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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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613TH MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

(OPEN)

+ + + + +

THURSDAY

APRIL 10, 2014

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ROCKVILLE, MARYLAND

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

COMMITTEE MEMBERS:

JOHN W. STETKAR, Chairman

HAROLD B. RAY, Member-at-Large

SANJOY BANERJEE, Member

DENNIS C. BLEY, Member

CHARLES H. BROWN, JR. Member

MICHAEL L. CORRADINI, Member

DANA A. POWERS, Member

JOY REMPE, Member
PETER RICCARDELLA, Member
MICHAEL T. RYAN, Member
GORDON R. SKILLMAN, Member

DESIGNATED FEDERAL OFFICIAL:
EDWIN M. HACKETT

ALSO PRESENT:
ROB BECK, Bechtel
PATRICIA CAMPBELL, GE Hitachi
PETER HASTINGS, B&W mPower
DAVE KANUCH, B&W mPower
DOUG LEE, B&W mPower
ERIC WILLIAMS, B&W mPower

NRC STAFF:
ANNA BRADFORD, NRO
HAROLD CHERNOFF, NRR
THERESA CLARK, NRO
STEPHANIE COFFIN, NRO
JOSEPH GIANTOLLI, NRR/DIRS
TEKIA GOVAN, NRO
A.H. HSIA, NRO
RONALDO JENKINS, NRO

MARK KING, NRR

ROBERT G. KRSEK, OCM/WDM

HUAN LI, NRO

STEWART MAGRUDER, NRO

DAVID MISENHIMER, NRO

JOHN NAKOSKI, RES

THOMAS SCARBROUGH, NRO

GEORGE TARTAL, NOR

ERIC THOMAS, NRR/DIRS

KENNY THOMAS, NSIR

JOSEPH WILLIAMS, NRO

TABLE OF CONTENTS

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

(8:32 a.m.)

CHAIRMAN STETKAR: The meeting will now come to order.

This is the first day of the 613th meeting of the Advisory Committee on Reactor Safeguards. During today's meeting, the Committee will discuss the following: Economic Simplified Boiling Water Reactors Supplemental Final Safety Evaluation Report, Overview of NRC Operating Experience Program, Overview of the B&W mPower Small Modular Reactor Design, NRC Staff Activities Regarding Small Modular Reactors, the Biennial Review of the NRC Research Program, and Preparation of ACRS Reports.

The session on the ESBWR Supplemental Final Safety Evaluation Report will be closed in order to discuss and protect information designated as proprietary, and the portion of the session on the overview of the B&W mPower small modular reactor design will also be closed to protect proprietary information.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Mr. Christopher Brown is the

Designated Federal Official for the initial portion of the meeting.

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

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

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

As an item of interest for us today, we would like to announce and congratulate Dr. Dana Powers for being appointed to his sixth term on the Committee.

(Applause.)

I would like to say we appreciate his sage wisdom, which is something I would like to say.

MEMBER POWERS: But you are not going to.

(Laughter.)

CHAIRMAN STETKAR: But I am not going to say it.

(Laughter.)

MEMBER POWERS: The words just won't come out, just your internal --

CHAIRMAN STETKAR: I'd like to say that.

Anyway, we will proceed with ESBWR, and I will turn the meeting over to Dr. Mike Corradini.

MEMBER CORRADINI: Okay. Thank you very much, John.

Today we are going to have -- our first topic will be essentially the NRC's review of the ESBWR steam dryer. I will note that the meeting is closed to the public, and I assume that that has been checked.

CHAIRMAN STETKAR: We're going to have to make sure that we have the bridge line closed. So let's let Chris take care of it.

(Whereupon, the proceedings in the foregoing matter entered into Closed Session at 8:35 a.m. and returned to Open Session at 10:16 a.m.)

CHAIRMAN STETKAR: We are back in session, and we are in open session now.

And the next topic on our agenda is NRC Operating Experience Program Overview, and Dick Skillman will lead us through that. So Dick, please?

MEMBER SKILLMAN: Mr. Chairman, thank you. Good morning. I would like to introduce this topic as follows. About six or eight months ago, Dennis Bley and I, Dr. Bley and I, were sitting in office cubicles talking about the amount of information that is available, not only to the ACRS staff but to the whole agency relative to operating experience. And as Dennis and I talked about this, we opined, wouldn't it be valuable to let the members of the ACRS know how much effort is invested in this topic and what resources are available.

And so this discussion this morning began with that short interaction, and I asked my colleague, Mark Banks, to please help. Mark has corralled a lot of this information and has invited Eric here today. So I welcome Eric Thomas from the Operating Experience Branch. Around this table I am sure there are people who remember AEOD and Carlisle Michaelson and when this began, and here we are I'm going to guess 20 years later.

And so I would ask you -- so I would like to ask you to take the lead, and this is an opportunity for you to dazzle the ACRS with what you've got there. So please take the lead.

MR. THOMAS: Don't set your expectations too, too high there.

Well, thank you. And contrary to my hairline, I do not remember the AEOD. I was not part of the agency then, but I have heard a lot about it.

Thanks for the introduction, and, again, my name is -- good morning. My name is Eric Thomas. I work for Harold Chernoff in the Operating Experience Branch in NRR. This morning I will be providing you all with an overview of the NRC's reactor operating experience program. I will start with a little bit of background, including a brief history of the program and some of the events and milestones that got us to where we are today.

This includes a discussion of how Three Mile Island changed the operating experience landscape, how the agency dealt with operating experience in the two decades that followed, and I will discuss how some of the observations in the Davis-Besse lessons learned task force report and the follow-on reactor operating experience task force report reshaped the NRC's reactor operating experience program into what it is today.

I'll show you where the current program fits into the agency's reactor oversight process.

We'll do our basic processes for dealing with reactor operating experience, and the people and programs that we have in place to accomplish our mission.

Finally, I'll touch on some of our internal and external interfaces, such as the other NRC staff, the Institute of Nuclear Power Operations, and our international partners.

Real quickly, our governing documents, Management Directive 8.7 came about, as well as LIC-401. NRC Office -- or NRR Office Instruction LIC-401 came about as part of the program in the last 10 to 12 years. These are our two program documents that govern the NRC's reactor operating experience program. In addition, Inspection Manual Chapter 2523 describes how we interact with the reactor oversight process in areas such as developing operating experience smart samples and proposing changes to inspection processes.

We'll spend a little bit of time on this slide here -- brief history. In 1978, the GAO found that the NRC had no -- in a GAO report, they found that the NRC had no systematic defined or dedicated program to analyze operational experience and feed this information back to licensees and to the nuclear industry. GAO identified the need for the NRC to

establish uniform reporting requirements and a system to promptly identify all safety-related problems from licensee event and other incident reports. That's right from the report.

So as we were looking at this, Three Mile Island happened, and it happened before the agency could formally respond to the GAO's audit. Following the accident at Three Mile Island, we formed the Office for Analysis and Evaluation of Operational Data, AEOD. It was created as an independent office reporting directly to the EDO. Their mission was to coordinate operational data collection, systematically analyze and evaluate operational experience, feedback the lessons learned of experience to improve operational safety, assess the effectiveness of the agency-wide program, and act as a focal point for interaction with outside organizations on issues pertaining to operational safety, data analysis, and evaluation.

So AEOD was disbanded around the 2000 timeframe based on some efficiencies that the agency thought we would gain by taking those functions and spreading them out across the agency to lower our operational overhead and for some other reasons. So basically the PRA, IPE, IPEEE, and generic safety

issues programs, along with longer term operating experience evaluation functions, went to the Office of Research.

The incident response and investigation function went to the then Incident Response Operations Directorate, which is now expanded into NSIR or the Office of Nuclear Security and Incident Response. And a short-term domestic and foreign operating experience review fell to NRR.

After the Davis-Besse vessel head degradation event in 2002, the reactor operating experience task force, which came out of the Davis-Besse lessons learned task force, evaluated the operating experience program and determined, among other things, that the most significant overall program weakness for the agency's operating experience program was the absence of a clear agency vision of how all the operating experience program activities should function together and be integrated with the licensing and inspection program activities.

Some of the other insights from the task force which speak to the makeup of our current organization are -- kind of paraphrasing here -- lack of clearinghouse function and routine distribution of operating experience to the NRC technical staff, and

also very few operating experience evaluations to identify important lessons learned from the operating experience information.

So the task force report went on to define the attributes of an effective operating experience program to include clearly defined and communicated roles and responsibilities; efficient collection, storage, and retrieval of operating experience information; effective screening of operating experience for followup evaluation; timely communication of operating experience to stakeholders for information or evaluation; timely and thorough evaluation of operating experience to identify trends, recurring events, or significant safety issues for appropriate followup; timely decisions on implementation and appropriate followup resulting from the review of operating experience; and periodic assessments of the program.

So the current program we have for operating experience, as well as our organizational structure, are based largely on the reactor operating experience task force report and recommendations.

One other thing I want to add on, in the last few years since the Office of New Reactors formed and has their own construction experience program, we

have teamed up with them and a Center of Expertise to ensure that there is one funnel for operating and construction experience data for the agency, and we don't get stovepiped in that aspect.

CHAIRMAN BLEY: Where do you fit in the organization now? You said AEOD reported directly to the EDO I think.

MR. THOMAS: The Operating Experience Branch, we have about a dozen people in the branch. We are in NRR, in the Division of Inspections and Regional Support.

CHAIRMAN BLEY: Okay.

MR. THOMAS: So we sit side by side with the Reactor Inspection Branch, the Performance Assessment Branch.

Okay. On this flowchart, I'm trying to show how the operating experience program fits into the agency's reactor oversight process. So here we are down here on the lower left. So basically the way this flowchart is written or put together, across the bottom you can see where daily events from domestic and international reporting systems, as long as -- as well as results from the inspection program and the performance indicator program, and other information

feed into or are fed by the operating experience process.

At the top of the flowchart you see where results of the operating experience program intersect with other NRC programs and potential internal and external interfaces. And we will go into a little more detail for some of these in later slides.

MEMBER SKILLMAN: Eric, before you -- will you discuss international events later?

MR. THOMAS: Yes.

MEMBER SKILLMAN: Okay. Thank you.

MR. THOMAS: Okay. So zooming in a little bit on the previous slide and that operating experience block, this graphic shows how information flows through our current NRR Operating Experience Branch process, or our Center of Expertise, NRR-led process.

So beginning on the left-hand side, left-hand column, you see the summary of information that feeds into the program from both internal and external sources. In the middle is the day-to-day work of the operating and construction experience staff.

We pulse each source of incoming information on a daily basis, and we use our

clearinghouse process to disposition each issue in a consistent manner that ensures all pertinent information is coded and stored, and that more important issues get forwarded to the correct parties around the agency.

On the right are the products --

CHAIRMAN BLEY: You actually, as reports come in, maybe the -- you're getting -- I don't see them up there, but you are getting the reports from INPO as well as from --

MR. THOMAS: That's correct.

CHAIRMAN BLEY: -- other places. So if something really hot comes in, you forward it immediately to whatever organization is most --

MR. THOMAS: Oh, yes. Yes. If there is -- you know, INPO puts out a variety of different INPO event reports, different levels, and if there is a Level 1, which we may see one every couple of years or, you know, during Fukushima we saw several in rapid succession, those go straight up to our EDO points of contact for distribution according to --

CHAIRMAN BLEY: And given you're in NRR --

MR. THOMAS: Yes.

CHAIRMAN BLEY: -- do you also get materials reports and that kind of stuff? Or is there a parallel organization?

MR. THOMAS: There is a parallel organization in NMSS for materials issues.

CHAIRMAN BLEY: There is. Okay.

MR. THOMAS: Yes.

CHAIRMAN STETKAR: Eric, under international, I'm familiar with INES, so I know what that means, the IRS I'm less familiar with. Is that a WANO function? Or what level of -- I guess let me get right to the point. What level of filtration is there in that IRS operating experience?

CHAIRMAN BLEY: Before it gets to you.

CHAIRMAN STETKAR: Before it gets to you.

MR. THOMAS: Before it gets to us, that's an IAEA --

CHAIRMAN BLEY: That is -- okay, that's the IAEA. All right.

MR. THOMAS: -- that's an IAEA-run database. As for filtration, I don't know of any. I'll defer to Harold here.

MR. CHERNOFF: Maybe I can add a little characterization here. That system is an IAEA administered database. It is also shared with NEA

through the working group on operating experience. Each country that is a member of IAEA has an IRS national coordinator. I'm the U.S. national coordinator.

And essentially what the system captures for our sensibilities, what we're familiar with, are incidents that are reported or identified by countries, regulators, and something akin to our LER, license event report system. However, what I would say is our event reporting goes to a much lower threshold than the international as a whole that gets in the system.

There are about 80 reports a year entered in this system.

CHAIRMAN STETKAR: Eighty total?

MR. CHERNOFF: Eight-zero, that's correct. Eighty reports. So, you know, it's not a huge volume. It's --

CHAIRMAN STETKAR: Is it working? I mean, I actually dealt with this --

MR. CHERNOFF: Yes.

CHAIRMAN STETKAR: -- about a decade ago, and it wasn't really working.

MR. CHERNOFF: As far as this is working, for the more significant events it identifies them,

and we have meetings twice a year where we go over the specifics of some of the more significant events. And it does a good job of -- you know, I'll give you an example.

You guys probably recently heard of the -- Tianj and Duhl. I was, you know, sitting in a meeting in Paris when the Belgians came in and said, "Here's what we're doing," and that was before it hit the press, before it hit the public announcements. They had just gotten a call from the operating agent and the regulator said, "Here's what we're doing."

So it ends up being a very good way for the regulators to communicate. These are, you know, regulators who are administering these things. On our end, I have a staffer, Dave Garman, who review all of the reports entered into the system, and we put them through our clearinghouse function, which Eric will talk about more. It goes out, and we have -- we review all of our licensee event reports and other incidents for potential incorporation.

The U.S. typically is putting in a little over 20 items a year.

CHAIRMAN STETKAR: Yes. That's what I was going to ask next. Out of 80, we're about a quarter of them?

MR. CHERNOFF: Yes. Yes.

CHAIRMAN STETKAR: Okay.

MR. CHERNOFF: And what we're trying to do as an organization, through IAEA, is really try to get more participation from some countries. Right now the focus is on China because they're doing all the builds right now. They're doing the vast majority of the builds. So everybody believes that there is -- and, frankly, we've had some good progress in the last year or so in --

CHAIRMAN STETKAR: They're builds, but, I mean, they're countries that have a large number and a long history of operating experience. Are they -- I won't name any countries, but are they participating very well?

MR. CHERNOFF: Everybody is participating. We actually -- one of the things we've established each time is which countries are reporting how much, and every year there seems to be a couple or three countries that don't have anything to report.

I would just say on the right side of that statistic are -- in many cases, a lot of the smaller countries only have one or two units, and it shouldn't come as a surprise if they don't have a significant thing to report. But the bigger countries -- Russia

is now supporting and reporting more. France has been. Canada, Great Britain, and the U.S., along with France, have been the majority of people providing the reports going in.

CHAIRMAN STETKAR: Japan?

MR. CHERNOFF: Japan we are working hard with --

CHAIRMAN STETKAR: Okay.

MR. CHERNOFF: Effort needs to be put there still, though.

CHAIRMAN STETKAR: Thanks.

MEMBER SKILLMAN: Let me pull a little bit further on this international. To what extent have you been able to mine the WANO operating event database?

MR. THOMAS: We don't have direct access to WANO reports. What we do get occasionally is through INPO's relationship with WANO. We will get an international -- you know, international report that is redacted by INPO and put out as an INPO event report. But those are, you know, quite frankly few and far between.

MEMBER SKILLMAN: I would just offer, there is a gold mine in that bucket.

MR. CHERNOFF: If I could add to that, IAEA signed a memorandum of understanding with WANO just about a year ago, and it provided access for WANO to the IAEA databases with the stated purpose of having reciprocity. We have not yet established the reciprocity part of that.

In fact, we were talking at our meeting last month, this is one of the subjects that came up about pushing for that reciprocity because in the U.S. we are -- and Eric is going to talk about it, we are extremely familiar and very thankful for the data in the INPO database, that we have full access to or almost full access to, and we are well aware that the same thing is out there in the WANO space.

MEMBER SKILLMAN: Well, here is an interesting twist. For a Part 52 applicant, that applicant has to identify foreign experience. And for the Part 52 applicant, getting that foreign experience is a real task. But I did that for the ABWR, and I got access to the WANO database. And there is information in that WANO database that is threshold TMI 2 stuff that is extremely valuable.

And so if your memorandum of understanding would get you access to that, that would be another

resource that is presently I think untapped that could be very valuable to the industry and this country.

MR. CHERNOFF: Agreed.

MEMBER SKILLMAN: Thank you.

MR. THOMAS: I think I was on products, so on the right side of this.

MEMBER SKILLMAN: Yes. You were on the right-hand side, Eric.

MR. THOMAS: So on the right side of the slide here, we have some of our products that are the result of the clearinghouse screening and analysis functions.

Okay. So it's a two-team approach with our branch over in NRR and teaming with our partners in NRO and Research. So getting a little bit more specific, the operating experience program uses two teams to work together and complement each other's efforts. The clearinghouse team takes in operating experience information from the various sources on a daily basis, as I said before.

It is comprised of staff from NRR, along with the Office of New Reactors, the Office of Research, and the Office of Nuclear Security and Incident Response. The team meets three times per week, and we have -- in the NRR Operating Experience

Branch we have staff members assigned to cover each region, and they will enter events and other issues identified for their region into an issue tracking database.

Team members from NRO, Research, and NSIR can also enter information into the database and bring it up in front of the clearinghouse. The team makes screening and coding decisions on each database entry and sends relevant entries to our internal stakeholders.

We generate -- the clearinghouse team generates most of our OpE communications, which are web postings posted on the internal website, which I will cover in more detail later, as well as issues for resolution, which are sort of on the comparison to a safety evaluation for a potential agency action.

And as I said, we code information into this issue tracking database, which also helps our technical review groups, our technical staff, who are interested in operating experience, be able to easily search on their areas of expertise.

We also have an analysis team, which evaluates events and inspection results across the industry for short-term trending. When a noteworthy trend is identified, the team will investigate further

and fully vet the issue, often resulting in a study or perhaps a management briefing, which can lead to other products.

We answer most external information requests coming into the branch, and also the technical review group and INPO liaison functions are a part of the analysis team.

MEMBER SKILLMAN: Before you change that slide, is a product out of the clearinghouse team an information bulletin or an advisory to the sites, an IB?

MR. THOMAS: It could be. Information Notice.

MEMBER SKILLMAN: IN.

MR. THOMAS: It could be -- yes, it could be a generic communication. It could be -- and I'll go through these in specifics on a later slide, but there is a variety of different products that we can put out as a result of our clearinghouse and analysis functions.

MEMBER SKILLMAN: Okay. Thank you, Eric.

CHAIRMAN BLEY: Do you have any direct interaction with the more significant inspection team reports, the AITs and IITs?

MR. THOMAS: And, again, this is good segues, but for the reactive inspection process we do play a part. That would cover, you know, special inspections, augmented inspection teams, and the occasional incident investigation team.

We generally do not send members out to be part of the inspection team, but we are part of the screening process. When the regions and NRR need to come together for more significant events and determine, you know, should this be an SIT or an AIT or higher, we're part of that decisionmaking process. And then once a team is put out in the field, while the inspection is in process, they normally have an end-of-the day phone call to wrap up what they found that day, you know, an exit meeting, phone call, that kind of stuff.

And our person -- you know, say it's Harris plant. You know, so the person that we have in the branch who is covering Region 2 will call into that call on a daily basis to stay apprised of what is going on.

MR. CHERNOFF: Eric, I might add in response to that that it's very frequent when those teams are in place that we get specific requests back to us to research, try to find things related to and

support the team directly. So there is a day-by-day interaction with our regional point of contact typically with those teams.

CHAIRMAN BLEY: You can leave that slide, but on that slide you talked about the analysis team, the analysis work.

MR. THOMAS: Yes.

CHAIRMAN BLEY: I know you weren't here when AEOD was still in operation, but they used to do lots of different kinds of analyses of operating experience trying to look for trends and characterize situations around the industry. Is that the kind of analysis work you're still doing?

MR. THOMAS: That is exactly what we still do.

CHAIRMAN BLEY: And to help me find your reports, are they just labeled OpE reports, or is there -- are they NUREGs, or what do you put out?

MR. THOMAS: We have had studies that have been put out in different formats. We recently did a study on component aging that was publicly -- we had a publicly available version, and I can, you know, provide that.

We have put out other studies in the form of operating experience communications, so a web posting internal --

CHAIRMAN BLEY: Ah, okay.

MR. THOMAS: -- with, you know, links to the report and the background information. And other topics have been covered as like NRR executive team briefings, and that sort of thing. And there are examples of, you know, things that we have done that have led to other products such as, you know, generic communication or something called an operating experience smart sample where we talk about an enhancement or something we can add in or point the region's focus to a specific issue that deals with the specific inspection procedure that they could look more closely at. And those are also publicly available.

MR. NAKOSKI: Eric, if I could add -- I'm John Nakoski. I'm the Branch Chief of the Performance Reliability Branch and Research. We also do part of what AEO used to do like detailed system studies. We haven't done one in a while, but moving forward we are looking at some of the operating experience to formulate a plan to look at electrical system component failures and the impact on safe operation.

That study is really just getting underway. Matter of fact, we're meeting internally in my branch to kind of kick that meeting -- that process of. But it just dovetails with what Eric was saying, that function -- a lot of it is done in NRR through this program, but we also in Research have a piece of that.

CHAIRMAN BLEY: Okay. Thank you.

MR. CHERNOFF: Also, one adder is I believe you guys have access to the Sharepoint sites through --

CHAIRMAN BLEY: We have access to some of them.

MR. CHERNOFF: Okay. We have put some enhanced easy access tools up there that would allow you guys ready access to all of our products.

CHAIRMAN BLEY: So that is under the NRR Sharepoint?

MR. CHERNOFF: It is actually under NRR/DIRS Sharepoint site, and there is a sub-bullet on operating experience. And we've got some pretty simple to use self-explanatory search tools there.

CHAIRMAN BLEY: Yes, I'd like to track that down.

MR. THOMAS: Okay. So digging a little more into this -- the clearinghouse function, as I mentioned before, the operating experience clearinghouse meets three days a week. So the team members will go through all of the information from all of those -- the various inputs here on the left side and enter items into issue tracking database, which is an application that we run.

They will also enter in -- each individual when they put an issue into the tracking database will enter their screening recommendations prior to the clearinghouse meeting. During the meeting, team members review -- or each member will come up and brief their events. Team members will review each of the items in the issue tracking database, and the clearinghouse chairperson will update the database with final screening decisions and disposition for each issue.

The database allows the team to record the disposition of each issue and search for issues by date, subject area, plant, region, and several other criteria.

There is hundreds of staff from around the agency that have read-only access to the database, so they can go in and perform searches of all of the

items that we are screening, and they can generate reports based on their search results. The capability is useful for groups such as our technical review groups, which use the issue tracking database as one of their information resources.

And so in the middle here -- and I'll speak more to these later, but some of our disposition results, you know, we can screen this in per our processes as an issue that needs to be resolved, needs some sort of report, investigation by our team. We can put it out as information internally as an OpE communication or just, you know, mark it as this goes under the, you know, auxiliary feedwater or electrical power distribution technical review group to make sure that they see it when they come back in and search the database.

MEMBER SKILLMAN: Eric, please speak a little bit to whether or not, for whatever the issue is, it can be identified as a human factors or human performance as opposed to a widget failure or a pipe leak or a component gizmo failure.

MR. THOMAS: Short answer is yes.

MEMBER SKILLMAN: Okay.

MR. THOMAS: We have a human performance -- it's actually human performance safety culture,

because we found we were always tagging things with both, so we combined the two into one of our technical review groups. So when any sort of human performance issue comes before the clearinghouse, you know, it could be, you know, something with RPS, but the reason that the -- you know, some failed in the reactor packing system was something human performance related --

MEMBER SKILLMAN: Lack of knowledge, training, that type of thing?

MR. THOMAS: Exactly. And that is probably one of our most often tagged references for the issue tracking database is human performance. And, you know, they give us probably one of the better technical review group inputs every year. The team meets and goes through, okay, how are we going to parse through all of this stuff that has been tagged for us and generate some sort of analysis back to the operating experience program?

MEMBER SKILLMAN: Okay. One more. Is there a toggle in there for root cause failure? Because the licensees are required to do a root cause, and sometimes those root causes are very good, and sometimes they are not so very good.

MR. THOMAS: As far as whether the issue had a root cause report, we don't have a specific toggle in there, but we do have ways of getting at that information. And one of the ways is through our access to the INPO consolidated event system. Another method is through our contacts with the region, you know, directly to the resident inspector, say, "Hey, is there a root cause? Can you send it to us?" Because once that gets put in the corrective action program, it is -- you know, it's available to us.

MEMBER SKILLMAN: Thank you. Thanks.

CHAIRMAN STETKAR: Eric, I haven't read LIC-401. You say the criteria for screening are listed in there. Can you give us some examples of what those criteria are? Yes, you can.

MR. THOMAS: Got my copy right here. I knew there was a reason I had this with me.

CHAIRMAN STETKAR: I am trying to get a flavor of what sort of things you look at.

MR. THOMAS: Well, basically, we look at -- sort of along the model of doing reactive inspections, we look at deterministic criteria, we look at risk criteria. So if it's got risk numbers that are basically above one E to the minus six, we

are going to consider it as something that could be screened in.

CHAIRMAN STETKAR: You make the risk determination, or you --

MR. THOMAS: No, we don't make the risk determination. We go off -- for example, for an escalated inspection finding, you know, if something is -- an event that resulted in a yellow or red finding, we are probably going to screen it in and at least look into it, you know --

CHAIRMAN STETKAR: But I'm more interested in -- you say you get reports daily of things that are happening. So you get a report that today at Plant X, you know, a high pressure injection valve failed to open.

MR. THOMAS: Right.

CHAIRMAN STETKAR: And you said you meet three times a week.

MR. THOMAS: Right.

CHAIRMAN STETKAR: You probably don't have an inspection report on that.

MR. THOMAS: No. We just have an event notification, and we'll probably code that to the pump and valve technical review group, maybe -- you know, maybe ECCS as well, and let them go back in, and when

they say, "Well, what have we seen throughout the year that has to do with HPC," they can search on that.

CHAIRMAN STETKAR: Let me try it from the opposite. If something comes in, how does it get screened out of your further consideration? I mean, what -- if it -- you know, basically --

MR. THOMAS: Yes, I know, if it doesn't meet the criteria.

MR. CHERNOFF: The general principle is things that have -- I will use the phrase "moderate or above safe significance" and some generic applicability. There is a list of, oh, about 20 items in the procedure characterizing it in a little finer detail. I don't know if you --

CHAIRMAN STETKAR: We have time here, so --

MR. THOMAS: Degradation of important systems, structures, and components that could lead to termination of a loss of safety function. Potential degradation of fission product barriers, potential adverse trend, transients that involve inappropriate operator actions or equipment performance that ended up affecting reactor safety. Those are some of the deterministic keys that we look at.

MR. CHERNOFF: It is a pretty comprehensive list, and there is also a -- there is a lot of flexibility in the way it's written, but there is also kind of a mother clause that, you know, if it's something that management of others feel we can also put --

CHAIRMAN STETKAR: In some sense, one of the reasons that -- I've got these two points that I'm trying to explore here. And one was the degree of subjectivity that enters into the screening process, because you're probably looking at a fairly large number of events over -- you know, in a continuous process with people who will change over time.

And I'm trying to explore a little bit of how much subjectivity there is on screening things in, not that you need -- you do need subjectivity. I'm just trying to understand what -- you know, if today I decide this sounds important to me, I put it in. Tomorrow you might decide that the same thing doesn't sound important to you.

MR. CHERNOFF: And the most difficult challenge is -- just as it was stated in the TMI era is finding the significant salient things, but not inundating people with everything else.

CHAIRMAN STETKAR: Exactly.

MR. THOMAS: I think a good way to answer that question is if you go back to 2005/2006 timeframe when this program in its current form started with this clearinghouse meeting, clearinghouse meetings weren't as well organized as they are now. There wasn't as clear a definition of roles, and we ended up screening a lot of stuff in.

I think the first year we put out over 100 issues for resolution reports. Did all of those things need to be issues for resolution? No, but I think we were failing safe.

Through the years, we have migrated that down to, you know, the 40 to 50 IFRs per year, issues for resolution per year, and today it's maybe a dozen or so. And I think one thing you'll find is an issue for resolution closeout that is done today is a lot better vetted, a lot more detail, a lot more focus on let's get all the different angles on this issue, and let's make sure we have some sort of usable outcome than in the past where it was more of just -- we looked at this, you know, and more often than not we didn't -- we didn't do anything.

And at the same time, our other tools have developed better, such as the operating experience communications have become a lot more user-friendly,

a lot broader distribution, and a lot more detail in each report. So it -- while issues for resolution are fewer and far between, any gap that could be construed in there is being filled in by a lot of the other stuff that is developed along the way that wasn't as well developed at the beginning of the program.

For instance, the database where we put all of our day-to-day information, that didn't come about until the program had been going for five years. So before that it was just -- we had put out a daily email of this is all the stuff we've screened, this is how it was dispositioned, and, you know, we found that corporate knowledge was appropriately two weeks. And after two weeks, I'm sorry, but, you know, my brain is only so big, and it's gone.

So we ended up doing a lot of email searching for stuff until finally it was like I'm pretty sure there is something, you know, called a database that would help with this.

CHAIRMAN STETKAR: Thanks. That helps a little bit, and I'll go look at those criteria.

The last bullet says, "Items screened by the clearinghouse are coded and stored." Do you mean items screened in or --

MR. THOMAS: No. I mean everything.

CHAIRMAN STETKAR: Everything. Good. good. Because, again part of my concern is if I today, because of whatever coffee I drank this morning, decide that this isn't -- doesn't seem all that important to me, it could obviously be important in terms of long-term trending and things like that. So good.

MR. KING: Eric, my name is Mark King. I work in the clearinghouse group, and I think it's important for the ACRS to recognize that we get like three cuts a lot of time on the U.S. events because we get the event notice up front, then we get a detailed LER that often includes risk numbers for us in the LER writeup, and then additionally we get the review of the inspection findings related to that event. So, and those will be colorized with a risk coding as well.

CHAIRMAN STETKAR: But if you're getting input from INPO, a lot of those things don't ever rise to the level of an LER or an inspection finding, right?

MR. KING: Correct.

CHAIRMAN STETKAR: Okay.

MR. THOMAS: Any more questions on screening function?

(No response.)

This sort of -- this is kind of a -- I don't know what the right term is -- preparatory slide for the next one. So in addition to our daily communications with the regions, and pushing the clearinghouse screening results out to the NRC technical staff, our operating experience Center of Expertise uses several methods and media to communicate program results to internal stakeholders.

So this graphic here starts with the more routine and less detailed communication methods at the top and works its way down to some of our more involved products. So I'll kind of take a sentence or two to describe each one.

At the top you have the periodic operating experience newsletter. This goes to a broad internal audience, goes out about once a month, and contains about normally half-page articles highlighting some of the more noteworthy events and issues from the past 30 to 60 days.

Operating experience notes respond to -- this is a response to the sort of one-time information requests. Often, for instance, the EDO's office, the EDO is going to talk to INPO or something, "Hey, what do you know about this?" And instead of just having

all of these one-pagers that people write and then who knows where they end up, we have -- we call them operating experience notes and save them and make sure we can reach back and grab, you know, the one we did three years ago.

Technical review group -- annual report is sort of -- is a form of operating experience note. The TRG members review operating experience information throughout the year and submit their team reports. Our staff pulls out the recommendations and accomplishments of the TRGs and publishes them in a newsletter to NRR management, which also goes out to the regions and back to the TRGs as well.

Notable operating experience report is a semi-annual operating experience note, and that is where our staff and NRR compiles notable events, issues, and studies, as well as trends from the past six months to provide the region sort of the operating experience landscape when they get together for their mid- and end-of-cycle meetings to discuss plant performance.

Periodic management and executive team briefings -- these generally occur once or twice per year. The operating experience analysis team will either be assigned a topic to study or else generate

a study based on recent trends and operating experience, and will brief the NRR executive team, along with quite often the region -- regional management is tied into these via GoToMeeting and teleconference. And these are often just for informational purposes. Sometimes there are actions discussed at these briefings.

And then finally the issue for -- well, issue for resolution, that is when an event does get screened in per our LIC-401 criteria. We call it a Level 2 screening.

The clearinghouse will screen the issue in and assign an issue manager from our ranks who will review the issue, engage technical staff, and make recommendations on potential courses of action for the agency.

And then, finally, the operating experience communication, which is perhaps one of our -- I'd say probably one of our most useful, if not our most useful tool, is an internal web posting where an issue or trend is identified by the clearinghouse for additional research and data-gathering.

Web postings are helpful because they provide sort of one-stop shopping for the issue, so if there's old generic communications or inspection

reports or perhaps a reactive inspection team report that is associated with the issue, we can link all of that information and have it all in one place to describe, you know, how it was first identified and what the end game was if you will. And we can, obviously, go back into the system and modify these as new information becomes available.

MR. CHERNOFF: I would like to add to that, Eric. That's the one that I think the regional people find both most useful and they also feed and build it. So our staff will put it together initially, and then as it gets circulated we find, you know, inputs also coming from the regional folks, building that, and then they share -- you know, share that amongst everybody.

So it ends up being a pretty good resource for inspection activities and just general awareness of evolving issues. It may eventually become something else, but that's a lot of times the first thing on the street, and then it evolves and grows as the information becomes available.

MEMBER SKILLMAN: Let me ask you to just hold your finger at 10 and go back to five for a second. Lower left-hand corner, operating experience block, this is just kind of a general question for you

to ponder, and, if you will, give an answer. Do you have a sense that there is a strata of information that is not being reported?

I mean, let me tell you why I ask. The toggle to get your attention is an event. The trigger that gets an event report causes some form of emotional excitement at the site, whether it's a pump trip, reactor trip, a failure in a system that is discovered because the system's command -- and the system doesn't respond as expected.

There is another layer of information that is at the site that may be applicable to many sites. Here is an example. The older plants are having difficulty getting parts. They are actually rebuilding relays. The relays have phosphor-bronze springs that are part of the contact assembly. And unless those springs contact firmly enough, the connectivity may not be provided.

And that can be discovered by an I&C tech who says, "Gee whiz, I bought these new springs, and the springs just don't function the way the old ones did." And so a smart tech will enter that into the corrective action program. It will come up in the discussion at the site.

But if it hasn't caused a trip or a transient or an event, that might get noodled away often to the procurement program and never rise to the level of "gee whiz." There could be contraband springs, there could be non-conforming parts that have been advertised as effective but not effective. How does that layer of information find its way up onto your radar screen?

MR. THOMAS: That's a good question. You know, we only know what we know is the one answer to that question. But, you know, often when we are sitting around at our analysis team meetings talking -- you know, discussing what to look at or going through the process of putting together a study, we do come up with this, you know, is this just the tip of the iceberg discussion?

We have resident inspectors at the site. We do talk to the regions on a daily basis. A lot of the stuff that comes up on those phone calls are below reporting threshold issues. It is the judgment of our person who is covering a region as to whether something below the threshold still merits, you know, an entry into the issue tracking database. So we've got to listen pretty hard.

Another way we can get at that sort of information is through the INPO system, the INPO consolidated event system, which is a merging of their plant events database, you know, EPIX and NPRDS systems. So we do get -- you know, if it is an equipment failure issue that is reported by the licensee into ISIS, we can pick it up that way. So we're looking for, you know, relay issues, and we have a couple of key words to go off of. We can formulate a search and pick up those sorts of things.

And then, if there is a corresponding corrective action program entry or, you know, root cause sort of thing, that will often be attached as a PDF file to the bottom of the report in ISIS. You know, the thing to be careful with is we can't always -- you know, unless it's something that we find as a regulator, we can't always pivot off the stuff that we pull out of INPO databases and turn it around. You know, there are some limitations on that. We don't take INPO things and --

MEMBER SKILLMAN: Fair enough. Thank you.

MR. THOMAS: I hope that answers your question.

MEMBER SKILLMAN: Good explanation. Thank you. Back to 10.

MR. THOMAS: Okay. So going on to 11, so occasionally the branch will generate support products that drive program changes and/or are communicated to an external audience, changes to the reactor oversight process and external communications, examples of these first two bullets that you see on the slide, those are all products that we have published in the last couple of years, whereas, you know, although we haven't used it since reorganizing the operating experience function back in 2005, rulemaking there at the bottom is also an option.

So as you can see here, you know, we will -- we interact through inspection manual Chapter 2523 with our partners over in the Reactor Inspection Branch and performance assessment. We have done several inspection procedure manual chapter revisions, operating experience, smart sample program. We have had, you know, a couple a year dating back to 2006. We do a lot of -- well, we do quite a few information notices. We did RIC sessions with industry and regional participation the last couple of years. We did not do one this year. And as we mentioned before, some of our studies do become publicly available.

CHAIRMAN STETKAR: Eric, again, I'm woefully uneducated about this. What is an operating

experience smart sample? Is that just someone who wants to find out all of the items that have been catalogued for a particular piece of equipment, or is it --

MR. THOMAS: A smart sample is when we are looking through some of the reported data and we see a trend of -- you know, one of them was on using vendor recommendations. So we see various events, maybe even other findings or reports that point to a lack of the licensee's ability to properly use vendor recommendations and maybe equipment replacement, that kind of thing.

CHAIRMAN STETKAR: Okay.

MR. THOMAS: And so we say, okay, well, we're seeing a lot of these. Where does the inspection program address this? Which inspection procedure addresses it? And we'll put together basically some temporary inspection guidance to provide to the regions. Now, you may say, well, how is that different from a temporary instruction or temporary inspection, TI?

Operating experience smart samples are voluntary. The regions don't have to do them. It's just, hey, you know, here is what we're seeing in the OpE -- operating experience realm. You may want to

use this procedure and look for these issues because we've been seeing a lot of them lately.

CHAIRMAN STETKAR: You mentioned -- do they typically come out of the regions? I mean, the region has an uneasiness about something and will --

MR. THOMAS: It is normally something that we're seeing, because --

CHAIRMAN STETKAR: Because you're --

MR. THOMAS: Yes. One of the sort of monitors that we follow here is, you know, a resident inspector is worried about his or her site. A division director in the region is worried about their plants.

CHAIRMAN STETKAR: Right, right. That's -- okay.

MR. THOMAS: We are the place that looks across all four regions and across all 100 plants to see trends.

CHAIRMAN STETKAR: Thanks.

MR. THOMAS: All right. So I put this one in here just to explain, you know, we do have quite a few internal interfaces that occur regularly. The structure and regularity of these meetings ensures that the right staff members are made aware of relevant operating experience information, and that

subject matter experts around the agency get a chance to evaluate and comment on important issues in their field of expertise.

So I think I have already mentioned a few times the daily regional calls. That is when a member of our staff in NRR will -- these usually happen in a branch chief's office up in the Division of Operator Reactor Licensing, you know, one floor above us. So they are going to talk to all the plants in their region. The region leads the call. You get a rollup of everything that has happened in the last 24 hours at all their plants.

So we get a lot of that lower level stuff comes out of those calls as well as additional discussion on anything that has been reported for plants in that region.

I think I have covered the team meetings pretty thoroughly so far. I'll skip over that.

The monthly reactor oversight program call, this is led by the Reactor Inspection Branch Chief, and it's an opportunity for first-line managers in headquarters and the region to discuss major issues with the reactor oversight program. We are not always an active participant in this call, but we do send a

representative to listen in and provide status of any new information.

You know, for instance, if there is a new operating experience smart sample going out, we will get on the call and talk about that. If there has been a higher level INPO report that has come out recently, we will brief that on the call as well.

Similarly, the bi-weekly regional management call is at the division director level, so our division director, along with their regional counterparts. And they will discuss a lot of the same issues that are in that monthly ROP call.

Major generic communications, cross-regional issues, status of TIs, and task interface agreements, et cetera. And, again, we are mostly listening on that. Occasionally, we will have something to bring up.

The reactive inspection process, I think we touched on this a little bit before as well. So normally if the regions will have the lead on initiating what we call a Management Directive 8.3 evaluation to determine whether or not they are going to do a followup reactive inspection based on an event.

When the risk gets past a certain threshold, and there is a question of whether we need to move up to an augmented inspection team or beyond, then we will have -- we will have some interaction along with operating reactor licensing. The project manager will facilitate a call between our risk analyst here in headquarters to talk to the folks in the region and see, okay, where did these numbers come out, and why? What is the region recommending as far as what level of inspection, what is the justification, and then we will turn around and let folks in NRR know what is going on, so they're apprised of the region's decision.

And then significant topics briefing -- again, I think I went over those. That is when we have something that is worthy of bringing together the NRR executive team and briefing them on, you know, a particular study or a particular issue.

Okay. So external interfaces -- the two major ones are INPO and International. These are the last two things I am going to cover here. So INPO coordination function, this ensures a regular line of communication between NRC staff and our counterparts at INPO. And over the years the relationship has evolved from a very formal relationship with pretty

minimum interface to more robust information exchange where staff from each organization -- you know, we feel free to pick up the phone any time and communicate regularly with our counterparts.

We maintain an NRC-INPO memorandum of agreement signed by the INPO president and the EDO as a guidance document for interactions between the two organizations. And some of the key aspects of this relationship are a bi-weekly counterpart call between our staff and NRR, the representative from New Reactors, and our INPO counterpart in the events analysis group.

We talk about recent significant events, event followup, whether there is an ongoing reactive inspections or related IPO evaluations going on, any upcoming visits or agenda, current topics of interest, and status of any upcoming INPO event reports or NRC generic communications or inspection reports.

MEMBER SKILLMAN: Eric, let me ask you a question. My colleagues and I are going to address the issue of subsequent license renewal here in the next 30 days. If one of us, or several of us, got it in our minds to ask your group, passive failure -- passive component failure past 120 months, past 10 years, could you produce a report for us?

CHAIRMAN STETKAR: We have to be careful here because the staff doesn't work for us. We can --

MEMBER SKILLMAN: No, I'm -- but I'm asking, if we ask the ACRS staff for that, and they pass that request to you, is that something you could respond to?

MR. CHERNOFF: Yes, we could respond to it. I will personally, tongue and check, say assuming you provide the definition of what you are considering a passive failure, because there is great variability from licensee to licensee. At last check about a week ago, the regulations still had a placekeeper from 1968 that we were all still working on defining passive failures and --

CHAIRMAN STETKAR: A check valve is passive, for example.

MR. CHERNOFF: But, no, I mean, going through the right protocol, a report could be generated, but I would just caution we have to make sure -- and there would have to be a lot of work going into putting the box around that report, because it could be a massive amount of data which probably would serve no useful purpose. But we have the databases available to us, and it would be a combination of stuff that we have and probably leveraging off of or

even working off of the INPO database, which is more -- much more data on equipment failures. Those are the only ones more related to events.

CHAIRMAN STETKAR: And all of us need to be very, very careful with the INPO data.

MR. CHERNOFF: Yes. And then we some strictures regarding what we can use that for, and we would want to make sure we stay in compliance with that.

CHAIRMAN BLEY: Now, from what they told use earlier, our staff can get onto their Sharepoint site and search for anything to their heart's content.

MR. CHERNOFF: Yes. In our NRC databases, yes.

CHAIRMAN BLEY: Yes.

MR. CHERNOFF: And we have been evolving that and growing that to make it more user-friendly versus the -- a number of years back and up until recently there has been a compilation of different databases from different sources, we are trying to get that all into -- basically using ADAMS as the base tool. We are not quite there yet, but we've got a lot of the products in there, headed that direction, which is the -- ADAMS is not perfect, but it's our officially agency record, and it provides a consistent

interface for you to do searches with. But we have tried to make that interface a little bit easier to use than plain vanilla ADAMS.

MEMBER SKILLMAN: Thank you.

MR. THOMAS: I think I have already touched on the INPO data that's available through the INPO consolidated events system. Again, a combination of the old EPIX and NPRDS, along with plant events database information.

So NRC staff have access to reports that plants put into the INPO system, but they are mostly equipment failures. And as I mentioned, often there is links to root cause reports, and there are some very powerful sorting tools on there and ability to find out more information about plant-specific equipment, that kind of stuff.

INPO regularly transmits their completed INPO event reports to us. We take those, as Harold said, you know, make sure they're marked "proprietary" and, you know, "do not share or else," and put them into ADAMS as non-publicly available documents. And that is working out really well.

And another thing I'll mention about the INPO relationship here in terms of special projects, you know, the fact that we have a good working

relationship between the two organizations allows us to find out more about, you know, things that INPO has in the pipeline. And when questions do come up, we have a lot of resources there that we have developed relationships with that we can tap for, hey, who is the person to talk to about this? And we can set up, you know, telecons or meetings or whatnot.

And, finally, interaction. The primary focus of NRC's efforts in the international operating experience area is to maintain effective and trusting relationships with foreign regulators. This is especially important and beneficial to the agency when foreign events or issues arise that may have domestic applicability, because this allows the agency operating experience staff to obtain information relatively quickly from reliable sources close to the issue of concern. So similar to having the INPO relationship.

Primary vehicle for establishing and maintaining the relationships is the Nuclear Energy Agency, the NEA working group on operating experience, or WGOE. NEA comprises about 30 member countries, any number of which send representatives to semi-annual working group meetings to exchange operating experience information and discuss policy.

The IAEA is comprised of over 150 member countries. And as far as from our end in the screening process, we treat international operating experience very similar to domestic information. We evaluate it for safety significance, determine whether it meets any of our screening criteria, and disposition it using the operating experience clearinghouse process.

And so this counterpart interaction represents a significant source of international operating experience. But as far as direct exchange of information, the international reporting system for operating experience, or IRS, is our primary source.

The database is administered by the IAEA. Every member state can contribute. I think we have discussed a lot of this -- 80 reports per year. We contribute about one quarter. And if you do the math, we've got about one-fifth of the world's plants, so not too far off.

So as per U.S. reporting, this includes selected generic communications, licensee event reports of interest, and safety significant inspection reports go into the IRS database. And then, finally, we have got the International Nuclear and Radiological Event Scale, the INES. This is another potential

source of international operating experience, but, as you know, very few events met the reporting thresholds for INES. Those are --

CHAIRMAN STETKAR: That is just a subset of IRS, basically.

MR. THOMAS: Right. Right. And it's, you know, few and far between. So, you know, usually we'll hear about those things through other medium -- media as well.

CHAIRMAN STETKAR: You said you haven't had too much direct interaction with WANO?

MR. THOMAS: Very little. We have --

MR. CHERNOFF: It's an area particularly, you know, at International we are trying to grow. For example, we have a workshop in Germany the summer -- or September, and it is keyed towards trying to work on performance indicators for operating experience programs, which I think it's really important. And we haven't been smart enough to come up with a good set of them ourselves, but together maybe we can get some good ideas.

One of the things we've done is we're -- and WANO has been very receptive to, as well as INPO, of having them come and participate in that workshop. So we are trying to build those bridges. I think WANO

collectively is maybe where INPO was about 10 years ago with regard to just their comfort level of sharing.

CHAIRMAN STETKAR: Yes, okay.

MR. CHERNOFF: And so --

CHAIRMAN STETKAR: Sharing externally. I think that they do get pretty good cooperation, as best as I can tell, taking snapshots of --

MR. CHERNOFF: Within their members, yes.

CHAIRMAN STETKAR: Within their members, you know, that degree of communication seems to be pretty good.

MR. CHERNOFF: We have made big strides with INPO and the comfort that INPO has sharing with regulators. Now, it's really very good. I spent 20 years in industry, and I know what it was, you know, 30 years ago. And it's way, way improved from that.

WANO I think is a little bit behind in that area, and hopefully with some help from INPO as well we are moving in that -- and we are trying to get involved in some of this international OpE, as well as what wasn't mentioned -- these forms are regulator forms, but at our meetings we actively solicit member countries to bring along owner-operator people.

Last year, vice president from PSE&G, we invited him and he gave a really interesting presentation about lessons they have learned from their spent fuel pool handling program, or spent fuel pool cask loading program. So we are -- it is not an exclusive regulatory forum. It is -- regulator forum. It is actually trying to get utility members as well involved.

MR. THOMAS: Those are my prepared comments, unless there are further questions.

MEMBER SKILLMAN: I would ask the members, any comments or questions for Eric?

MEMBER POWERS: Well, I think it seems like there is a wealth of information here from all of the products they have generated. It is still very unclear to me how I get to look at it. And it would be useful if somebody could provide me a child's guide on how to get to examine.

MEMBER SKILLMAN: Good question? How can we get this information? How can we get to it, Eric?

MR. THOMAS: Well, you know, Harold mentioned protocols. I mean, you know, we can always add Mark or somebody to distribution, and he can parse things out. I'm not sure about direct -- the policy on direct communications between the staff and the

ACRS. You know, with access to the NRC internal website you can get to everything, and it's just a matter of having somebody show you how.

MR. BANKS: And I can do that.

MEMBER SKILLMAN: Well, I would offer this observation. In a week or a month or six months of industry progress, there will be a number of issues that come from the licensees that are of threshold interest to this Committee, that there will be probably three or four that rise to kind of "Ah ha, gee whiz, how about that, that's interesting."

I would think that information could be valuable to the members. So you produce INs or the old IBs, the information bulletins or the information notices. I think it would be valuable if the small handful of big hitters that rise above kind of that "gee whiz" level found their way to the membership, simply for notification, because some are plugged into industry, some are plugged into labs and R&D, some are in academia, but every once in a while one of these things pops up and we say, "Boy, that was the very thing we were talking about two weeks ago." How about that? To bring some flesh and life to some of the -- some of the things that we deliberate on here.

MR. CHERNOFF: Maybe as a first step we can work with Mark with getting -- I don't know if Mark has had an opportunity to look at any of the search tool changes that we have made. Get Mark briefed in on the links and the search tools as a starting point, and I think we would have a couple of suggestions of -- out of our products, maybe the right ones at the level of detail for what you're talking about. I mean, this prompted me -- one other comment I wanted to make is -- and I think it's a good thing that we have done is it was going on, and I think we have tried to include incorporation of non-nuclear industry operating experience as well.

So we don't have a huge number of examples where we have done this, but do not be surprised if you are looking through some of our documents and, for example, in one of our periodic operating experience newsletters a little while back we had a discussion of lithium-ion batteries from the 777s, the problems that they were having.

So we obviously don't -- we can't have a flood of information from all industries, but we are trying to also be a little bit proactive with regard to thinking outside of just the nuclear utility box

for other insights to the kinds of equipment these plants run with and that keep them safe.

CHAIRMAN STETKAR: You just reminded me of something. We have kind of touched on this in our Digital I&C Subcommittee where we have asked, you know, how far has the staff probed operating experience, particularly in digital I&C systems. Now, there might not be the integrated protection control systems, but there are several industries who have quite a bit of operating experience. And we get feedback saying, "Well, we have tried to do that, you know, piecemeal. We have tried to do it through Oak Ridge National Laboratory with varying degrees of success." Do you get requests from specific groups within NRR or NRO or RES or, you know, wherever with this kind of queries? You know, coming to you saying, "Hey, do you have this?"

Because we've gotten feedback that, "Well, I had Oak Ridge National Laboratory go out and look at the aviation industry or NASA and railroad industry," and things like that and had not all that much success necessarily.

MR. THOMAS: I think Harold mentioned this earlier. You know, as much as we have tried to make our search tools easier for, you know, the members of

the agency at large to use, we're the specialists, and one of us can, you know, do in a morning what would take, you know, somebody in the I&C Branch weeks to do. And so --

CHAIRMAN STETKAR: But also, are we duplicating things, where some branches are going out and initiating searches for stuff that: a) you might have, or b) you might have better connections than they do. This is something ACRS doesn't get involved in. I was just curious.

MR. THOMAS: I can't really give you a good answer for that, because, you know, we don't track every contract that somebody has. You know, we do talk to our counterparts in Research, and, you know, try to keep a handle on what they are doing.

But, you know, sometimes it's for a different purpose and, you know, the output that is required may be different for a contract-based study than, you know, what we are going to give you which is more of just, you know, here are all the generic communications from over the years that deal with this, here is all of the licensee event reports.

You know, that is more the kind of stuff we are going to do. And if there is any rolled up analysis that we're aware of, we are going to throw

that in there as well. But, you know, to answer part of your question, yes, it is something we do routinely.

CHAIRMAN STETKAR: Okay.

MEMBER SKILLMAN: I would think that there are a couple of areas that are really fruitful for the ACRS. We've gone through the flooding and the seismic issues as a consequence of Fukushima. This past winter, the Alleghany backed up. There was severe flooding north of Pittsburgh. Beaver Valley is just down the river 12 miles. Did Ohio freeze-over flood into Beaver Valley experience -- an incident report on icing or flooding? And that question could be asked of a number of plants in the northeast. Has there been -- have there been some major component issues that have risen, particularly those that threaten electrical power? Those are the types of things that I would think are the types of operating experience events that this Committee would say, "Gee, that's interesting. That's information." That's the kind of threshold I'm talking about.

And I'll be happy to work with Mark to maybe find a box that would establish kind of the set of parameters that we bring to --

MR. CHERNOFF: We can try some things and then get some feedback on how that is working and adapt to that.

MR. THOMAS: And I think we did -- we actually did get a query from -- it was either WGOE or somebody --

MR. CHERNOFF: It was ISRM, the French regulators, regarding the -- it's the arctic vortex.

MEMBER SKILLMAN: I only ask the question because they had -- they had flooding in Europe that they haven't seen for 40 years. And there have to be some riverine plants in Germany and France, maybe Belgium, that had to start --

MR. CHERNOFF: And, actually, about a year ago we brought over Monticello's experience with -- I think you've actually been briefed on that with regard to the plans for building dikes, et cetera. And there was a good exchange from some of the European regulators on their facilities that as a result of that extensive flooding they had, I believe it was last year, and including some interesting modifications that plants have made to deal with things such as gravel and landslides into rivers, and how to sustain water flow to the cooling systems in those conditions.

MEMBER SKILLMAN: Great. Members, any other comments or questions?

(No response.)

Eric, thank you very much.

MR. THOMAS: Thank you.

MEMBER SKILLMAN: Thank you. Back to you, John.

CHAIRMAN STETKAR: Thank you very much, Dick, Eric. And, again, thanks. That was a good overview, good presentation.

With that, we will recess until 12:45.

(Whereupon, at 11:38 a.m., the proceedings recessed for lunch.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

CHAIRMAN STETKAR: We are back in session and we're going to hear about the B&W mPower SMR design and it will be led by Dr. Bley. Dennis.

MEMBER BLEY: Thank you, John. We're going to have an information briefing on mPower, and we have the members of the B&W Generation mPower team to brief us on the technology for their integrated pressurized water reactors, the key design features, safety strategies, use of PRA, and an overview of the test program.

As we're preparing to review the mPower-specific review standards this will likely help us, although, I'm not sure when we're actually going to be doing that. But parts of this meeting may be closed to protect the information that's proprietary to B&W.

Before we go into closed session, I'll ask the NRO Staff and mPower to confirm that only people with due clearance and need to know are in the room. Technicians at the booth will disconnect the telephone bridge line. I have to tell you all this, but you'll know what's coming then, and close the public line and open the closed line if you have people coming in or NRC Staff does. And then we'll open it again at the end. If we ask you questions, if we should stray into

an area that's proprietary, feel free to tell us please wait for the closed session. We'll be glad to do that.

At this time I invite Ms. Joelle Sterefos, the NRO Project Manager, to introduce the presenters on the briefing.

MS. STEREFOS: Thank you very much. Thank for the opportunity to say a few words about the NRC Staff's effort to prepare the anticipate mPower design certification application. My name is Joelle Sterefos, and I'm the Senior Project Manager in the Office of New Reactors responsible for the NRC interaction on the mPower design.

During this extensive pre-application period since about 2009, the Staff has focused on developing the infrastructure to review the mPower design cert application in a risk-informed, effective, and efficient manner consistent with NRC regulations. In addition, the Staff used this time to interact with Generation mPower, B&W Nuclear, and Bechtel Power Company to identify any technical issues that were unique to this design that could challenge our schedule planning.

Since about 2010, the Staff has been working to develop a risk-informed and integrated

review framework for the near-term efforts pertaining to the small modular reactor designs. The effort is outlined in SECY-11-0024 entitled "Use of Risk Insights to Enhance the Safety Focus of Small Modular Reactor Reviews."

The paper identified four main aspects of the framework. First, the revision of the standard review plan introduction to address the risk-informed implementation for small modular reactor designs. Second, to develop a detailed review schedule using tools available in NRO, specially the EPM scheduling tools. Third, development of design-specific safety evaluation report templates. And, fourth, the development of an mPower design specific review standard or DSRS that the Staff will have an opportunity to present to the ACRS Future Plant Subcommittee in the near future.

Today, Generation mPower, the applicant for the mPower design certification application, is here before the Committee to describe their design and the unique attributes that have informed the development of the Staff's mPower DSRS. With that, let me introduce Peter Hastings, Director of Licensing with Generation mPower.

MR. HASTINGS: Thank you, Joelle. I am Peter Hastings, Director of Licensing and Regulatory Affairs for Generation mPower. Joining me at the front today are Jeff Halfinger, JMP's Chief Technology Officer; Doug Lee, our B&W mPower Vice President of Engineering; and Dave Kanuch with mPower Engineering. We also have with us on the side Eric Williams also from mPower, and Ron Beck, the Project Manager for Bechtel. GMP is a partnership between B&W mPower and Bechtel, and GMP is the prospective applicant for the design certification.

As has been mentioned before, we'll update the Committee today on the mPower design and safety strategy. Jeff will lead us through that discussion during the open session. We'll follow that with additional details that lend themselves to discussion of proprietary information in the closed session. And as Dennis indicated, if any questions come up that require proprietary answers we'll defer those to the closed session.

We've been engaged with the staff for, as Joelle indicated, something like four years, very active pre-application interaction. We think it's been a very positive experience not only for the NRC Staff but also for us. It gives us a lot of insight into

what some of the issues are that we will need to be prepared to address in our design certification application. And we're very happy to be here this afternoon to support discussions with the ACRS in preparation for your review of the mPower Design Specific Review Standard. And so that we don't intrude on valuable presentation and Q&A time, without any further ado, I'll turn it over to Jeff.

MR. HALFINGER: All right, thank you. The first of the session I'm going to give a very high-level overview of the technology and some of the insights that we've used in the development of the mPower technology. During the closed session, Doug will be giving you a lot more detail in some of those areas and dive a little bit deeper.

So, we're going to see if Dave can drive this thing and keep this going. So, the overview today is give you a little description on the module, look at the reactor service building, talk a little bit about the reactor itself and the module components, have a slide on the steam generator design which is based on the B&W once-through steam generator concept that we've been making for years.

I don't have a particular slide on PRA. Doug does in his presentation, but suffice it to say

for the open session that we are using PRA insights in the development of the mPower design, in a lot of different areas of the design informing the emergency core cooling system, informing the defense-in-depth strategy, informing the relationship of certain values and components within the plant. We've been using PRA insights really from the very beginning.

The way we have our system design group arranged, the PRA people actually sit within the system's design organization within B&W, so it's a very interactive discussion between PRA and design. And then I'll give you a very high-level strategy on how we're implementing our safety and defense-in-depth strategy.

MEMBER BLEY: Well, since you've told us that about having the PRA team in with the design people, do you also have operators and people who are thinking about human performance integrated, as well?

MR. HALFINGER: We do. We have a dedicated human factors engineering group. They're working significantly with the control room layout and those sorts of things, but they're also embedded and integrated within the design team itself, so they're looking at plant layout, they're looking at functionality, they're looking at how do you get to

that, what are the radiation doses within the area that we're expecting operators to go to, so that's also integrated in our team.

MEMBER BLEY: And you have people who have been licensed operators?

MR. HALFINGER: All sorts of levels of licensed operators, SROs, ROs. Okay?

MEMBER BLEY: Thank you.

MR. HALFINGER: So, we're using everything at our disposal to try to get the best design to be functional for the operators at the end of the day.

So, basically, when we talk about mPower, well, what's the difference between mPower? It's a light water reactor design, but we call it an integral reactor, and basically what we did was the lefthand picture on this slide shows the old B&W 177 two-loop clamp, so it has a reactor vessel, two steam generators, pressurizer, four reactor coolant pumps. We basically took all of those components and put them into one vessel, so we have the core, the reactor, the steam generator, the pressurizer and the coolant pumps all contained within one vessel. And what that does is -- the most significant things it does for us is it eliminates all the interloop piping between all the

different components which is the source of large break LOCAs at least in analysis space.

So, getting into –- I'll show you a little bit more detail on the reactor itself. I think the next slide goes through the –- we take that reactor and we put it into what we call our standard plant which is a two-pack. The white building on the left of this picture is our reactor service building so that's where the two reactors are housed. It also has all of the safety equipment necessary to keep the reactor safe within that building.

The tall building to the right of that is the turbine island. That's where the two turbines are. Each reactor feeds it own dependent turbine, one reactor/one turbine. And all the feedwater systems are contained within that building.

Separated from the reactor building by a couple of hundred feet which we did primarily for security reasons, but there are a lot of secondary effects that come into play when we did that. Constructability, we can construct the turbine island at the same time we're building the nuclear island. The turbine island becomes a very simple steel metal structure. It's not seismically qualified because it's

not relied on for safety, and it's separated significantly from all the safety equipment.

In this particular plant, our standard plant has a mechanical draft cooling tower. It's also able to have a plug 'n play air-cooled condenser if a customer desires that. Take a little bit of a hit on efficiency but it's very feasible with the size of reactor that we're dealing with.

Outside the main owner-controlled fence area is our administration building, outside warehousing. Our strategy is to bring warehouse trucks, trucks from vendors, deliveries into an outside warehouse. It'll be transferred to a company truck, and then transferred into the secured area. That's a feature we've taken from some of our other secure facilities that we've been dealing with for the last 40 or 50 years. Administration is outside the fence so, basically, the outer fence that you see there is about 36 acres. And that will generate 360 megawatts of electricity. Okay? Any questions on the general layout?

So, if you look at the reactor service building and you take a cross section basically east to west, this is a cross section of that reactor service building, so --

MEMBER CORRADINI: So, we're looking at the same building that was up on the right side. Is that correct?

MR. HALFINGER: The left side.

MEMBER CORRADINI: I'm sorry, left side.

MR. HALFINGER: And it's cut top to bottom there. So, when you look at the site plan, basically what you see is a one-story structure where the reactor service building is. And, basically, from the ground up is one story in the reactor service building. All of the vital equipment for the plant to keep the reactor safe and operating is below grade. Our grade slab is a significant slab that will protect all the components underground.

The other two significant features that you can see from this diagram, and you'll see other things when Doug shows you his diagram, which is the same but in a different orientation. Each containment -- each reactor is within its own containment, and each containment structure contains all of the safety equipment necessary to keep that module safe and independent of the other module. So, that's why we go to its own independent turbine so that we don't have interaction between the two modules if we have an

upset in one reactor affecting the other one. So, the safety systems are independent between the two.

What you see, the blue on top of the containment structure is our passive containment cooling system. It's a tank of water that will absorb the water, the heat coming out of any postulated accident within containment. What you don't see in the picture out of the plain is our refueling water storage tank which is contained within containment. It's primary function, as its name implies is it's for refueling so it will fill the refueling canal, allow us to refuel the reactor. But it's also, therefore, passively cooling the reactor in the event that we need to do that. It's part of our emergency core cooling system.

MEMBER BLEY: So, the containment dome is actually the bottom of that tank.

MR. HALFINGER: Yes, it's integral to the tank.

MEMBER CORRADINI: So, it's a steel shell where that arrow is?

MR. HALFINGER: Yes.

MEMBER CORRADINI: Okay, thank you.

MR. HALFINGER: It's steel shell all the way down around and embedded in the basement.

MEMBER REMPE: Where is the control room?

MR. HALFINGER: The control room is 60 feet underground. In this view it's into the picture on the other end if you go back one slide, Dave. It's on the north side of the plant on the other end to the right. Keep going, right there. Yes, the other right. About 80 feet under grade.

MEMBER BLEY: While you're on this picture, where are the two reactors?

MR. HALFINGER: You want to point them out, Dave?

MR. KANUCH: Yes, the mouse –-

MR. HALFINGER: You can see a little white disk barely visible right here, and there's one over here.

MEMBER BLEY: Oh, yes.

MR. HALFINGER: And the idea on that is that the reactor is small enough that we'll be able to bring the reactor in at the end of construction and it will be put down through this disk in the roof.

MEMBER BLEY: It's that whole integrated package that –-

MR. HALFINGER: Probably put it in in multiple pieces, but it's going to –- the intent is

that it comes in very late in the construction cycle. Okay? Any more questions on that?

MEMBER BANERJEE: So, we are seeing this in different planes, is that it?

MR. HALFINGER: Right. So, go back one, Dave. So, what the cut is that you're looking at, I apologize for my back but it's basically right through here looking from this direction back north. So, this is Plant South, this is Plant North. So, we're cutting through the two reactor containment structures and we're looking north.

MEMBER BANERJEE: And what's that higher building?

MR. HALFINGER: This one?

MEMBER BANERJEE: No, on the –- that part, yes.

MR. HALFINGER: This is shipping and receiving, and the rad waste services building part of the plant.

MEMBER BANERJEE: Okay, thank you.

MR. HALFINGER: Okay, Dave.

MR. KANUCH: Yes. So, here's the disk, Jeff.

MR. HALFINGER: Yes, so I showed you that white disk. This is the white disk that you saw in the

other picture and it's in parallel with the disk that's in the grade slab which goes right through the top of the dome and be able to put the reactor right into the containment structure.

The other significant thing on this view, the top level doesn't contain any equipment that's necessary to keep the reactor safe in a design basis accident. And the other significant thing is a spent fuel pool is located between the two containment structures so it's a shared pool between the two modules.

MEMBER SKILLMAN: Jeff, what is the yellow disk that is the lower left image that we –- right there. What is that?

MR. HALFINGER: That's a good question.

MEMBER SKILLMAN: The yellow disk.

MR. HASTINGS: That could be the RCI heat exchanger cut away.

MR. HALFINGER: Yes. It's where they took the cut, so that's part of the reactor coolant inventory purification system. It's a high-pressure heat exchanger.

MEMBER SKILLMAN: Thank you.

MEMBER RICCARDELLA: What's the vessel diameter?

MR. HALFINGER: Reactor vessel or –-

MEMBER RICCARDELLA: Reactor.

MR. HALFINGER: About 13 feet in diameter at the flange.

MEMBER REMPE: When you're building this thing, you mentioned you put the vessel in, how do you put the dome –- is the dome not fully constructed? Is one piece that's lowered like you see in a big containment, or how is this done?

MR. HALFINGER: During construction the expectation is the two white disks that you see are concrete plugs, so they're removable. We'll take them out. And then there's going to be a hole in the top of the containment structure during construction that we'll be able to put the reactor down through the hole.

MEMBER REMPE: And then you finish the dome off.

MR. HALFINGER: And then we just –-

MEMBER REMPE: Okay.

MR. HALFINGER: We weld that pancake on the top which is open to the structure because of the way that you see the passive containment tank on the top doesn't go all the way to the center, so it actually has a 15 or 18 foot blank area in the top where we

don't have any water, so we can put our –- finish the containment construction.

And then 50 years from now when we need to do a steam generator replacement we would just do that process in reverse. We cut that dome out of the top of containment, lift the reactor right out the top.

MEMBER CORRADINI: Probably this is for closed session, but you have design details such that the free volume of containment per kilowatt or megawatt is known at this point, or is it still being evaluated?

MR. HALFINGER: It's known.

MEMBER CORRADINI: Okay. Thank you.

MEMBER BROWN: I'm going to ask this. You say that's a slice right through when you look at that picture, but yet it looks like on your previous view that there's nothing in between those two reactors, and there's no projection up above the roof level in that previous view. It's almost like a courtyard in between.

MR. HALFINGER: Yes.

MEMBER CORRADINI: Charlie is wondering why there's no courtyard in your cartoon.

MEMBER BROWN: No. Go across this way as you showed top to bottom, right. No, you're still in the wrong place. Right there is what he showed us.

MEMBER SKILLMAN: That's where he said a slice --

MEMBER BROWN: And it's all hollow in between, and yet that's not what your other picture shows.

MR. HALFINGER: This is showing that hump in the -- right here is the raised area in the roof, so when we go to the next page what you see on the right-hand side this level, and this level back here. This level in the middle is actually raised up by 12 or 15 feet.

MEMBER BROWN: Just didn't look like it in the picture.

MR. HALFINGER: Right there is a --

MEMBER SKILLMAN: There's a shadow, so the black is the shadow and the sun is on the far end of the --

MR. HALFINGER: Correct.

MR. KANUCH: That's right.

(Simultaneous speaking.)

MEMBER BROWN: No, that's actually raised up. That thing is the black --

PARTICIPANT: Is the shadow.

MEMBER BROWN: Is the shadow.

PARTICIPANT: A raised shadow with the sun on the other side.

MR. HALFINGER: What you're seeing with the raised area here, you can see the offset in the side wall. This roof level is the same all the way back here.

MEMBER BROWN: Oh, okay. The sun is on the upper lefthand corner.

MR. HALFINGER: Correct. The cut, this is that raised portion that's --

(Simultaneous speaking.)

MEMBER BROWN: Sorry, had to ask.

(Off the record comments.)

MEMBER RAY: Carry on.

MR. HALFINGER: So, we'll take a note that we'll actually show the sun going across --

MEMBER REMPE: That would help.

MEMBER CORRADINI: Oh, please don't.

MR. HALFINGER: Okay. So, if we go to the next slide, this is the breakaway of the reactor itself. The picture on the far left is the assembled reactor vessel. If we start over there at the very bottom of that vessel is the reactor core, the nuclear

core. Above that is what we call the upper internal structure which has the control rod drive mechanism and guide frames for the control rod controls themselves. Above that is the steam generator, and then above that is the pressurizer, and that's where our reactor coolant pumps are located.

So, we go to the right, the breakdown is basically what I just said. So, the core and the core form are in the bottom, 69 assemblies, fuel assemblies in the core. The upper internal structure sits on top of the core. All the control rods are contained and the mechanisms are contained within that upper internal structure, so when we do a refueling that whole structure gets lifted out as one lift.

And then to the right of that, the steam generator, again it's a once-through steam generator, very conventional with the exception it has a 3-foot diameter vessel inside of it so that we have the primary coolant flowing up through the steam generator, turns in the pump plenums and then gets pushed down inside the tubes of the steam generator.

MEMBER CORRADINI: So, if there were a leg, the pumps are on the hot leg.

MR. HALFINGER: That's correct.

MR. LEE: They are on the hot side.

MR. HALFINGER: The pumps are on the hot side of the steam generator.

MEMBER CORRADINI: I'm sorry?

MR. LEE: They are in the core outlet.

MEMBER CORRADINI: Core outlet. Okay.

MR. LEE: Yes, sir.

MR. HALFINGER: There's eight reactor coolant pumps sitting around the pressurizer. They are not centrifugal, they're not your father's reactor coolant pumps. They're vertical flow –- the word's gone. Can rotor pumps.

MR. LEE: They're can rotor pumps, they're very much like the impeller system on your outboard motor for your boat where they actually receive a radial input flow and then accelerate that flow through more like a propeller than centrifugal impeller. Okay? There's a lot of operating experience with this pump in other applications, so this is not really a first of a kind design for this pump.

MR. HALFINGER: And no pump seals.

MR. LEE: And no seals.

MR. HALFINGER: No shaft seals on it.

MEMBER SKILLMAN: What is not indicated here is the umbilical for the control rod drives for the power for the rad coolant pump motors. Where might

we find that if it had been provided on this image, please?

MR. HALFINGER: The motor power is –- for the reactor coolant pumps is provided directly to the motors on top of the reactor vessel. The power for the control rod drive mechanisms comes through that flange on the upper internals. You see the flange, there's going to be power penetrations that come through that location and they're permanently affixed to the upper internals. So, there'll be a –-

MR. LEE: So, we need a disconnect there to disconnect both power and signal from internal, inside the reactor. And we're developing those penetrations now.

MEMBER CORRADINI: So, the electrical connections come in radially at that flange ring.

MR. LEE: Yes.

MR. HALFINGER: That's correct.

MR. LEE: Yes. We have to be able to pull the mechanisms out, so we have to be able to disconnect them at that ring. And, of course, the lower vessel stays in place, stays situ for refueling.

MEMBER SKILLMAN: You said 69 fuel assemblies. Are these 8-foot long assemblies? These are 8? No, these are not 12-footers, these are –-

MR. LEE: Little under, they're like two meters but yes, on the order of 8-feet.

MEMBER SKILLMAN: Okay.

MR. LEE: So, almost half-size.

MEMBER SKILLMAN: Okay, thank you.

MR. HALFINGER: Okay? Next slide is just the detail on the steam generator. As I said, it's a very conventional once-through steam generator with tubesheet top and bottom, tube support plates, broached tube support plates like the way that B&W fabricates them. We have one steam inlet, or feedwater inlet, one steam outlet that goes over to the turbine. It's an integral economizer so that the feedwater comes in, it goes down the steam generator, goes into the tube water, flows around the outside of the tubes up through the steam generator, down the gap between the tube bundle and the outer shell, and then out the steam outlet.

MEMBER SKILLMAN: A question please about the direction of forces. Where is the vertical mass supported, and what grows up from that location, and what grows down from that location, please?

MR. HALFINGER: Okay. If you go back one slide, the support for the reactor –- basically, this is where the reactor is going to be –-

COURT REPORTER: You need to project your voice this way.

MR. HALFINGER: Sorry. The support for the reactor is going to be just at the mid flange, so from this point down in grows down, from this point up it grows up. That's the only support, other than seismic supports that we're going to have to have, and we're still figuring that part out, but –- so, it's basically not quite in the middle of the reactor. It's at 30-feet, probably, from the bottom up to here, 50-feet from there to the top.

MEMBER SKILLMAN: So, when this plant goes from cold shutdown to operating temperature the upper portion grows an inch and a half, two inches, a number like that?

MR. LEE: Almost three.

MR. HALFINGER: Three inches.

MEMBER SKILLMAN: And downward an inch and a half or so?

MR. LEE: Almost three.

MEMBER SKILLMAN: Oh, really.

MR. HALFINGER: Two, two and a half.

MEMBER SKILLMAN: So, three up and two down.

MR. LEE: Something like that, yes.

MEMBER SKILLMAN: Okay, thank you.

MEMBER BROWN: We know that because in our integrated system test facility we supported it in precisely the same location and we've actually measured the growth both vertically upward and vertically downward, and we have a comparable leg so -- and it's an alpha delta T calculation.

MEMBER SKILLMAN: Thank you, Doug. Okay, got it.

MR. HALFINGER: Okay? So, defense-in-depth for mPower is different than what you're normally used to thinking about. The way we're doing our strategy for safety is to have a very robust defense-in-depth strategy, but we put a lot of systems in front of the one that we're really counting on, so we have active systems like our auxiliary condenser systems, CNX that provides high-pressure decay heat if we need to in the event of loss of feedwater or station blackout conditions.

We also have a reactor coolant inventory purification system that can provide high pressure and low pressure decay heat. If the auxiliary condenser system isn't available to us, we can go right to RCI. We like to use CNX first, then go to RCI for low pressure.

MEMBER BLEY: And either one is fully capable of --

MR. HALFINGER: Either one is fully capable. But they're active systems. Well, CNX really isn't an active system. It does have natural circulation through an air-cooled condenser. It's battery powered for the fan. The reactor coolant inventory purification system requires AC power either from normal house loads or from the diesel generators. So, we rely on those, they're robust systems. We rely on those. We want them to come in in the event that we need to do something or act because of an incident that's going on. But if they're not available, if we have a full station blackout and the diesels don't start, our emergency core cooling system is fully passive. It relies on natural circulation, gravity feeds, depressurization of the primary system, those sorts of things, all run on batteries, so we don't rely on AC power for our emergency core cooling system. So, the only credited system in our whole plant that we use in Chapter 15 is the emergency core cooling system. All the other systems we assume aren't available. We want them to be available. We want to use them, and that's what gets us our very favorable core damage frequencies in PRA space.

The integral design --

MEMBER RICCARDELLA: How long do the batteries last then?

MR. HALFINGER: The batteries last at least 72 hours.

MEMBER BANERJEE: Where are they located?

MR. HALFINGER: They're in the reactor service building under grade, basically what we call the annex. If I showed you a cross section of the reactor service building in the north-south direction looking east or west, the annex is on the north end of the building, and it doesn't go as deep as the reactors go so it's in like a shallower but still underground part of the building.

MEMBER BLEY: After you've established natural circulation do you still need the batteries for it to continue to work, so it's just a change --

MR. HALFINGER: The only thing we need the batteries for is to change position on the valves to get the whole system --

MEMBER BLEY: You do that up front, so you really don't need them for 72 hours.

MR. HALFINGER: No, we don't need them past the first 45 minutes or hour. And I think we'll -- are we showing the video in the closed session?

MR. LEE: We will show that.

MR. HALFINGER: So, the closed session we'll show you exactly how that works.

MEMBER BANERJEE: Okay.

MR. HALFINGER: It's really pretty cool. The other thing --

MEMBER BANERJEE: So, what's the elevation difference cold and hot in this system on the average, roughly?

MR. HALFINGER: Probably 40 feet.

MEMBER BANERJEE: Forty feet.

MR. HALFINGER: Would be my guess from the hot part of the center of the core to the center of the steam generator, the thermal centers.

MEMBER BANERJEE: And do you take into account two-phase flow for the natural circulation, or is it all single phase?

MR. HALFINGER: We assume that it does turn into two-phase flow.

MR. HALFINGER: Okay.

PARTICIPANT: The core boils.

MEMBER BANERJEE: So you take that into account to establish your natural --

MR. HALFINGER: Absolutely.

MEMBER BANERJEE: -- circulation.

MR. HALFINGER: Absolutely.

MEMBER BANERJEE: All right.

MR. HALFINGER: So, the other part of the safety system is the integral design itself. I showed you what the integral reactor looks like versus a two-loop plant, so a lot of the things, the features of the integral reactor for mPower, we don't have inner loop piping, the large diameter piping. We don't have any of that, so all of our transients are very slow and very drawn out. We have low power density. We have large thermal center so we can get natural circulation set up very easily. We have low pressure drop through the core and through the system so we can get natural circulation set up. So, all this are features that were specifically put into mPower to be able to support the defense-in-depth strategy that we talk about. So, that's all I had on the overview, pretty high level, much more interesting when Doug tells you what he's going to tell you.

MEMBER BANERJEE: We're still in open session. Right?

MEMBER BLEY: We're still open, yes.

MR. HALFINGER: You can grill him in a minute.

MEMBER BLEY: Anything more from us? Are you ready to go into closed session now, or not yet?

MR. HALFINGER: I am.

PARTICIPANT: We are, yes.

MEMBER BLEY: You are.

PARTICIPANT: Let me make sure that --

MEMBER BLEY: Maitri, yes. Have you looked around?

MEMBER SKILLMAN: Jeff, what is the horsepower of the electrical and pump motors, please?

MR. HALFINGER: They're 500 kilowatts.

MEMBER SKILLMAN: Each?

MR. HALFINGER: Each.

MEMBER SKILLMAN: Thank you.

MR. HALFINGER: It's not a little pump.

(Off the record comments.)

MEMBER BANERJEE: What's the refueling frequency here?

MR. HALFINGER: Four years.

MEMBER CORRADINI: That's still at 5 percent enrichment.

MR. HALFINGER: Yes.

MEMBER BANERJEE: And you change out what, half the core?

MR. HALFINGER: Full core.

MEMBER BANERJEE: Full core.

(Off the record comments.)

MEMBER BLEY: I think your folks and our's are checking in.

MEMBER BANERJEE: Single pass core.

MR. HALFINGER: Single pass? Yes.

(Whereupon, the proceedings went off the record at 1:20 p.m. and went back on the record at 3:00 p.m.)

CHAIRMAN STETKAR: We are back in session, and Dr. Bley will lead us through the next presentation.

MEMBER BLEY: Why, thank you, Mr. Chairman. I'm just going to turn it over to Stu Magruder and they're going to tell us about the Staff activities on the small modular reactors, and what's going on. Stu.

MR. MAGRUDER: Thank you, Dr. Bley. It's been a couple of years since we've talked to the Committee about our activities, and in spite of what you may hear, a lot of activity has been going on with the staff. You just heard a good presentation from Generation mPower about their activities. We talked about all the other designs.

Joining me is Anna Bradford. She's also a Branch Chief from the Division of Advanced Reactors

and Rulemaking at NRO. The activity has picked up so much over the last couple of years that we formed a second branch, so we actually split the designs. I have the mPower and Holtec designs, and Anna has NuScale and Westinghouse, and the other non-light water reactor designs which we'll talk about a little bit.

MEMBER POWERS: Who got first pick, by the way?

MR. MAGRUDER: It was a mutual decision.

PARTICIPANT: We're on the record.

MEMBER POWERS: Just checking.

MR. MAGRUDER: There's pluses and minuses for all the designs. So, the discussion topics here, first I want to provide a little bit of a historical context for the Advanced Reactor program at NRO, give you an idea of how we've evolved over the years. Then we'll go through –- I'll go through the projects at very high level, but we can answer a few questions, but if you start probing too deep we'll show our ignorance on these designs. And then I'll turn it over to Anna and she can talk about the rest of the topics here, including some of the key policy and technical issues that we have been working on.

So, back in 2008, NRO formed what was then called the Advanced Reactor program. There was only a handful of people. It included Project Managers and technical staff, and the main focus of that group was NGNP, the Next Generation Nuclear Plant, which was a DOE proposal for a high-temperature gas reactor. Our focus was really working with the Office of Research on activities, working with DOE. We developed the licensing process for NGNP.

The NuScale design was just in its infancy. It was kind of evolving from the DOE program, and we were just beginning to think about some of the policy and technical issues that we were facing.

MEMBER BLEY: Is the fuels research still going on for the NGNP out at Idaho?

MR. MAGRUDER: Yes. Do you want to –-

MS. BRADFORD: Yes, it is.

MR. MAGRUDER: Yes, they've actually been fairly successful, I think.

MEMBER BLEY: Yes, the last we heard. It's been a while since we heard from them.

MR. MAGRUDER: Correct. Yes.

MEMBER BLEY: I didn't know if they still had funding that was moving them forward.

MS. BRADFORD: Yes.

MR. MAGRUDER: And I think because it's been successful, some of the other vendors are looking at that trisofuel and thinking about using it in other designs. And we can talk about that.

MEMBER BLEY: Okay, yes. Thanks.

MR. MAGRUDER: So, we started meeting with the industry. NEI formed an SMR working group and other groups, and we looked at some of the generic topics that would be unique to SMR designs. And we discovered that our ideas of what the issues were and the industry's idea of the issues were very similar. And as many of you know, we sent up a paper to the Commission listing a whole bunch of issues, that was SECY-10-0034, and we've been working through those issues steadily.

So, now in 2014 we now have a division in NRO, the Advanced Reactor program, it's the Division of Advanced Reactors and Rulemaking. Advanced Reactors are two branches within the division, and we also have a policy rulemaking branch, and we also have planning optimization branch which is planning and scheduling and IT people in NRO. But the focus for most of our work right now is on the light water SMR designs that we'll talk about here.

There is increasing interest in other non-light water reactors. We still have information on the GE Prism design and the Toshiba 4S design, but we haven't really engaged them much, but there is -- there are other vendors that are contacting us about their designs, and we'll talk about them a little bit in the future when we are doing some activities. But our resources for non-light water reactor work is pretty minimal.

We've also had a lot of interactions in the last several years with international regulators. Other countries around the world are either developing SMR's technologies or are thinking about implementing SMR technologies, and through the IAEA we've formed a group of SMR regulators to get together occasionally to talk about some of the common issues. And I think we'll talk some more about this. There's a slide later on that.

And, finally, we have developed papers and positions on the majority of the policy issues that we've identified. We think we have a path forward. The message really is that the Staff is ready to review SMR designs. We're ready to license them.

There may be some issues that the applicants or the designers may want to push the

boundaries a little bit more, and we will have to discuss more with them on those issues. But if somebody were to submit a design certification to us today, we could review that.

MEMBER REMPE: Can I ask a question that's a little –- on the previous slide that's a little off topic that I just was curious about? Is there some sort of U.S. Government requirement that if the U.S., someone in the U.S., a vendor or not a vendor that's trying to be a vendor decides to develop a design and export it, is there any sort of requirement for export control they come to NRC for review? There is?

MR. MAGRUDER: Yes. Mike can answer better.

MR. MAFIELD: It's a part of 810 process.

MR. MAGRUDER: Right. The DOE –- is it 10 CFR 810?

MR. MAFIELD: 10 CFR Part 810.

MR. MAGRUDER: Right.

MEMBER REMPE: So, there is a requirement that before a U.S. technologies exported –-

MR. MAFIELD: It's export technology control.

MEMBER REMPE: But there is a vendor right now, or an organization that's trying to market to China, and how does that work?

MEMBER CORRADINI: But I don't think -- I think Mike's answer, though, was not certified.

MEMBER REMPE: No, this is not a -- they just decide I'm going to take this technology that was developed in the U.S. and they go overseas and sell, it's --

MR. MAFIELD: They may be facing criminal action. If they haven't gone through the 810 process, they may have a serious problem.

MEMBER REMPE: And part of that 18 process, 810 --

MR. MAFIELD: 810.

MEMBER REMPE: -- process is to come through NRC?

MR. MAFIELD: No, no, it's an interagency process that I think DOE actually manages.

MEMBER CORRADINI: And it wouldn't require certification.

MEMBER REMPE: No, there's just --

MR. MAFIELD: No, it's technology export.

MEMBER REMPE: But there's nothing that comes to NRC --

MR. MAFIELD: No, we're part of that but we don't -- we're part of that export control. We can talk about it --

MEMBER REMPE: I'm just curious because there is an example right now you're aware of, and I just was curious.

MR. MAFIELD: We're part of that export control process but we're only one part.

MEMBER REMPE: Okay.

MR. MAGRUDER: Yes, there's coordination between Department of State, Department of Commerce, NMSA, DOE all get involved in that --

MEMBER REMPE: Okay.

MEMBER POWERS: You don't take import/export control training at Idaho?

MEMBER REMPE: Yes, we do. And I always have everything export controlled but there's just an example I'm curious about.

MEMBER POWERS: It's locked down just like they say. There's certain government agencies responsible. Each category at NRC has a particular area of responsibility.

MR. MAGRUDER: Correct.

MEMBER POWERS: And the penalties are horrible.

MEMBER BLEY: And it's not just hardware. I mean, it's paper studies. We've had to go through that, as well.

MR. MAFIELD: Including people who wish to work overseas have to go through that process.

MR. MAGRUDER: Yes. Our Office of International Programs has a group that focuses on that.

MEMBER SKILLMAN: Stu, I'm Dick Skillman. Let me ask you a question, please. You said you could respond to a design cert application. Would it make a difference to you whether that application came in under Part 50 or under Part 52?

MR. MAGRUDER: No, it wouldn't. We're in the process of –- well, let me see. No, I don't think it would. We're in the process of actually developing a Commission paper which we'll brief the Committee on soon. I think –-

PARTICIPANT: Next month, or two months.

MR. MAGRUDER: Two months. In June, actually. Where we've actually analyzed the difference between the requirements in Part 52 and Part 50. And, of course, I mean not of course, there are things that we've included in Part 52 that we did not go back and implement in Part 50. Mainly, it was PRAs, severe accident requirements, things like that. So, we think that if we made some fairly straightforward changes to Part 50 and got Commission

buy-in that the decisions they made with regard to Part 52 also apply to the Part 50 licensing process, we could review an application under Part 50.

MEMBER SKILLMAN: Thank you.

MR. MAGRUDER: Okay. As I mentioned earlier, mPower was in just prior to this discussion to give a detailed presentation on their design, so I won't talk a lot about that except to give you an idea of what our Staff activities have been.

The first bullet is our best guess about when they will actually come in with an application. As many of you know, there's a lot of uncertainty about the B&W support for the mPower design now and the funding is a question. But based on statements from the B&W President, we expect the design certification will come in in early 2015. And that's what the Staff is --

MEMBER BANERJEE: When was that statement made, before or after the last uncertainty of funding.

MR. MAGRUDER: That statement was made on actually a shareholders' quarterly briefing with Wall Street reporters about a month and a half ago.

We've had a lot of technical meetings with mPower, more than 50 meetings is accurate here. We have approved their Quality Assurance program, or a

previous version of their Quality Assurance program I should say in the Instrument Set Point Methodology topical report, and we've got another –- actually a couple of topical reports under review. Core nuclear design methods is the most active one right now.

So, we are also developing a design-specific review standard for mPower that is –- you can think of it as a tailored standard review plan for the mPower design. That's really been the focus of most of our meetings over the last several years, is gathering information about the design and updating the review guidance for the Staff.

We published a draft version of that for use and comment in May of 2013. That included almost all the sections. There were a few sections that mPower still held as proprietary because they had not gotten their patents on that information yet. They did receive the patents last fall. The Staff has worked with them and we've gotten –- we're about ready to actually publish the draft versions of those remaining DSRS sections.

As I said, we published the draft in May of last year for public comment. We got almost 2,000 comments on the DSRS. Staff has done a tremendous job, all the disciplines in NRO and NSIR, and NRR now have

kind of weighed in, answered the public comments, and we're in the process of getting those revisions and the public comment resolution reviewed by management in the Agency and our Office of General Counsel. And we will be coming hopefully soon to Dr. Bley's Subcommittee and talk more about the DSRS.

MEMBER BLEY: We look forward to that, yes.

MR. MAGRUDER: Chapter 7 has been completely rewritten for the mPower review, and we continue to have meetings on that topic. Okay, next slide, please.

MEMBER BROWN: A question.

MR. MAGRUDER: Yes, sir?

MEMBER BROWN: If you've completely rewritten it since the last time we looked at it –-

MR. MAGRUDER: No, not since the last time you looked at it, sir. Since –-

MEMBER BROWN: Okay.

MR. MAGRUDER: It's rewritten from the SRP Chapter 7.

MEMBER BROWN: Okay. All right. I was just about to have a heart attack.

MR. MAGRUDER: No, no, no. Sorry about that. It's consistent with what you've seen before.

MEMBER BROWN: Thank you very much.

MR. MAGRUDER: And I'm sure it reflects your comments.

MEMBER BROWN: I just blanched.

MR. MAGRUDER: Yes.

MEMBER CORRADINI: They would never go against what you –-

MEMBER BANERJEE: You can't blanch.

MEMBER BROWN: Pardon?

MR. MAGRUDER: So, we do have active discussions with a potential applicant for a Part 50 construction permit, and that's TVA. They're proposing to build four mPower units, that's two packs at the Clinch River site which is adjacent to Oak Ridge National Laboratories in Tennessee. They were –- TVA was part of the mPower America team that was awarded money from DOE. The idea is to demonstrate that you can build and operate SMRs in the United States, and the award was based on having these units operating by 2022. So, that's what TVA is basing their schedule on.

We've had several meetings with them. We've had several staff down at the site. TVA has done a lot of site prep work and work to prepare their environmental report. Things are going well. These are some of the topics that they want to talk about with the Staff in the near future.

And we were also developing guidance, since it's been many years since we've reviewed a construction permit application, we need to update our Staff guidance on how to do that, so that's a big effort that we're starting on now.

Okay. The Holtec design is, I would say, in a conceptual stage still. We've had a couple very high-level meetings with Holtec, and as you can see, they've done some drop-ins with the Commissioners. They initially told us that they would come in towards the end of calendar year 2016, but in their most recent response they said they're reevaluating that schedule, so we don't have a firm date for Holtec and their design certification application.

We are reviewing their QA topical now, and actually are almost finished with that. That's a key part of any application, is making sure the Quality Assurance program is of high quality.

So, this is a very high-level idea of the Holtec design. It's a very thin pressure vessel. The core is obviously down at the very bottom. The steam generator is attached by flange to the reactor vessel so it's not truly integral design; however, they –- I mean there's no piping in this design. This is totally natural circulation. There are no pumps in the design.

It's also below grade similar to the mPower design that we were looking at earlier today.

Holtec has partnered with PSE&G in New Jersey, and they've got many engineers from PSE&G working with them on the design, which is encouraging for us. They've also just recently announced that they're planning to build an integral test facility similar to what you heard from mPower today up in Camden, New Jersey.

NuScale, I would say besides mPower, NuScale is the most active vendor that we've been dealing with. They recently announced that they are flipping their application date from the summer of 2015 to the summer of 2016. They also got awarded money from the Department of Energy in the second funding opportunity.

We're doing a DSRS also for NuScale, and that, as you might imagine, is building off what we've done for the mPower DSRS. Many of the sections are similar, and the Staff is kind of going through that more quickly than the mPower DSRS.

You can see the testing that they're doing out at Oregon State University where they have a one-third scale test facility out there. They've also done critical heat flux testing at Stern Labs in Canada,

and they did some interesting tests. They have a -- they're proposing a helical coil steam generator as opposed to a straight tube steam generator, and they did some testing at SIET in Italy in the fall which we observed that went very well, actually.

They're also doing testing of fuel designs in South Korea. They haven't confirmed, I don't think they've confirmed that they'll use KEPCO as a vendor, but they've done testing in South Korea with their fuel.

Some of the challenges of NuScale design we've talked about before, but this concept, and maybe go to the next slide, show you the cutaway view here. This is, essentially, the reactor building for NuScale. It's a big submerged pool of water where all the reactors and the containment vessels are underwater. Nominally in their design they're going to have 12 reactors in this pool. This shows six of them here. And one of the challenges there, they're proposing to have fewer control room operators than our requirements would have since they're going to be operating 12 units from one control room, so that's a challenge that we're looking at now. They have a full-scale control room mock up in Corvallis. The Staff has been out to look at it and are interacting with them

on how they're going to actually –- how many operators they actually will need.

This is also a total natural circulation reactor, no reactor coolant pumps.

MEMBER BLEY: Are their plants also completely separate from each other?

MR. MAGRUDER: Yes, they are, separate safety systems, separate turbine generators, that's for each reactor. These are much smaller. These are only 45 megawatt electric per reactor. Again, this uses standard PWR fuel, just shorter fuel similar to mPower.

MEMBER BANERJEE: You have six modules. Right? Is that it?

MR. MAGRUDER: This is half of the pool.

MEMBER BLEY: Twelve.

MR. MAGRUDER: Right. This is just showing six.

MEMBER BANERJEE: So, when you say 45 megawatt net power per module, what do you mean? With 12 modules they –-

(Simultaneous speaking.)

MR. MAGRUDER: Yes, so a little over 500 megawatt for all 12 units. But their plan is to refuel

these every two years so that they would essentially have about 500 megawatts on line all the time.

MEMBER RICCARDELLA: They refuel each unit individually?

MR. MAGRUDER: Individually, yes. Yes, they would move to the other end of the pool there where they've got a spent fuel pool and refueling capability. So, theoretically, once they get all 12 units operating, they're refueling about every two months, so they would have a permanent staff there that does refueling.

MEMBER BROWN: So, they can pull one out while all the rest of them are still operating at power.

MS. BRADFORD: That's their proposal.

MR. MAGRUDER: That's their proposal, yes.

MEMBER BROWN: Disconnecting the steam lines.

MR. MAGRUDER: Yes. They have an instrument that while they move it --

MEMBER RICCARDELLA: Each one has its own containment?

MR. MAGRUDER: Yes.

MEMBER RICCARDELLA: Each one of those things you're showing there is a containment?

MR. MAGRUDER: Yes. It's kind of like a thermos, actually, because you've got the reactor vessel and then a small air space, and then the containment vessel.

MEMBER BANERJEE: And the steam generator?

MR. MAGRUDER: Inside the reactor vessel. Two steam generators.

Westinghouse SMR, Westinghouse came late to the game and focused a lot of attention on their SMR design. They were trying to utilize a lot of the lessons they learned from the AP1000 design. This would also be a passive design, single unit, a little bit larger than mPower. But after DOE made the second funding opportunity announcement and Westinghouse did not receive funding, they made a corporate decision to slow down significantly on their SMR work. So, we really haven't had much interaction with them other than to kind of finish up the work that we started on their LOCA PIRT topical. We're still doing a little bit of work on that.

They were also partnered with Ameren Missouri to build these units at the Callaway site, but Ameren has kind of backed off, also, and haven't decided which technology they're going to use.

Okay. This is a cutaway view of the Westinghouse design. It's kind of a hybrid, I guess. I mean, it's a dry containment but it's small containment. Again, the vessel is kind of tall and thin like the other vessels, they're once-through steam generator, but that's just a very high-level view of that design.

MEMBER RICCARDELLA: Pumps or natural circ?

MR. MAGRUDER: Pumps.

MEMBER RICCARDELLA: Pumps.

MR. MAGRUDER: Reactor coolant pumps, yes. They're mid-flange there as opposed to mPower which are on the top of the vessel.

MEMBER RICCARDELLA: Oh, I see.

MS. BRADFORD: Yes.

MR. MAGRUDER: Thanks. Okay. Anna.

MS. BRADFORD: Okay, thank you. So, everything Stu has been talking about have been the light water designs that we've been interacting with. We've been trying to do some strategic thinking about non-light water designs. There's a lot of interest in them internationally, a little bit of interest here domestically. We've received letters from two non-light water vendors. They're proprietary so I can't really go into the details, but at the very kind of

beginning stages of thinking about what they might want to do.

One that's not proprietary I can talk about for a minute is X Energy. It's 100 megawatt thermal SMR pebble bed HDGR that they're thinking about, but that's several years in the future before they come to us for a license. But we wanted to sit back and think well, how would we handle that if someone came in the door? You asked if we could handle an application under 50 or 52, and we thought could we handle an application or either of those for a non-light water design, because I'm sure you all know those regulations are really geared towards our light water experience. So, I think what we concluded was we could do it, but it would be messy, and it would take a long time.

And one thing we heard in our communications with the Department of Energy, who they often talk to the non-light water vendors and industry as a whole, was that they thought there needed to be better regulatory framework for non-light water applications. So, we talked to DOE and we came up with something that we're calling a two-phase strategy.

The first phase, DOE is taking the lead. They're in the middle of that right now. They started

about the beginning of this year/end of last year. What they're doing is they're taking all of their technical expertise, they're looking at all of our old documents that are publicly available, they're talking to vendors, they're using the National Labs to look at the general design criteria in Appendix A of Part 50. Those are mostly also geared to light water reactors. It says in the introductory text at the beginning something about these are for light water reactors but they could provide guidance for non-light water designs. So, what do we really need to do if we wanted to apply these to a non-light water design? DOE is doing that part right now.

They're actually having a two-day meeting next week with industry to talk about this. What does industry think we would need to do with GDCs? So, if a GDC has water in it, and your coolant is not water, maybe that's clearly a problem, maybe you just need to take out the word "water," maybe you want to make it more generic so it's any type of coolant. They're thinking through those things.

MEMBER CORRADINI: So, the meeting next week is for what then?

MS. BRADFORD: DOE.

MEMBER CORRADINI: That part I got.

MS. BRADFORD: It's DOE's meeting with -- they have invited representatives of industry that they have contact with.

MEMBER CORRADINI: That might be interested in pursuing non-LWR --

MS. BRADFORD: Yes.

MEMBER CORRADINI: -- SMRs.

MS. BRADFORD: Yes. So, what they're going to give us hopefully, they're planning by the end of this year, is some kind of report where they, I think what they're thinking is would go through the GDCs, talk about how they would recommend that they be revised, and the basis for it.

MEMBER BLEY: I'm just --

MEMBER CORRADINI: I --

MEMBER BLEY: I'm sorry, Mike.

MEMBER CORRADINI: No, you go.

MEMBER BLEY: I've seen another group do that.

MS. BRADFORD: Yes.

MEMBER BLEY: And what they did was identified all the things that don't apply.

MS. BRADFORD: Right.

MEMBER BLEY: But they didn't investigate what else you might need. Now, the work you're doing on the design-specific guidance --

MS. BRADFORD: Yes.

MEMBER BLEY: -- is doing that. Is DOE up to speed on that side of it, what you've been doing, and the kind of things to think about to make sure you don't just strike things, but you add in the new regulations?

MS. BRADFORD: We have been, I would say, observing this phase one.

MEMBER BLEY: Okay, so you've been involved.

MS. BRADFORD: And we've tried to make points like that. Like, okay, so maybe some don't apply, but maybe there's whole new ones that you need to create because of some new system, or some new -- so they definitely have that as sort of a box they need to think about and check.

MEMBER CORRADINI: So, just to follow on, I guess I'm -- since we just finished with NGNP --

MS. BRADFORD: Yes.

MEMBER CORRADINI: So, is there something, lessons learned there that you're going to tell DOE so they don't march up that same path? I'm still

struggling with we've already did this, or tried this, and there was a, I guess the word I would come up with is misunderstanding, different expectations. And before this gets too far, are those expectations clear between NRC and DOE so they don't develop other expectations?

MS. BRADFORD: My one response would be, again, that we've interacted with them significantly on NGNP where we can on this phase one. And that this is broader than just HDGRs. They're thinking about fast reactors. They're trying to make it technology neutral where they can.

MEMBER CORRADINI: Oh, so that leads me to the other thing. So, where does the NUREG that was never issued but was in draft form, NUREG –-

(Simultaneous speaking.)

MEMBER CORRADINI: It was? Thank you very much. No, it's out.

MS. BRADFORD: It was issued.

MEMBER CORRADINI: It was issued, but it was never used.

MEMBER BANERJEE: Always ask that question.

MS. BRADFORD: That is a framework as opposed to the details of how you would implement it. So, you might be able to build off some of the things

in there if they're applicable, but it's not going to tell you how to implement that.

MEMBER CORRADINI: The only reason I'm asking all this is –- so, let me just cut to the –- where I sense there was a misunderstanding. And I'm sure Mr. Mafield will correct me.

MR. MAFIELD: Never.

MEMBER CORRADINI: My impression was when we had the meeting, and I can't remember if it was a year ago, six months ago, or whatever when we had this, Dennis –- it was a Subcommittee meeting, I think, Dennis ran, is that DOE came in with the impression that they could get to essentially an end state that didn't require a prototype, and from the other side of the NRC, I got the definite impression that to really get something clear on what were the regulatory requirements, a prototype was probably necessary. And I never sensed that DOE –- I never sensed the two parties really –- I sensed that we walked away from the meeting like this instead of like they were facing–-

MEMBER BLEY: DOE had argued they couldn't get industry support for the prototype, so they couldn't do it. That's my memory.

MR. MAFIELD: If I could –-

MEMBER BLEY: Well, that was based on 50-50 cost sharing.

MS. BRADFORD: Yes, they couldn't get a cost share partner.

MR. MAFIELD: But let's –- we've got to be a little careful in –-

MEMBER CORRADINI: That's why I want –-

MR. MAFIELD: You've got to be a little careful about mixing in NGNP and the attempts to push forward that as a licensing strategy. And we'll be happy to come back, and we can bring in John Kelly and Tom O'Connor and have a great debate, but it won't move the ball forward much.

MEMBER CORRADINI: Okay.

MR. MAFIELD: So, the conversation we had –- that Tom Cavern and I had, Anna was involved was wait a minute, let's take a step back. With NGNP we were trying to take a great huge bit out of the apple. And, once again, tried to take a great huge bit out of the apple and it wasn't working all that well. Let us take a step back and think smaller. Let's think about general design criteria. Right? Some of the specific things that people that might actually design something, some guidelines, criteria to follow through on. So, we met with John Kelly and his staff and

talked about the notion of how can you go forward for general design criteria? What makes sense, of the ones that exist, what of them make sense, what of them don't make sense? There's a lot of activity with A&S, as you well know, on the four different technologies, four different standards, a lot of interest in sodium. Right, wrong, or indifferent there's a lot of interest in sodium technology. So, let's look at sodium technology, what can we do as sort of the immediate case? What of the GDC apply, what don't apply, and what new ones, either new or modified ones do you need? So, we had some discussion around that as a general framework.

At that point, NRC stepped back and went to an observer status. So, on the going in side there was a lot of discussion between Staff, including lawyers on both sides, to make sure that we didn't get into a conflict of interest situation. So, those legalistic boundaries were drawn. NRC stepped back, and we've been observing what the Department and their contractors are doing in developing an appropriate set of proposed general design criteria.

Those will, at some point, come to the Staff for us to then pick that up and look at what we can or can't do, and then make proposals to the

Commission through a normal regulatory rulemaking process.

MEMBER CORRADINI: If I might just clarify one thing, though, Mike. That all sounds good, but what I was –- so that must be the going in plan by DOE, which we could have people, but you probably will clarify it. Since Fort St. Vrain had been empirically licensed, and Clinch River was empirically licensed, and Prism got close, that means there is a process already. That means that DOE would want to modify that process on how they engage the NRC for these advanced reactors. Is that –-

MR. MAFIELD: Yes. But what we were trying to start with rather than reinvent a whole set of regulations, let’s start small. Let’s go to something, and as a small step, something that we can hopefully come to agreement on.

MEMBER CORRADINI: Okay.

MR. MAFIELD: That gives a designer some basic ground rules to start working from, rather than reinvent the whole process in one fell swoop which has been sort of an abysmal failure on a number of tries, but start small. Let’s then step through this and gain agreement at each step so that we’re not debating NGNP all over again.

MEMBER CORRADINI: Okay, fine. Thank you.

MR. MAFIELD: Now, the other thing I will tell you is that stemming largely from the discussions with the Department and with Idaho about the NGNP and the degree of what's risk-informed, what's an appropriate level of defense-in-depth, what was the terrible event that the Committee put a label to, Gargantuan event.

MS. BRADFORD: Godzilla event.

MR. MAFIELD: Godzilla event, so let's try and not go down that path again. Let's --

(Simultaneous speaking.)

MR. MAFIELD: It was pretty clear where that term came from, I just couldn't come up with it. But let's take this a step at a time, rather than get into this. And we want to build on the work that's going on, Commission-directed work looking at Recommendation 1 from the Near-Term Task Force, what's going to come out of that. Then let's look at the Risk Management Task Force, what activities are going to come out of that, and start building on those things rather than reinvented specific to any given project. Let's build on the Commission-mandated activities as they evolve. So, we're trying to build a structure rather than bringing the whole thing in at one fell

swoop, build a structure. The piece that Anna is talking about, now that I've side brained her presentation, the piece that Anna is talking about is one small step down that path.

MEMBER RAY: Well, at the same time, keep the Hill from writing another 2005 EPA, until all that's—-

MR. MAFIELD: I have relatively little ability to influence my own staff, much less the Hill.

MEMBER RAY: I understand, but my point in making that comment was everything was being driven really, including the 50-50 cost sharing, the Part 52 and all of that stuff is completely unrealistic, but it was being driven out of that –- the requirements of the EPA.

MEMBER CORRADINI: You mean EPAct.

MEMBER RAY: I'm talking about the Energy Policy Act of 2005.

MEMBER CORRADINI: Okay. I wasn't sure what EPA you were talking about?

MEMBER RAY: That's what I was talking about. And the decision, while it got floored I'll say, the TVA decision to go with Part 50 was part of a debate that I was involved in, and I think is a right decision. Now, that's not what we're talking

about right now because it's light water reactor, but that's got to be part of the mix, as well. And the whole idea of industry cost-sharing and so on was based on a premise that it's not viable. So, anyway, I agree with you, but I just wanted to add those comments.

MEMBER REMPE: While you derail, is this all coming from the SMR program at DOE, just like NGNP you guys covered through DOE. And is that what this is, only it's the SMR project, so you actually bill DOE back for phase two?

MS. BRADFORD: No, we do not.

MEMBER REMPE: So, this is coming –-

MS. BRADFORD: This is our own activity, yes. It's not a fund reimbursable type of thing.

MEMBER REMPE: Okay.

MR. MAGRUDER: But it's still under John Kelly. Right?

MS. BRADFORD: Right. It's the same group, but not the same financial setup.

MEMBER REMPE: But they pay for the DOE, and you'll pay for the NRC.

MS. BRADFORD: Yes. Right.

MEMBER REMPE: That's interesting.

MS. BRADFORD: So, I feel like I should hurry up and get off this slide, but –-

PARTICIPANT: No, phase two.

MS. BRADFORD: Phase two. Like I think I said, they'll be giving us their deliverable towards the end of this year. We will take that, evaluate it with our technical staff. I'm sure we'll have some interactions with DOE to discuss what they've given us, and why they did what they did. And then we'll have to decide our next step. And we haven't decided for sure what that is yet, is it a guidance document, standard review plan? You know, the biggest step of all would be a rule. I don't know if we're there, but we'll take that and think about it, and decide what to do next.

MEMBER BLEY: Mike probably answered this for me, but I'm going to ask it anyway. Back when you published the new introduction to the review plan, you had a plan laid out in there that there would kind of be two tracks. There would be a track, I think it sounded like the phase one you talked about, and something that smelled a lot like the technology neutral framework as a development but for a specific plant. And then we saw somewhere that that part went away.

MS. BRADFORD: Yes.

MEMBER BLEY: That's completely off the table now. Right?

MS. BRADFORD: I think you're referring to, we sent a memo up to the Commission earlier this year saying that we weren't going to do the pilot study for the technology neutral framework on a plant.

MEMBER BLEY: Right.

MS. BRADFORD: So, yes, you're right about that.

CHAIRMAN STETKAR: Why? I mean, I read the memo but –-

MS. BRADFORD: Yes, a few different reasons. One was we didn't have anybody jumping up and down to participate in that with us. And then some of the schedules started slipping out, so it became harder for us to do that, as well as everything else we needed to do with the resources that we had.

CHAIRMAN STETKAR: We've learned a lot about the real benefits of earlier piloting processes before you get into real world constraints on schedules and budgets for licensing issues, or many things. And this seems to be heading down that –- the path that we know doesn't work.

MEMBER CORRADINI: I mean, the only reason I guess I started this is that what worries me is, I mean, I understand where Mike is coming from and the plan that you guys are kind of standing back and watching them, but if they get too far down a path that their expectation doesn't meet your expectation, I just see this all happening again.

MR. MAFIELD: If I could, one, I'm not bashful. And, two, we are watching --

MEMBER CORRADINI: I knew that part. That was an obvious one.

MR. MAFIELD: We do attend their meetings and their video sessions, so we are staying pretty well engaged with what they're doing. And if we start seeing difficulties, Dr. Kelly and I will have a chat. But so far, so far Staff feels like the path they're on makes sense. We've got some issues that we're going to talk with them about.

MEMBER CORRADINI: Okay.

MR. MAFIELD: But it -- I am sensitive to your point about if you just sit back and let others go to develop their own notions, then at the end of the day you start having difficulties. That's not what -- that's exactly what we're trying to avoid here, at

the same time being sensitive to and respectful of the conflict of interest issues.

MEMBER CORRADINI: Okay.

MR. MAFIELD: Because if you get crossways of that, you just damn the whole activity from the getgo. If I could come back to the pilot project, we weren't objecting to doing a pilot project. The original plan for that pilot project was to take 1860 essentially out for a test drive on high temperature gas.

MEMBER CORRADINI: Right.

MR. MAFIELD: That project went away. Then we were looking at well, can we make some progress by looking at one of the small PWRs. As Anna pointed out, those schedules started drifting out further, and further, and further, and how much progress were we really going to be able to make given budget constraints and timing constraints, just the real world of where I have to live. And at some point we said, you know, enough is enough. Let's take a step back, table this until we get something that's moved far enough along where we could actually try it.

MEMBER CORRADINI: Okay, so it's not --

MR. MAFIELD: It's not completely dead, but it's on near -- sort of long-term life support. I

don't want to suggest to you it's going to happen any time soon.

MEMBER CORRADINI: Yes, okay.

MR. MAFIELD: But it wasn't something where we said it's a bad idea, it's just not now.

MEMBER RAY: Before you move on, let me just make one other unrelated comment, because I make it down at Forrestal all the time, which is when people say why do this at all, keep in mind that most non-LWR reactors are high temperature, which has the really big advantage of not being water consumption requirements as much. And having gone through a lot of siting efforts in my life in the west, that's a big, big deal. Okay? If you're not going to –- if you're west of the Mississippi River and you're going to consume water in a new power plant, you are in big trouble. So, like I say, people tend to forget why are we doing this? That's one reason to keep on your list that really important, because you're not going to put a light water reactor, I don't think, very far west of the Mississippi River ever, not withstanding what my former chairman friend who was trying to do that said. It's just not going to happen. Anyway, for what it's worth, that's –-

MS. BRADFORD: Thank you. Okay, completely different topic. SMR review schedules, and now we're here back to talking about the light water designs that Stu went over. We challenged ourselves to look at what's the best schedule we could achieve once an application comes through the door, and we're going to start the review. We looked at past review schedules for the large light water reactors, we've looked at a certain number of assumptions. For example, we would have a DSRS in place before the application came in, the policy issues would be resolved, the applicant would answer RAIs in about 30 days or so. And what we came up with is that we think under an ideal case we could finish our review within 39 months. And I'll show you the breakdown of that on the next slide. And, of course, we're not going to compromise safety or our technical review to achieve that, but we did want to challenge ourselves to see what we could do.

This is the breakdown of that 39-month schedule. This is the normal six phases we thought about. We stepped back and thought could we do less phases, could we do four phases? We actually came and talked to some ACRS staff about what if we only came to ACRS for one review instead of two, and that didn't go very well, so we went back to the six phases, which

I think actually we all agree works better with the two reviews.

So, it starts with the acceptance review which doesn't count as part of the 39 months, but assuming we accept it at the end of that two months, phase one and two is the duration basically of the technical review, so 18 months for the staff to do that, RAIs and the preliminary SER.

Then phase three is coming to the ACRS. As you can see there's some overlap there because I think we're thinking in real life we could start sending you some sections even though we're not completely done with phase two. Then we would prepare the advanced SER, come back to the ACRS in phase five, and then in phase six prepare the final SER. And this is, again, the ideal case. Everything is, except that one phase, is exactly one after the other, everything has gone smoothly, there's no major design changes by the applicant, there's no major things discovered in the RAI responses. There's a lot that goes into this.

MEMBER POWERS: We have been doing certifications for light water reactors in phase 3 in a piecemeal fashion. Chapters are reviewed when they become available.

MS. BRADFORD: Yes.

MEMBER POWERS: And sometimes those chapters come in and it does take some Dramamine to survive the change in subjects. Now, if you were to do that with a wholly new technology and, indeed, with modified regulatory considerations, you think the ACRS would really accept a piecemeal review?

MS. BRADFORD: Well, I think there's pros and cons to both sides. I think there's some disadvantage to --

MEMBER POWERS: That's not what I asked you. I asked you if the ACRS would accept a piecemeal review?

MS. BRADFORD: Oh, I think we would ask the ACRS if you would accept a piecemeal review.

(Simultaneous speaking.)

MEMBER POWERS: I guarantee you you would get one vote that said not just no, but hell no.

MS. BRADFORD: Yes.

MEMBER POWERS: That I would want to look at -- I mean, even if it comes in under the same ground rules that there are open items, then I would want to look at the length and the breadth, because by and large Staff does a very good job on the things they do. And we read these things, at least I read them not for what's there but what's not there. And

ask me to look at the Quality Review Plan before I have seen the hardware probably is not going to make me a very good reviewer.

MS. BRADFORD: I think we would have to, in conjunction with the ACRS, think about if we did it piecemeal, the best way to group things. Because, yes, absolutely some things should come together so you can see the whole picture. But there may be some that we finished early and maybe aren't as crucial to seeing the big picture that we could send early. And this is definitely something we can talk to the ACRS about in terms of staggering reviews or not.

MR. MAGRUDER: Yes. I would say that we are very conscious of –- one of the things, I think one of the big lessons learned was that the reviews were too compartmentalized and stove piped, and we're going to try very hard for these SMR reviews to get more interaction between the Staff, and to share and take a more holistic view of the design.

We already have the advantage of looking at the risk insights earlier than we have for other designs which will help with the review. So, I agree it's much easier to look at it all –-

MEMBER POWERS: I don't think the 50.52 debate is nearly as big as the problem that you have

on 10 CFR Part 100 on these plants. I mean, I may be just asking too much to say okay, you're going to get this piecemeal over six months. The first place, I don't think we've done a piecemeal certification over six months. I don't think it's physically possible.

MEMBER BROWN: Well, we haven't even gotten I&C architecture --

(Simultaneous speaking.)

MEMBER BROWN: -- requirements in six months. I mean, we spent two years trying to get the ESBWR and AP1000 to --

MS. BRADFORD: That will be another --

MEMBER BROWN: Part of the protestations from our chairman of that particular one, that one was ugly at first, and then they finally gave us an AP1000. It took a while.

MS. BRADFORD: That's one advantage, also.

MEMBER BROWN: EPR has not even come through it yet.

MS. BRADFORD: Yes, to --

MEMBER BROWN: Am I correct? We haven't gotten a response on the last -- excuse me.

MS. BRADFORD: That's okay.

MEMBER BROWN: No, no, no, it's not okay. Excuse me. Go ahead.

MS. BRADFORD: I was going to say that's one advantage to coming to you with DSRS sections. Like Stu's group is coming to you with that Chapter 7 I&C, so that will give you some –- at least this won't be hitting you completely out of the –-

MEMBER BROWN: Yes, as long as the Staff agrees to put in the stuff we want so that the vendor comes –-

MS. BRADFORD: Maybe that was a bad example.

MEMBER POWERS: I mean, what's interesting on this is that we try to –- what we've been asking for is less.

MEMBER BROWN: Oh, yes. I don't need as much as long as we comply with the –-

MEMBER POWERS: We've been asking for less and can't get it.

MS. BRADFORD: Okay, thank you. As Stu, I think, mentioned there are some key technical and policy issues that we've been working on since at least 2010 when we wrote that one big SECY paper that kind of consolidated all of our thoughts. This is some of them, both technical and policy.

Emergency preparedness for SMRs is one. They are interested in perhaps justifying a smaller

emergency planning zone based on their smaller core, so smaller source term. They to do mechanistic source term maybe, where they actually look at what's released, so they haven't given us any specifics on this. We don't have any numbers in front of us, but we know this is something they're thinking about. We did get a paper from NEI that was the industry's --

MEMBER POWERS: When they say mechanistic source term are they talking like the DOE White Paper on mechanistic source term which had absolutely nothing to do with mechanisms or source terms that I can tell?

MR. MAGRUDER: Everybody, as you know, everybody has a slightly different definition of mechanistic source term. And I would say their approach, at least to mPower and NuScale so far are kind of more traditional. They want to take advantage of some of the technology. I mean, mPower mentioned earlier today some of the things they want to take advantage of.

MEMBER POWERS: I mean, they should take advantage of all the technology they can, but on the other hand the idea that you would come in with a mechanistic source term and no experimental data puzzles me some.

MS. BRADFORD: I do know that DOE is working with EPRI to do some of those studies, try to get some information. When those are supposed to be done, and if they support these schedules I'm not sure.

MEMBER POWERS: Well, I have, for instance, seen people proposing to do experiments in support of some of these reactors that look like they're escapees from about 1982. I mean, they don't do –- take advantage of the fact that a lot of water has gone through the turbine since 1982, and that we understand things better.

MR. MAGRUDER: Yes, we look forward to more discussions with that. I think there's a lot that could be done.

MEMBER POWERS: Well, I mean, I think they're particularly easy –- I mean, with these kinds of plants the experiments are much easier to do in a fairly prototypic fashion than they are for a 1500 megawatt electrical plant because everything is smaller.

MR. MAGRUDER: Right.

MEMBER POWERS: Everything is shorter.

MS. BRADFORD: So, like I said, NEI submitted an industry paper to us on EP just this past

December. We had a public meeting with them this past Tuesday to talk about that, so they talked us through their methodology and their approaches, and our Staff asked a lot of questions. And we're thinking about what our path forward is going to be for that.

Staffing is another issue. Stu mentioned the control room staffing in terms of the number of modules that are controlled from the control room, and how many operators do they need to have in there.

Another aspect of staffing is maybe the security staffing. If they try to say our design is so safe even from a security viewpoint that we don't need as many guards that a normal large light would have, they might come in propose something different.

Deeply embedded structures, I think you heard from mPower on that today, and I think that's an issue for pretty much all four of the designs that Stu talked about. All of them are below grade.

Digital I&C --

MEMBER POWERS: Before you jump off, and disconnected from any of the designs you're looking at, just out of my own personal area, have you ever given thought to deeply underground units? That is, I mean, these are below grade. I'm talking about

something that's 500 feet below the surface of the earth.

MR. MAGRUDER: I don't think we've --

MS. BRADFORD: I don't think so.

MR. MAGRUDER: I don't think we've ever had any proposals for that.

MS. BRADFORD: No. I think the most we've heard discussed, at least for these discussions are about 100 feet, 120 feet, something like that, 80.

MR. MAGRUDER: Did hear a proposal to have something offshore. There are system designs that are proposing to put the whole reactor under water.

MEMBER POWERS: But it just strikes me that, you know, we looked at underground siting back in around '74 or '75, but there what they did was they took an existing design and just stuck it in a big cave underground, and they were looking do you get any advantages on safety on that. They weren't even considering security. But I'm disappointed that no one has ever looked at how you would redesign a reactor that was very deeply underground, and now we have both safety and security, aircraft impact kinds of issues that might shift the balance. When we looked at just taking from the surface and putting it underground, it was a wash. What you lost on the cod you got back on

the mackerel, you know. It was just a wash. It may not be a wash now to go deeply underground.

MS. BRADFORD: Okay. The next item that we've been thinking about, and we know that vendors have been thinking about is digital I&C. And there's not necessarily something unique here for SMRs, but just the fact that it can be a challenge for all the reviews we perform.

ASME code applicability, we've encouraged the vendors, and they are interacting with ASME to see if they want to do something different, is the code -- are they going to be able to fit within the code sections that we've already approved and already used. Do they need to be working with ASME to develop something new? For example, if they're not going to inspect something for two years and the code says you should inspect it twice a year, what's their path to success going to be there? So, they're working on that, is our understanding.

And piping design, mostly because of design maturity, you know, do they have the piping design, and are they going to want to use DAC, Design Acceptance Criteria for that? And there's been some conversations going back and forth. I don't know that we have resolution from the two main people we've been

talking about, mPower and NuScale, on whether they want to use DAC or not.

International interface on SMR, Stu mentioned there are several countries involved or interested in SMR licensing, so Stu has actually taken the lead in proposing a forum just for the regulators, not the vendors or the promoters, but the regulators for SMRs in different countries. And the goal there is to just identify and talk about key regulatory challenges and benefit from each other's experiences and insights. And that's just getting off the ground this year. The pilot is proposed to go for two years. You can see the list of countries there that are interested, and those meetings –- there's been two meetings, or one meeting so far over in Vienna?

MR. MAGRUDER: Yes, just one.

MS. BRADFORD: One.

MEMBER POWERS: If I go back to your first –- previous slide on your list of issues, you did not have neutronics on that. And, yet, neutronics –- I mean, I have no idea how you do a neutronic analysis on a pebble bed reactor. I mean, that seems to be completely beyond my ability to comprehend, but I think you have similar issues on any of these high temperature hot or fast designs.

MS. BRADFORD: We should –- the title on this is not quite complete. We should have said a partial list for light water SMRs.

MR. MAGRUDER: Yes.

MS. BRADFORD: If this was for non-light water it would be much longer.

MEMBER POWERS: Just neutronics alone, I mean, we just –- I mean, if you call up and say give me the cross sections for use in some of these reactors, I think you'd get a dotted line.

MS. BRADFORD: Okay.

MEMBER POWERS: I mean, they say well, this is where we think it is. You can't prove it. So, what do you do in those circumstances? I don't have cross sections, you say vendor, that's fine, but give me a cross section set that's agreed and approved?

MS. BRADFORD: I can tell you that for non-light water reactors, we're trying to stay engaged with the international community that might have more experience in these things than we do, so the Generation IV international forum and INPRO over at IAEA, we're trying to stay plugged into that and the discussions that they're having, and benefit from their experience.

MEMBER POWERS: Don't you run into a problem that international sources for cross sections haven't got a clue what NQA-1 is?

MS. BRADFORD: Yes, I don't want to imply that we could just take that data and use it. We would need to do our own checks on it. Definitely. But we're not close to that for the non-light water design.

MEMBER BLEY: I hate to interrupt the interesting discussion but I think we need to finish up.

MS. BRADFORD: Yes, I'm almost done. I'm almost done.

MEMBER BLEY: Yes, two slides. Right?

MS. BRADFORD: So, overall, just readiness. We've been getting ready for a few years. We think we're very close to being ready, if not all ready. We've looked at lessons learned from the large light water reactor licensing experience and taken that, and tried to improve what we would do for an SMR license review.

We're developing the DSRSs and we've made significant progress on those. And the industry seems to be embracing those and supporting those. And we're holding extensive pre-application meetings with the applicants to develop the DSRS, as well as just become

familiar with their design so that we already are up and running if and when an application comes in the door.

This is just an example of all the papers we've put up since that original 2010 paper with the consolidation of issues. 2011 was very busy for us. We talked about a wide range of issues there. We sent up memos recently providing the status of things. We're working on a SECY paper right now that will look at our overall readiness to license SMR. It's on concurrence. I'm sure that you guys will see a copy of that.

So just in summary, we're committed to insuring that we are ready to review these if an application should come in the door, and we encourage engagement from all the applicants, as well as all stakeholders. We think that's critical throughout the process for success for all of us. Thank you.

MEMBER BLEY: Thank you very much. Anything else from the Committee? We look forward to seeing you in a couple of months on the DSRSs, but thank you very much for bringing us to speed here. Mr. Chairman.

CHAIRMAN STETKAR: Thank you. The next topic we have is the research report. We're off the record. Right? And we will be off the record, so we

are actually adjourned for the day as far as the record is concerned.

(Whereupon, the proceedings went off the

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NRC Operating Experience Program

Eric Thomas
Operating Experience Branch, NRR/DIRS
ACRS Briefing
April 10, 2014

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Topics

- A Brief History
- Operating Experience Program Overview
  - Team approach
  - Screening function
  - Communication, Evaluations, Products
- Operating Experience Interfaces
  - Staff
  - INPO
  - International

Governing Documents

- ***Management Directive 8.7***, "Reactor Operating Experience Program"

- ***NRR/NRO Office Instruction LIC-401/REG-112***, "NRR-NRO Reactor Operating Experience Program"

- ***Inspection Manual Chapter 2523***, "NRC Application of the Reactor Operating Experience Program in NRC Oversight Processes"

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A Brief History

- 1978 – GAO Report under consideration at the time of the TMI accident

- AEOD – Created in 1979…eliminated in 2000
  - Critical functions consolidated into other offices

- Davis Besse Lessons Learned (2003-2004)
  - Need for a better-defined operating experience program.
  - Need a focal point for coordination of screening and information management
  - Need an Analysis function to identify recurring events/assess effectiveness of past regulatory actions

- Center of Expertise – Combined operating reactor and new reactor functions

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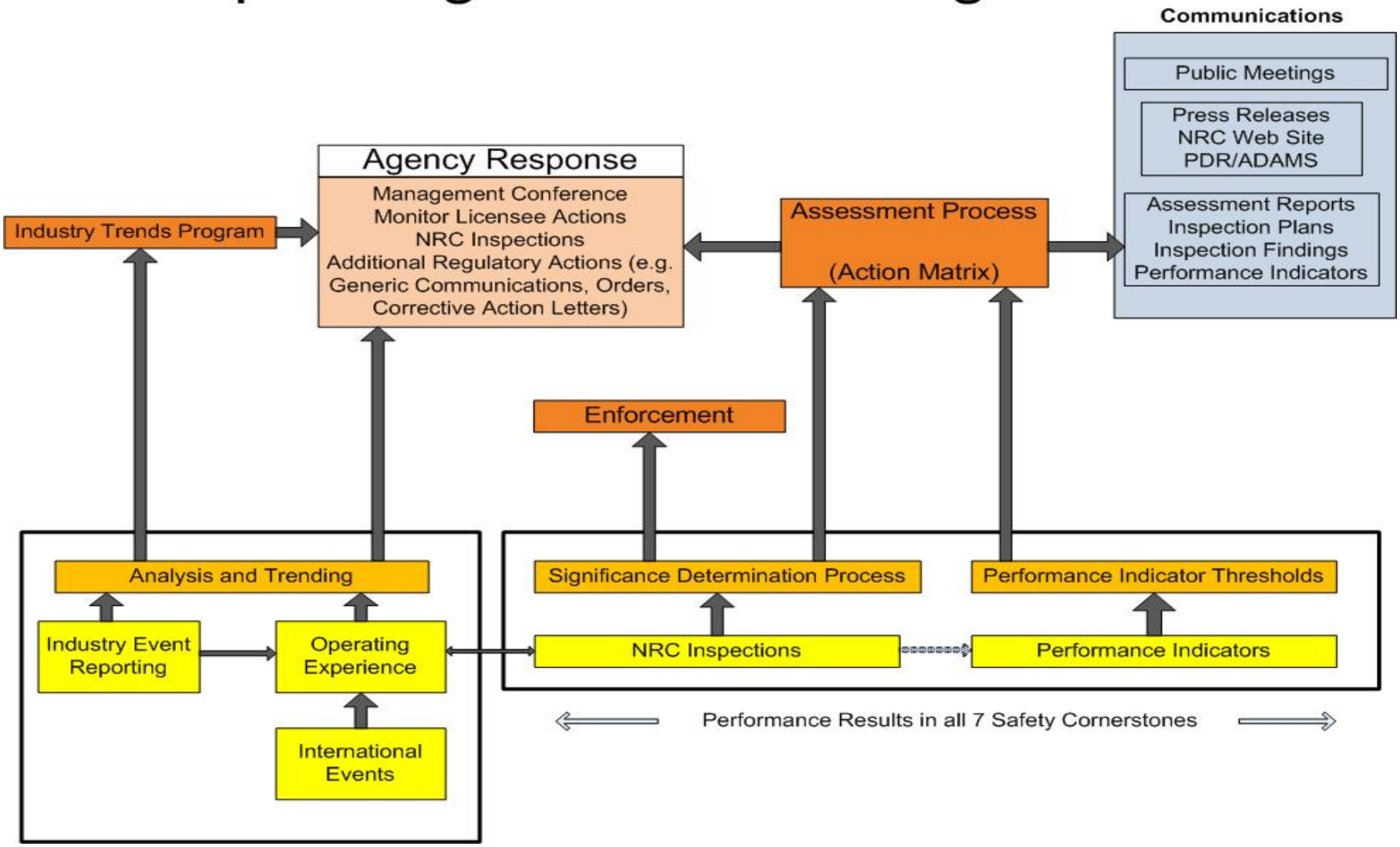
NRC Operating Reactor Oversight



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Inputs → **OpE Program** → **Products**

Domestic OpE: Industry

Daily Event Reports *
Licensee Event Reports *
Part 21 Reports *

Domestic OpE: NRC

Inspection Findings *
Regional Project Calls
Studies/Trends
Significant Non-Nuclear Events

International OpE

Int'l Reporting System for OpE (IRS)
International Nuclear Event Scale (INES)
Working Groups/Conventions

OpE Center of Expertise (COE)

Screening

Communication

Evaluation

Application

Communicate to SME and Store Info.

Informing Stakeholders

Generic Communications *
Internal Products
TRG Reports
OpE Briefings

Influencing Agency programs

Inspection *
Licensing *

Taking Regulatory Actions

Rulemaking *
Information Request *

* = Publicly Available on the NRC Web Page

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Two Team Approach

- Clearinghouse Team
  - "Center of Expertise" approach
  - Daily interface with regions
  - Screen all events/issues that meet thresholds
  - Database stores all screening/coding info
  - Communicates OpE to technical staff/management

- Analysis Team
  - Longer-term, programmatic focus
  - Looks for trends in events, industry data, inspection results
  - Interface with INPO
  - Interface with NRC Technical Review Groups (TRGs)

Screening Function
(Clearinghouse Team)

- Criteria listed in LIC-401, "NRR-NRO Reactor Operating Experience Program"

- Tiered response/disposition
  - Formal screen in → *Issue for Resolution*
  - Staff follow-up and summary → *OpE COMMunication*
  - Email issue → *Technical Review Group*
  - Information only → *No Action*

- Items screened by the Clearinghouse are coded and stored in the Issue Tracking Database

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Communication Function (internal)

- Can apply to:
  - Daily screening results
  - In-depth studies/analyses
  - Response to management requests
- Several different means of Communication (see following slide)

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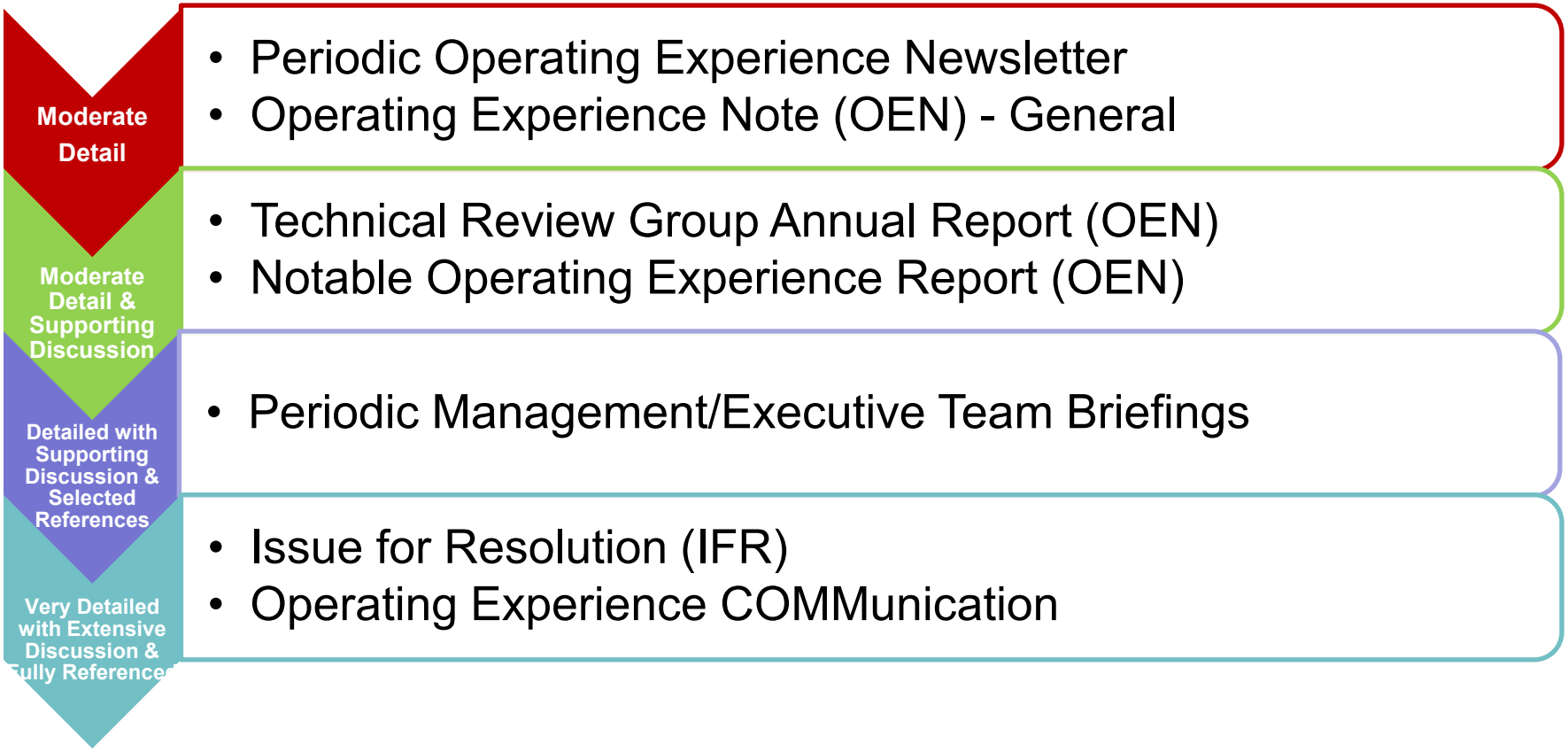
Operating Experience Internal Communication Options



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Additional OpE Products

- Changes to the Reactor Oversight Process
  - Inspection Procedure/Manual Chapter revision
  - Operating Experience Smart Sample
- External Communication
  - Generic Communication
  - RIC Session
  - Publication of an OpE Study/Analysis
- Rulemaking

Staff (Internal) Interfaces

- Daily interface with each Region
- Team meetings
  - Clearinghouse - 3x/week. Regular communication with Technical Review Groups
  - Analysis Team – weekly
- Monthly ROP call (regional/HQ branch chiefs)
- Bi-weekly regional management call
- Reactive Inspection Process
- Significant Topic Briefs (1-2 per year)

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INPO Interface

- INPO's Events Analysis Division
  - Operating Experience
  - Event Follow up
  - Data Analysis

- Additional Interfaces
  - NRC/INPO Memorandum of Agreement
  - Document sharing
  - Special Projects

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International Activities

- Relationship focused
  - NEA's Working Group on Operating Experience (WGOE)
  - National Coordinator for IAEA's International Reporting System
- International OpE is handled similarly to domestic OpE
- Sources
  - Colleague interaction
  - IRS - International Reporting System for Operating Experience (similar to LERs)
  - INES - International Nuclear and Radiological Event Scale

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Questions & Comments

generation

mPower

ACRS Presentation – Design Overview

(Public Presentation)

April 10, 2014

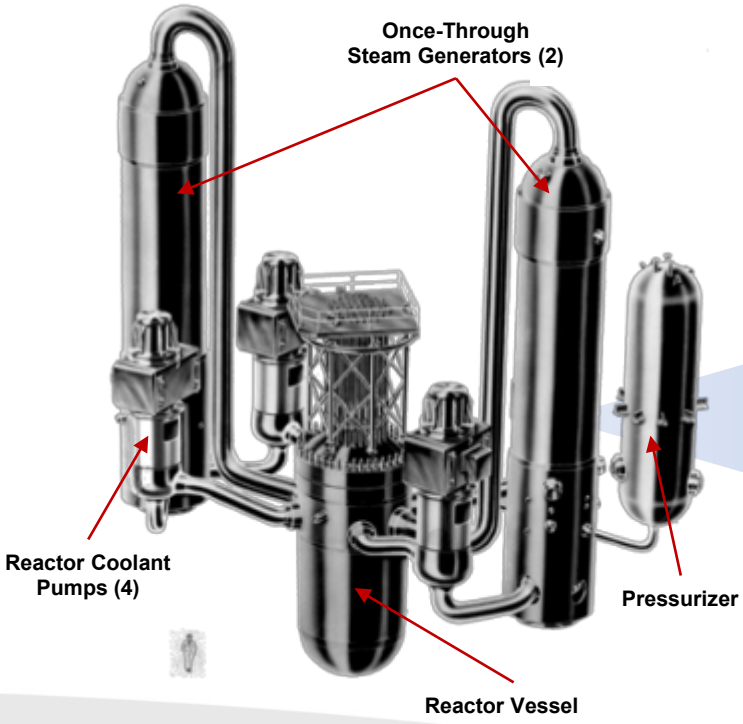
This material is based upon work supported by the Department of Energy under Award Number DE-NE0000583.

Agenda

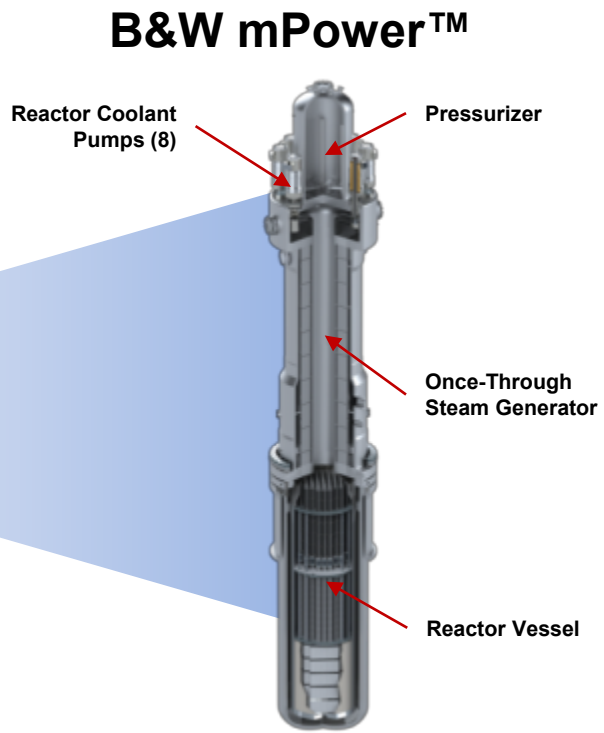
- Plant Overview:
  - What is a mPower SMR?
  - 2-Unit Plant
  - Cross Section of Reactor Services Building
  - Reactor Component Breakdown
  - Steam Generator
- Unique “Defense in Depth” and Safety Strategies

What is a mPower Small Modular Reactor (SMR)?

Traditional 1000 MWe+ PWR

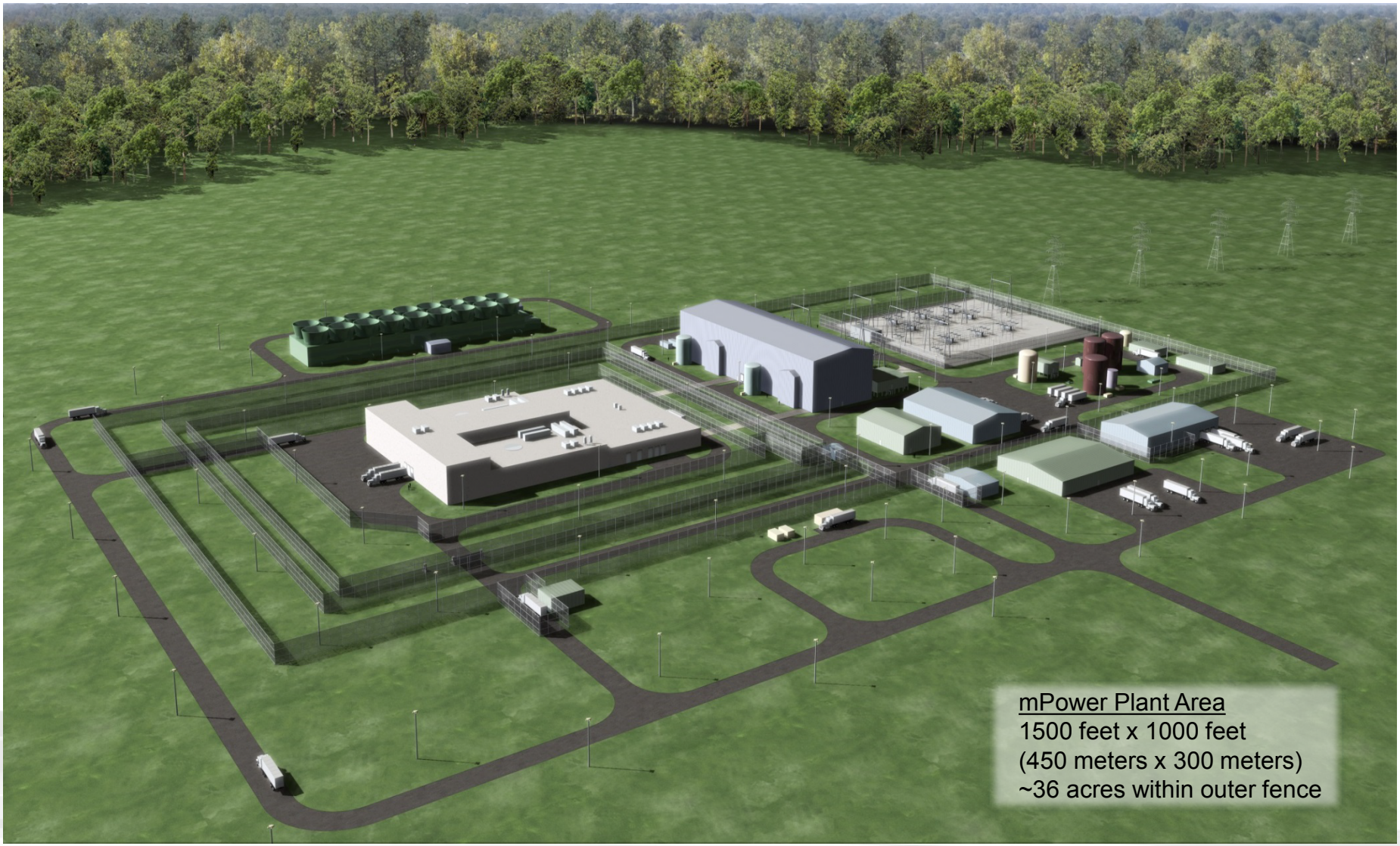


Integral PWR Small Modular Reactor



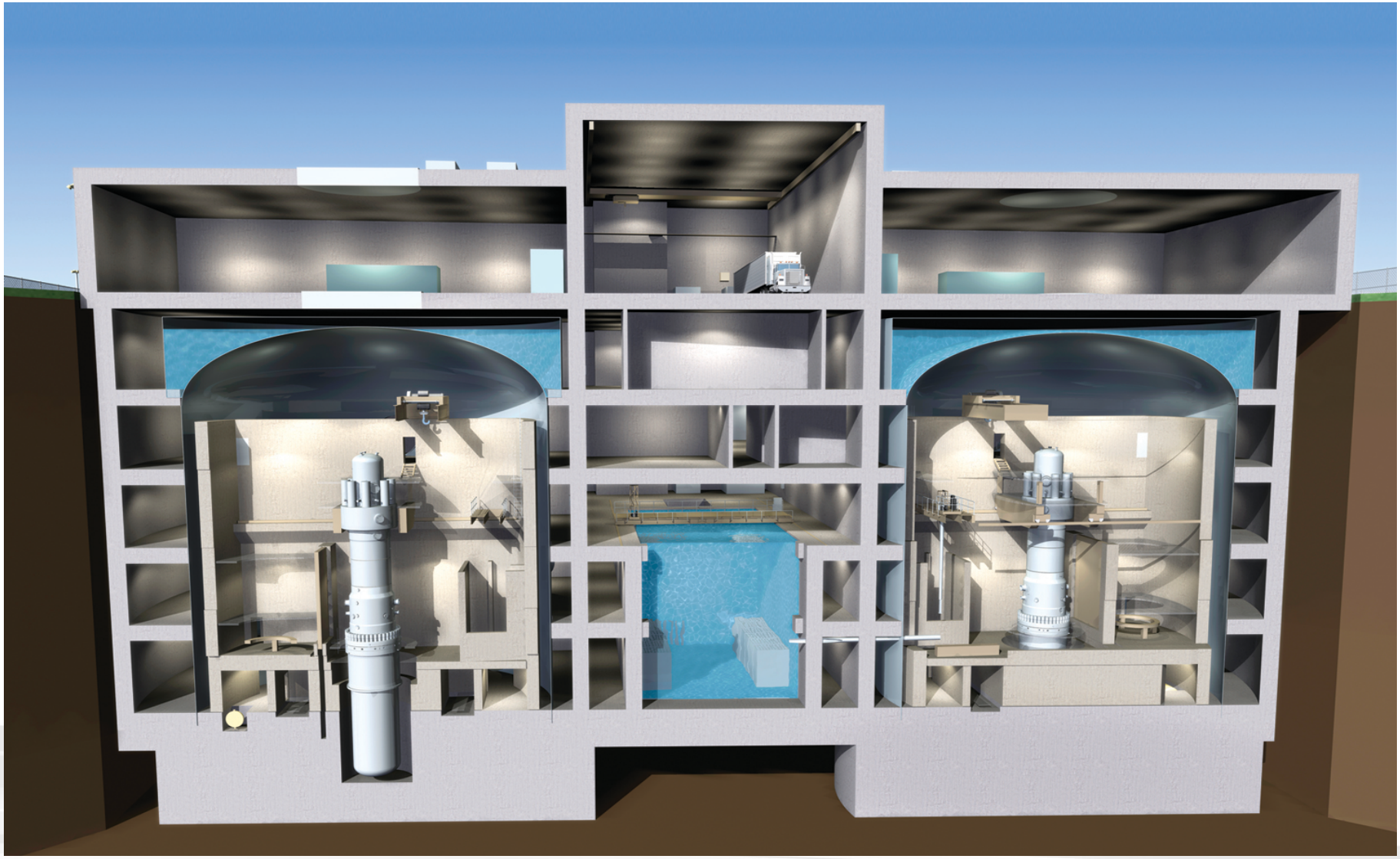
Proven technology, better architecture

Generation mPower 2-Unit Plant

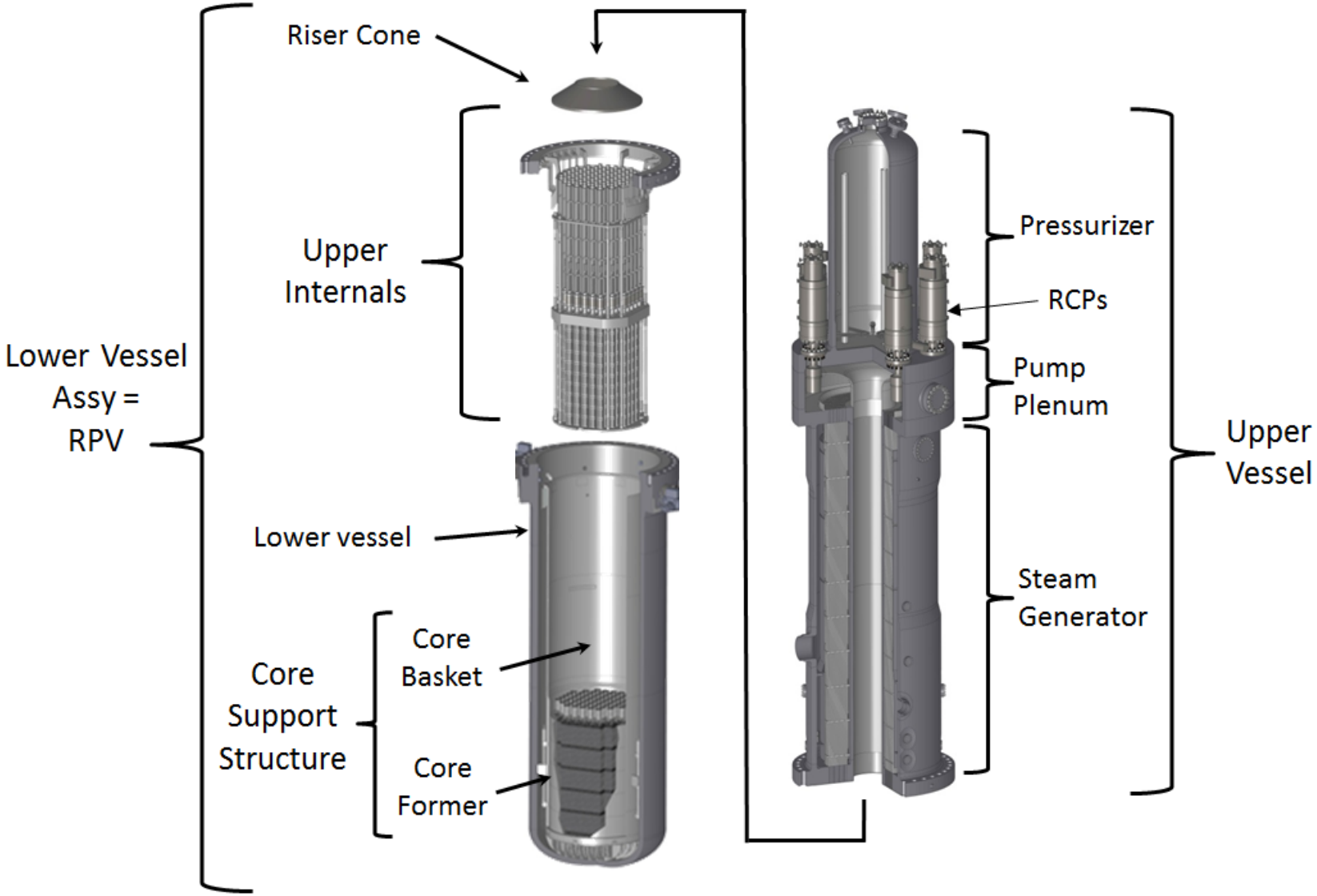


generation mPower

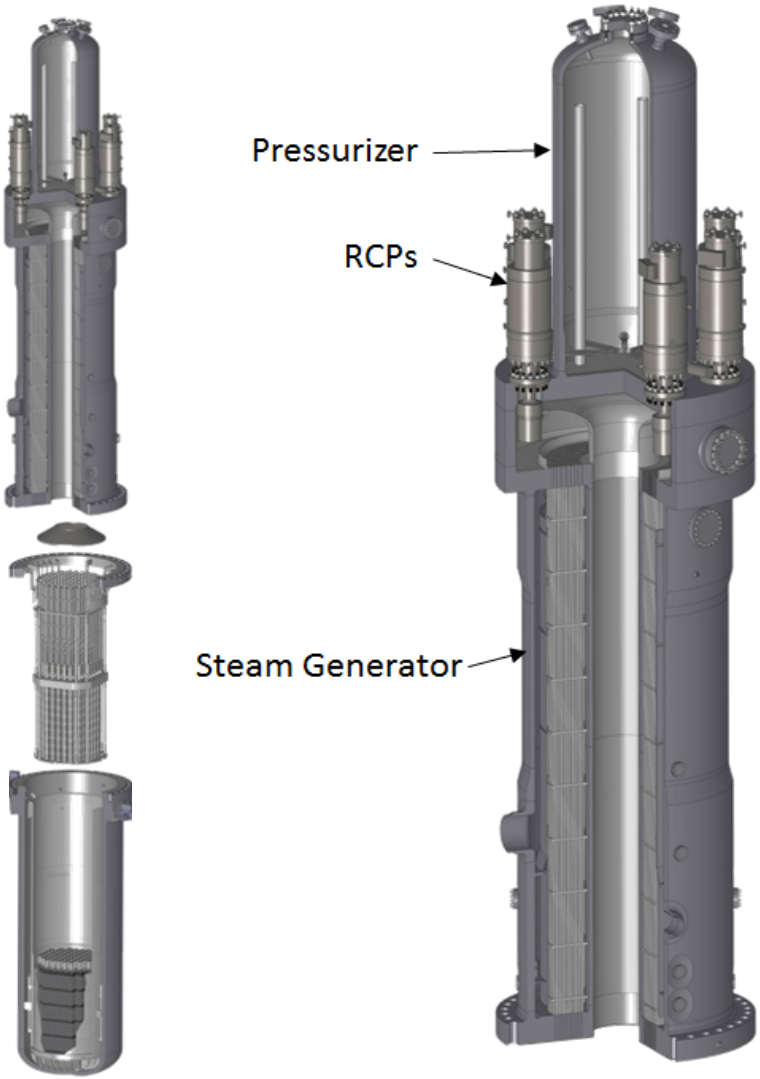
Cross Section of RSB

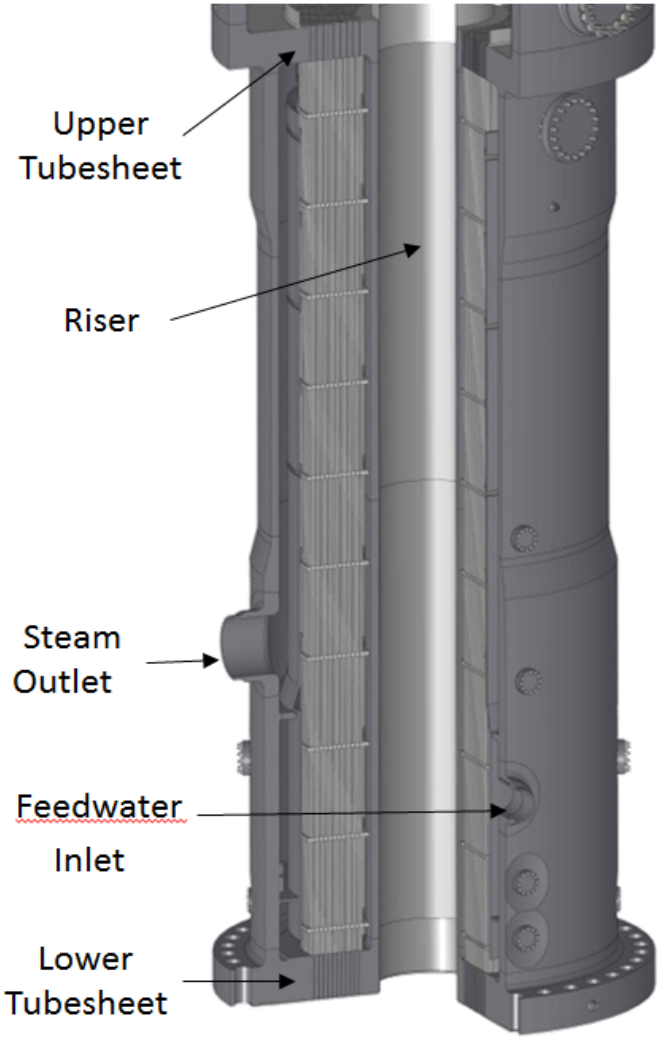


Reactor Component Breakdown



Steam Generator





Unique "Defense in Depth" and Safety Strategies

Design prevents core uncovery during all credible events

- Diverse non-safety systems provide first defense beyond normal operations
  - Auxiliary Condenser System (CNX) – Provides HP Decay Heat Removal during LOFW and SBO events
  - Rx Coolant Inventory and Purification System (RCI) – Provides HP and Low Pressure Decay Heat Removal during LOFW events and Inventory Control during small breaks
- Simple passive safety systems protect from low probability, design basis and beyond-design-basis events
  - Emergency Core Cooling System (ECC) – Provides safety related RCS Depressurization, Decay Heat Removal, Core Cooling Injection, and Long Term Core Cooling
- Integral design eliminates many Design Basis Events and postulated accidents
- Inherent features protect reactor and containment for "non-credible" events

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NRC Staff Activities Regarding Small Modular Reactors

Stewart Magruder, Chief, SMR Licensing Branch 1

Anna Bradford, Chief, SMR Licensing Branch 2

Division of Advanced Reactors and Rulemaking, NRO

April 10, 2014

Discussion Topics

- Historical Context
- Overview of Small Modular Reactor (SMR) Projects
  - mPower
  - Clinch River
  - Holtec
  - NuScale
  - Westinghouse
- Licensing Strategy for Non-LWR Reactors
- SMRs Key Technical/Policy Issues
- International Interface on SMRs
- Staff Readiness to Review SMR Applications
- Summary

2008 – Advanced Reactor Program

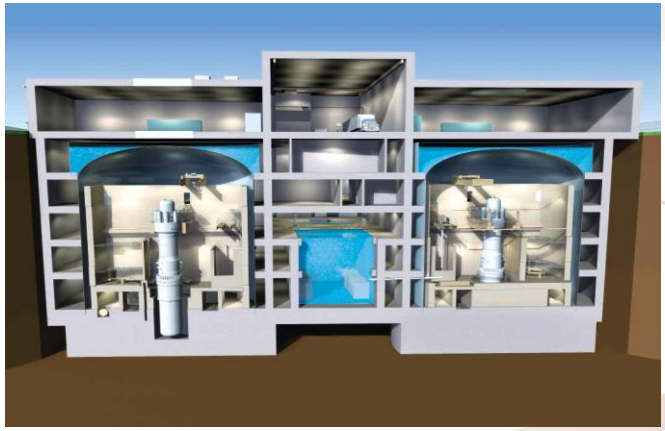
- Focus was on NGNP
- NuScale was in its infancy
- Staff and industry were beginning to think about policy and technical issues
  - Initial planning for SECY-10-0034
    - "Potential Policy, Licensing, and Key Technical Issues for Small Modular Nuclear Reactor Designs" March 28, 2010

2014 – Division of Advanced Reactors and Rulemaking

- NGNP is on hold
- Focus is on light water SMRs
- Increasing interest in other non-light water reactors
- Increasing interactions with international regulators
- Staff positions on most policy issues

B&W mPower™ Design

- Design Certification application expected early CY 2015
- Extensive pre-application interaction on design since 2009
- More than 50 meetings during pre-application
- Staff has approved “quality assurance program” and “instrument set-point methodology” Topical Reports
- “Core nuclear design methods” Topical Report is under review



Conceptual drawing of an underground containment structure housing two B&W mPower reactor modules.

B&W mPower™ Design (Cont'd)

- B&W mPower Design-Specific Review Standard (DSRS)
  - Developed in response to Commission direction to risk-inform infrastructure for small modular reactor reviews
  - FRNs for public comment published in May 2013, and expected in April 2014
  - Received nearly 2,000 comments from stakeholders (including NEI, IAEA, Generation mPower, and NuScale) responding to the FRN
  - Chapter 7, I&C, discussed with ACRS sub- and full-Committees in late 2012, early 2013, and planned for May 2014
  - Remaining mPower DSRS sections will be discussed with the ACRS Future Plant Designs subcommittee in May and August 2014

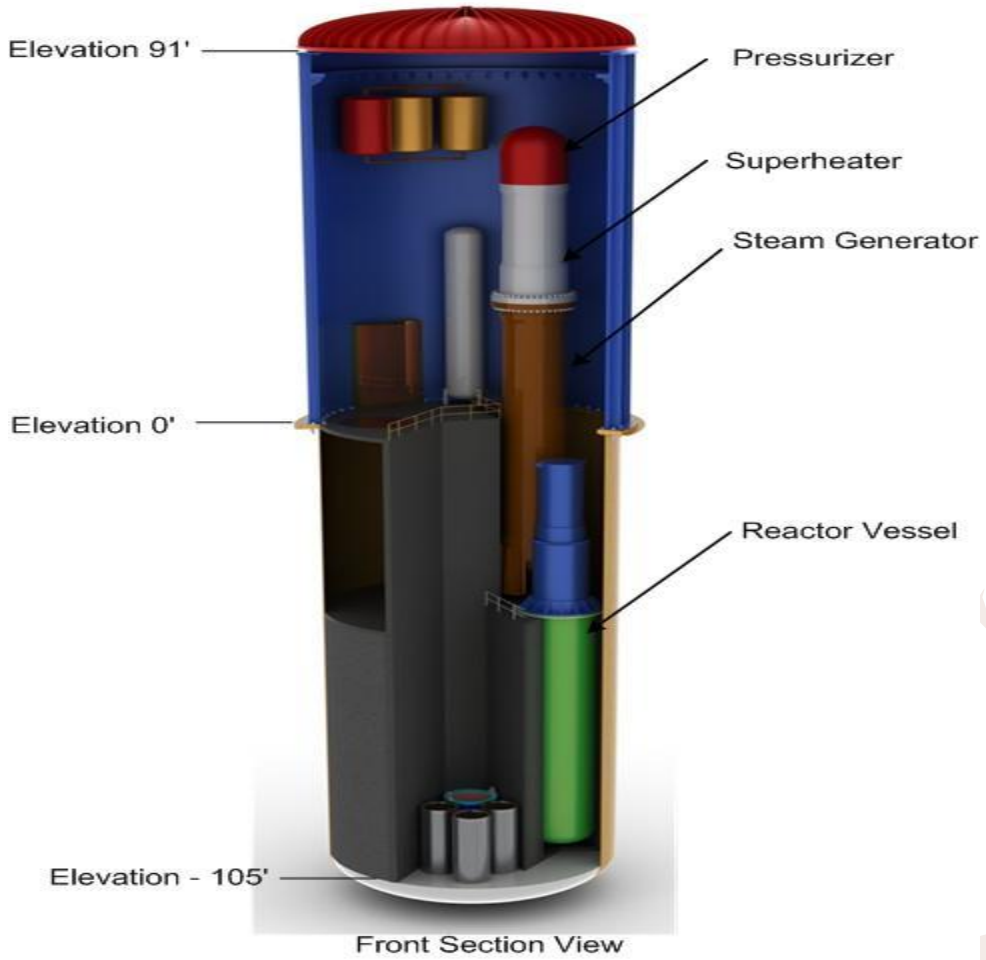
Clinch River Construction Permit

- A Construction Permit application is expected in 2015, under 10 CFR Part 50
- DOE cost-sharing through partnership with Bechtel and Generation mPower
- Pre-application topics
  - Flooding and groundwater analysis
  - Geology, seismology, and geotechnical
  - Emergency planning
  - Environmental issues
- Guidance development

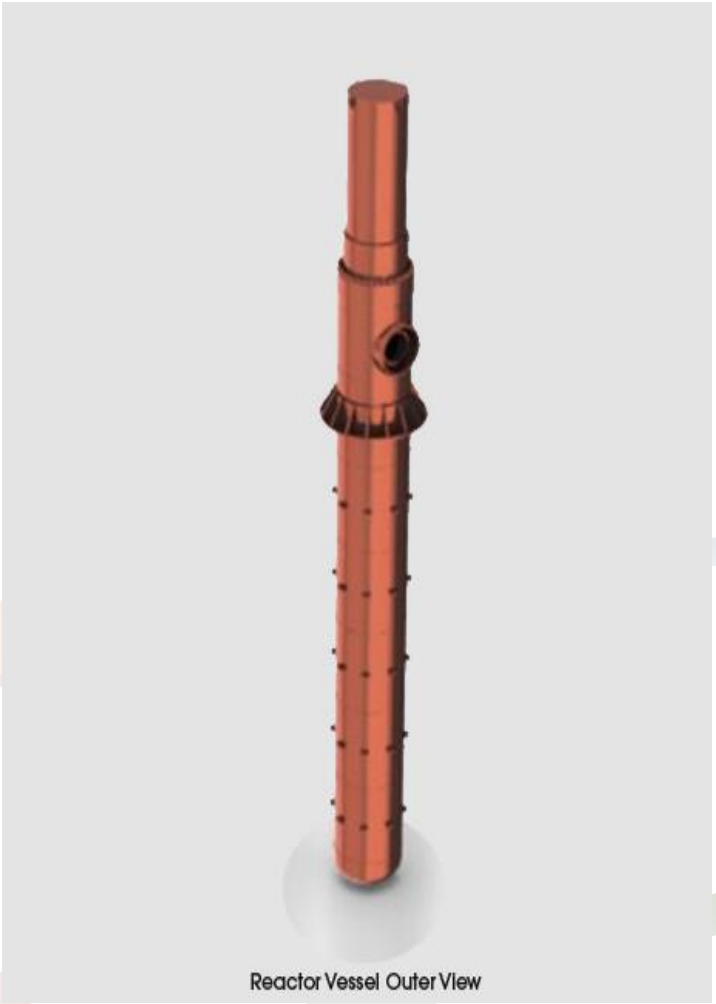
Holtec SMR-160

- Holtec plans to apply for a Design Certification
- In its response to NRC RIS, Holtec informed the staff that they are reevaluating the initial submittal date of 4th quarter CY2016
- Recent and Ongoing Interactions
  - Drop in with Chairman Macfarlane, Commissioners Svinicki and Ostendorff, and NRO Management on September 9, 2013
  - Quality Assurance Topical Report accepted for review in August 2013 and the staff's Draft SER is expected in April 2014

Holtec SMR-160 (Cont'd)



Front Section View


Reactor Vessel Outer View

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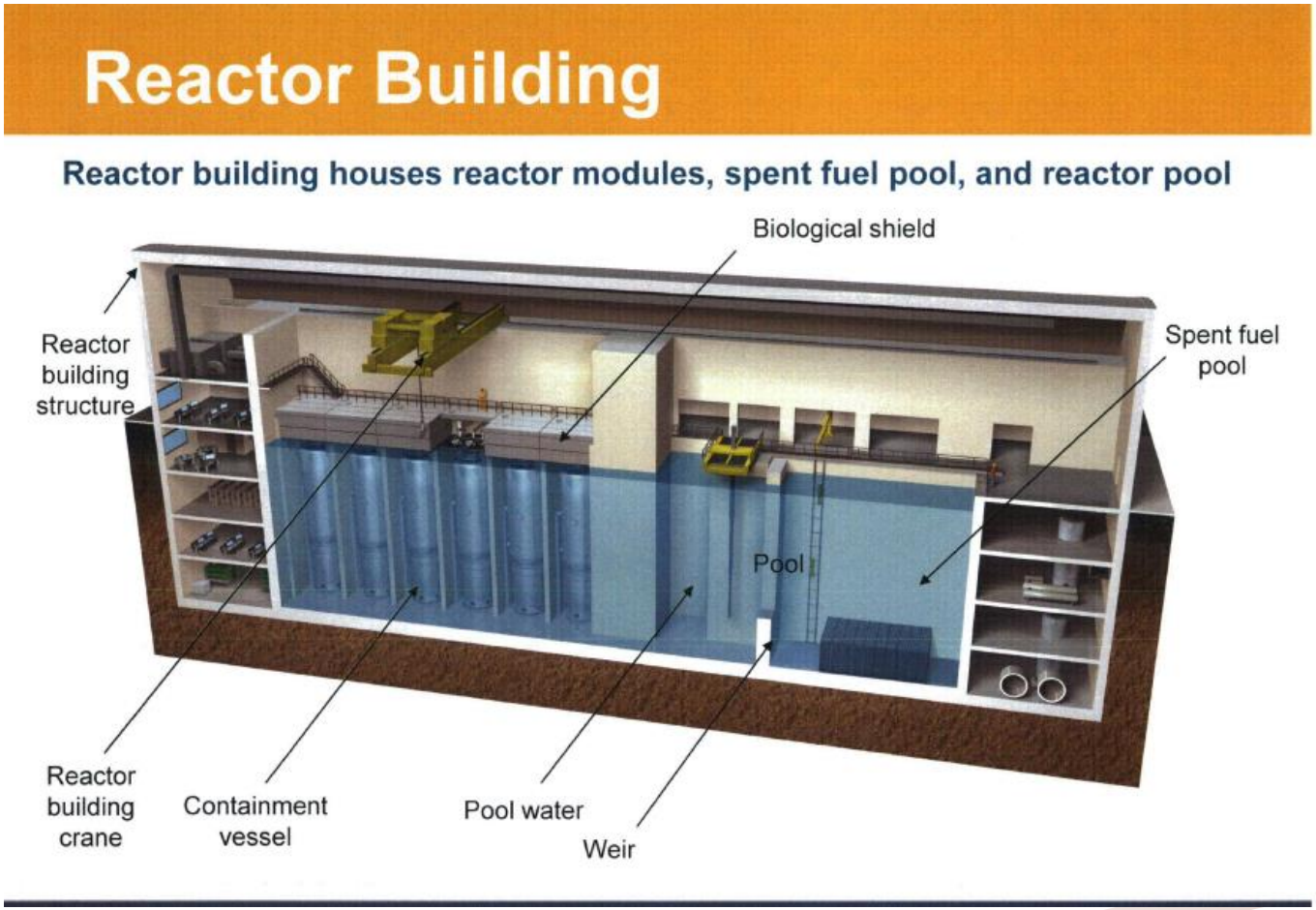
NuScale Power, LLC

- **Design Certification application is scheduled for submittal in the second half of CY2016**
- **About 140 DSRSs and 100 SRPs for NuScale**
  - About 98% of completed mPower DSRSs applicable to NuScale with little or no change
  - Technical Branches have commenced preparation of NuScale DSRSs
  - Final DSRS drafts scheduled to be issued for public comment in June 2015
- **Ongoing and upcoming system testing**
  - Thermal hydraulic testing to resume at NuScale's 1/3-scale test facility at Oregon State University in 3rd quarter of CY14
  - Critical Heat Flux testing at Stern Labs in Canada - ongoing
  - Helical Coil Steam Generator testing at SIET Labs in Italy – ongoing (1st test completed in December 2013)
  - Fuel assembly testing at KEPCO Nuclear Fuel in South Korea – late 2014
- **Challenges**
  - Control Room and Plant Staffing
  - No Class 1E power (AC or DC) needed except DC for Control Room indications
  - EPZ boundary (size)

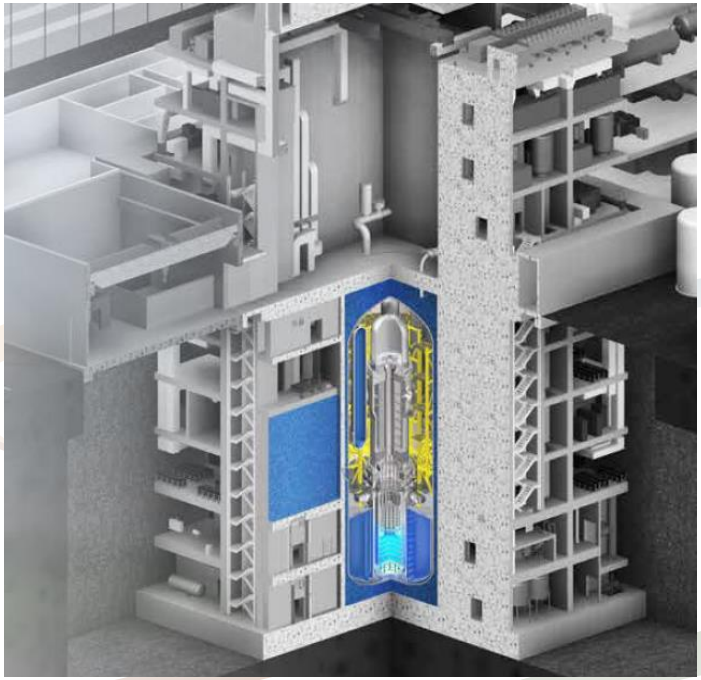
NuScale Power Inc. (Cont'd)



- Each module installed in own isolated bay – up to 12 modules
- Natural circulation – normal and post accident (no reactor coolant pumps; no emergency core cooling pumps)
- 37 standard 17x17 PWR fuel assemblies (half height)
- Internal helical steam generator and pressurizer
- 45MWe net power/module

Westinghouse Small Modular Reactor

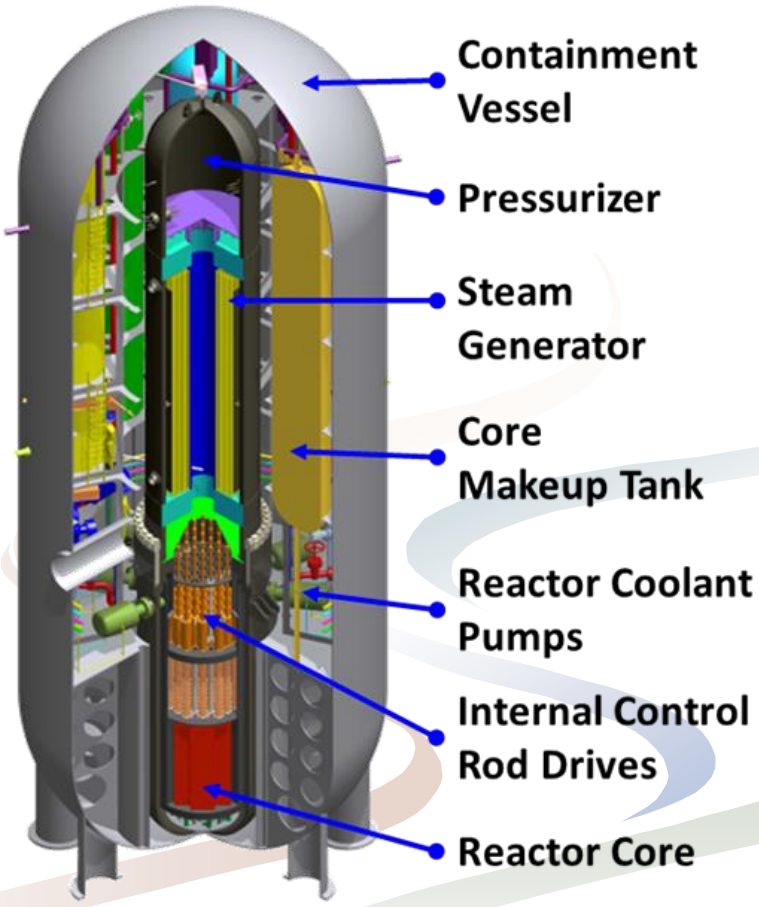
- A Design Certification application date will be communicated in the future
- SRP approach, no DSRS
- Ameren Missouri continues to pursue opportunities that would support the submission of an RCOL for multiple SMRs at the Callaway Site. Submittal date will be communicated in the future
- Staff issued draft SER for the SBLOCA PIRT Topical Report in March 2014
- A pre-application readiness review for the DCA acceptance will be scheduled in the future



Westinghouse Small Modular Reactor (Cont'd)

Specifications

- Output: 800 MWt (>225 MWe)
- Core Design: 89 17x17 FAs, 8 ft, <5% w/o
- Reactor Coolant: Soluble Boron, 8 RCP
- RV Size: 11.5 ft OD, 81 ft tall
- Pressurizer: Integral to RV
- Steam Generator: Once-through, straight tube
- Containment size: 32 ft OD by 89 ft tall, underground
- Construction: modular
- Passive safety systems



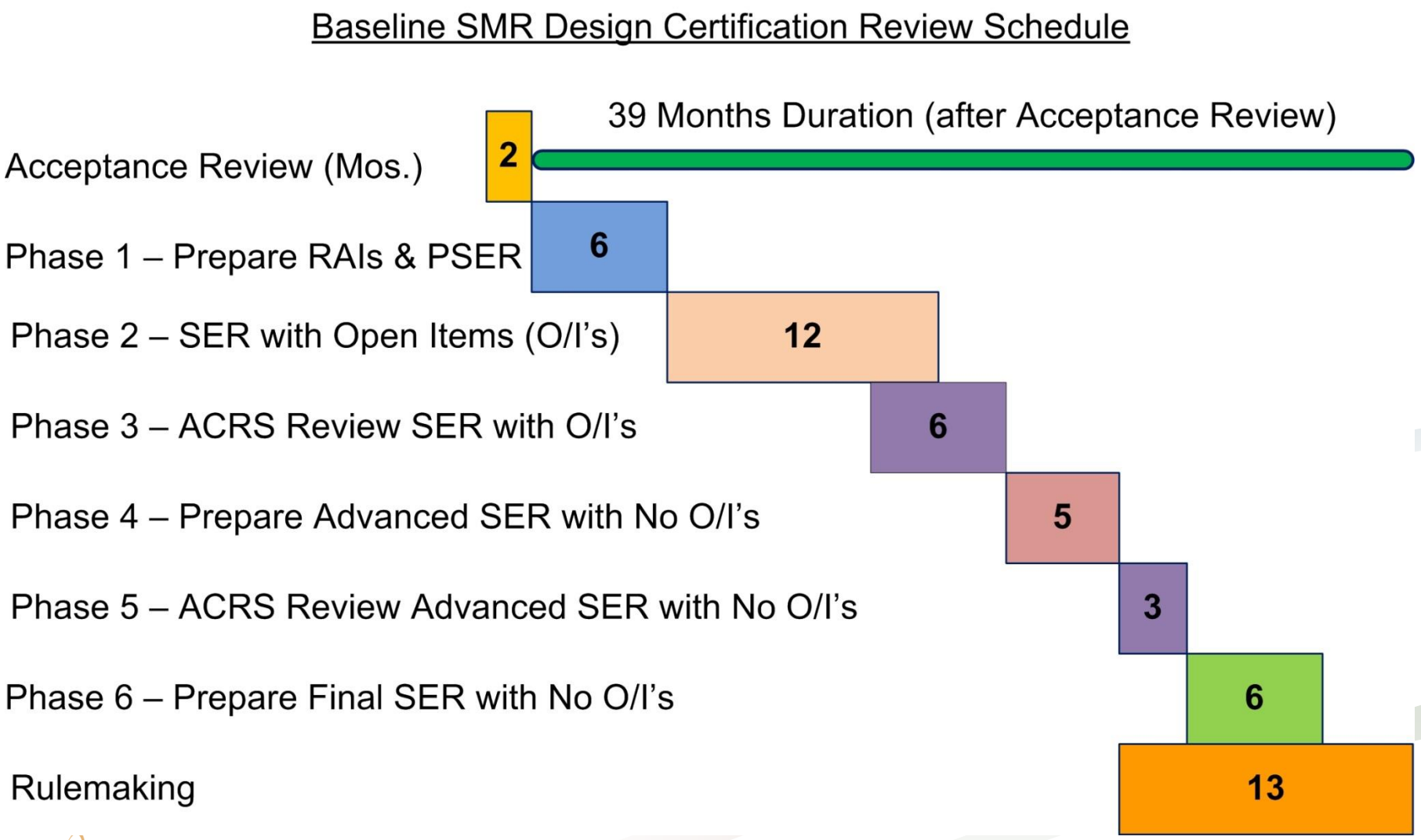
Licensing Strategy for Non-LWR Reactors

- Challenge: Appendix A, GDC, are specific to LWRs
- NRC and DOE agreed on a 2-phase licensing strategy
- Phase 1 – DOE
  - Expertise applied to research, analysis, evaluation, documentation
  - Deliverables – technical reports to NRC
- Phase 2 – NRC
  - Initiate regulatory development process
  - Issue regulatory documentation (e.g., ISG, SRP, regulatory guide, rule)

SMR Review Schedules

- Design Certification reviews may be shorter for SMRs
  - Potentially 39 months
- Requires discipline from applicant and staff
- Safety remains the top priority and will not be compromised to achieve review schedule

Baseline SMR DC Review – Ideal Scenario



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SMRs Key Technical/Policy Issues

- Emergency Preparedness for SMRs
- Staffing
- Deeply embedded structures
- Digital I&C
- ASME Code applicability
- Piping Design

International Interface on SMRs

- Several countries involved or interested in SMR licensing have proposed to pilot a forum for regulators
  - The goal would be to identify and address common key regulatory challenges
  - The pilot is proposed to be for a 2-year period
  - Participating countries include: Argentina, Canada, China, Finland, France, Germany, India, Japan, Korea, Russia, South Africa, UK, and the US
- Staying engaged with INPRO and GIF regarding advancements in standards for non light-water SMRs

Staff Readiness Activities to Conduct the Review of SMR Applications

- Staff is refining internal and external guidance documents to incorporate lessons learned from the review of large LWR licensing applications
- Staff is developing DSRSs and the implementation of a risk-informed, integrated review framework for SMRs.
- Staff is holding extensive pre-application meetings with potential applicants to identify licensing issues early and to develop strategies to address them.

SMR Papers/Memos

- **SECY-10-0034**: Potential Policy, Licensing, and Key Technical Issues for Small Modular Nuclear Reactor Designs
- **SECY-11-0024**: Use of Risk Insights to Enhance the Safety Focus of Small Modular Reactor Reviews
- **SECY-11-0079**: License Structure for Multi-module Facilities Related to Small Modular Nuclear Power Reactors
- **SECY-11-0098**: Operator Staffing for Small or Multi-module Nuclear Power Plant Facilities
- **SECY-11-0112**: Staff Assessment of Selected Small Modular Reactor Issues Identified in SECY-10-0034
- **SECY-11-0152**: Development of an Emergency Planning and Preparedness Framework for Small Modular Reactors
- **SECY-11-0178:** Insurance and Liability Regulatory Requirements for Small Modular Reactor Facilities
- **SECY-11-0181**: Decommissioning Funding Assurance for Small Modular Nuclear Reactors
- **SECY-11-0184**: Security Regulatory Framework for Certifying, Approving, and Licensing Small Modular Nuclear Reactors
- **Commission Memo**: Status of Staff Activities to Address Mechanistic Source Term Methodology (12/29/11)
- **Commission Memo**: Staff Assessment of the Manufacturing License Requirements Issue for Small Modular Reactors (3/27/13)
- **Commission Memo**: Current Status of the Source Term and Emergency Preparedness Policy Issues for Small Modular Reactors (5/30/13)
- **Commission Memo**: Update Regarding Recommendations for Use of Risk Insights for Small Modular Reactor Reviews (1/30/14)

Summary

- NRC is committed to ensuring that policies, requirements, and internal and external guidance are in place to support review of SMRs
- Engagement from potential applicants and stakeholders throughout the process is critical