. I was referring to the FLEX application of the validation requirement.

MEMBER REMPE: Right.

MR. KRAFT: So, in our order there will probably be a similar thing done to inspect, done under this order. And then, there is a separate rulemaking, as you know, that will be codifying or making generally-applicable -- sorry, Bill -- these requirements into the Code of Federal Regulations.

So, I suspect some process to be followed, but we are behind. We are running behind that. So, we are not quite at all this documentation.

But, in general, the V&V process reflects it will be inspected as part of, what we looked at as part of the inspection for FLEX, which is what, a year or two after you install it, Phil, or something like that?

MEMBER BROWN: Okay, you need water-level information. You need pressure information. I presume those are existing.

MR. AMWAY: Yes. Those are the --

MEMBER BROWN: And are those already designed to operate within the expected environmental conditions, such as radiation? Temperature and pressure, I would expect are just fine, but what about the radiation environment now?

MR. AMWAY: That is something we would look at. If you go back to the White Paper 2 discussion, that gives you the tools you need to calculate the integrated dose that that instrument would receive from HCVS system operation.

What we expect to find and the analysis that I have seen done at the few plants that have done it, it is if you look at the seven-day integrated dose from HCVS operation, it is bounded by the analysis that was done for that same instrumentation for the 100-day integrated dose post-accident that is part of the license basis.

MEMBER BROWN: So, you expect the cabling, the instrumentation, the sensors, et cetera, all to withstand during this period what you are required to demonstrate, this seven-day period, that it will withstand the environment satisfactorily then?

MR. AMWAY: Correct.

MEMBER BROWN: Based on its existing --

MR. AMWAY: Based on its existing requirements.

MEMBER BROWN: -- requirements? Okay.

MR. AMWAY: Because the instruments we would be wanting to use are the ones that are already defined in the plant tech spec for post-accident monitoring.

MEMBER BROWN: Okay.

MR. AMWAY: They have been qualified to Reg Guide 1.97 in most instances. There are instances where plants were pre-Reg-Guide-1.97, but they have similar, equivalent qualifications for those instruments as well.

The third part being we have got to confirm that when we do the preparation of the Phase 2 OIPs. We will do the evaluation for radiological and thermal aging as part of that analysis for Phase 2, but make sure that those instruments that we count on would last for the seven days.

MEMBER BROWN: And it is going to take into account the evaluation of the stuff that has been installed for 40 years possibly or --

MR. AMWAY: It would have to take a look at that, but, usually, that is a small fraction of -- if there is no severe accident or no accident condition that occurs in the life of the plant, that is relatively low compared to the accident dose rates it would see.

MEMBER BROWN: Oh, dose rates I would agree with, but the thermal performance might be a slightly-different problem --

MR. AMWAY: Right.

MEMBER BROWN: -- relative to the insulation systems.

MR. AMWAY: Correct. It is something that we have to look at and evaluate as part of the process.

MEMBER BROWN: Isn't this gear already subject to the aging requirements under extension?

MR. AMWAY: It is EQ. Yes. It is EQ, and it is addressed under plant life extension. But we have to look at in terms of, you know, whatever that instrument is, we would be able to take a look and say we would expect the temperatures here to be at whatever value for that seven-day period we plan to credit it for this order.

MEMBER REMPE: But Jeff mentioned that the operator actions will reduce the flow rate. And then, I don't think there is any flow rate monitor, right? Or are you going to have --

MR. AMWAY: On the skid.

MEMBER REMPE: So, there will be a --

MR. AMWAY: It will be included on the skid.

MEMBER REMPE: Okay. So, you have got sensors. You have got the water level to check.

MR. AMWAY: Right.

MEMBER REMPE: If the water level, for some reason, is just not working, you have got that to --

MR. AMWAY: Correct.

MEMBER REMPE: -- instill some confidence in it.

MR. GABOR: Yes, the idea that the torus

level -- you know, we have engaged in a lot of discussion about is torus level adequate for this. Do I need other instrumentation?

The way we do it is, if the torus level is going up, you are putting water in the drywell to cover the debris, the torus level is going up. It is a pretty good indicator that some fraction of that water is not being effective at cooling the core. And it feeds back.

At the same time, if the water level is going down, it means you probably need more or you could have more. And again, couple that with the pressure response; it tells you a lot about the re-cooling and the balance between steam generation and vent flow. So, I really think that just simply looking at the torus level gives you a pretty good indication of where you are at.

MEMBER REMPE: I agree. And again, there is a thought process that there might be other sensors that provide insights to it, but I am not sure that anyone else, other than industry, will be reviewing it if things go in one direction here.

MR. GABOR: But I think yesterday temperature was brought up as indicator.

MEMBER REMPE: Uh-hum.

MR. GABOR: And I have issues with that just because interpreting that indication could be really difficult in a severe accident, whether it works or it doesn't work, where it is located, what it has seen, what is it telling you, where torus level seems to be a much simpler direct feedback.

MEMBER REMPE: But is it a DP cell or what is it in the plants? Or does it vary?

MR. AMWAY: For the level indicators, it is a simple DP cell.

MEMBER REMPE: Okay. So, there are some issues with it if something happens with the reference leg. And so, I think that you guys are very able to go through a thought process to come up with a good plan. I just think sometimes review is good, too.

MEMBER BLEY: Just quick, since you didn't have a slide on it, I assume the FAQs are going to remain as an appendix, not be integrated into the report. Is that right?

MR. KRAFT: I think it is with Phase 1, having been put in Rev 1, will be put in Rev 1, and NRC understands that. Then, we will go through an FAQ process for Phase 2. That may be some future revision to the guidance. We will put it in just for a convenience, so that it is all in one spot.

One of the problems we had with implementation of FLEX was reliance on FAQs. The way an FAQ works is that we talk to the NRC about it, and there is sort of an around-the-table agreement it is okay, but there is no formal endorsement like you do with a White Paper.

MEMBER BLEY: But they are an appendix to the report, and I asked them directly if that includes the endorsed FAQs, and they said yes.

MR. KRAFT: That is why we did that, because in FLEX there was reliance on FAQs that during audit, "Well, wait a minute. We never endorsed that." So, okay, now we have got a problem. So, we learned that lesson, and that is why we have taken our FAQs from page 1, putting them in the document, and then, we will ultimately do the same thing.

But we are trying to get to a higher level of agreement of the FAQs.

MEMBER BLEY: All I really asked was, when it comes out, it will still have Appendix J in it.

MR. AMWAY: Yes, absolutely.

MEMBER BLEY: That's all. Go ahead.

MR. AMWAY: And the delta between E and F is going to be based on some feedback I have gotten. That is, we should be able to go through those FAQs that were developed for Phase 1 --

MEMBER BLEY: Yes.

MR. AMWAY: -- and predetermine whether they are applicable or not applicable to Phase 2. There are some additions in there for each of those FAQs where I did that.

MEMBER BLEY: Okay. So, that will be a place to redo it?

MR. AMWAY: Right.

CHAIRMAN SCHULTZ: Next slide, Phil.

MR. KRAFT: Okay. I think that concludes our --

MR. AMWAY: Yes, that's pretty much it for the presentation. This is a conclusion slide just summarizing a high level of what we went through today.

MEMBER STETKAR: I have three questions I need to get on the record, and I don't want answers because of the time, but I need to get it on the record, so that the staff can think about it.

In your Section 6.2.4, there is a table about testing and inspection requirements. There is a footnote that says that I don't need to cycle check valves. I would like the staff to give me answer eventually about why one doesn't need to cycle check valves to see whether they work.

The second question that I have is that, in Section 6.3.1.1, there are effectively allowed outage times. It says that I can have part of the system out -- this is HCVS -- for 90 days or I could have the total system out for 30 days. And I would like to know the basis for those times, how you came up with them, why, what they are based on.

And it says that, if I don't meet those times -- for example, I have the whole system out for more than 30 days -- I must initiate compensatory actions. And there didn't seem to be any time limit on those things. So, basically, I can take it out and do some sort of compensatory thing. And I am curious about that because it starts to smell like years and years of compensatory actions for fire protection stuff. So, I would like to know what the staff feels about those compensatory actions because nothing in the staff's questions addressed any of that sort of issue.

As I said, I don't want answers today because of the time.

Thanks. I'm sorry.

CHAIRMAN SCHULTZ: No, that's fine.

Any other questions by Committee members for the industry?

(No response.)

Hearing none, I would like to go to public comments and allow an opportunity for members of the public within the room to make comments to the Committee, if they so desire. And we will open the line.

(No response.)

I think the line is open to members of the public. We believe the line is open. If we have members of the public on the line, could you please say hello to us, so we know the line, in fact, is open?

MR. BUMP: This is Randy Bump. The line is open.

CHAIRMAN SCHULTZ: Thank you, Randy.

Now would any members of the public like to make a comment for the Committee's benefit at this time?

(No response.)

Then, I will close the public comment period.

And I will move for summary comments from the Committee.

Joy?

I had no volunteers from the room for comment, so we will close the public comment period.

MEMBER REMPE: I want to thank everyone for their presentations. I think my biggest concern is what John raised at the beginning of the meeting about timing. It will great to have the calculational basis coming to us soon, but we are not going to perhaps get the staff update for their guidance. And it is hard to provide comments on an updated guidance if we haven't gotten that.

CHAIRMAN SCHULTZ: We have a short timeframe; that's for sure. They have given some level of assurance from the staff that they will work even harder to get us what we feel we need to support our position for the full Committee and understand what will be presented at the full Committee meeting.

Charlie, no further comments?

MEMBER BROWN: Yes, no further comments.

MEMBER BALLINGER: No.

MEMBER STETKAR: Nothing else from me.

MEMBER BLEY: Nothing from me.

MEMBER POWERS: I have a whole bunch of comments, but I think they deal with the issue of progression of the accident, whether containment dropwells are going to survive all these transitions, and maybe they don't fall directly in this issue. But I'll probably get together and bump heads a little bit.

CHAIRMAN SCHULTZ: Okay. Dick?

MEMBER SKILLMAN: Several comments.

Thank you for the presentation, to the staff and to industry.

On a lightwater accident, more water is better than less water. We really understand that.

But your conclusion slide is really pushing towards water and control of water. You suggested that you are going to count on SRV leakage or a head, lower head, failure. And I challenge whether those are appropriate assumptions.

What we learned is you need to know your hole size; otherwise, you will not be able to deliver the mass that you are depending on to remove decay heat and to circulate the heat.

MR. AMWAY: The only thing I would point out is, just remember, anytime we leave the EOPs and enter SAMGs, which we do under severe accident conditions, we will execute emergency depressurization using ADS.

MEMBER SKILLMAN: Okay, but I here to tell you, you made a presentation and you said, "We are going to get 500 gallons a minute. We are going to count on a hole, and we are going to count on a simmering SRV." And I'm saying time out. I am not sure that that is where at least we want to be.

I want to make one final comment. NEI put together a very good paper on dose, on the HCVS piping. And you are showing radiation levels on that piping exactly at the same levels that we experienced real-time at TMI, 3,000, 5,000, 10,000 R per hour.

And I would suggest that it has been a long time since we have dealt with the frontal recognition of those radiation levels. We saw it again at Fukushima. But those numbers are real.

When you are talking about hooking up pipes, hooking up FLEX equipment for an accident that is as severe as the one that we are contemplating, we need to be serious about how to protect workers from those very significant radiation levels.

MR. AMWAY: Certainly agree. Thank you.

MR. KRAFT: Yes, we absolutely agree. Thank you.

In fact, just an example, one plant -- and I won't mention who it was -- they had put in a hardened vent back in 1989, but it wasn't severe accident back in those days we were thinking about. And the route of that hard pipe went right behind the controller.

So, that is why this paper was so important. And they did an evaluation and said, "Yes, we are still fine," but they had to go through that evaluation. And I thought that was one of the real benefits of this work. It is a regime we are not used to.

MEMBER SKILLMAN: Yes, you don't want to be putting up lead brick walls on the fly.

MR. KRAFT: Yes.

MEMBER SKILLMAN: We did that at TMI, and it is very, very costly, dangerous, and painful, and it is not always a success path.

Thank you.

CHAIRMAN SCHULTZ: Comments, Bill?

CONSULTANT SHACK: I am just a little curious about the 545 temperature, again, looking at the data on the seals. You know, it is a perfectly-fine design for the vent. But, if I am thinking about Recommendation 6 and the Tier 3 consideration of where the hydrogen goes, I mean, we didn't get into that degradation region. But, again, you may not have a whole lot of choice.

I would caution, when you are using the Klaus paper, make sure you realize that there are typographical errors in figure 1 and figure 2, where they switched the silicon and the EPDM.

(Laughter.)

CHAIRMAN SCHULTZ: I would also like to thank the industry as well as the NRC staff.

Oh, Pete, I'm sorry.

MEMBER RICCARDELLA: Yes, this is Pete. I have no comments.

CHAIRMAN SCHULTZ: Okay, thank you.

I would to thank the industry and the staff for the presentations today and for the discussion and for the staff's response to our request to provide information. And also, the industry has indicated that the staff needs information from them in order to support the accelerated schedule; they will provide it. So, I appreciate that very much, and I know the Committee will also. We will look forward to receiving that information shortly.

Seeing no other comments, we will close the meeting for today.

(Whereupon, at 12:42 p.m., the meeting was adjourned.)

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Advisory Committee on Reactor Safeguards

Mark I and Mark II BWRs
Containment Venting Systems

Draft Guidance for Phase 2 of Order

EA-13-109 and Draft ISG JLD-ISG-2015-01

March 20, 2015

U.S.NRC
United States Nuclear Regulatory Commission
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Agenda

- Introductions
- Background and Schedule
- NRC staff presentation – Interim staff guidance development for Phase 2 of Order EA-13-109 (JLD-ISG-2015-01)
- Questions and comments

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.

Phase 1

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.

Phase 2

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

Order EA-13-109 Implementation Timeline

- Phase 1
  - no later than startup from the second refueling outage that begins after June 30, 2014, or June 30, 2018, whichever comes first.
  - Overall Integrated Plan – June 30, 2014
- Phase 2
  - no later than startup from the first refueling outage that begins after June 30, 2017, or June 30, 2019, whichever comes first
  - Overall Integrated Plan – December 31, 2015

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Order EA-13-109 Background – Phase 1

- ACRS Interactions
  - Letter Dated October 18, 2013
- Guidance for Phase 1 Implementation
  - NEI-13-02, Rev 0, "Industry Guidance for Compliance with Order EA-13-109"
  - NRC Interim Staff Guidance (ISG) JLD-ISG-2013-02, "Compliance with Order Modifying Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions"
- Overall Integrated Plan Templates (Appendix K to NEI-13-02)
- Overall Integrated Plans
  - Submitted by June 30, 2014 (supporting implementation no later than startup from the second refueling outage that begins after June 30, 2014, or June 30, 2018, whichever comes first)
- Interim Staff Evaluations

Order EA-13-109
Background – Phase 1

- ACRS Letter Conclusions and Recommendations
  - JLD-ISG-2013-02 *(issued)*
  - Better define scenarios for drywell venting
  - Assessing additional combustible gas control measures should be given higher priority
  - Venting procedures should not compromise core cooling which depends on containment accident pressure (CAP) *(cautions added to NEI-13-02, Rev 0)*
  - Drywell temperatures (545°F design specification)

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 ends – 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

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Order EA-13-109
Phase 2

- Revisions to Industry Guidance Document
  - NEI-13-02, Draft 0E2
- Draft Interim Staff Guidance JLD-ISG-2015-01
  - Three Methods of Compliance Identified
    1) Severe accident capable drywell vent without additional provisions for water addition
    2) Severe accident capable drywell vent with severe accident water addition (SAWA)
    3) Severe accident water management (SAWM) without severe accident capable drywell vent
- Resolution of Issues and Issuance of Guidance by April 30, 2015 (supporting submittal of overall integrated plans by Dec 31, 2015)

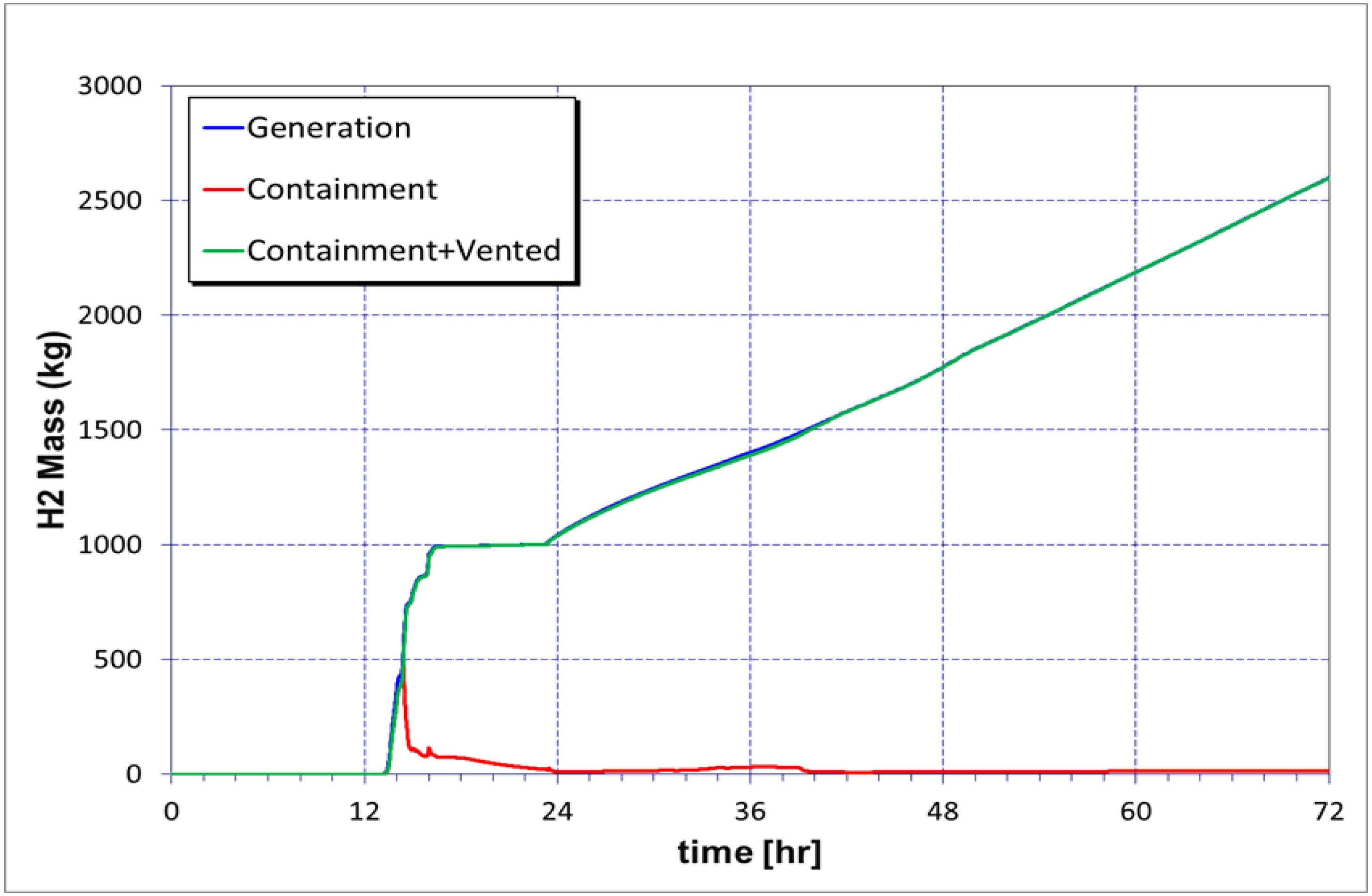
Order EA-13-109 Revisions to NEI-13-02

- Updates
  - Phase 1 Overall Integrated Plan Template (App K)
  - Dedicated Motive Forces (HCVS-WP-01)
  - Evaluation of Doses & Source Terms (App F & G, HCVS-WP-02)
  - Flammable Gases (App H & HCVS-WP-03)
  - Frequently Asked Questions (App J)
  - Appendix A (Glossary)
- 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 Case 9 (SAWA)

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INTERIM STAFF GUIDANCE JLD-ISG-2015-01

Method 1

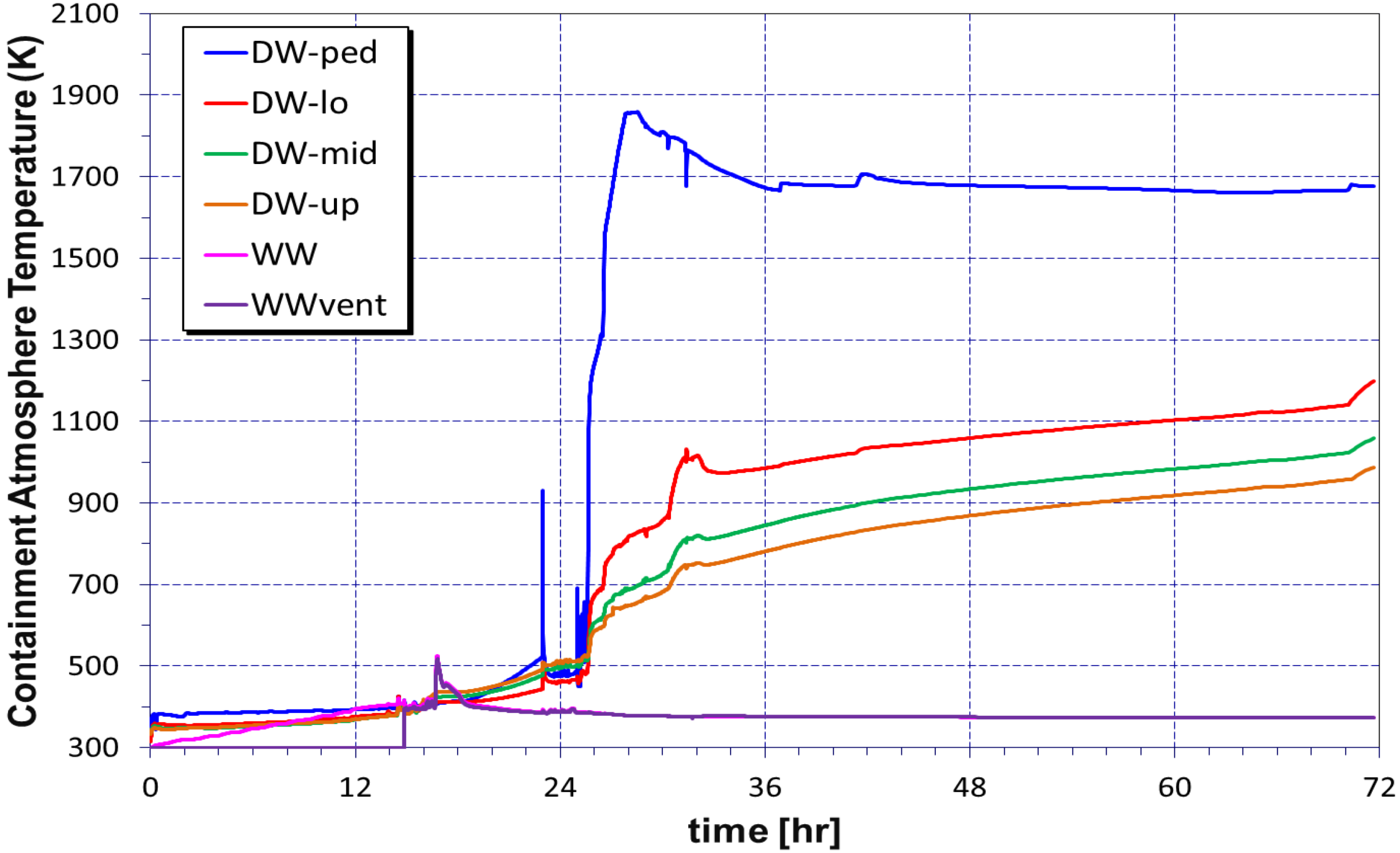
- Severe accident drywell vent (SADV)
- No additional provisions for severe accident water addition
  - drywell temperatures could exceed 1000°F

- No guidance provided in NEI 13-02, Rev. 0E2. 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

- Plant Specific reviews if a licensee were to pursue

Evaluation of Drywell Temperatures



Mark I Containment Gas Temperature for Case 1 (no water)

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

- Guidance provided in Appendix I to NEI-13-02 (Draft 0E2)

Severe Accident Water Addition

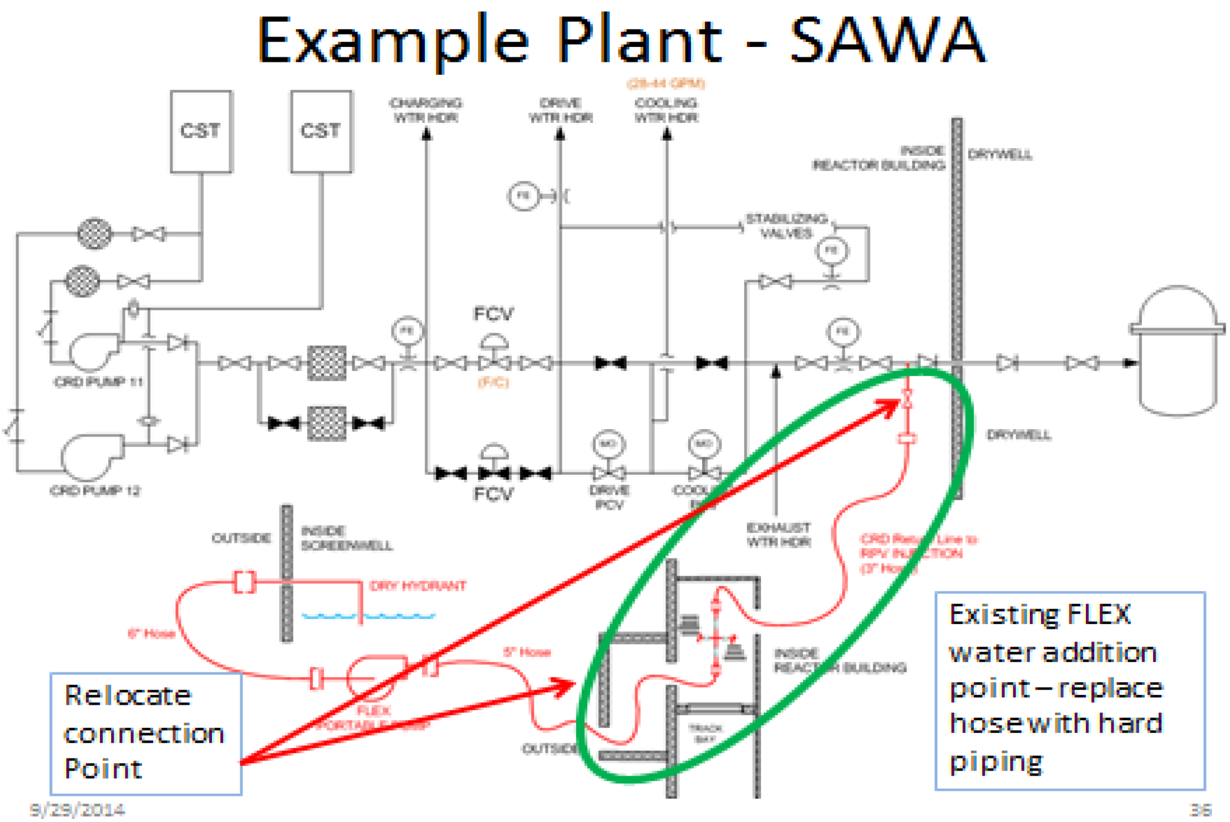
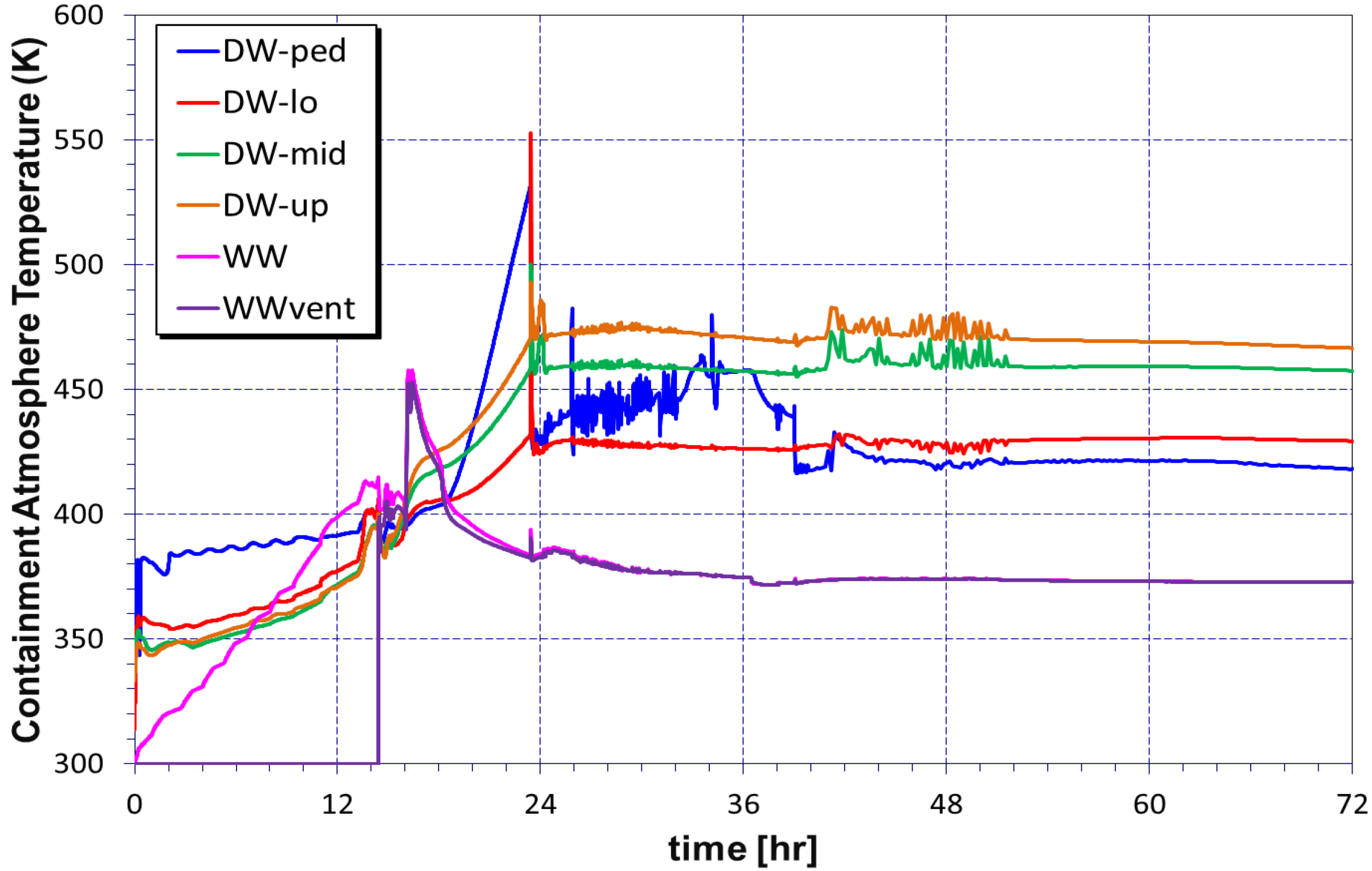


Figure from NEI 13-02 (Draft 0E2)

Evaluation of Drywell Temperatures



Mark I Containment Gas Temperature for Case 9 (SAWA/SAWM)

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INTERIM STAFF GUIDANCE JLD-ISG-2015-01

Method 2 – Issues in Draft ISG

- Defining functional requirements for SAWA provision. Staff finds that the functional requirements defined in Section B.1 provides a logical starting point for addressing functional requirements for equipment used in proposed strategies.

- All permanently installed equipment that will be relied in the strategy should have the functional requirements defined and shown to be met.

- **Proposed Resolution:** Industry proposing to add discussion to NEI 13-02 regarding functional requirements for SAWA to address time sensitive actions and equipment capabilities

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INTERIM STAFF GUIDANCE JLD-ISG-2015-01

Method 3

- Additional provisions for severe accident water addition (SAWA)
- Additional provisions for severe accident water management (SAWM)
  - Sustained operations using severe accident wetwell vent and/or alternate reliable heat removal capabilities
- No severe accident drywell vent (SADV)

- Guidance provided in Appendix C to NEI-13-02 (Draft 0E2)

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INTERIM STAFF GUIDANCE JLD-ISG-2015-01

Method 3 – Issues in Draft ISG

- Clarify functional requirements and coping time concept (72 hours) for preserving wetwell vent and/or providing alternate reliable containment heat removal and pressure control
- Clarify how procedures and functional requirements associated with establishing alternate means of containment heat removal justify the proposed coping time (72 hours)
- An acceptable approach for Phase 2 could be for licensees to develop procedures and functional requirements for installed and portable equipment supporting SAWM and venting from the wetwell for the Phase 1 period of sustained operations (7 days)
- Licensees proposing to reduce the 7 day sustained operation concept could identify potential success paths to establish an alternate heat removal system in the desired time, supported by a discussion of the availability of equipment that could be used during the severe accident conditions.

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INTERIM STAFF GUIDANCE
JLD-ISG-2015-01

Method 3 – Proposed Resolution:

- Three tier approach for SAWM:
  1. Sustained operations via capability to manage water for at least 7 days with venting from wetwell
  2. Sustained operations via capability of wetwell venting for between 72 hours and 7 days with licensees providing a functional description of alternate reliable containment heat removal in Phase 2 overall integrated plans
  3. Sustained operations via capability of wetwell venting for less than 72 hours with licensees providing an evaluation of alternate reliable containment removal that includes equipment to be used and connection points described or committed to in Phase 2 overall integrated plan

INTERIM STAFF GUIDANCE JLD-ISG-2015-01

Alternate Containment Pressure Control

- Guidance should instruct licensees to identify and include in their overall integrated plans possible means of providing alternative pressure control for longer-term plant recovery

- If drywell venting would be a necessary accident management function after the wetwell is flooded and within seven days, licensees should address within SAWM functional requirements

- **Proposed Resolution:**
  Discussion of post severe accident overpressure protection use of the drywell vent that is not severe accident capable per Order EA-13-109 has been moved to Section 1.3, Procedure Interface (SAMGs)

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INTERIM STAFF GUIDANCE JLD-ISG-2015-01

Remaining Exceptions and Clarifications

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

Questions & Discussion

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

ACRS Fukushima Subcommittee

March 20, 2015

BWR OWNERS' GROUP

NUCLEAR ENERGY INSTITUTE

General Characterization

- Revised NEI 13-02 to include Phase 2 guidance
- Numerous public meetings and technical exchanges to develop interim staff guidance
- Industry is working toward common design elements for implementation of the order
- Limited number of open items between guidance document and draft ISG

Functional Requirements

- Limit containment pressure
- Phase 1 - Vent capability from wetwell
- Phase 2 - Vent capability from drywell or alternate venting strategy
- Control the use of common systems within and between units
- Addresses all modes of vent usage from normal operation through ELAP and severe accident conditions

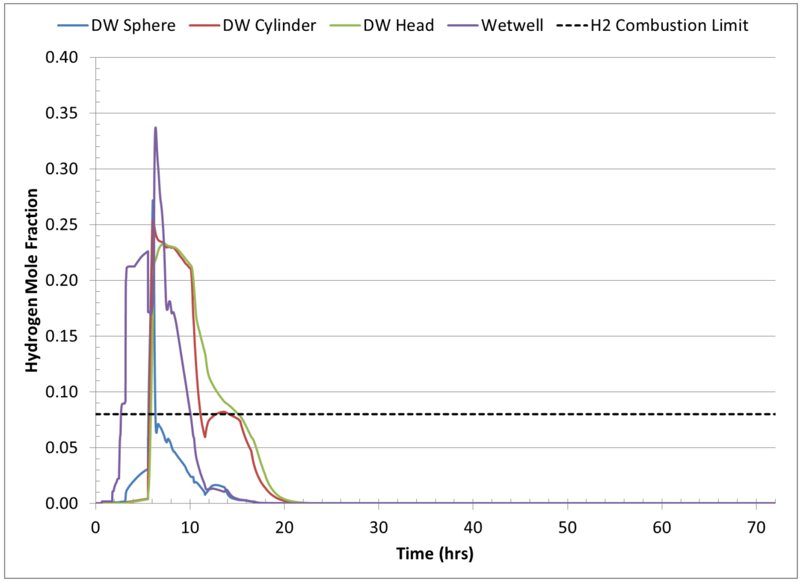
Phase 1 Status

- JLD-ISG-2013-02 endorsed NEI 13-02 Rev 0 with non-technical exceptions and clarifications
- NRC endorsed industry template for Phase 1 OIP
- Pilot plants' Phase 1 OIPs complete
- All phase 1 OIPs submitted 06/30/14
- Initial NRC audits of Phase 1 OIPs conducted
- Some ISEs have been issued
- Detailed engineering in progress

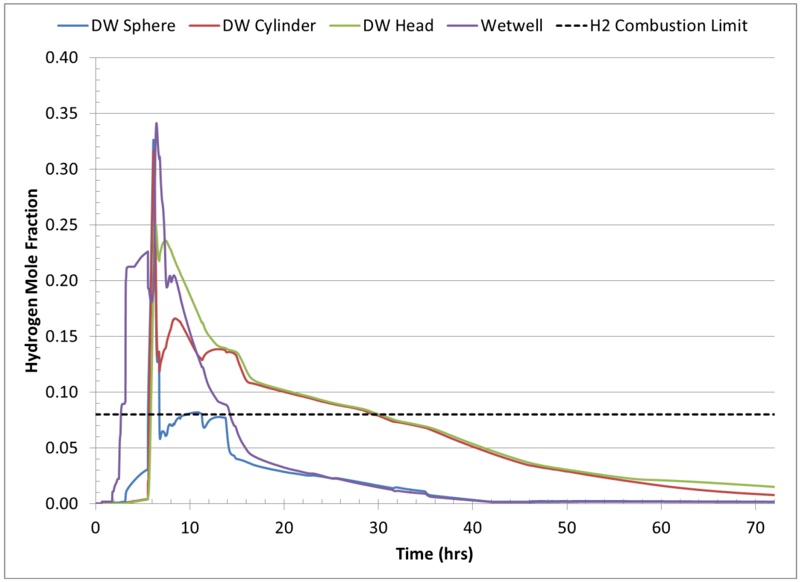
Phase 1 ACRS Open Items

- Anticipatory Venting – resolved through endorsed industry paper (ML13352A057/ML13358A206)
  - Requires consideration of impact on NPSH available for RCIC
- Combustible gas control – resolved in part by endorsed HCVS-WP-03, that addresses the combustible gas elements of Order EA-13-109 with respect to the HCVS system (ML14302A066/ ML15040A038)
  - Analysis shows combustible gases are vented as part of the SAWM strategy within 24 hours

Hydrogen Distribution Simulations



Best-estimate ex-vessel core debris cooling



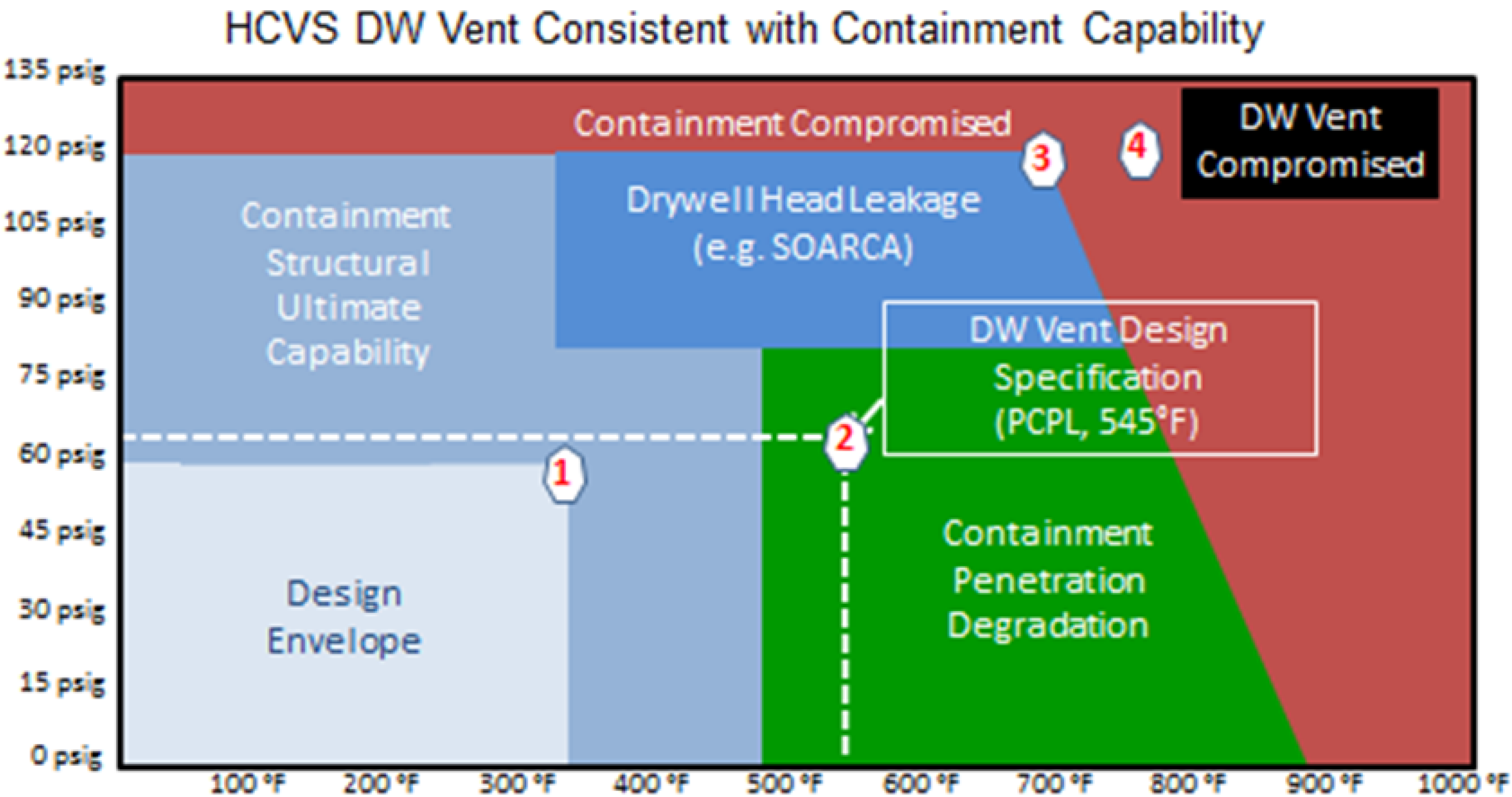
Pessimistic ex-vessel core debris cooling

- Hydrogen will be transferred out of the containment via vent path
- Some sensitivity to RPV melt release and success of debris cooling
  - MAAP represents rapid high temperature melt release
- Lower concentrations expected in RB due to reduced leak rates and large well mixed atmosphere

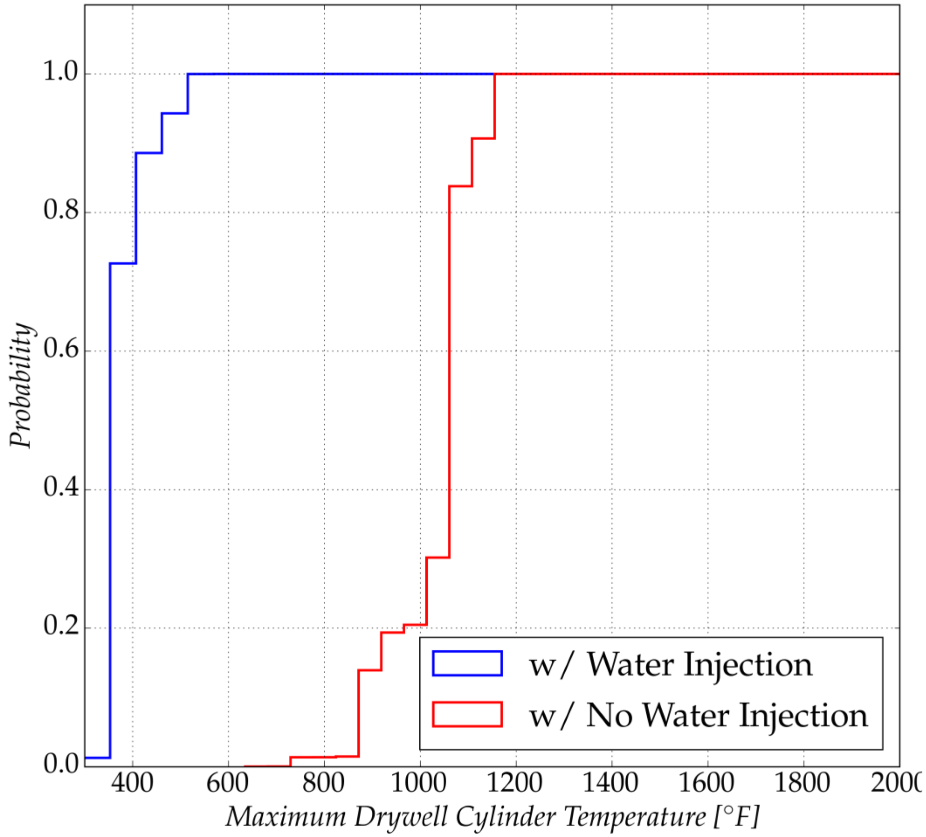
Phase 1 ACRS Open Items

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

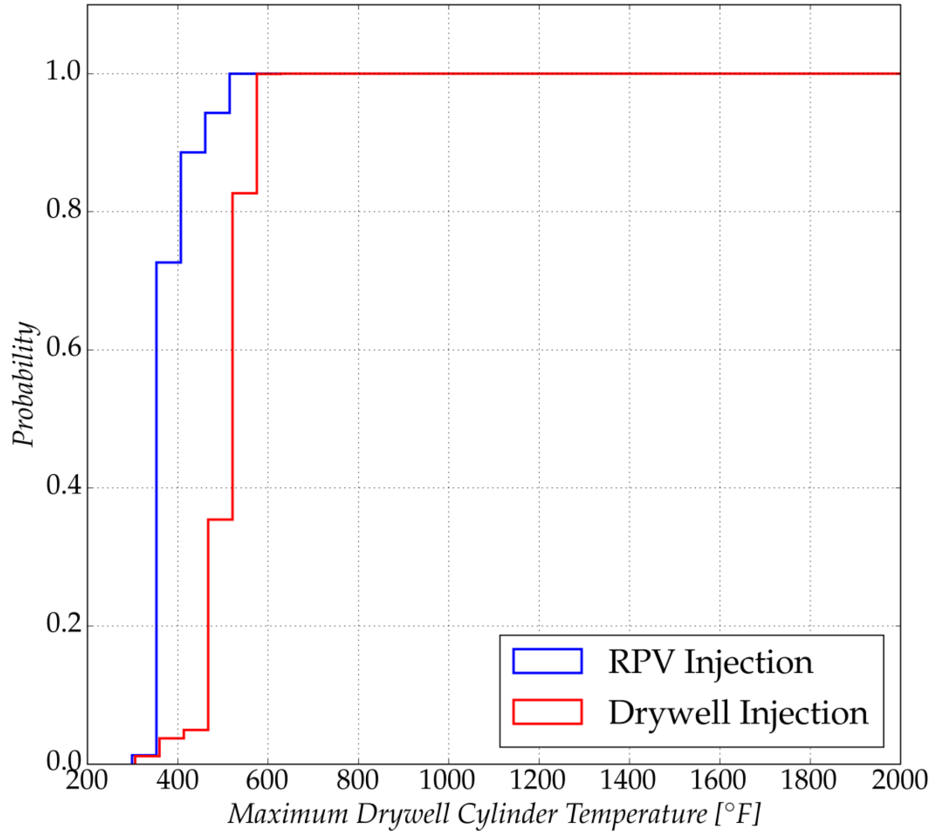
Basis for 545°F Design Criterion



Phase 1 ACRS Open Items



Probability of Maximum Drywell Temperature under Various Severe Accident Sequences, Water Addition vs. No Water Addition

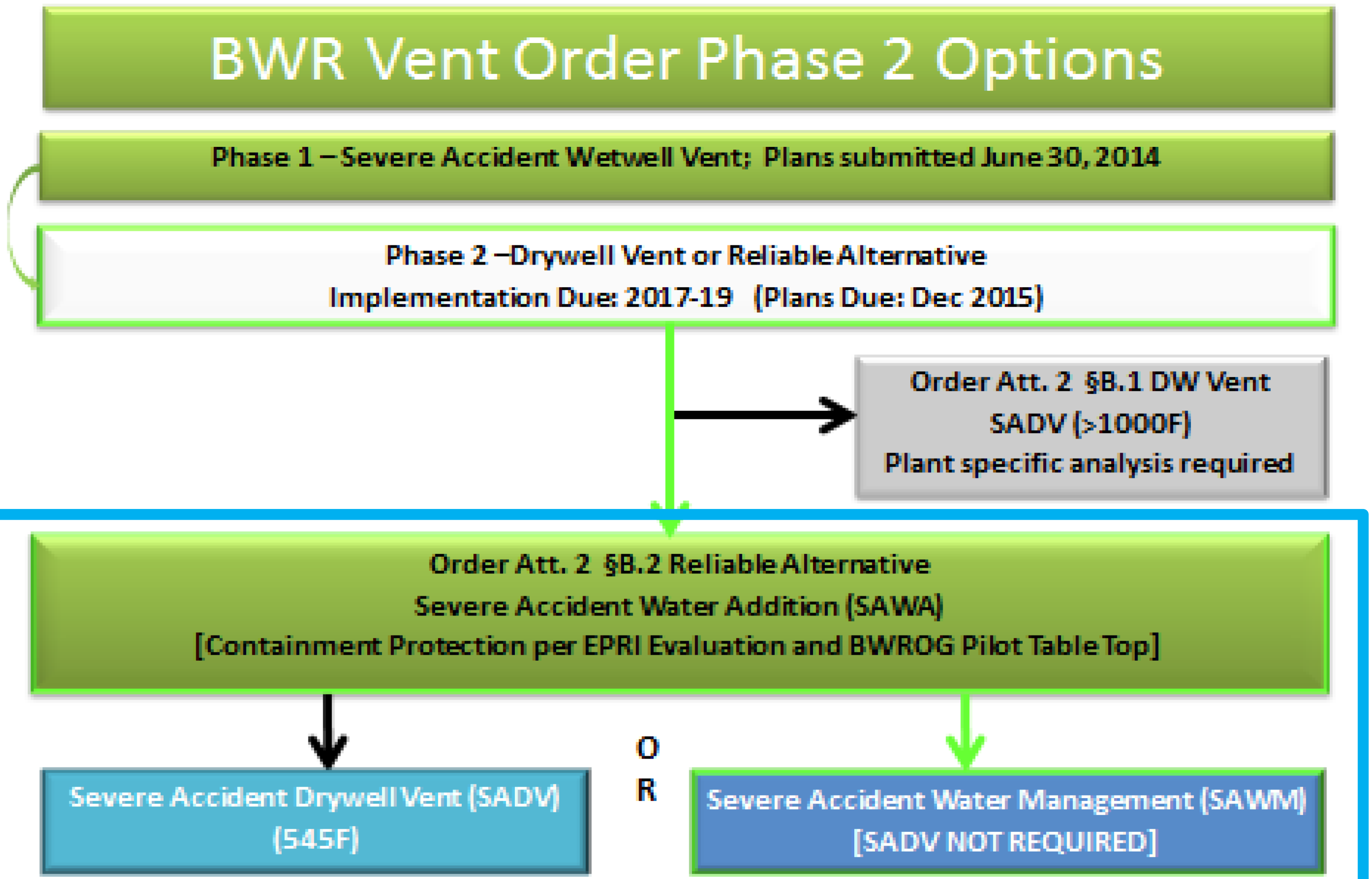


Probability of Maximum Drywell Temperature under Various Severe Accident Sequences, water addition to RPV vs. water addition to Drywell

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

Severe Accident Water Addition (SAWA)

- Water addition path – RPV or Drywell
- Utilization (Motive force, Instrumentation)
- Severe accident deployment considerations (Temperature, Radiation)

Severe Accident Water Management (SAWM)

- Requires implementation of SAWA
- Requires use of the Phase 1 wetwell vent
- Designed to preserve wetwell vent path for a period of Sustained Operation, as defined in this guidance,

Severe Accident Drywell Vent (SADV)

- Requires implementation of SAWA
- Design Temperature 545°F after second Containment Isolation Valve
- Utilization (Motive force, Instrumentation)
- Severe accident deployment considerations (Temperature, Radiation)

Phase 2 Guidance

Draft JLD-ISG-2015-01 Section 4.1, 4.2 and 4.3

- Section 3 (ISG Method 1) will:
  - 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 (ISG Method 2), or
  - SAWM approach for Phase 2 alternate venting strategy (ISG Method 3)

Option B.2 Conformance with Order Section A Functional Requirements

Draft JLD-ISG-2015-01 Section 4.2

- NEI 13-02 will define functional requirements for B.2 Options
  - Order Section A is a logical starting point for defining functional requirements for:
    - SAWA – most Section A requirements apply
    - 545°F SADV – the full set of Section A requirements apply
  - NEI 13-02 Sections 4.1, 4.2, 5 and 6 will define for the SAWA and 545°F SADV options the functional requirements based on Order Section A for design considerations, quality requirements, training and maintenance

Operator Actions Required

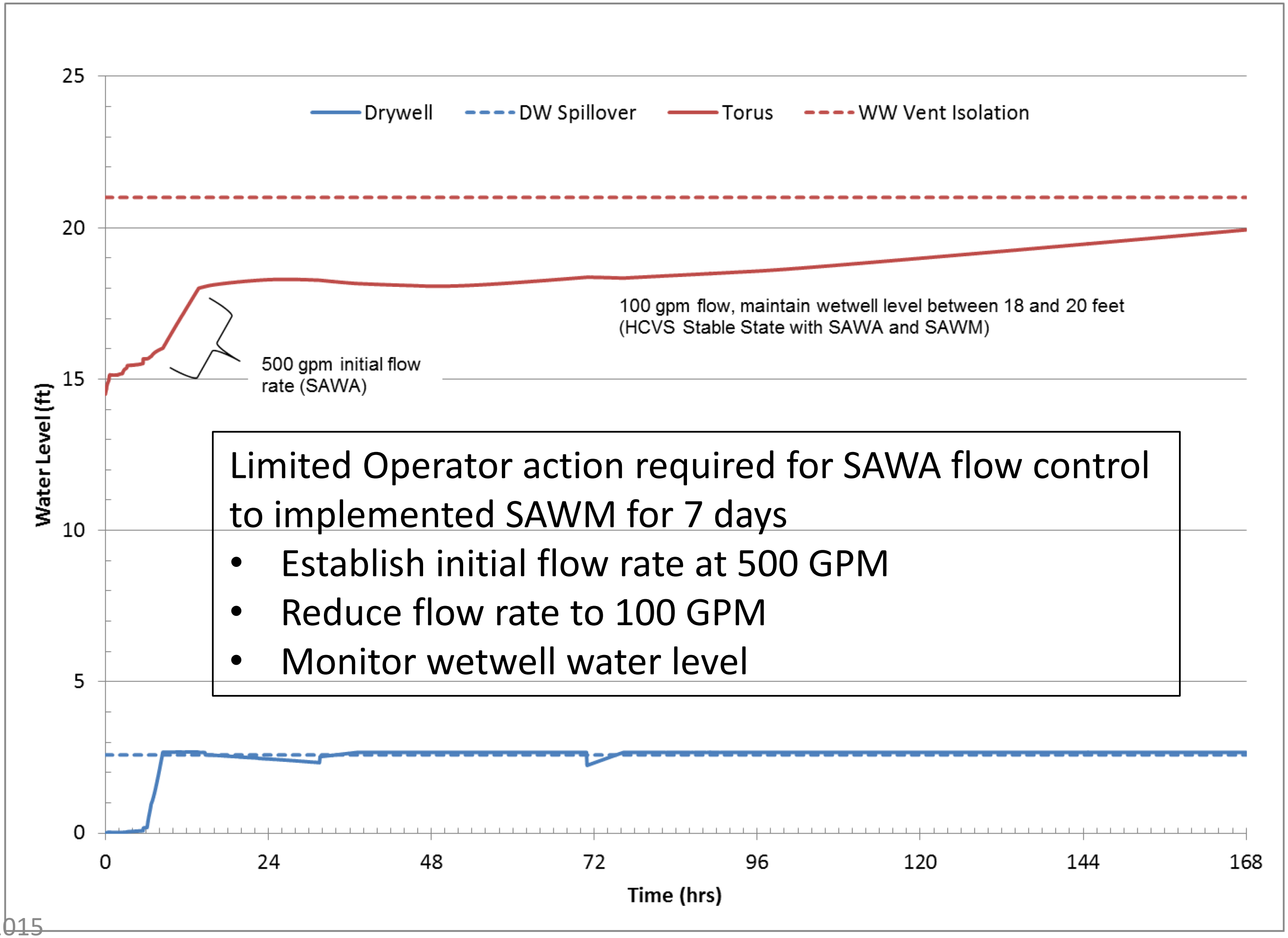
- Operator action is required for vent control to implement anticipatory venting
- Operator action is required for SAWA will be similar to FLEX for RPPV makeup and portable electrical power
- Operator actions for venting and SAWA must be achievable under severe accident conditions
  - Radiological
  - Temperature and humidity

Wetwell Vent Preservation Time

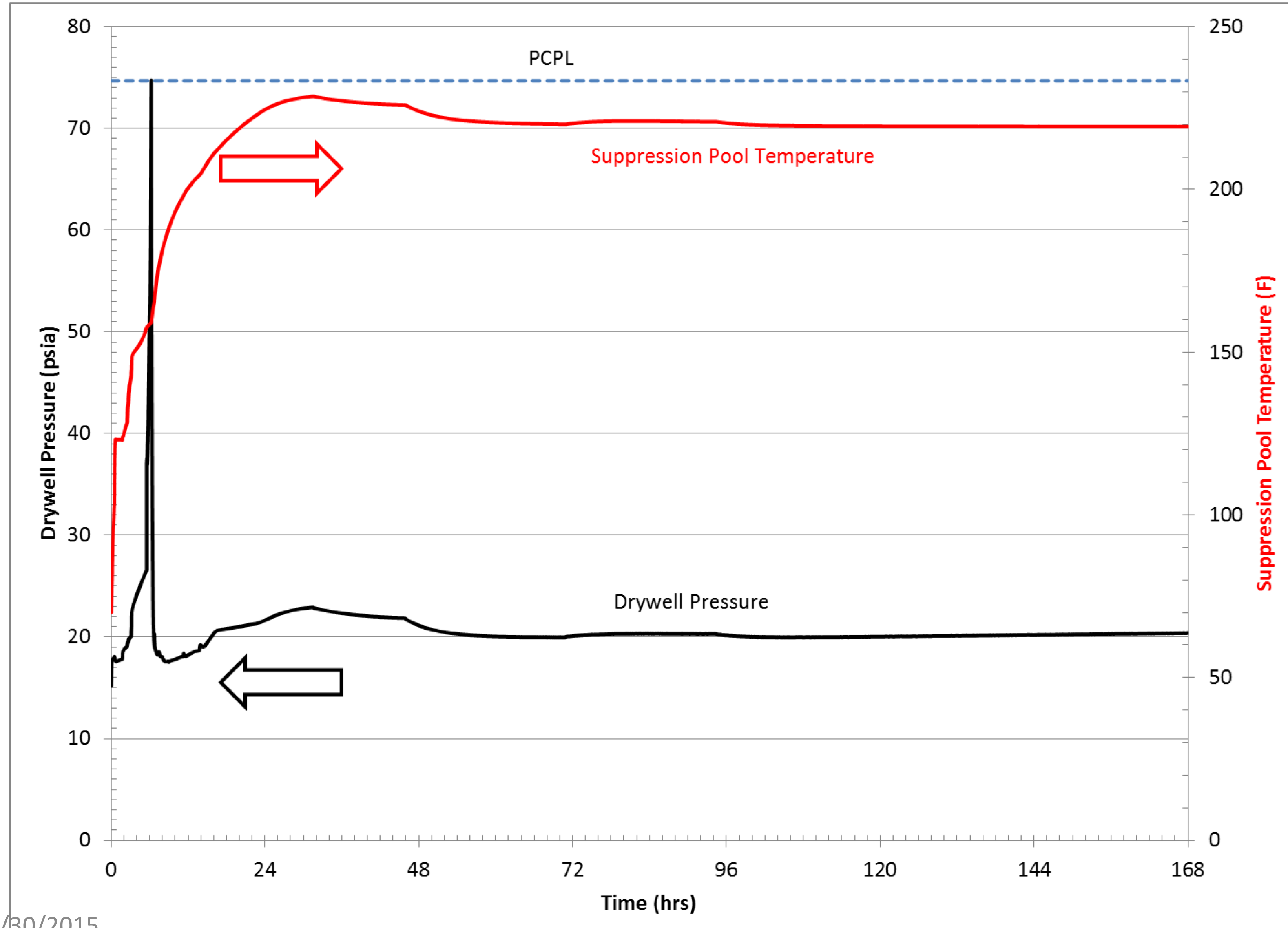
Draft JLD-ISG-2015-01 Section 4.3.1

- Three tier approach for SAWM:
  - 7 days of Sustained Operation – all subsequent actions beyond 7 days are not subject to 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 Order EA-12-049 S/D Refueling Modes)
  - <72 hours of Sustained Operation – an evaluation of alternate reliable containment removal that includes equipment to be used and connection points will be described or committed to in Phase 2 OIP

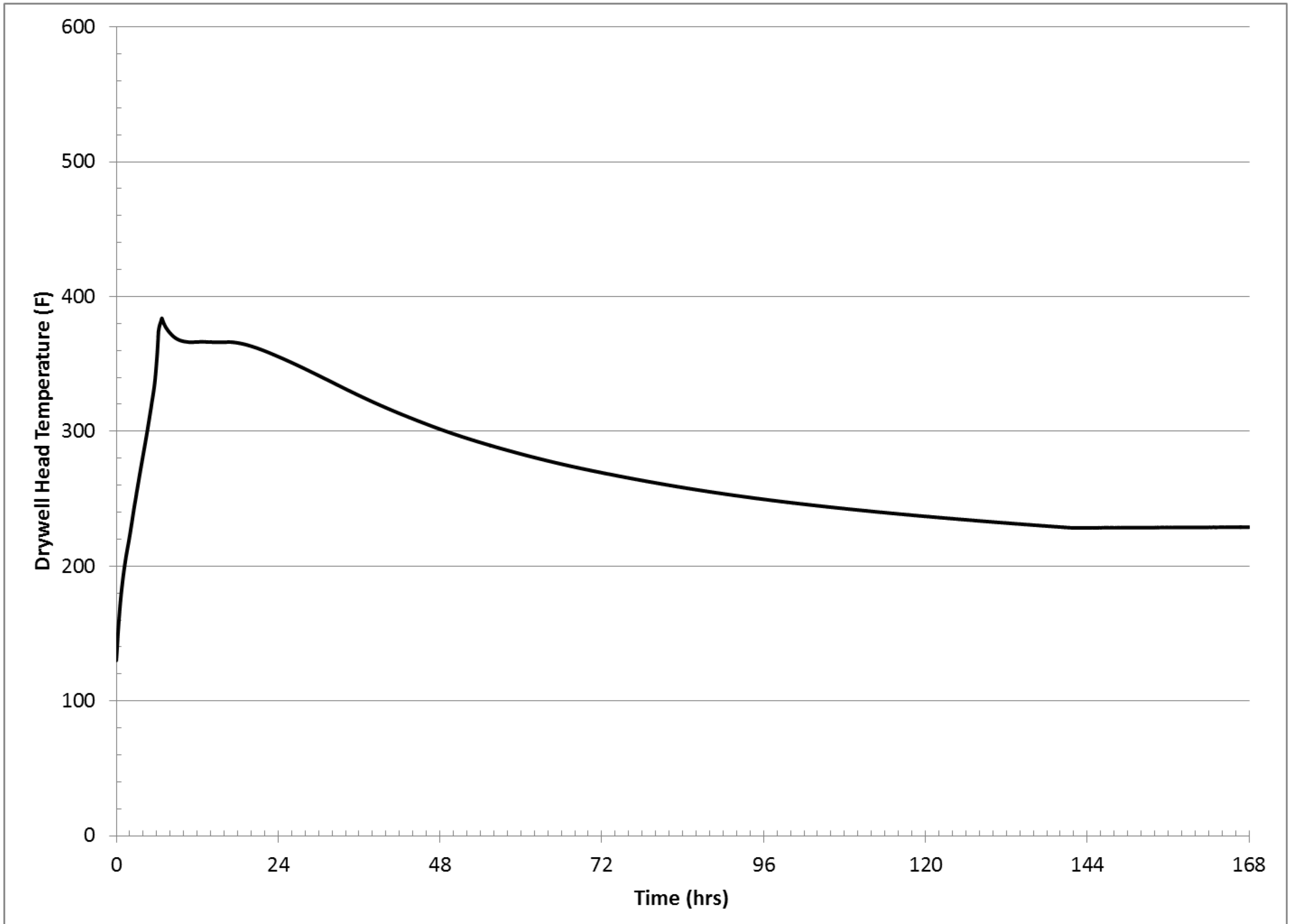
MAAP 5.02 SAWM Simulation



MAAP 5.02 SAWM Simulation



MAAP 5.02 SAWM Simulation



72 Hour to 7 Day Functional Description

- Written plan that should address
  - Multiple means of alternate containment heat removal available
  - Include multiple approaches such as use of installed, portable or combinations of installed and portable equipment
  - List equipment available for use
  - Identify where electrical/mechanical connections can be made
  - Address accessibility of actions under severe accident condition
- ERO will be utilized to perform actions needed based on written plans
  - **Detailed procedures are not required**
  - **Permanent modifications to plant are not required**
- Example of possible tie in points
  - Cut into RCIC or HPCI test return line for suction path
  - Connect to SAWA connection for return path

<72 Hour Functional Level Description Supported by Procedures/Modifications

- Written plan that should address
  - Multiple means of alternate containment heat removal available
  - Include multiple approaches such as use of installed, portable or combinations of installed and portable equipment
  - List equipment available for use
  - Identify where electrical/mechanical connections can be made
  - Address accessibility of actions under severe accident condition
- ERO will be utilized to perform actions needed based on written plans, procedures and modifications
  - **Detailed procedures are required for at least one method**
  - **Permanent modifications to plant are required for at least one method**
- Examples of plant modifications
  - Install 5” flange in RCIC or HPCI test return line for suction path
  - Return to SAWA connection point

Alternate Containment Pressure Control

Draft JLD-ISG-2015-01 Section 4.3.2

- The guidance should instruct licensees to identify and include in their OIPs possible means of providing the alternative pressure control.
  - Guidance related to possible use of a non-severe accident capable drywell vent within either the 7 day Sustained Operation period or before alternate containment heat removal and pressure control is established has been removed
  - Any discussion of post severe accident use of the drywell vent that is not severe accident capable per Order EA-13-109 has been moved to Section 1.3, Procedure Interface.
  - Any use of a drywell vent within the 7 day period of sustained operation or prior to establishing alternate containment heat removal will be severe accident capable

SAWA Equipment

Draft JLD-ISG-2015-01 Section 4.3.3

- NEI 13 – 02 will contain 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
  - These motive force requirements are not within the scope of the installed 24 hour dedicated equipment requirements of the Order
    - For less than 24 hours, an Order EA-12-049 Level “A” validation under severe accident conditions will be used to demonstrate acceptability (treated similar to a “Time Sensitive Action” (TSA))
    - Providing installed dedicated 24 hour motive force is an acceptable option

EA-12-049 Validation Process (4.3.3)

- Outlines a process that may be used by licensees to reasonably assure required tasks, manual actions and decisions for FLEX strategies are feasible and may be executed within the constraints identified
  - A graded approach for validation is used in order to apply a higher level of detail and rigor to validations for TSAs that occur shortly after the event. This is the timeframe where personnel resources would be assumed to be at minimum administrative staffing levels. Resources to accomplish the TSA are considered in the application of validation methods.
  - Identify the tasks, manual actions and/or decisions that require validation
  - Select the appropriate graded approach (Level A, B or C as discussed below) for the applicable decisions and/or actions
    - **Level A: Used for TSAs started within the first 6 hours**
    - Level B: Used for TSAs started between 6 and 24 hours after the event
    - Level C: Other tasks or manual actions in the OIP/FIP that are labor intensive or require significant coordination
  - **Level A will be selected for all SAWA TSAs required within the first 24 hours**

Required Instruments for SAWM (4.3.3)

- NEI 13-02 Appendices C and I will include guidance regarding functional requirements such as how power to required instruments is ensured
  - Includes portable and installed instruments
  - Portable instruments will typically be included as part of the SAWA pump skid mounted equipment

SAWM Installed Instruments (4.3.3)

- 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
  - Phase 2 OIPs will describe how these instruments will be powered through the period of sustained operation or until alternate containment heat removal is established

Conclusion

- SAWM is a viable strategy for meeting Option B.2 of EA-13-109
- 545°F design boundary condition confirmed acceptable with SAWA
- HCV-WP-03 provides methods to address combustible gas challenges to HCVS design