UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

October 21, 2016

MEMORANDUM TO: ACRS Members

FROM: Maitri Banerjee, Senior Staff Engineer **/RA/**
Technical Support Branch
Advisory Committee on Reactor Safeguards

SUBJECT: CERTIFICATION OF THE MINUTES OF THE ACRS FUTURE PLANT DESIGNS SUBCOMMITTEE ON JULY 6, 2016, ROCKVILLE, MARYLAND

The minutes for the subject meeting were certified on October 17, 2016. Along with the transcripts and presentation materials, this is the official record of the proceedings of that meeting. A copy of the certified minutes is attached.

Attachment: As stated

cc with Attachment: A. Veil
M. Banks

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

MEMORANDUM TO: Maitri Banerjee, Senior Staff Engineer
Technical Support Branch
Advisory Committee on Reactor Safeguards

FROM: Dennis Bley, Chairman
Future Plant Designs Subcommittee
Advisory Committee on Reactor Safeguards

SUBJECT: CERTIFIED MINUTES OF THE ACRS FUTURE PLANT DESIGNS SUBCOMMITTEE MEETING ON JULY 6, 2016

I hereby certify, to the best of my knowledge and belief, that the minutes of the subject meeting on July 6, 2016, are an accurate record of the proceedings for that meeting.

/RA/ **October 17, 2016**

Dennis Bley, Chairman Dated
Future Plant Designs Subcommittee

Certified on: October 17, 2016
Certified by: Dennis Bley

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
MINUTES OF THE FUTURE PLANT DESIGNS SUBCOMMITTEE
MEETING ON ADVANCED REACTOR INITIATIVES
JULY 6, 2016, ROCKVILLE, MD

The ACRS Future Plant Designs Subcommittee held a meeting on July 6, 2016 in T2B1, 11545 Rockville Pike, Rockville, Maryland. The meeting convened at 8:30 a.m. and adjourned at 12:05 p.m. The meeting was open to the public.

No written comments or requests for time to make oral statements were received from members of the public related to this meeting.

ATTENDEES

ACRS Members/Staff:

Dennis Bley, Chairman
Charles Brown, Member
Michael Corradini, Member
Walter Kirchner, Member
Jose March-Leuba, Member
Dana Powers, Member
Harold Ray, Member
Joy Rempe, Member
Gordon Skillman, Member
John Stetkar, Member
Matthew Sunseri, Member
M. Snodderly, ACRS Staff (Designated Federal Official)
Andrea Valentin, ACRS Staff
M. Banerjee, ACRS Staff*

NRC Staff and Consultants:

Michael Mayfield, NRO	Anna Bradford, NRO
Michael Jones, NRO	Stephen Smith, NRR
Jan Mazza, NRO	Deborah Jackson, NRO
Theresa Buchanan, NRR	Amanda Toth, NRR
Mike Case, RES	Bob Fitzpatrick, NRR
George Tartal, NRO	Sud Basu, RES
Bob Caldwell, NRO	Alfred Hathaway, RES
Ian Irvin, OGC	David Werkheiser, Region I
Lynn Mrowca, NRO	Nicholas Hansing, NRO

Michelle Hart, NRO	Nicholas McMurray, NRO
Kevin Ramsey, NMSS	Ata Istar, NRO
John Monninger, NRO	Joe Williams, NRO
Lauren Ning, NRO	Anita Ghosh, OGC
Don Carlson, NRO	Diane Jackson, NRO
Joe Ashcraft, NRO	Sheila Ray, NRR
Tara Inverso, EDO	

Other Attendees:

Russel Bell, Nuclear Energy Institute	David Blee, Nuclear Infrastructure Council
Jeffrey Merrifield, Nuclear Infrastructure Council*	Steven Blossom, STP
Craig Welling, Department of Energy	Phil Grissom, SNC
Marvin Lewis, Public Participant*	Jana Bergman, Curtiss-Wright

*Connected via telephone

SUMMARY

The purpose of the meeting was for the members to receive an information briefing from NRC staff and the industry on advanced reactor initiatives. The meeting transcripts are attached and contain a description of each matter discussed during the meeting. The presentation slides and handouts used during the meeting are attached to these transcripts.

The following list describes significant issues discussed during the meeting with corresponding pages of the transcript referenced.

SIGNIFICANT ISSUES	
Issue	Reference Pages in Transcript
Chairman Bley started the meeting introducing the ACRS members present. He noted the members of the NRC staff, DOE and the industry were to brief the Subcommittee on the development of advanced reactor design criteria (ARDC) and related initiatives. He invited Mike Mayfield, NRO, to introduce the staff presenters and start the briefing.	4-5
Mr. Mayfield discussed the increased congressional, executive branch, and industry interest in advanced and non-light water reactor (non-LWR) technology. He noted the draft regulatory guide on design criteria specific to advanced reactor technologies is expected to be published for formal comment by early 2017. He mentioned other activities and the joint DOE and NRC workshops being held.	6-12

Mr. Russel Bell, NEI, provided a summary of industry's activities related to non-LWRs. He discussed the activities of the industry working groups, the New Plants Advisory Committee (NPAC) formed to integrate and coordinate the working group activities, strategic plans issued by the industry, and "four pillars" to a more efficient and predictable regulatory process. Member Corradini mentioned the DOE option study on advanced test and demonstration reactors that has recommendations on the licensing strategy. Member Rempe noted the industry's short term schedule for non-LWR designs to be available for commercial deployment in the 2030-2035 timeframe, and emphasized the need for a technology selection and focus. Mr. Bell discussed industry's need for options. The need for "focus" was a comment shared by other members, and rebuffed by former NRC Commissioner Jeffrey Merrifield during the public comment period at the end of the meeting.	12-31
Mr. Bell mentioned the policy issues involved. A discussion on the need for a disciplined RAI process took place.	21-24
Mr. Bell stated that the timelines in the NRC's vision and strategy document may send a wrong message as it indicated NRC won't be ready to efficiently field an application for nine years. Member Rempe wanted to know if the industry was ready to submit an application with the needed details.	24-27
Mr. Bell noted the comments made by NEI on ARDC. A discussion took place on NRC staff use of the term "important to safety," and "safety related," in risk-informed applications.	27-29
Mr. David Blee, Nuclear Infrastructure Council (NIC), made a presentation on behalf of their Advanced Reactor Task Force which is headed by former NRC Commissioner Merrifield. Mr. Blee talked about their organization and initiatives. He noted over 52 advanced reactor (non-LWR) startup companies, at least three of whom are planning to commercialize their design prior to 2030, and need for an NP2010-style program for advanced reactors. A discussion on industry readiness followed. Member Rempe emphasized fuel development. Industry wants the market forces to cull out the number of viable companies from 52 to about 3. Mr. Mayfield noted the processes (including RIS) NRC uses to keep abreast of upcoming licensing applications.	31-57
Mr. Blee noted that they had laid out some thoughts in June on how the Congressional proposal of $5 million to NRC for initiatives on advanced reactors might be spent. He mentioned three advanced reactor technical summits in association with Argonne and Oak Ridge National Labs, and the University of Massachusetts at Lowell; the takeaway being the licensing paradigm for a non-LWR Gen IV reactor is not workable. A February 2016 industry white paper on advanced reactor licensing reportedly addresses that. A question on advanced reactor economic basis was raised.	42-46

Member Brown noted the paramount focus of the US Navy that got the first nuclear submarine built in six or seven years, and if the past technical and safety experience of sodium cooled and gas reactors was being addressed. Mr. Blee stated that the industry is building on the foundation of what is there. Mr. Welling (DOE) pointed to some proven safety advantages of (non-LWR) designs.	46-50
Upon member Rempe's question a discussion on the need for a non-LWR test reactor ensued.	51-52
Mr. Blee mentioned the industry desire for a staged licensing approach, and noted the Canadian approach. Mr. Mayfield discussed NRC plans in this area.	52-56
In conclusion Mr. Blee noted that Southern Nuclear was working on a probabilistic technical basis for licensing requirements of various advanced reactors, and that it could be of interest to the Committee in future.	53
Mr. Craig Welling, DOE, presented the DOE initiatives on the vision and strategy for advanced non-LWRs. Member Ray noted advantages of siting a higher temperature reactor.	57-76
Member Powers asked for the reason behind the DOE goal to have at least two advanced reactor concepts ready to begin construction in the early 2030s. Industry desire for options was noted again. A discussion followed.	62-65
Mr. Welling discussed six objectives included in the DOE strategy document, GAIN initiatives, need for expanding testing capabilities, and DOE support to reduce the technical and economic risk in innovative technology development. DOE will explore the benefits of non-traditional uses of nuclear energy and technical approaches for integrating significant nuclear energy expansion with the evolving nature of the future U.S. grid.	65-67
Regarding fuel cycle options, member Rempe brought out the need for a technology focus to resolve issues like corrosion experienced with sodium reactor (as an example) and need for further technical insights.	68-69
Mr. Welling noted the alignment between DOE and NRC on strategies, and discussed the joint efforts (development of ARDC) undertaken. Upon member Corradini's question he explained the objective of the July workshop with the industry as an initiative undertaken through the GAIN Program.	69-71
Mr. Welling discussed DOE initiatives in developing the future nuclear workforce, industry cost-shared support, and the advance test and demonstration reactor planning study. He noted the DOE Nuclear Energy Advisory Committee (NEAC) was reviewing the planning study report.	71-73
Mr. Bell's rebuttal on members' comments on "focus" led to another discussion.	73-75

At the onset of the presentation of NRC's Vision and Strategy for non-LWRs by Mr. Mike Jones, NRO, member Skillman wanted to know if the NRC has the trained, qualified, and experienced manpower needed for the effort.	78-79
Mr. Jones discussed the two phased process. He noted the NRC goal was to be ready to effectively and efficiently review and support the rollout of two technologies by early 2030s. However, the industry maturity (when designs might be ready for reviews) would dictate staging of qualified personnel and processes [re: Slide "Near-Term Strategies (0-5 years)"]. Upon member Sunseri's question on defining the NRC review starting points to meet a target end point, Mr. Jones mentioned an NRC case study regarding the opportunity for efficiencies in the Part 52 process.	79-85
Regarding Chairman Bley's question on a past revision to (SRP) Chapter 19 for the DSRS, Ms. Anna Bradford, NRO, noted that the DSRS was still applicable. His question on how NRC staff envisions staged licensing initiated a discussion to be followed in the presentation by Ms. Bradford.	85-87
When does the staff reviewer ask for experimental data to verify applicant's calculations, member Powers asked. Mr. Jones noted that staff's near-term implementation action plans would look at specific needs and availabilities of different tools to meet the decision criteria. Needed emphasis on developing the methods and codes (for advanced reactors) was noted as a missing point by member March-Leuba. Mr. Mayfield mentioned the legislation put forward in the Congress for DOE to create a test bed, likely at Idaho; the issues of time and level of rigor warranted, and the industry notion that the bar for "adequate protection" needed to be better defined. A long discussion came to an end with Member Bley stating that computer codes and experimental data would be items members would follow, and Mr. Mayfield noting that implementation action plans (in very initial developmental stage) would indicate areas where staff would be requesting ACRS review.	87-97
Member Ray pointed out the enormous difficulty inherent in Part 52 review process in making the needed safety finding with so much unknown, even with ITAACs and stages of review that have their own difficulties.	97-98
Member Corradini asked if staff had looked at the DOE option study (noted in a paragraph before) regarding the timeline, cost number, and licensing approach, specifically the DOE analysis on demonstration reactor. The staff had attended the DOE meeting on the subject but did not do a formal review.	99-101
Chairman Bley noted a conflict with another meeting that he and member Corradini needed to attend requiring them to leave at around 11:45 a.m.	101
Mr. Jones discussed their mid-term strategies (technology-specific) and long-term strategies (whole new framework if needed), and implementation action plans.	102-104

Presentation on NRC regulatory readiness and options for regulatory review processes – Ms. Bradford mentioned processes under Parts 50 and 52 currently being used and new processes NRC staff is considering, for example, the conceptual design assessment approach and the staged design review using standard design approval under Part 52. A need for rulemaking was not envisioned. NRO has done case studies and lessons learned of previous reviews. Members explored use of Part 52 vs. 50 and member Corradini encouraged the staff again to review the DOE option study and report to ACRS.	105-116
Chairman Bley asked if there were any feedback from the industry regarding NRC idea that the first advanced reactor plant could be licensed as a prototype (re: Slides #6 and 7). A discussion followed.	116-117
Ms. Bradford presented advanced reactor policy issues (Slides# 10, 11). Slides show only three issues are open: Mechanistic Source Term, Emergency Preparedness, and Insurance and Liability. Upon member Rempe's question a discussion on mechanistic source term followed. Member Skillman asked for references for staff resolution of issues, particularly multi-modular risk. Ms. Bradford mentioned an attachment to Commission paper SECY-14-0095 on staff readiness to review SMRs.	117-122
Ms. Jan Mazza presented the joint NRC and DOE effort on the advanced non-LWR design criteria. She presented the background, current status of criteria development including public interactions, security design considerations, further engagement needed on key issues, future activities and a summary. Member Corradini wanted to know if there were areas where NRC staff took a different approach from what the DOE recommended.	123-148
A discussion on expectations for enhanced safety for advanced reactors was initiated by member Rempe. Staff will follow the advanced reactor policy statement.	130-132
Staff identified several areas for further engagement with stakeholders (Slide #12). A discussion on functional containment ensued, followed by a discussion on specified acceptable core radionuclide release design limits (SACRRDL) versus specified acceptable fuel design limits (SAFDL). Member Skillman noted the need to identify the AOOs (anticipated operational occurances) for the type of reactor before these limits could be defined. Ms. Mazza noted several public comments regarding removing single failure criterion that staff is considering, which could be discussed in the future.	132-139
Member Skillman asked about the staff proposal to promulgate advanced reactor design criteria through a regulatory guide. A discussion followed.	143-147
Mr. Mayfield noted that the staff was not looking for a letter from the ACRS at the time. Chairman Bley noted that the Committee would want an opportunity to comment on non-LWR design criteria when further developed.	148-149

Chairman Bley followed up on member Corradini's comment on the implementation action plans. Mr. Mayfield noted that the staff would bring the action plans package to the Committee before submitting the complete set to the EDO (date to the EDO: near term action plans by September 30, and action plans on all strategies by February 15, 2017). NRO staff will support ACRS review of the complete action plan before February 15, 2017.	149-150
Member Corradini thanked the staff and asked that the industry and the NRC staff review the DOE option study. He noted that the staff would use the lessons learned from NuScale as they pertain to the technology-neutral aspects in going forward.	151-152
Chairman Bley asked for public comments. Mr. Jeff Merrifield, former NRC Commissioner, chair of the NIC Advanced Reactor Task Force, and of Pillsbury Law Firm that represents several advanced reactor companies, indicated he would welcome the opportunity in future to meet with the ACRS on issues discussed. He indicated market forces should narrow down the choices in the many current advanced reactor companies, and reminded that down selection of designs by the DOE or the NRC was not supported by the US legal framework. He noted the role of ACRS should help define the appropriate and important NRC standards, and licensing requirements. He pointed out the NIC comment that additional ARDC, such as for molten salt or bismuth, could be useful. Additional focus should be provided on implications of reduced source terms, on a group of generic design issues like that for the high-temperature reactor, pebble-bed reactor, molten salt reactor, and others. He noted that understanding the streamlined (licensing) process (when proposed) would be very helpful for the developers of advanced reactor designs in preparing their applications and avoid unnecessary work.	153-156
Chairman Bley turned over the chairmanship of the meeting to Dr. Rempe.	156
Mr. Marvin Lewis, public, reminded the NRC and DOE about historic releases from facilities like Santa Susana at Simi Valley, Clinch River and Fukushima.	157
Acting Chairman Rempe asked for comments from members. Member Powers noted the extensive nature of the upcoming task and asked the NRC staff to involve the members at the onset, noting areas like adequate protection and defense-in-depth, and need for experimental data vs. computer codes. Member Stetkar asked the NRC staff not to wait until concepts are finalized before coming to ACRS. Member March-Leuba noted the large amount of time it takes to develop evolutionary fuel designs that do not even look much different from present designs, and indicated skepticism that a brand-new reactor of completely different technology, without experimental data, could be developed in the advocated timeframe (of about 13 years to 2030). He indicated concern that there was no emphasis on developing methods and codes, including the need for benchmark data and validation to determine the	158-164

operating limits. He indicated an additional caution for NRC staff that they would need to emphasize streamlining the review process and keep an eye on the desired end point.	
In her comments, Acting Chairman Rempe noted the need for the staff to prioritize so that most emphasis can be applied to the near-term issues.	164-165
Acting Chairman Rempe adjourned the meeting at 12:05 p.m.	165

KEY FOLLOW-UP ISSUES	
Key Issues	Reference Pages in Transcript
Key Issue 1: NRC staff was requested to review the DOE option study and report to ACRS their opinion.	113
Key Issue 2: Committee would want an opportunity to comment on the non-LWR design criteria when further developed.	148-149
Key Issue 3: NRO staff stated that it will support ACRS review of the implementation action plan by February 15, 2017 in advance of submitting the complete set to the EDO.	149-150

Documents provided to the Subcommittee

1. INL/EXT-14-31179, Revision 1, Guidance for Developing Principal Design Criteria for Advanced (Non-Light Water) Reactors, December 2014 (ML14353A246 and ML14353A248)
2. Responses to NRC Staff questions on DOE Report (INL/EXT-14-31179), September 15, 2015 (ML15272A096)
3. Responses to NRC Staff questions on DOE Report (INL/EXT-14-31179), July 15, 2015 (ML15204A579)
4. DOE Document: Vision and Strategy for the Development and Deployment of Advanced Reactors, 2016 Version 21, 27 May 2016, Unpublished Draft
5. DOE Report: Advanced Reactor Concepts Technical Review Panel Report, Evaluation and Identification of future R&D on eight Advanced Reactor Concepts, conducted April – September 2012, December 2012
6. NRC Vision and Strategy: Safely Achieving Effective and Efficient Non-Light Water Reactor Mission Readiness, Draft Version 7, May 18, 2016 (ML16139A812)
7. "Report to Congress, Advanced Reactor Licensing," August 2012 (ML12153A014)
8. ACRS letter "Next Generation Nuclear Plant (NGNP) Key Licensing Issues," May 15, 2013 (ML13135A290)
9. NRC letter to John Kelly, "Next Generation Nuclear Plant Assessment of Key Licensing Issues," 7/17/2014 (ML14174A734),

1. Enclosure 1, Summary Feedback on Four Key Licensing Issues - Next Generation Nuclear Plant, 7/17/2014 (ML14174A774)
2. Enclosure 2, Assessment of White Paper Submittal on Fuel Qualification And Mechanistic Source Terms (Revision 1) - Next Generation Nuclear Plant, 7/17/2014 (ML14174A845)

10. NCP-2013-015 NGNP Non-Concurrence in favor of adding clarifying statements, NRC Form 757, 5/2/2014 (ML14126A242)
11. NCP-2014-007 NGNP Non-Concurrence in opposition to major assessment revisions, NRC Form 757, 5/29/2014 (ML14154A080)
12. DOE/INL Report INL/EXT-1 1-22708, "Modular HTGR Safety Basis and Approach," August 2011.

Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
Future Plant Designs Subcommittee

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Wednesday, July 6, 2016

Work Order No.: NRC-2481 Pages 1-158

NEAL R. GROSS AND CO., INC.
Court Reporters and Transcribers
1323 Rhode Island Avenue, N.W.
Washington, D.C. 20005
(202) 234-4433

DISCLAIMER

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

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, as reported herein, is a record of the discussions recorded at the meeting.

This transcript has not been reviewed, corrected, and edited, and it may contain inaccuracies.

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

FUTURE PLANT DESIGNS SUBCOMMITTEE

+ + + + +

OPEN SESSION

+ + + + +

WEDNESDAY

JULY 6, 2016

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:38 a.m., Dennis C. Bley, Chairman, presiding.

COMMITTEE MEMBERS:

DENNIS C. BLEY, Chairman

CHARLES H. BROWN, JR. Member

MICHAEL L. CORRADINI, Member

WALTER L. KIRCHNER, Member

JOSE A. MARCH-LEUBA, Member

DANA A. POWERS, Member

HAROLD B. RAY, Member

JOY REMPE, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

MATTHEW W. SUNSERI, Member

DESIGNATED FEDERAL OFFICIAL:

MICHAEL SNODDERLY

ALSO PRESENT:

RUSSELL BELL, NEI

DAVID BLEE, NRO

ANNA BRADFORD, NRO

MICHAEL JONES, NRO

MARVIN LEWIS, Public Participant*

MICHAEL MAYFIELD, NRO

JAN MAZZA, NRO

JEFFREY MERRIFIELD, Public Participant*

ANDREA D. VALENTIN, Executive Director, ACRS

CRAIG WELLING, DOE

MAITRI BANERJEE, ACRS Staff*

*Present via telephone

T-A-B-L-E O-F C-O-N-T-E-N-T-S

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

8:38 a.m.

CHAIRMAN BLEY: The meeting will now come to order, please.

This is a meeting of the Future Plant Design Subcommittee of the Advisory Committee on Reactor Safeguards. I'm Dennis Bley, Chairman of the Future Plant Design Subcommittee. ACRS members in attendance today are Dana Powers, Mike Corradini, Joy Rempe, John Stetkar, Charlie Brown, Dick Skillman, and our new members Matt Sunseri, Walt Kirchner and José March-Leuba. We are expecting Margaret Chu and Pete Riccardella to join us a little bit later.

Mr. Mike Snodderly is the designated federal official for this meeting.

Today we have members of the NRC staff, DOE and the industry to brief the Subcommittee on the development of the design criteria for advanced reactors and other developments in the areas of advanced reactors.

The design criteria developed through a joint venture of DOE and NRC was noticed in the *Federal Register* for public comments.

The staff has incorporated comments from

the public, including the nuclear industry, and is getting ready to finalize the criteria. Also, we expect to hear about additional activities in the area of development and licensing of advanced reactors in the United States.

The rules for participation in today's meeting were announced in the *Federal Register* on June 22nd, 2016. The meeting was announced as open/closed to public meeting, which means that we can close the meeting to discuss any sensitive issues if they come and presenters can defer questions that should not be answered in the public session. And I guess I'd ask the presenters from staff and DOE if we start to go into those areas to warn us and we'll save that discussion for the end of the meeting.

No request for making a statement to the Subcommittee has been received from the public.

We have a bridge line established for the public to attend the meeting. The bridge number and password were published in the agenda, posted on the NRC public web site. To minimize disturbance the public line will be kept in a listen-in-only mode. The public will have the opportunity to make a statement or provide comments at designated times

towards the end of the meeting.

Also, to avoid disturbance I request that attendees put their listening devices and cell phones, other devices in a noise-free mode.

Also, for people who haven't been here in awhile or --

MEMBER POWERS: That includes me.

CHAIRMAN BLEY: -- ever, remember to use the little push button at the front of your microphone at the table to turn on your mic and turn it off when you're finished to avoid noise on the phone line.

At this time I'd like to invite Mike Mayfield, Director of NRO, Division of Engineering, Infrastructure and Advanced Reactors, to introduce the presenters and start the briefing.

Mike?

MR. MAYFIELD: Thank you, sir. Good morning.

We wanted to start off just giving a little bit of background on why we had suggested this meeting. Going back to 2012 NRC got a request from Congress to provide a report on how we would go about licensing advanced reactors. Really what they were talking about in the congressional request was

for the small modular reactors, the NuScales, the mPowers, but we included in that how we would go about dealing with things other than light water technology.

Since 2012 the level of interest in non-light water technology has skyrocketed. We have just -- you can see from the representation this morning colleagues came in from NEI, NIC and DOE to share with you their programs, what they're doing. We see huge interest from the vendor community. We see huge interest from the industrial organizations supporting the vendor community. We're seeing interest from utilities, which is a new piece to this, at least the level of interest we're seeing. We're seeing very, very large interest from the financial community in supporting the vendors moving some of these projects forward.

Historically the non-light water technology projects have tended to be supported by the U.S. Government, mostly through the Department of Energy. As funding priorities changed, as industry interests changed, those projects tended to fade into the background. This time with the private funding we're seeing what we think to be a more stable environment for developing these

technologies.

The other things that's a bit different this time is the level of interest from the Administration and from the Congress. The Administration has hosted two -- I guess they call them summits, one just about a year ago and then a second one, a much larger activity last November 6th. Those activities suggest a level of interest from the Administration that we just haven't seen before.

The other thing, the interest from Congress, there are something like five separate bits of legislation between the House and the Senate that have been floated, varying states as they're getting

-- working their way through the process. Some of the legislation points more directly to DOE than it does to NRC.

Other pieces point very directly to NRC and what we need to be doing and on what time frame. We're waiting to see what Congress does with those bits of legislation and we will react accordingly once they do or don't pass. So we are seeing a lot of interest that suggests we really need to be pushing forward and expanding the 2012 plan that we

sent to Congress.

As Dr. Bley noted, we started working with DOE 2013 or so on this activity, joint activity to develop advanced reactor design criteria, basically GDC-specific to advanced reactor technologies. So that is moving forward. We expect to, hope to have the draft guidance published for formal comment by the end of -- or I guess it's early 2017.

So that project is moving. We think it's moving along well. We got good informal comment back, useful input as opposed to what's the matter with you guys? So that was good. So we're making progress and you'll hear some more about that this morning.

The other things we have going: NRC and DOE have co-hosted two workshops now, each attended by over 300 people looking at what needs to be done to support the non-light water community, try to clarify some misunderstandings from that community about what NRC's role is, what DOE's role is. The number of times we've been criticized for not funding the development of new technologies is kind of interesting. So we have Craig's number on speed dial just to kind of send them in the right

direction.

So part of the workshop -- what got the workshop started was really to try and clarify for the industry, for these start-up companies what the roles and responsibilities are for the two organizations and then to start hearing from them about their needs and interests.

So we're looking at having a third workshop. We're still trying to pin down the date, but I hope this isn't all news for Craig, but we're -- just because of venue challenges, we're probably going to push out past October into early 2017 for this third workshop. So we're making progress on that.

And there is still strong interest from the community in having those workshops and being able to participate and hear from both the NRC and DOE about what the programs are and what's happening. So the level of interest has been remarkable.

We get criticized, we the NRC get criticized fairly regularly as being an obstacle to moving forward these new technologies. Interesting criticism. But what we have been doing is looking more closely at what would be involved in in

licensing non-light water technologies in an efficient manner, a predictable manner.

So we are going to have put together a vision and strategy document laying out how we think the regulatory side of things should move forward. DOE similarly has a vision and strategy document looking at where they think the community is going to go. And those two documents actually align fairly well. There has been a document prepared by the Nuclear Infrastructure Council Innovation Alliance, one of those things; it's not David, where they laid out the industry's vision on how these things should move forward.

And again, there is pretty good agreement among the three documents, so we think that we by and large are on a success path. It's just a question of the timing and can we really make the changes that are being requested and that we can support in a time frame that will be supportive of these vendors and what they actually can and can't do? We think we're on a pretty good timeline to be supportive of their desires. We'll see. You're going to hear more about that this morning. And overall you're going to hear more about what we're doing, what the industry is doing, what the

Department of Energy is doing.

So with that, I think I would like to turn first to the three speakers we have this morning: Russell Bell from the Nuclear Energy Institute, Craig Welling from the Department of Energy, and David Blee from the nuclear infrastructure.

So with that, Russ, could I ask you to open up?

MR. BELL: All right. Thank you, Mike, and thank you to the Committee for inviting me to brief you on the industry's activities related to the non-light water reactors. Certainly a growth area for the industry, as Mike mentioned. I suspect it's going to be a growth area for the Committee as well.

Just as Mike said, like NRC industry has gotten very busy in this area of non-light water advanced reactors. Last year we formed a working group which is our principal mechanism for dealing with generic issues. The Advanced Reactor Working Group formed last year. But the real surge in activity came this year with a flurry of congressional interest, as Mike said, and significant utility interest comes to bear as well.

We formed three task forces, one in the legislative area to kind of respond to the congressional interest and provide input there, one in the regulatory area; I'll show you some more about those activities in a minute, and then one we just called a technical task force kind of facilitating coordination among the vendors, among EPRI and among DOE. A lot of players, a lot of cooks in the kitchen, as you might expect.

We have issued this year strategic plans. DOE has done one. The NRC has done one. So the industry, obviously we had to do one ourselves. In fact, we did two. So we have one on the advanced non-light water reactor area and a separate one on small modular reactors.

Now, these are props. I can make these available, Mike, for you to share with the Committee. No problem.

They're modeled after the ALWR Strategic Plan from way back in the 1990s that we still consider a success. It led to the eventual design certification, licensing and now construction of the four AP1000 units, as well as other design certifications. So you'll see building blocks in there. That's kind of the familiar format. But

we're working those strategic plans.

In the advanced reactor area we've defined some strategic goals that two or more advanced non-light water reactor designs ought to be available for commercial deployment in the 2030-2035 time frame. By 2025 one or more demonstration-type scale reactor demonstrations be out there and up and running. And thirdly, that an efficient and predictable licensing process for advanced non-light water reactors is in place. Three strategic goals.

We keep circling back on what we've started calling four pillars to get to that more efficient predictable regulatory process. And I'll say a few more words about each of these: a staged application review, a more risk-informed approach, a performance-based approach and something that's technology-inclusive that can serve a wide variety of designs and vendors.

The surge in advanced reactor activity prompted NEI to revamp our committee's structure. So we have three working groups: the venerable New Plant Work Group in place since I'd say 2001 focused on the Part 52 process, focused on supporting Southern and SCANA all the way through to the very end, including the ITAAC process. So that groups

still very much in place. The Small Reactor Working Group formed in like 2010, I want to say, to support the interests in there and especially the NuScale application and the TVA ESP application that's going forward.

And thirdly, most recently we formed the Advanced Reactor Working Group. So three working groups in three separable but related areas. So we recognize the need to integrate and make sure we're coordinated. And so, overall we also formed a new New Plants Advisory Committee, NPAC. Each of the working groups nominally kind of reports to that group, and not that we expect it, but if there are ever any conflicts or crossroads, we would go to that group to resolve those issues. Also there are very high level groups that will rely on them for carrying messages to the Hill and to Congress and so forth.

MEMBER CORRADINI: So is the NPAC members of the three others, or are C&Os, or who is NPAC?

MR. BELL: Typically no. The NPAC is CEO C&O type of individuals. It is chaired by Steve Kuczynski --

MEMBER CORRADINI: Okay.

MR. BELL: -- of Southern. And Steve has also chaired, to answer your question, the Advanced Reactor Working Group, which is -- I should have --

(Simultaneous speaking.)

MEMBER CORRADINI: Those are the three?

MR. BELL: That's right. That's right.

MEMBER CORRADINI: Another question: Maybe at this point or maybe later, have the three working groups had enough progress that they would see the same path forward as Light Water Reactors, or a different path forward to actually engage the regulatory? In other words, is Part 52 the logical way to do this?

MR. BELL: That's a raging debate, and there are schools of thought.

MEMBER CORRADINI: So there's no conclusion as of yet? There's just raging debate?

MR. BELL: I think that's fair. I think we can help the members, the vendors, the customers come to a common level of understanding about that decision, the pros and cons. And we intend to do that, but I would say that we have not done that yet and there are absolutely two schools of thought there.

MEMBER CORRADINI: Have the three groups or one of the three groups seen the option study result from the DOE? There was a required -- one of the slides in one of these presentations is going to mention that Congress forced the DOE to do an option study on advanced test and demo reactors. And they had some language in there of what they thought was an appropriate licensing strategy going forward. Have you seen that?

MR. BELL: Perhaps not. You mentioned test and demo, and that's going to be kind of a separate process.

MEMBER CORRADINI: Well, Craig's got it in his slide deck somewhere, because I saw it.

MR. BELL: Let me listen with interest when we get there.

MEMBER CORRADINI: Okay. All right. Because that concluded with a very specific recommendation on how to engage the regulator for anything that's a non-light water reactor.

MR. BELL: For the moment NEI's agnostic, however, we think that both processes ought to be viable. So we need to make sure that that is so, applying the lessons learned and making corrections or adjustments as needed while we have

this opportunity.

MEMBER REMPE: So you mentioned this goal, which you see with DOE and other places about having at least two --

MR. BELL: Yes.

MEMBER REMPE: -- technologies ready to roll out and build by 2030. And we need to have fuel that you can characterize as performance for a non-LWR by 2030, which is what, at least a decade? And so in all these advisory groups and meetings and things that you have has anyone started to think about we need to focus here if we want to have two? Because I always see a lot of, oh, we-got-to-have-the-regulator on-board stuff, but the regulator can't totally answer the questions of if the technology is ready to go by 2030. They can say it's safe, but they really don't care whether it stays critical or not, for example. And so, has anyone in your group or NEI taken a lead about, jeepers, we need to start focusing if we really want to do something with all this money. Because it's always nice to say you've got the financial group involved, but if you're asking for taxpayer money to help subsidize the venture capitalists, is anybody starting to think about how are we going to start

focusing this and do something reasonable with the taxpayers' --

(Simultaneous speaking.)

MR. BELL: I don't know if we're going to talk more about the fuel side of it, but I will certainly say that's been recognized as a long pole in the tent. In fact, it was a substantial focus of the recent workshop that Mike referred to back --

MEMBER REMPE: I went to that workshop and I sure didn't see it with a lot of the technologies that were presented, and I'd really like to see that because I think it's an important --

MR. BELL: Well, I think it's a fair comment.

MEMBER REMPE: Yes, because when you get folks on the Hill involved, somebody needs to start in the industry focusing what's going on.

MR. BELL: Our newly integrated committee structure and our approach to all this at NEI reflects what we refer to as all-of-the-above nuclear strategy. So that includes large lights and the importance of success of Southern and SCANA on those first AP1000 units that are demonstrating the Part 52 process for the first time and a number of

other processes that will be common to any new project.

MEMBER CORRADINI: So this is not fair, but that strategy doesn't seem to be working very well with Energy, so how's it going to work here?

MR. BELL: With --

MEMBER CORRADINI: All of the above. In other words, I'm kind of with Joy. I'm worried about lack of focus because it would drive -- if I was a regulator, it would drive me crazy.

MR. BELL: Well, I'll explain what I mean by that. What our members tell us is they want optionality.

MEMBER CORRADINI: Okay.

MR. BELL: They may need a large base load plant like an AP1000 and they want that in the tool kit. They may want a small modular reactor that is more easily financed, more adaptable to some smaller markets. And they want some advanced designs that have features like high temperature that can be used in other non-electrical applications. So they want optionality. And that's what we mean by all of the above. So that's why we have the three working groups and we consider all of these a priority.

MEMBER RAY: Russ, let me make one correction. AP1000 is fully dispatch-able, so referring to it as base load doesn't square with that in my mind. You ought to have a base load of course, but it is capable of dispatching against load.

MR. BELL: Okay. Thank you. So very important for those first four units to finish successfully. Very important for the NuScale application to be successful. I think we're going to learn a lot from that. It's an advanced design, although light water. It employs an innovative safety strategy that would be challenging for both the vendor and the NRC, but they're working through those issues. There are policy issues that are associated with the small modular design like a *90058 fee, an NRC annual fee. NRC just passed a rule that accomplishes that based on thermal output.

Both the NuScale and TVA applications reflect the desire to have an alternative emergency planning approach, a consequence-based emergency planning approach. So that's a significant policy issue that is important to the SMRs, but would be also applicable and important to future reactors.

Off-site power connections. GDC-17

requires two. AP1000 got an exemption. They're required to have one. The NuScale design, their safety case does not rely on electrical power and they're arguing and they have just a basis for seeking exemption from GDC-17 zero off-site power connections. This is a policy issue. We're not there yet. That will be common I think to some of the other designs.

So I think we're going to be watching that very closely for those reasons, but also more mundane reasons like accountability to schedule and timelines, a disciplined RAI process, and a risk-informed design review. NRC has already said they plan to use the NuScale as a model for a risk-informed review. Obviously we're going to need more of that as you get into non-LWR space.

So all of the above also obviously includes advanced non-light water reactors, and that's what we're here to talk about. There's a consensus that an efficient and a corrective review of advanced reactors requires new thinking and new tools, not necessarily new regulations, at least not right away. We found the NRC's vision and strategy document to be a commendable effort. It includes near-term, mid-term, long-term actions.

It includes concepts that have also been identified by the industry such as conceptual design approval and standard design approval, and it certainly emphasizes a more risk-informed performance-based approach. And you'll be hearing more about that. And we certainly appreciate the opportunity for stakeholder input.

CHAIRMAN BLEY: Russ? Excuse me.

MR. BELL: Yes.

CHAIRMAN BLEY: I've heard this disciplined RAI process come up at the workshop a few weeks ago and other places. The other side of that is you might call it disciplined application process, because an awful lot of the RAIs I see exist because people didn't justify the assumptions they've made or defend their analyses. So there's two sides to that. Have you guys worked on that very much?

MR. BELL: There is, and if it can have three sides, you would need to start with very clear guidance, very clear expectations on what belongs in an application. So I think there's a virtuous circle here to get the guidance and expectations right. The applicant needs to do their job and provide a fulsome and complete application, quality

application, so called, and then the disciplined review and RAI process. So absolutely that's on everybody. But we certainly want to see more -- the RAI process to be more disciplined than perhaps it has been in the past.

So timeline is a question that always gets a lot of attention. Are there timelines in the NRC's vision and strategy document? They're useful but may send some wrong messages. We've provided this input informally back to the staff already. The readiness activities labeled there suggest that NRC won't be ready to efficiently field an application for nine years. I don't think that was the intent. We certainly don't think that's the case, but it's certainly a message that you could glean from a glance at that timeline.

In addition, the time frame for design and licensing reviews is like five years, or something. I forget exactly. But it doesn't really reflect the presumed benefit of the effort put into make that review more efficient and timely. So we think the timelines are very, very helpful. They foment the discussion. We think they may send some mixed messages. We'll keep providing that input to the NRC.

As Mike said, the NRC is already moving on some items we look forward to engaging with the staff. He mentioned the advanced reactor design criteria, which the Committee will hear more about later.

MEMBER REMPE: I want to go back to the comment about the timeline.

MR. BELL: Yes.

MEMBER REMPE: Again, you're talking about the non-LWRs, because the staff is involved right now with the NuScale review.

MR. BELL: Yes.

MEMBER REMPE: And again, with the non-LWRs, my understanding only the gas reactor has done much with respect to having a vendor with the fuel and some sort of irradiation in recent years. You might have a little bit with the TerraPower one, but perhaps it's not even going to come to the NRC. So is there a rush to do something with the staff? I mean, what would you do if you were told staff was ready to go with a molten salt reactor today? Are you guys ready to submit? I mean is it a problem the staff is saying 5 to 10 years to get ready?

MR. BELL: I don't know if it's quite a chicken and egg, but to mount and launch an

application takes a significant effort and the ground rules for that and a soft understanding of what the ground rules of the application expectations are is needed way in advance of that. And so, the kinds of issues we're talking about: how to risk-inform, how to performance-base, what are the design criteria going to be, these are the things that NRC has rooted out on now. We need to clarify that for vendors who need to make business decisions, need to attract investment. And those investors need to see the clear path through it. So we're trying to make sure that those guideposts and processes are in place.

MEMBER REMPE: But again, if you look at that advanced design criteria document for the PRISM and the Modular HTGR, they had enough details they could do quite a bit, but in some cases they said you don't have enough details yet for these two concepts. And those concepts are fairly well defined. I'm thinking the devil's really going to be in the details on when we have a molten fluoride and a molten chloride advanced reactor being talked about. Jeepers, I think there's a fusion on a battery one. I mean, this is really hard unless industry will focus for the regulator to try and do

much. And then how much should they even be required to --

(Simultaneous speaking.)

MR. BELL: I think a lot of work is needed on all sides. There's no question.

MEMBER REMPE: I think so, too.

MR. BELL: The ARDC. We provided some comments to make sure they're consistently performance based, particularly in the area of containment function versus traditional containment. And I already mentioned the off-site power design criteria

-- make that performance-based by -- if you don't rely on electrical power, then your GDC should allow for that.

We also made a comment that the General Design Criteria that exists today uses the term "important to safety." It's a term that has been interpreted and misinterpreted over the years many times. Our suggestion is we shouldn't perpetuate that going forward and that we say what we mean. And typically the interpretation of that in this context has been safety-related, and so our suggestion was just to simply say safety-related. I think there's a conversation that needs to be had in

that area. We hope that our comment again foments that conversation.

MEMBER STETKAR: Russ, how do you resolve that clear statement with the fact that risk assessments often show that non-safety-related stuff is more important to risk than the thing you hang the safety-related tag on?

MR. BELL: And of course any risk-informed approach is going to reflect that reality, but --

MEMBER STETKAR: Okay. So then why get tied up with the semantics of if I hang a tag on something and call it safety-related, it is therefore different than something that's more important to risk that I don't call safety-related? Why do you guys need to hang that semantics on something if you're promoting risk-informed --

(Simultaneous speaking.)

MR. BELL: Well, we're promoting clarity and in the context of the design criteria we think it's going to be clearer to use the more well-understood and defined term and allow the risk-informed -- the balance of the risk-informed regulatory process to account for the very thing you're talking about, the --

(Simultaneous speaking.)

MEMBER STETKAR: Well, but I hear you promoting the notion of risk-informed, but falling back onto the fact that I need to hang a specific tag. Something must be black. And if it's black, I need to apply these specific requirements to it. And if it's not black, it's a free-for-all. That's not the sense of a risk-informed approach.

MR. BELL: I agree.

MEMBER STETKAR: So you can't have it both ways.

MR. BELL: I agree. Well, I mentioned that we hoped that this would start a conversation. I think we just did that. But we think there's some enhancement that should be made there for clarity's sake. And we look forward to that conversation with the staff and the Committee.

Well, and the staff -- for instance on the staged application review process, I think you'll hear more about it. A public meeting has already been set for later this month, I think, and maybe the NRC will confirm that. We're looking forward to that.

The NuScale application of course coming through. And as I mentioned, we and the staff hope

to learn a lot from that particularly with respect to risk-informing.

And then in addition to the policies issues I mentioned earlier that are being -- that have risen in the context of the small modular, you run into a other suite of policy issues when you talk about non-lights.

CHAIRMAN BLEY: Russ?

MR. BELL: The two best examples are --

CHAIRMAN BLEY: Let me interrupt up. We're on a really tight schedule today and we have to finish right at noon because we have another meeting following that, so I'm going to try to hold everybody to the schedule. So you got a couple minutes left.

MR. BELL: Okay. I'm right at the end of my page, so I apologize for taking too long.

I just wanted to say a couple examples of the policy issues that come to the fore for non-lights or licensing basis event selection. You may not have a large break LOCA as your limiting event. You will not have that. So, but what is it? Okay.

And I mentioned functional containment versus traditional containment. Fortunately we have a lot of NGNP work to draw upon, so we're not

starting from whole cloth on these types of areas. And I think that it's these types of things that I suspect will be of a strong committee interest in the months and years ahead.

And, Chairman, that's where I was going to stop.

CHAIRMAN BLEY: Right on time. Thank you, Russ.

MR. BLEE: Okay. Thank you for the opportunity to be here today, and, Mike, thank you for that welcome and a very eloquent overview of where we are in terms of things that have gone in in the last couple of years. It's a multi-stage arena and a lot of things have happened even in the last six months.

We talked a little bit about organization and I am here today on behalf of our Advanced Reactor Task Force which is headed by Former Commissioner Jeff Merrifield, who couldn't be here today. We also have under that a Technology Owners Group headed by Robert Prince, who is the former CEO of Duratek, but also is currently president of Gen4 Energy.

And what I'm going to cover today is a little bit of background on the council. Since this

is our first meeting, we welcome this conversation. And then I'll talk a little bit about some of our initiatives and then talk a little bit about some things that are on your docket here today.

This is entitled, "Commercialization Advanced Nuclear Reactor Technology." And that's initially applicable to what you're doing today. This is sort of in the long range. But that is really our focus is commercialization advanced reactor technology. We represent a business consortium of *91436 companies, and so our focus is on moving the ball forward on that front; and actually on multiple fronts, as I'll talk about later.

With respect to -- and I was a little troubled by what I heard here earlier today in the sense of we are moving too fast. Isn't the Government sort of going to be -- it's sort of going to sound like a command and control approach to things. This is really a market up. There are over 52 advanced reactor design companies currently in existence. Certainly that will narrow down. But we have at least three members right now who are planning to commercialize their design, or hoping to commercialize it prior to 2030. So if you mention

the word "2035" to them, that's not where they're headed.

Now, they have a lot of hurdles to overcome, but we look upon the time right now as a window of opportunity to set the stage and make improvements and refinements. And I think the NRC has been very responsive to that and the DOE has been responsive as well in the form of Craig Welling today and his boss Tom O'Connor.

MEMBER BROWN: Can I --

MR. BLEE: Yes.

MEMBER BROWN: -- interrupt for a second? When you say "advanced," are you talking non-light water or are you talking --

MR. BLEE: Non-light water.

MEMBER BROWN: Non-light water?

MR. BLEE: Yes.

MEMBER BROWN: Okay. I just want to make sure --

(Simultaneous speaking.)

MR. BLEE: Our friends at NuScale Power who are a member company would certainly consider themselves an advanced reactor as well. And they've been actually very, very helpful appearing at a number of our meetings to talk about the work that's

being done on generic issues, which are very applicable to this as well in terms of policy issues. And certainly when this clock starts ticking at the end of this year this will be a harbinger really of how effective the light water reactor technology is working and how that could work for non-light water reactors.

But in terms of a little -- I mentioned we are over 80 companies now, the who's who of the industry, going from really the designers: GE, Westinghouse, NuScale, AREVA, General Atomics, to manufacturer, supply chain members across the board.

Again, in terms of all of the above, we strongly support these technologies moving forward in parallel. So we don't think it's an either/or situation and we're delighted I think that the Department is moving forward to really -- to put together a funding opportunity announcement for the SMRs. They've done one now for Gen IV. We think it's about $900 million short --

(Laughter.)

MR. BLEE: -- of where it should be, but we think there should be an NP2010-style program for the advanced reactors.

CHAIRMAN BLEY: Can you explain what

that is to those of us who aren't fully familiar with it?

MR. BLEE: Well, probably Craig can just tell better than I can, but --

(Simultaneous speaking.)

MR. BLEE: -- commercialize the Gen III+ designs.

MR. WELLING: Yes, the NP2010 Program was a program whereby we supported the development of the AP1000 and ESBWR as reactor types to be pursued for licensing.

Another example of a successful effort is the NuScale Program right now. It's the SMR Licensing Technical Support Program. And we see that as a very good example of how Government efforts to coordinate with the NRC for the licensing aspects can support a possible advanced design deployment.

CHAIRMAN BLEY: Okay. Thanks. And I wanted to say I really liked some of your opening remarks, David. I was at that meeting a couple -- few weeks ago, the joint meeting on non-LWRs, and I saw flow charts of how organizations are going to -- and unless somebody actually bites the bullet and starts building, nothing's going to happen. NuScale

is another good example. If you've got three groups that are ready to go, that's really exciting.

MR. BLEE: Well, I would agree with you that -- and there is a lot of focus right now on getting one into the queue as soon as possible. One word on the --

MEMBER REMPE: You're saying they're ready to go. Do they have fuel to performance as ready to go?

MR. BLEE: Well, not ready to go immediately, but their goal is to have a license by 2030. In fact, your goal I think is 2030-'35, right? Yes.

MEMBER REMPE: I understand that, but again DOE's spending opportunity went to a molten -- I always get the fluoride and chloride mixed up, but the --

PARTICIPANT: Molten salt.

MEMBER REMPE: Yes, one of those molten salt ones and the pebble bed reactor. And I'm guess those two to three that are ready to go are not the two to three that DOE just funded. Right? Which two or three are they?

MR. BLEE: That's inclusive of at least, yes, one of those.

MEMBER REMPE: One of those?

MR. BLEE: Yes.

MEMBER REMPE: And then the other two are something else, lead bismuth, or what is it, what are the other two --

(Simultaneous speaking.)

MR. BLEE: Well, it's an interesting point on that. And the other two actually are headed to Canada for the moment to go through a preliminary review which the Canadians have, which is a two-year process with a fixed cost.

MEMBER REMPE: But do they have fuel that's been manufactured and irradiated?

MR. BLEE: They're working in parallel. I mean, again ready to go. Maybe that's an overstatement, clearly.

MEMBER REMPE: That takes about a decade.

MR. BLEE: Yes.

MEMBER REMPE: So we got to understand that a little bit more.

MR. BLEE: Well, that leaves them another three years, I guess.

MEMBER REMPE: Yes, better get going.

MR. BLEE: Perfect, yes. By the way,

you had talked about subsidies. These aren't subsidies. These are cost-share programs. So in the case of the Advanced Reactor Program, it's an 80/20. In the case of NuScale it's 50/50. So actually it's a good return on investment for the Government.

MEMBER REMPE: But again I guess I'm wondering about -- again, you said there's 52. Last time I heard it was 48. But there's 52 of these start-up companies. If there's two or three that have some sort of fuel manufacturing process developed and a vendor identified, then I have more confidence that it's a good thing to have some sort of Government help and assistance. But again, we don't create monopolies with our taxpayer dollars. You just try and help enable the technology. But going from 52 to 3 is where I'm kind of struggling with, and is industry focusing on that?

MR. BLEE: Well, again, I don't think we should be picking winners and losers. That's our personal view. Let the market play out. It shouldn't be the Government -- in fact, we're not entirely comfortable with the Government picking two for the FRA. We're market based, so we think -- frankly, I think that it would be -- well, we're

very interested in hearing the -- having the voices of these individual technology folks speak. I think a good suggestion for your next meeting is to have a bunch of them in here to make presentations to you on the status of their projects.

MEMBER REMPE: And again, I've heard that we should let the market decide, but again where does the -- you want to have something that's been technically reviewed. It's not just something -- if we're asking for some sort of Government funding to help enable -- and that's done with a lot of technologies. I'm not complaining about that. It's just I want to understand the process because we can't enable 52 of these.

MR. BLEE: But I think Craig will talk --

MEMBER REMPE: What's the criteria for getting into the Government queue, is what I'm asking.

MR. BLEE: I don't think Mike should expect 52 applications in 2025. I mean, there are some that are looking further out. I wouldn't suggest that all 52 --

MEMBER REMPE: And is there a process to help the staff understand which technologies should

be focused on in the near term? And it's a consistent process?

MR. BLEE: I think the staff has -- well, that's really a question for Mike, but I think, yes, he keeps his ear to the ground, I think, on that and responds as necessary.

MR. MAYFIELD: Yes, just to chime in here. Two things: Fuel and fuel qualification is one of the top subjects that we talk about at these workshops and we expect that that will continue to be a major source of discussion so that the vendor community understands what they must do, however they're going to come up with those data. But fuel qualification is a key subject of discussion with the community.

In terms of how we are knowing what we can reasonably expect, we annually put out a RIS, a regulatory information summary. Okay. What are your plans? When are you going to submit?

The other thing we add to that are a series of questions. And while I don't particularly care about the answer, if they come back and they don't have a testing program, they haven't done this, haven't done that, likelihood that they're going to show up in 2018 diminishes. So we use

these more as qualitative assessments so we can forecast our workload and what's likely to show up and when.

So we, by visiting conferences, going to the summits that David has sponsored, other meetings that are ongoing we get a fairly good sense of who's real, who's still in the gee-want-to-be mode. And so we use that insight. Qualitative as it is, we use those insights to help us forecast who's going to show up, with what technologies and on what timeline.

MEMBER REMPE: This is good. I just would like to see industry starting to acknowledge that in some of the documentation and strategic plans. I've not read your strategic plans, but it would be good to see that.

MR. BLEE: Okay. And thank you for that. Another important point is that in terms of the organizational aspect is that I think in some cases the idea of one message, one voice is appealing. We have set up a Coordinating Council with NEA and the NIA and other interested parties and we have message, but many voices. And so ours happens to be more commercial, technology owners. Because some of the end users of this may not just

be investor-owned utilities. There may be industrial applications and things like that. So it's a little different mosaic than what the NRC sometimes is used to, but I think again the NRC has been responsive to this approach and we've been working with the Coordinating Council to try to present initiatives and messages in a more seamless fashion.

I think Mike talked about this in terms of the progress, and I won't cover this. A lot of action here on many fronts, both on the NRC, DOE and in the Congress. Happy to talk about -- there is legislation in the 4084 that has passed the House and the Senate, and that deals with a test reactor, something that Mike is focusing on with his other advisory committee at DOE. That's Mike Corradini.

One thing I would mention in terms of here is that the Congress with the NRC has requested $5 million off-budget to look at to put initiatives in place on advanced reactors. We think that's a great initiative that Congress has included in both budgets, on both the House and Senate, that hasn't passed yet. But back in June we laid out some thoughts on how that $5 million might be spent since there hasn't been a whole lot of focus on that, or

detail on that. And that's something I think that this advisory group could focus on, certainly. That would certainly be in place before the end of this calendar year.

Again, source of our interest here; you've seen this in many forms, is basically life after 60 and the need for additional capacity, the booming global market demand, and of course the fact that we're 5 or 67 really now, 4 of 66 may be under construction depending on whose calculations you're using, and certainly if you're looking at this two percent scenario for clean energy, the need for advanced nuclear.

Our interest started back in 2011 when we wrote to Secretary Chu. I think most of these issues really reflect DOE, but the fact is the message is really the same as it was five years ago, although things are moving in the right direction.

We have had three advanced reactor technical summits in association with Argonne, UMass Lowell and Oak Ridge. I think Mike talked about these. If you listen to the customer, the takeaway from those has been very consistent saying the licensing paradigm for a non-light water reactor Gen IV is not workable. And again, that's an easy term

to use, but that's a matter of meshing up where they think improvements can be made. And I think we did address that in a white paper on advanced reactor licensing in February 2016.

MEMBER REMPE: Excuse me.

MR. BLEE: Yes?

MEMBER REMPE: Back on slide 9 there was a bullet you kind of skipped over. Advanced reactors offer significant economic advantages. Is there any hard evidence to support that statement?

MR. BLEE: Well, based on some of the cost figures I've seen from some of the advanced reactors, the answer is yes. I mean, they're not good at --

CHAIRMAN BLEY: Well, but they haven't been built, so --

MR. BLEE: Yes, they haven't been built. But they are not building these to -- they're building these because they will be smaller, they'll have some economic attributes.

MEMBER CORRADINI: So I can share with you a 1953 letter from the admiral that says all paper reactors are cheaper than real reactors?

MR. BLEE: I would never argue with you on that point.

(Laughter.)

MEMBER CORRADINI: So I think Joy's point -- this is one of the bullets that keeps on arising and arising, and I think you want to be real careful about that. That's just my --

(Simultaneous speaking.)

MR. BLEE: Well, the onus is certainly on them to make that case. And I think the one thing -- the *92925 that you should be thinking in that regard is they've gotten about $22 million, which isn't a lot in Government parlance, but $22 million of private sector funding for their concepts. So it wouldn't be because we're going to design the same thing that's already out here or it's going to be more expensive than what's out there. They have --

(Simultaneous speaking.)

MEMBER REMPE: Did the private sector do any sort of review, technical review, have some economics folks go out and scope and see? I mean, even the NuScale one, which does have some possible good advantages -- I'm not trying to cast aspersions, but the economic case has not yet been made yet. And until you sell a lot of them I'm not sure we'll see that.

MR. BLEE: Well, again we're believers in the market. If they cannot get the funding to do forward, it'll be because they're not economical or there's not an advantage over Gen III+. I mean, frankly, AP1000s and the Gen III+ designs out there are very good designs. They're being built. And the SMR, same thing. The NuScale SMR. So they have the hurdle of having something that is better, faster, more cost-effective than what's out there. And if it doesn't, it won't be because Craig Welling decides or Stephen Burns. It will be because the market decides it and they don't get the funding to go forward.

MEMBER REMPE: Well, again --

MR. BLEE: So again, that's why we think that not down selecting now and having a command and control approach is, we think, really a competitive approach, and it's working at the moment. I may come back in five years and tell you you were right, we should have let DOE select everything, but I kind of doubt it.

MEMBER BROWN: Things get lost. All I keep hearing is that we've got to have a licensing basis, we got to have risk-informed, we got to have performance-based whatever. Where is the emphasis

on safety, technical performance, the risk of those designs? I'm from the Naval Nuclear Program. I grew up in it since 1965. And all you have to do is go back and read -- I know Mike referred to one comment from the venerable Admiral Rickover. But if you read -- I guess it's Duncan's historical perspective on how that was brought forth, from '47 to '54, it took six or seven years to deliver from no technology, zero technology to a submarine at sea, the *Nautilus*.

And if you go read the first 100 -- and I just did this a couple days ago because it looked interesting after looking at your all's visions, of DOE's vision and the NRC vision, is there was no licensing, okay, venue or methodology at the time. And the only reason it got done was because there was a focused -- one person, one program beating the drum. And if you looked in that first 100, 150 to 200 pages of that book, the outside -- all the stuff you're talking about: commercial -- GE was trying to sabotage it like crazy. They wanted to commercialize, get the Government out of it. They were going to do all these great things. Finally, they drove right through them and got, what, a sodium reactor built,

water reactors built, and so on and so forth. That's a historical precedent for how to get something done.

And after reading these two vision documents and looking at the size even of some of these advanced reactors you're talking -- the non-light water ones, it seems to me the focus of all this other industry -- all these different paths -- and we've lost sight; personal opinion, not a Committee opinion, of how do we resolve and get rid of the safety, the technical risk aspects that are just endemic in the sodium, lead bismuth, gas reactor, etcetera, etcetera, etcetera?

All the past projects have -- two or three of them have been built. What is it, two gas reactors and a sodium reactor, aside from the Naval Program, and they're both out of service. Nobody built any more of them. How do we take that information, play it into the assessment of why are these better than the advanced light water reactors which don't generate other materials, which are more toxic than water, etcetera? And I just don't see any of that in either one of these two visions other than one line in the DOE one, which says demonstrate performance and retire technical risk, which is the

second line in your general game plan.

MR. BLEE: Yes, we come from the point of view of -- well, there are safety enhancements in all of these designs, and that's one of the things we're focused on, but we're not leading with that because the presumption is the NRC would not license an unsafe design.

MEMBER BROWN: But you have to present a safe design and you have to --

MR. BLEE: Sure.

MEMBER BROWN: -- resolve the technical risk. I mean, everybody out there that's designing -- I mean --

MR. BLEE: But you're not going to sell a reactor on the basis of its safer than the other one. There are safety enhancements. They're all safe, frankly. And this program was not started from scratch. I mean, this is not going back to the late '40s. That was a wonderful -- I mean, an incredible effort, but you're building on the foundation of what is there. These are adaptations. In fact, some of these are based on reactor designs that were tried and discarded for various reasons in the '50s and '60s in some cases, not because they're unsafe, not because they're not feasible. It's

because the Navy went in a different direction.

MEMBER BROWN: Well, we found out sodium just eats the hell out of steam generators and tubes and everything else.

MR. BLEE: We'll keep an open mind.

MEMBER BROWN: Very open.

MR. BLEE: I would like a copy of that book, though, or a cite for it.

MEMBER REMPE: Before you leave --

MR. WELLING: There are some proven safety advantages of potential designs. Sodium fast reactors have some inherent safety features associated with them and --

PARTICIPANT: That's what I wanted to hear more about.

(Laughter.)

MR. WELLING: And TRISO-coated particle fuel has some safety benefits. There's information to be had that shows the safety benefits. And the General Design Criteria that is being developed for the advanced reactors recognizes some of the safety benefits. And as an example we recognize that for a high-temperature gas reactor that we can make some changes with respect to functional containment. And that recognizes what's available in the safety area.

MEMBER REMPE: Before you leave that slide, just real quick, the last bullet --

CHAIRMAN BLEY: Okay. We've got five more minutes on -- four more minutes on this one.

MEMBER REMPE: But the last bullet, that's totally in contrast with this report that Mike mentioned earlier. Several technologies did not claim they need a high-flux test reactor. So I'm a little puzzled about where you got that last bullet.

MR. BLEE: Well, I think again this puzzle where I got it, this comes from our last three summits. This comes from the people who were attending.

MEMBER REMPE: All of the concepts are saying that, because the PRISM and the --

MR. BLEE: Well, this is a consensus document, so not everyone subscribes to all parts of it, but again what this comes down to, we think the United States has to be the go-to country for development of advanced nuclear technology and we don't think that -- I think the general view of the group is they don't think that we should be running over to Russia to do tests that --

MEMBER REMPE: You think in order to get

a reactor out they're going -- two technologies or more by 2030 you also need a test reactor?

MR. BLEE: Well, again, in some cases some people don't feel they need a test reactor, but in the long term we believe we need a non-light water test reactor and we don't think it's an either/or situation. So again, not every company is asking. Some have more needs in terms of materials testing and stuff where this is going to be important.

But again, if we're going to be the go-to country we can't -- we've got a 60-year-old test reactor that is not applicable for this process and we believe there is legislation in Congress asking DOE to come up with a funding profile for this. But again, not at the expense of moving these other designs forward and providing needed collaboration money in terms of moving that forward.

An important point on the -- also I skipped over this was in terms of licensing, again a staged approach. I think that Russ talked about that as well. A staged approach is something. And that relates to the trenches of funding. As they go along they want to have different milestones met as opposed to just one at the very end.

Again -- where are we? Mentioned our paper. We identified some gaps and needs. This is just an update from September 2015 into the last workshop. And we did provide comments on June 8th on the non-light water reactor design criteria. And we certainly welcome the NRC's move on this front.

So in conclusion, I should mention one other initiative that is also out there is that Southern Nuclear, which is a member of both organizations here, is working on a probabilistic technical basis for licensing requirements of various reactors, advanced reactors. I don't have a lot of detail on this. I asked Amir for it. And he was getting on a plane, but he wanted me to mention that. So I did mention it. I think it will be of interest to you all as that emerges forward.

MEMBER POWERS: I'd like to understand a little better about staged licensing. I personally have had difficulties in the way that we are doing design certifications and particularly a piecemeal fashion as things become available we review them. But quite frankly, the knee bone is connected to the thigh bone in looking at safety. And looking at things in an abstraction and always coming to, well, wait until next month when that chapter becomes

available is not an efficient way for us to do our review. In your staged review are we going to have the same kind of difficulty?

MR. BLEE: Well, easier said than done. I think this is a work in progress. I think that again the appeal of what the Canadians are doing is a good example of -- why there is interest in that is it's a finite -- right now of course by and large generally you know mail your application into the NRC. Within 60 days it's either accepted or rejected and then you're waiting for the first round of -- for additional information. Hopefully you don't -- you hope you don't have round two. So you could look upon that as staged.

I think they're looking for -- what people are looking for; again this has got to be more definitized, is various stages were essentially the NRC says you have complied up to this point. And they would like to have half a dozen stages as opposed to two or three stages, because what that does basically is they can take that back to funding sources.

Now, you don't want to compromise safety, you don't want to compromise the NRC process. So again, this is something that Mike and

his team are focused on. This is something that industry is focused on in terms of working out some specification beyond, hey, the Canadian process is a good first step.

And in fact, the current legislation that's passed both the House and the Senate and could very well get through Congress this year on advanced reactor reform -- sorry, it's on NRC modernization and reform, does ask NRC to look at a staged approach. So it looks to me as while industry is working on it and will provide input into it, the NRC will be coming up with a straw person in that regard.

Isn't that about right, Mike?

MR. MAYFIELD: Yes.

MR. BLEE: And even if the legislation isn't passed, the NRC has expressed a willingness.

MR. MAYFIELD: David's exactly right. This is something we're looking at and to do it within existing regulation and existing structure. And exactly, Dana, to your point, how do these things connect and how can you do this in an efficient and predictable manner? These are all good questions. They're questions that we've started posing to ourselves and in the public

meetings we're going to be having, that you can't lose the connection to safety, you can't lose the notion that I may have approved this piece conditionally, piece of the design, but if the next piece comes in and it influences the first piece, we're going to have to go back and look at that. So the predictability of the process, the efficiency in the process, the timeline in the process is something that we're going to have to engage and engage on actively.

So we're going to talk about that some more in Anna and Mike Jones' presentation.

MR. BLEE: Right, and the legislation contemplates 2018, 2017 milestones for that, so moving forward.

MEMBER BROWN: Is it useful to have Congress dictating the path in legislation?

(Laughter.)

PARTICIPANT: They are our representative.

MEMBER BROWN: What was that?

PARTICIPANT: No.

CHAIRMAN BLEY: Charlie, we're going to move on.

(Laughter.)

MEMBER CHARLIE: I'll take that correction.

CHAIRMAN BLEY: Craig, it's your turn. We'll give you --

(Simultaneous speaking.)

MR. BLEE: Well, in brief thank you very much for being here. Your technical respect is very much appreciated. We look forward to this hopefully as a journey towards a destination and we look forward to appearing here again. I've suggested some other things you may all want to look at in terms of the $5 million that is looming in terms of hearing directly from some of the reactor developers to hear more about what they're doing and so you understand that fully.

CHAIRMAN BLEY: All right. David, thank you.

MR. BLEE: Thank you.

CHAIRMAN BLEY: Craig, we'll give you a few extra minutes on the back end. Shorten our break a little. I really don't want to lose any time from the design criteria section later this morning.

MR. WELLING: Okay. Thank you for the opportunity to speak on DOE initiatives in support

of non-light water advanced reactors. I note that Anna will be speaking on the General Design Criteria for advanced reactors after the break, so I will focus my presentation on the vision and strategy for advanced reactors.

This is indeed an exciting time to be involved with advanced non-light water reactors. As Mike has indicated, we've seen increasing interest in advanced reactors. That has included Administration interest, support from Congress, DOE efforts to reduce technical and regulatory risk, industry-led activities, as David and Russ have spoken of, and an expansion in the number of vendors. And as David indicated, there are well over 30 advanced reactor non-light water designs out there.

As a result, DOE has pursued initiatives including development of a vision and strategy for advanced reactors, establishment of the Gateway for Accelerated Innovation in Nuclear, or GAIN, conduct of a test/demonstration advanced reactor planning study, and providing cost-shared support for reactor concepts. These initiatives support development of new nuclear capacity that will be needed in the 2030 to 2050 time frame.

This provides some perspective on why advanced reactors will be needed. The blue, red and green lines show nuclear capacity, or the reduction of nuclear capacity for certain licensing scenarios. As an example, the red line shows nuclear capacity of current light water reactors that have 60-year licenses. Recognizing also there's a strong desire to increase clean energy. In order to double nuclear capacity by 2050, the purple line would need to show a capacity necessary to reach that goal in about the 2050 time frame.

We envision a mix of new Gen IV, III+ plants such as the Westinghouse AP1000s and GE ESBWRs followed by light water-based SMRs. Ultimately we envision advanced reactors to be introduced beginning in about the 2030 time frame. Many of these concepts will have significantly higher reactor outlet temperatures and can serve additional benefits or functions besides electricity production.

As you can see --

MEMBER RAY: Excuse me. Let me interrupt for just one second because the implication of what you just said is that higher temperatures are only used for non-electricity

production. In areas where water is in short supply they're used for electricity production, too. And that's one of the things that should always be kept in mind is higher temperatures make siting a plant much easier. I've done it. I know.

MR. WELLING: Yes.

MEMBER RAY: Okay.

MEMBER POWERS: We seem to be losing plants left and right off your plot there for reasons that are not being addressed at all by any of your things on the long time scale length of your plant, of your plot there.

MR. WELLING: I'm sorry. What was your question?

MEMBER POWERS: Well, I mean, nothing -- Gen IV, small modular or advanced light water reactors don't seem to address the reason that we're losing plants left and right off the current fleet.

MR. WELLING: What we're expecting is that in the future we're going to need a mix of the advanced light water reactor plus small modular reactors plus the Gen IV plants.

MEMBER POWERS: Well, I mean, that's your expectation, but that doesn't seem to be the current expectation at all. I mean, I suspect

you're not alone in your expectation, but I mean, I've got the whole State of California that says we don't need the nuclear. And that's a non-trivial state.

MR. WELLING: Yes, noted.

MEMBER RAY: Being from California let me just say there's a response to that, but we don't have time for it now.

(Laughter.)

MR. WELLING: One of the DOE initiatives in development is the development of vision and strategy for the development and deployment of advanced reactors. Over the course of several months we circulated draft documents through the Office of Nuclear Energy, national laboratories and DOE offices, other Government agencies and through informal stakeholder interactions. The final draft of that document is now publicly available on the DOE web site. It was posted on June 6th.

We tried to take a holistic view of all elements needed to support the overall vision including DOE, NRC and the industry while it is focused on advanced non-light water reactors. It complements other reactor technologies. The DOE Nuclear Energy Advisory Committee has been asked to

provide comments on that document.

This is the vision and goal that are included in our vision and strategy for advanced reactors. The long-term vision reflects advanced reactors becoming a significant and growing component of the nuclear fleet by 2050. And by that we envision a range of 30 to 50 gigawatts. As an interim step we established a goal to have at least two concepts ready to begin construction in the early 2030s.

MEMBER POWERS: Why did you insist that you have to have two?

MR. WELLING: We decided that we needed to have two concepts so that there are options available to the utilities out there.

MEMBER POWERS: Now you're just repeating what your slide says. I'll defer to my colleague from the Navy Nuclear. Isn't it better to say I have limited resources. Let me take one concept and do it well rather than doing a half-assed job on two?

MR. WELLING: That could be an option.

(Laughter.)

MR. BELL: I think the industry is interested in options and I think there's history

that indicates that when there's competition it doesn't result in a half-assed job, but actually one pushes the other to --

MEMBER POWERS: Well, I mean, you have all sung the praises of AP1000 and said that was just terrific. From my perspective I've been regaled by time after time after time coming in and saying, okay, we got to change the licensing basis. I mean, are things so fundamental as the return flow? The condensate return flow wasn't designed correctly in the AP1000. The containment couldn't meet the deciding criteria on a real site. I mean, I didn't see it as a ringing success here.

MEMBER CORRADINI: So Dana is taking it off track a bit, Craig, but -- so I'm not going to address this one to you, but '15, '16, whenever Gen IV started Road Map there were two co-chairs of the GRINS Committee, which was the oversight committee before there was a NIAC, right? Neil Todreas and Saul Levy. And both of them in that; I can get you the minutes from the meetings, basically said what Charlie and what Dana has said, which is you've got to focus.

The process to me worries me more than anything else. I understand competition, but it's

got to be organized competition. If it's disorganized competition, I guess his adjective to what you end up with might be appropriate.

So I'm more concerned not that you're going to let industry decide. I want to know what industries qualify, what's the process. It's probably not technology-driven. It's probably economically-driven. And unless that's clear, it could be a very

-- a lot of entropy production. And if you go back to what we --

(Simultaneous speaking.)

MR. WELLING: Well, let me address your point on whether you go with two or whether you down select to one. Look at where we are with small modular reactors. We went with two and, well, look what happened. One of the vendors backed out or essentially backed out. So we're looking to have options. And at this point in time, in 2016, with our goal of having potentially two designs ready to be deployed in the early 2030s, we think that's a reasonable response or a reasonable approach to take.

MEMBER CORRADINI: Okay.

MR. WELLING: But let me proceed on so I

can get through the slides.

MEMBER CORRADINI: But I just want to make sure I draw us back to history, because these comments, not coming from Dana or Charlie, came from Neil and Saul back when Gen IV Road Map was there in '99. Same concerns.

MR. WELLING: Yes.

MEMBER CORRADINI: Okay.

MR. WELLING: Yes, I agree. This document, the vision and strategy, is structured in six strategic objectives which include enhancing or improving access to infrastructure, retiring technical risk, developing fuel cycle pathways, supporting the establishment of an efficient and reliable regulatory framework, effectively leveraging resources and addressing human capital needs. An individual slide follows for each of the six objectives. As you might imagine, some of the activities span more than one strategic objective, but we attempted to bin activities into a single objective.

To support the growing number of reactor designers interested in advanced reactors we developed the GAIN Initiative. As the name implies, the focus is on accelerated nuclear technology

innovation. GAIN will provide a single point of access for nuclear technology developers, improve and streamline access to Government infrastructure and capabilities and facilitate interactions between reactor vendors and the NRC.

We have made great progress in developing modeling tools and techniques to better understand and predict fundamental behaviors and greatly improve fidelity. And that's one example of the capability that we're going to provide access to through GAIN.

We also are well on our way to expanding testing capabilities. As an example we are looking to restart the Transient Reactor Test Facility, TREAT, at INL here soon.

MEMBER POWERS: (Off microphone.)

MR. WELLING: I don't have that answer for you. I'm sorry.

DOE is currently supporting innovative reactor development to reduce the technical and economic risk. We do this through various means including targeted laboratory R&D, cost-shared R&D with industry and competitively award projects to industry. We will continue these activities to define, prioritize and address the key obstacles to

commercialization. We will consider results of the advanced test demo reactor planning study and solicit additional input on how best to meet the needs of the stakeholder community.

We will also continue to explore benefits of non-traditional uses of nuclear energy and the technical approaches for integrating significant nuclear energy expansion with the evolving nature of the future U.S. grid.

The various advanced reactor concepts include a wide variety of coolants, fuel forms and recycling or refueling cycling cycles and waste forms. In addition to the reactor design and fuel design all aspects of the fuel cycle will be considered. This includes potential separations and enrichment techniques as well as the storage, transportation and ultimate disposal of waste streams. DOE will work with industry to explore the implications of existing and future fuel cycle options.

In response to Joy's question earlier on fuel, the workshop that we held with the NRC explored fuel cycle options, explored the time frame necessary to develop advanced fuels. One comment in that area: The TRISO-coated particle fuel is nearly

ready. It has gone through a multi-phase program to develop the fuel and to test the fuel. So that is one advanced fuel design or type that will be ready fairly soon and would be ready in the early 2020s time frame.

MEMBER REMPE: So I understand that, and I suppose based on the ATTC study that we could easily say, well, sodium fuel is probably the next in line, but then we have the all-of-the-above strategy and it just seems like if we want to get something done, we ought to focus. Because there was a study we were given in preparation for this meeting -- a couple of studies. One with the gas reactor and one with the sodium reactor. And the Sandia sodium reactor, because I'm not as familiar with it -- that that study had a lot of issues with the corrosion and things like that. And there's just a lot of devils in the details and it just seems like as a taxpayer that -- I mean, we need to focus and prioritize.

And, yes, I've heard the complaints. Oh, don't let DOE do it. But, jeepers, somebody needs to do it and they need to have some technical insights. Because I think in any program, yes, you could get some college students to review some of

these designs and whittle them down pretty quickly. And I'd sure like to see something like that. And I don't know who to be spouting this off to, DOE or the industry organizations, but I'd sure like to see somebody do something about this as a taxpayer.

MR. WELLING: I understand.

DOE will continue to support the NRC on its efforts to prepare for the efficient and timely review of advanced reactor designs. And DOE will with the NRC to implement a process or providing accurate and current information to DOE in support of the GAIN Initiative. DOE and the NRC are coordinating their activities consistent with respect to roles. Examples include the joint project on advanced reactor design criteria and the successful and widely attended joint workshops that Mike mentioned earlier, which were held in September 2015 and June 2016 and attracted well over 300 participants.

NRC is moving aggressively to develop the step-wide process including a pre-licensing review to address the needs and desires of the advanced reactors designer community.

One thing I'd like to note is that at the workshop that we held in early June we did note

there is alignment between DOE and NRC on our strategies, both on the elements of our strategies and the timelines that we are expected that need to be ready for deployment of advanced reactors.

DOE will also explore new ways to work with the private sector to accelerate advanced reactor deployment and support further development of advanced reactor concepts. DOE would use private/public partnerships and also technology-centered working groups to identify opportunities. We are looking to have our first round of technology-centered workshops in the July time frame. We're going to have three technology-centered working groups, one for high-temperature reactors, one for molten salt reactors and one for fast reactors. Those workshops will be held in the middle of July time frame.

DOE and the Administration will also explore the use of appropriate policy and financial incentives. As I mentioned earlier, the Licensing Technical Support Program for SMRs is an example of a useful initiative. This is clearly a work in progress effort in order to maximize the effectiveness of both public and private sector investments to support deployment of advanced

reactors.

MEMBER CORRADINI: Could you just tell us a bit more about the July; I can't remember what you called them, workshops, the industry workshops?

MR. WELLING: Yes, one of the things we identified was that there is a benefit -- and it's going to be done through the GAIN Program, the Gateway for Accelerated Innovation in Nuclear -- is there's a benefit for getting vendors, designers together to identify what issues they have that could be possibly supported by DOE and the GAIN Initiative. We see that there could be technical issues associated with materials, technical issues associated with fuels. And by getting the specific groups together we can kind of pool our efforts to identify where we want to put our investments in the future.

MEMBER CORRADINI: Thank you.

MR. WELLING: Developing the nuclear workforce in the future. We place substantial value on investing in the next generation of engineers and scientists. We provide up to 20 percent of our R&D funds for university-led research through multi-year competitive awards. We provide support to universities through scholarships and fellowships as

well as university research reactor fuel management.

Since 2009 we have awarded more than $450 million to 113 schools in 40 states. As part of this last strategic initiative we will continue to explore ways to cultivate our partnerships with academia.

Collaboration with industry through cost-shared support has been an important step in development of new concepts. DOE has made multiple awards totaling 162 million in '13 and '14 for cost-shared R&D to address specific technical R&D needs of advanced reactors. And in FY '15 DOE started funding concepts for further development of their concepts. We provided 12.5 million from FY '15 funds and we look to provide a total of up to 80 million total over 5 years for the further development of two advanced reactor concepts.

Those two concepts are X-Energy for their pebble bed high temperature gas reactor and Southern Company Services for a molten chloride fast reactor. I would note that this is not a down select of these technologies. We used the merit review process to select these two concepts and we certainly looked to see that those concepts will get help in moving their concepts forward.

DOE currently is concluding the advance test demo reactor planning study. The study is evaluating advanced reactor options toward pursuing a test or demonstration reactor to support innovation in nuclear energy. A test reactor could provide beneficial radiation capability and a demonstration reactor could provide valuable proof of operation of an innovative concept. That planning study report is in review right now and has been provided to the Nuclear Energy Advisory Committee for their comments.

In summary, the vision and strategy and other initiatives are key elements of our efforts to support development and deployment of advanced non-light water reactors. We will work closely with the NRC and other stakeholders to provide support for the eventual deployment of advanced reactors.

That concludes my presentation.

CHAIRMAN BLEY: Okay. Thank you. At this time --

MR. BELL: Mr. Chairman, could I make a quick comment?

CHAIRMAN BLEY: A quick one. Sure.

MR. BELL: There was discussion about focus, to be focused. There are a lot of concepts

out there, 40 or 50. They're not all going to come to fruition. We know that. It's not been the tradition of the Government to pick winners and losers, nor an industry organization centered in Washington to pick winners and losers. So that is not our approach.

We kind of saw this take care of itself in the SMR case where NuScale is now moving forward kind of on its own through the U.S. process. Something like that could happen. That's the market deciding.

The point I wanted to get to was I think the nice thing about the staged approach is we wanted to provide a structured way for bright ideas to be brought forward and to frankly fail early, or succeed. But they ought to be given their shot. The NRC's focus would certainly be on safety, to the point about safety. Indirectly that is going to have implications for the marketability of the design.

So I think the staged approach has an attribute here that will help bring focus and pass through only the most worthy --

(Simultaneous speaking.)

MEMBER REMPE: You're relying on the

NRC, which has a limited focus, safety, to help you down select. And my concern is that you're asking -- not you personally, but they're asking the taxpayer to do that and have something that still won't give you something that may be -- you keep saying the market, but there's different parts of the market. Do you clearly have user utility that wants to own and operate that plant? Is it going to stay critical?

A technical review. Who does the technical review? You can't just rely on the NRC to do this and it just seems like -- before you get the regulator involved who's facing pressures about their finances on the Hill, it seems like the industry folks need to step up to the plate and say we need to do this ourselves. DOE can't even do that. It's you guys. And that's my point that I've been trying to -- with my questions today to focus on.

MR. BELL: No, I think that's fair. I think the NRC's --

CHAIRMAN BLEY: We've got all the comments on the record I think on that --

MR. BELL: Very good.

CHAIRMAN BLEY: -- so I'm going to call

a recess, but only for 10 minutes because we're -- well, until 10:25. We'll come back. We'll try to make up a few minutes later.

David, what?

MR. BLEE: Parliamentary inquiry. Is there an opportunity for a comment, public comment in terms of people on the phone, that sort of thing?

CHAIRMAN BLEY: There is, but it's short.

MR. BLEE: Okay. I got a couple emails.

CHAIRMAN BLEY: Okay.

MR. BLEE: Is that now or --

CHAIRMAN BLEY: No, it's at the end of the meeting.

MR. BLEE: End of the meeting?

CHAIRMAN BLEY: Yes.

MR. BLEE: Okay. Thanks.

CHAIRMAN BLEY: But it's short.

MR. MAYFIELD: Dr. Bley, if I could very quickly before you break, I wanted to thank Russ, David and Craig for coming in this morning to make their presentations. It turned out to be very short notice. And the staff very much appreciates their willingness to come in and appear before the Committee.

CHAIRMAN BLEY: Thanks, Mike. And we appreciate you being here as well. Thank you.

We'll recess until 10:25.

(Whereupon, the above-entitled matter went off the record at 10:12 a.m. and resumed at 10:25 a.m.)

MEMBER BLEY: The meeting will please come back to order, and we will continue with the staff presentation with Mike.

MR. JONES: Thank you.

Good morning, everyone.

I want to take a few minutes this morning to go over the NRC's Vision and Strategy for non-light-water reactors. You have heard from DOE. You have heard some from the industry about that.

Then, a little background. We have licensed -- "we" meaning the AEC in this case -- some commercial reactors, Fermi I, Peach Bottom, and Port Saint-Laurent. The last retired in 1989, Port Saint-Laurent.

More recently, we did a molybdenum isotope facility, production facility license for construction permit. We are calling it the SHINE facility for SHINE Medical. The purpose of bringing that up was that we have done a good job of telling

everybody we can still do this. The SHINE exercise is going to show that we are still able to think about things in a different way and look at our existing framework and to get things out the door. And so, that was one particular example.

Again, our message has been we could license a non-light-water reactor if it came in for an application today. That doesn't mean it would be efficient or a pretty process. We recognize that. And so, we are moving towards making it more efficient and effective.

MEMBER SKILLMAN: May I ask this question, please?

MR. JONES: Yes.

MEMBER SKILLMAN: The issue of resources, the particularly younger men and women, trained, qualified, experienced, are they in place, if an application should come in, to do the review at the standard that the NRC would desire to have?

MR. JONES: In the near-term, what we are doing as part of our process, and I will describe it a little bit, is to, in effect, create an inventory of folks who are still the people that were around for non-light-water work previously. Of course, all this work is not specific to a

particular technology like mechanical, electric, those kinds of things.

And so, what we think is that we have sufficient resources right now for the predominant technologies that may come in early, and that is a guess, though. Or we could potentially acquire through contract other expertise in order for a short-term look at something to successfully complete an application review.

MEMBER SKILLMAN: Okay. Thank you, Mike.

MR. JONES: Yes. Yes, sir.

The non-light-water Vision and Strategy was issued in early June, and we also rolled it out with DOE at the latest workshop. There is an ML number in teeny, tiny print up there at the top right, and you can bring that out.

We are working it in two phases. We are going to talk about the phases in a moment. We are also getting ready to issue this for our formal public comment period. The notion is 60 days of public comments. That is coming up soon. And we are looking at completion of the near-term draft for the second phase at the end of September.

I am going to talk a little bit about

the architecture of the Vision and Strategy. First of all, I don't want to talk too much about architecture; it is kind of boring. But it was made to mirror the NRC's Strategic Plan in terms of mission, vision, strategic goals, strategies, and contributing activities, those kinds of things. Those words and the meetings ascribed to them all line up with the NRC's Strategic Plan for the overall agency.

You can see we have got phase one at the little break there, the top four boxes. There is a blue box for the strategic goal. There is a little side box, and that shows an alignment point with DOE. Our goal is to be ready to effectively and efficiently review and support the rollout of two technologies.

In the early 2030s that aligns with DOE's stated goal and their vision and strategy. That, of course, means that, by the early 2030s, we will have done some kind of review. And so, we have to back up from that point.

And in phase two, which I will talk a little bit about, are the implementation action plans and the actual task execution, broken into two because we need to plan to be ready in any case to

the greatest extent possible. We are starting those activities, actually, today on figuring out the detail, what we need to do to get ready, what can we do that is technology-inclusive, things like that. And task execution, where we actually go out and take the implementation plans and put them into effect, depends on budget.

Next. The strategic goal we have talked about. What I wanted to do in this slide was talk a little bit about timing. I mean, we heard some comments from Russ Bell this morning and we have heard from others about a couple of the Gantt charts that were in the Vision and Strategy document. If you have had a chance to take a look at those, you will see what Russ was talking about.

And what we wanted to do was clarify there that those charts were built on working backwards from the DOE alignment point of the early 2030s. What we did is build in the activities that would be required to get ready. And so, those timelines that Russ was talking about, the 90 or get-ready period, the five-year licensing period, those are the longest possible timeframes within that construct that we would have available. That is our target. We are going to say five years or

nine years, whatever. Those are the longest timeframes that are available within that construct.

Another aspect of timing that I wanted to bring up was we heard a lot about letting the market decide, having the government decide, things like that. There is a balance point here that we see between market making a selection and the demand for timely reviews by the NRC, regulatory certainty, things like that where we want the churn of the market to make a decision, and yet, we want the certainty of the regulators to be ready to go as soon as that end-product pops up. Those are intention.

So, of course, we are dependent on the maturity of the industry and when designs might be ready for reviews. We are going to be dependent on those things to help us determine staging, for example, of qualified personnel, of qualified processes, things like that.

Finally, again, I mentioned budget briefly, but we are already in the 2018 budget process, coming soon to the 2019 budget process. So, that eats away on our front-end in terms of resourcing and being ready to actually go implement things that we are planning for. But we think it is

the best approach to plan, so that we are ready, if, in fact, the money does come.

MEMBER SUNSERI: Mike, I had a question about those planning windows. And you said they are not really targets for execution, but kind of we have to be done by this point in time and they were backed out.

MR. JONES: Right.

MEMBER SUNSERI: So, do you know enough about the duration of your activities to find out how much margin you have within those windows? In other words, when should I start if I am going to be able to make the end-point and have those kind of starting points been communicated back to the applicants, if you will, if I can use that term?

MR. JONES: Yes, I would say that our best experience so far was most recently reviewed in a thing we called the case study, but it was an opportunity for efficiencies in Part 52. It gave some ideas of aggressive targets, you know, early four-years kinds of things out to a longer time period, frankly, for first-of-a-kind designs and things like that.

So, I think it is probably not fair to equate what we are able to accomplish after we have

done a few particular specific designs to what we could do for first-of-a-kind technology. We are not even sure what the technology is going to be. But we think we could achieve it within those windows to support the DOE target, but that is really as specific as I have.

MS. BRADFORD: And one addition to that is that we are starting that process right now of figuring out the individual tasks we need to do and what the duration of those tasks might be, so that we can figure out whether or not they are all going to fit in that window and how they have to be staged.

MEMBER SUNSERI: Yes, I think that is an important aspect, because, you know, if you are going to finish on time, you have got to start on time, right?

MR. JONES: Yes, so we are going to talk a little bit about the strategies, and we are focusing right now on zero to five years. We picked zero to five because we want to start initially within the current regulatory framework. We want to find where the flexibilities are. We are going to find out where the hard points are. Can we do a staged review, for example, in the current

framework? Can we do a conceptual design assessment in the current framework? And Anna is going to talk to some of that.

MEMBER BLEY: I have a couple of questions for you. Again, I have read through your document and it is pretty high-level.

But a few years ago you did a revision to Chapter 19 for the DSRS and you had a third option, which was non-light-water reactors where you had put down an outline of thoughts. Is that still in your thinking or is that something separate from where you are right now?

MR. JONES: I am not familiar with it.

MS. BRADFORD: It is not separate. We worked closely with the branch that did the revision of Chapter 19. Obviously, we are all in NRO. And that is that kind of ongoing discussion. So, yes, I would say that is still in play.

MEMBER BLEY: So, the kind of meat that that adds to this is still --

MS. BRADFORD: Yes.

MEMBER BLEY: -- in the process? That is encouraging to me because I thought it was at least pretty well-conceived at the time.

The other is you just threw out that

work that we have heard earlier, which is the staged licensing. What does it mean to you? Now I have read some stuff from other organizations who aren't here today who said we ought to look to the pharmaceutical industry, the way they stage it, and that makes no sense at all to me. It is not even relevant. The Canadian experience is worthy of watching, and we are watching that. What does it mean to the staff?

MR. JONES: I mean, in the near-term we are still looking within the framework. And that means a Part 52 standard design process where it allows you to look at major portions as submittals until you get to a final overall review.

MEMBER BLEY: Okay. I think my impression was the people who are pushing it came up with those words, "We're looking for something that starts earlier and has some kind of partial approval," or at least no big items sitting there early in the process, the kind of things I think you are engaged with or were engaged with on --

MR. JONES: Yes, Anna is going to talk more about that.

MEMBER BLEY: Oh, okay.

MR. JONES: But we will also talk about

this conceptual design assessment, which is really pre-application.

MEMBER BLEY: Okay. I will wait for that. That's all right.

MR. JONES: Okay. The work we did to build the Vision and Strategy, again, focused on the near-term. What we did was we tried to find the large bins of activities that we would need in order to get ready, with a focus on technical readiness, regulatory readiness, and communications.

You can see the list then. It is the typical kind of list. You need to have people. You need to have processes. You need to have the types of tools you need for analytical work.

We talk here about more flexible risk-informed performance based review process, but, of course, that still has to get fleshed out. And it is always, of course, dependent on the technology, knowing about the technology, knowing some of the details.

MEMBER POWERS: One of the features that is touted much about especially advanced and non-light-water reactor designs with a heavy reliance on massive computer calculations with elaborate multi-colored plots that I am totally

unable to decipher, the question becomes, then, at what point does the regulator say, "I am sure your calculations are accurate and complete and massively detailed and certainly your plots are gorgeous, but we really need to have experimental data to verify this."? Do you have criteria for making that judgment?

MR. JONES: I think that one of the things we are going to look at in the near-term with these implementation action plans is the specific needs and availabilities of different kinds of tools, the decision criteria to decide, even if you have got all this data, how do you know it is safe enough, for example? How much review is adequate? How do we keep our independence if we are not using our own developed tools, things like this?

So, it is sort of an indirect answer to you, but it is one of the focus points for going forward.

MEMBER POWERS: Well, I mean, you certainly raise another issue. If the licensee comes in and says, "Here my multi-colored plot has been generated by this computer, of which there is exactly one in the entire world, and it predicts that everything is okay. So, please give me a

license," but you are completely unable to reproduce that calculation because you don't have a 1,000 processor, you can't even run their code yourself you don't have a 1,000 processor computer. You certainly cannot review the code. I mean, there are not enough people in the agency to review the code. What do you do with things like that?

MR. JONES: I think we have to decide when we see it. We balance our resources and balanced by what the specifics are in the submittal, and make our independent judgment, decide if we need more tools, decide what kind of impact it will have on the review.

MEMBER MARCH-LEUBA: Yes, I wanted to, before you go, I wanted to think on this opinion because I have been here biting my tongue. I don't want you to waste your time. But I see absolutely no effort or emphasis on developing the methods and codes and reviewing them. And from where I am sitting, you guys are lacking a lot of credibility in your statements because I know the reactor hasn't operated for 50 years with a code that has already been validated. And now, an industry wants to change a little bit in the methods. It takes five years to review.

Now you come in with a multi-colored graph, one of a kind, and there is absolutely no thought given, either in the industry or in the staff, to produce these methods and to review them and validate them.

MS. BRADFORD: I think, actually, I would argue with that point because those activities are included in some of the strategies that we think we need to look internally to see if we are prepared and if we do have the codes and the tools and the ability review those new codes or new outputs.

And I think in terms of how would we make the decision, I am not sure the threshold would be different than how we make a regulatory decision right now. If AP1000 came in with a code that, for whatever reason, we could absolutely not validate, I don't think we would have said, "Well, okay, that's all right." You know, I think the process would be similar in terms of what we need to see.

MEMBER POWERS: Remember that you approved AP1000 when, in fact, its return flow wouldn't work.

MS. BRADFORD: I am giving an example if anyone came in with a code that we could not validate and had no confidence in and only one

computer could produce it, I'm not sure that would satisfy the technical staff. That is my larger point.

MEMBER MARCH-LEUBA: My comment is on existing reactors. The fastest thing you can review a method is two years and the typical one is five. So, we need to do something to speed that up, but at least focus on it.

MS. BRADFORD: Understood. And we do plan to take a look at that within the schedules that we are trying to lay out for our timeframes.

MEMBER POWERS: Well, I mean, it seems to me that a lot of things get damaged or certainly affected by schedules and pronouncements that we are going to do this review in "X" number of weeks. And you have to do that, I understand, but at points in the review that is being submitted to you in a piecemeal fashion, I think you are going to encounter points where you really ought to say, "Now I'm sure the calculation is right. I'm sure it is complete, but I really need you go do experiments." And darn, one of your headaches that you are going to have is there is no experimental facility in the United States capable of doing the required experiments.

MS. BRADFORD: I agree with you.

MEMBER POWERS: And the other thing is that people will come in and say, "Well, we've done these experiments at a reactor you've never seen located in a country you can't get to by people that don't speak English."

MS. BRADFORD: Uh-hum.

MEMBER POWERS: Now what do you do? I mean, these seem to be conundrums that --

MR. MAYFIELD: Dana, if I could, this is Mike Mayfield from the staff.

If you would go back and look at some of the bits of legislation, there is a lot of emphasis that has been put forward to the Congress and, subsequently, put forward in these bits of legislation, for DOE to create, if you will, a test bed. And Idaho figures prominently into the discussion.

But the notion is these vendors would go and set up their reactor, whether it is fueled or still is a test device, to provide exactly the design-specific kinds of information you are wanting or asking about. The issue that I have had with this is how much time and what level of rigor is going to be required.

At the workshop we had in June, Steve Kuczynski made a presentation talking about we need to not lower the adequate protection bar, but to better define where it is. And that resonated positively, at least with me. It is that it is not a movable bar; we are not asking to lower it, but it would be nice if we could all agree on how you establish where it is. I think that goes to part of your question.

MEMBER POWERS: I think I agree with you that it is an adequate protection issue. It would surprise me if there is algorithmic answer to my question. I think it does take a substantial amount of engineering judgment and is different in every case, but it is one that I would certainly wrestle with.

The classic example is the RAI issue on high-burnup fuel. A small change in burnup produces a huge change in response. That was detected largely by accident.

MR. MAYFIELD: I think I find myself again in general agreement with you. What I will tell you is --

MEMBER POWERS: That means that there is something desperately wrong with one or both of us.

(Laughter.)

MR. MAYFIELD: Yes. But your questions are things that we have been asking ourselves. Again, when you look at the legislation that has been proposed, they are not asking NRC to approve this pig in a poke. Okay? There is a notion of we need to go and demonstrate these technologies in an environment where we can get to the data we need and not risk public health and safety.

MEMBER POWERS: Well, without knowing exactly all the length and the breadth of this, when you see that they are going to resurrect TREAT, which is probably a reactor built about the time I was entering high school, you know that is not a comforting feeling.

MR. MAYFIELD: From '54 to '94?

MS. BRADFORD: '59 to '94.

MEMBER POWERS: Okay. So, it preceded high school. It preceded junior high.

(Laughter.)

MR. MAYFIELD: I think we are losing this battle. So, perhaps turn it back to him.

MEMBER BLEY: But one last comment on this. You didn't ask us to review your Strategy and Vision document and make comments. But I note there

are quite a few places in the document, including my big red box, about computer codes and your competency. I only find one bullet that hints about this connection with experimental data, and I think that is an important piece. I think it is one we will be following pretty closely.

MS. BRADFORD: Thank you.

MR. MAYFIELD: If I could, just to reply to you, Dr. Bley, I was less concerned about getting the Committee to weigh-in on the Vision and Strategy document, which somebody noted earlier is fairly high-level. I am much more interested in seeing the Committee weigh-in on the implementation action plans that Mike has talked about and help us identify any shortcomings you see in those plans.

Those plans and how we go about implementing them are key to whether this is going to be a successful venture or not. So, that is where, for me --

MEMBER BLEY: Okay. Thanks.

MR. MAYFIELD: -- I would rather have the Committee invest time in looking at those action plans.

MEMBER BLEY: Where are those?

MR. MAYFIELD: In Mike's head.

(Laughter.)

MS. BRADFORD: They are in the very beginning stages.

MEMBER BLEY: Okay.

MEMBER POWERS: You know, I think that is a terrific point. And I would encourage Mike to try to schedule opportunities before he can even write down viewgraphs to come chat with us.

MR. MAYFIELD: What we have, Mike has put together a working group of the people that were involved, actually, in developing the strategies. And as we go forward, before we go spending money that we don't yet have and may not get, I would expect that we would schedule time with the Committee and come back and share those plans with you and seek your input.

MEMBER POWERS: Yes, I think, you know, I would put the Committee to work for you. When you get to thorny issues, ask the Committee to think about them.

MR. MAYFIELD: And I think that is not an unreasonable expectation of the staff.

MEMBER POWERS: I mean, I think that we would be delighted to try to help on this because this is a very difficult thing to approach. I mean,

it is quite a different thing licensing a reactor for which one has been running for 85 years on DOE property than it is when you don't have the prototype or anything else.

MR. MAYFIELD: We agree.

I am going to shut up now and let the people that know what they are talking about talk some more.

MEMBER RAY: Let me, as long as you are paused, let me make one comment that I intended to make here at some point.

Having gone through the AP1000 design certification, one of the things that is most challenging here is not, in my judgment, looking at what you have, but trying to figure out what it is you don't have and what to say about it. I am talking about design detail now.

In the case of Part 52 certification, you have ITAAC, for example, and they become extremely difficult to decide what they should contain in order to issue the certification based on things that are yet to be developed.

As we go through this stepwise process, which I think is necessary -- I don't question that -- but, to Dana's point, what can we do to help

identify what the process needs to contain? It is how to describe so that all parties are clear what you are assuming about things you don't know yet, because it is not designed yet. That is the tough part, the really tough part.

MR. MAYFIELD: I agree, and that has consistently been the thing, as I have worked with staff, my own staff, in getting through the AP1000 and the ESBWR, that has been the thing that has been the greatest struggle to how do you implement Part 52 and do so in a comprehensive way, given the information that is needed for the Commission to make all their safety findings. And what is that right balance? So, it is not easy. It is something that is going to require a lot of thought and effort as we go forward.

MEMBER RAY: But, so often, folks -- and I understand why -- think, well, we can just approve things incrementally step one, step two, step three. But the problem is step one depends on --

MR. MAYFIELD: Yes.

MEMBER RAY: -- so much that you don't yet know.

MR. MAYFIELD: Exactly. We agree. We are, much like with Dr. Powers, you and I are in

vigorous agreement.

MEMBER CORRADINI: So, I have one question that maybe you have seen or not. I asked the folks from industry before about the DOE option study on demo reactors. Have you seen it?

MR. JONES: I have seen it. I have attended the last two NEAC meetings --

MEMBER CORRADINI: Okay.

MR. JONES: -- and kind of watched the --

MEMBER CORRADINI: So, there is a timeline in it. There is a cost number in it, and there is a judgment about licensing in it. So, I'm curious about at least your reaction to it, if you have read through it, because all three of those things feed together. Their best estimate, if all was perfect, is you couldn't have a demo reactor that we believe doesn't need anything more than just building it in 15 years, and if there was anything more complex or less organized than that, at least 20 years. And it would be a large amount of money, and current licensing approaches are doable as long as you didn't necessarily start with 52, but you started with 10 CFR 50.

So, I am kind of curious, is there a

reaction from the staff or are you guys still mulling what is written there over?

MR. JONES: No. I mean, first of all, it is a test of demo reactors study. It is focused on not an up-and-running commercial plant. So, its focus takes it back towards 50 and more towards the prototype licensing process.

MEMBER CORRADINI: Right. Right, but, as I understood it, as I read it, whether I pick -- let's just pick two -- a gas reactor or a sodium reactor, either of those cases, the next logical thing would be an NRC license of a demo?

MR. JONES: Yes, if you look at the plan and you look at the schedule in there, part of this early chunk that is in this nine-year piece between now and 2025 is this question mark of what do you do with the test reactor. What is coming in? How do you get ready for that?

MEMBER CORRADINI: But putting the test reactor aside, I want to put the test reactor aside, I am more interested in the analysis that DOE had on the demo. And you don't have to answer now, but I thought, actually, it was a fairly good analysis where they looked at very specific designs, as specific as one can when they are paper --

MR. JONES: Right.

MEMBER CORRADINI: -- and tried to ferret out time, money, and what is a workable licensing approach to it.

MS. BRADFORD: We haven't formally looked at that report. Mike attended the meeting where the NEAC went over kind of their conclusions, but that hasn't been sent to us.

MEMBER CORRADINI: Okay. Fine. It is still going through the comment period, is my understanding.

MS. BRADFORD: Right.

MEMBER BLEY: I need to interrupt things right now because I am going to rearrange things a little bit. Mike Corradini and I have to leave at noon for a separate meeting; not everybody else has to do that. I want to get through a few key things by 11:45 and, then, give Subcommittee members a chance to make some comments. If we have skipped things and you have time to stay and go over it, I would turn the meeting over at noon to Dr. Rempe to continue it, which is an odd way for us to do business, but we have run into this schedule. We have essentially used up all the time we had allotted for this and we are halfway through the

presentation.

Based on what Mike Mayfield said, I am thinking if you could just on the five-, ten-year-and-greater, and ten-year strategies give just a sentence or two now, come back to them later, if we need; talk through the action plans for about five minutes, and then, we will get to Jan's talk because I want to hear some of that. We will quit at 11:45, have a summary, and then, it can go on later to pick up some of the things we have missed.

So, if you can do that, Mike, we will go ahead and try to finish in about five minutes.

MR. JONES: Okay.

For the mid-term strategies, what we are doing is we are kind of moving from technology-inclusive towards knowing more about potential designs and things like that. As we get more of those insights that Mike talked about on what potential technologies could come in, we get better feed information on what to do with staff qualifications, things like that. So, it all helps go forward.

But mid-term is basically moving towards technology-specific, and then, the long-term strategy -- next slide -- the long-term is really

focused on what do we do if we need a whole new framework. What if 50 or 52 just isn't the right way to go? And so, that is for our consideration of what to do, which would include rulemaking.

Again, one of those considerations is should we build a new regulatory framework if one is going to come in? We just don't know those answers yet. But that is the continuum from short-term to long-term.

The implementation action plans which we are starting actually take the contributing activities that are listed in the Vision and Strategy document, we flesh those out in a work breakdown form to try to figure out some more detail about what is required, who needs to participate, and what we think would be a notional estimate of time and job hours to do this particular task.

The idea is to have something that becomes more actionable, not as high-level, as you noted, but something we can use to actually do real planning and actual budget processing to help us better inform how much money we ask for, what we need for resources, things like that.

And it is also going to help us understand better our overall readiness posture for

these things. We have said we can do it right now. We have said it might not be effective and efficient, but it is going to better flesh out our real posture. It will help answer questions like Dr. Powers' question about what do you do with tools; you know, what if it is a one-of-a-kind thing, those types of things. So, the action plans really will be where we do some more detailed planning and give us some flesh on the bones here.

To conclude, we have talked a little bit about the strategy. We have said we could license it today. It wouldn't necessarily be perfect, but we could get through it. I am sure it wouldn't be as fast as everyone wants, but we just have to deal with it as we go.

We have outlined a number of near-term, mid-term, and long-term strategies and activities that we are going to use to get to the next point of readiness here. We are focused on technical readiness, regulatory readiness, and communications.

That's it.

MS. BRADFORD: Dr. Bley, do you want me to go through the regulatory readiness? It will take five minutes.

MEMBER BLEY: Okay.

MS. BRADFORD: Yes.

MEMBER BLEY: Five minutes is good.

MS. BRADFORD: Okay.

MEMBER BLEY: And we might have some people want to come back and ask you more about it --

MS. BRADFORD: Yes.

MEMBER BLEY: -- after we finish. Go ahead.

MS. BRADFORD: Is that presentation on there?

So, you heard us talking, you heard industry and DOE talking this morning about their plans, and Mike talked about our Vision and Strategy. I just wanted to make the point that, while the NRC staff is doing this work, of course, safety is paramount in our mind. We know we don't have a lot of experience with these type of reactors. We know there is not a lot of necessarily U.S. operating experience with these reactors.

That is one reason why our timeframes stretch out to the point where industry complains that we are being slow, because we want to be comfortable that what we are doing is supported by the safety case and that we think we can get there.

We just don't want to quickly move forward just for the sake of moving forward and, then, realize we have made a mistake or we have gone somewhere that we are not comfortable that it is going to be protective of public health and safety. So, I just want to make that point before I started going through what we are considering for our regulatory review processes.

So, there's a few reasons we are talking about regulatory review processes and looking internally. You heard them during the discussions this morning that the non-light-water industry would like to see some different approaches from us to get some flexibility in terms of how they can interact with us.

We would like to become familiar with new designs and technologies. Of course, we would always like to have information about what industry plans and what designs are moving forward. So, we think these four goals are met by the processes that I am about to talk about.

As I think Mike said, we have previously, or AEC or NRC has previously had some involvement with non-light-water reactors. These were all quite a while ago, but we would and have

been going back and looking at these experiences and the documents that came out of them. Of course, we would need to check to see how applicable those are to the designs we are talking about today, but there is that experience on the books that we would want to look at.

So, review processes, we are looking right now in the short-term about what can we do in the existing regulatory framework under Part 50 and Part 52. So, if we wanted to do something in the near-term to provide some flexibility and some options without having to undertake rulemaking, which you all know can take a long time, what are our options?

So, we looked at the design certification review processes and we looked at our licensing review processes for now. And then, in the future if we have the resources and the time and there is the interest, the need to do it, we may develop a new regulatory framework, maybe a Part 53, something like that.

So, this slide shows processes under Part 52. The yellow ones are things that exist and have or are being used now, so things like letters and white papers submitted by industry that we

provide feedback on, pre-app readiness reviews. We go often to a potential applicant's offices and look to see if their application looks generally complete. We do pre-app audits. These are all things that I am sure that the Committee is familiar with. Those are processes one and two.

Five, six, and seven, again, are things that have been or are being used. The pre-application SER we mentioned PRISM and SAFR earlier today. That was that process, the preliminary design review. The standard design approval and, of course, standard design certification.

The two in green are the new things that we are thinking about. One is a conceptual design assessment. We heard a little bit of mention this morning about Canada, CNSC, what they do. It is sort of similar to that. The idea is that the designers can come in earlier. You know, they don't have a complete application. They don't have all 19 chapters to submit for us to review against the SRP, but they do have a certain level of information that we can take a look at, and we could give them some kind of feedback. It would be a shorter review. We would limit it. Maybe it is a year; maybe it is

two.

And then, the second one is the staged design review, which I am going to show a flowchart about in one moment. So, those two green ones are the newer flexibilities that we are thinking about under the current process.

Yes?

MEMBER REMPE: Okay. So, you're claiming these are new, but I can remember back in my old days at General Atomics where we had a preconceptual design which was the twinkle in your daddy's eye, as I was taught.

(Laughter.)

MS. BRADFORD: Yes.

MEMBER REMPE: And I thought we interacted with the staff with that preconceptual. So, are these truly new or are they just reinstating the past? Because we did the SIDs also when the staff responded.

MS. BRADFORD: Yes. I mean, I don't know where you were in the process. That might have been similar to the process five up there, that preliminary design review. Those were submitted PSIDs and all those types of things, and we took a look --

MEMBER REMPE: Yes, but we did something, I thought, earlier, too.

MS. BRADFORD: What is old is new again. Some of these things may have been used. We are going to try to formalize them a little bit more, have the process laid out, and what it is we would want to see and hope to -- what the output would be of those processes. So, I think that is it, just more trying to formalize it.

MEMBER REMPE: Rulemaking would not be required --

MS. BRADFORD: No.

MEMBER REMPE: -- for any of these things that you are suggesting?

MS. BRADFORD: Yes, right.

MEMBER REMPE: Thank you.

MS. BRADFORD: Yes.

MEMBER POWERS: You have experience with steps one and two. Has someone looked at that and said, "Did these things work?", "How well did they work?", "What things were we accepting that subsequently proved we shouldn't have accepted?"

MS. BRADFORD: Sure. The NRO has done case studies and sort of lessons learned of previous reviews.

MEMBER POWERS: Can we have access to those case studies? I think that would be fascinating.

MS. BRADFORD: Uh-hum, we can do that.

MEMBER CORRADINI: So, to follow on, as you are going to describe to us, one through five is whether it is 10 CFR 50 or 52?

MS. BRADFORD: These are all 52. I am going to talk to 50 in a different slide.

MEMBER CORRADINI: Oh, on a different slide?

MS. BRADFORD: Yes. These are 52. I mean, I guess you can do Topical Reports and things under Part 50, but, in general, this is meant for the design certification stuff.

MEMBER CORRADINI: Okay. Okay.

MS. BRADFORD: So, they don't have a site yet. They are not doing a license. This is to get the design certified.

MEMBER CORRADINI: Okay. So, I will repeat my question about -- I guess maybe I am process-oriented, not technology-oriented -- I am concerned about the process being backwards for things that are, however much we built them in the past and we licensed them in the past with the

current GDCs, are different enough that I don't see how 52 fits at all. That's my kind of going-in thing.

MS. BRADFORD: In terms of the technical requirements you mean?

MEMBER CORRADINI: Yes. Well, in terms of, if I am going to want to build it, really build it at a site with a utility or some owner/operator --

MS. BRADFORD: Yes.

MEMBER CORRADINI: -- 52 just seems, after the experiences of AP1000, et cetera, not the way to go. And I am curious, maybe that is just repeating what Dana asked you.

MS. BRADFORD: And they could be Part 50. Part 50 is not closed. That is an avenue that is open to them. If they wanted to go ahead and, instead, do the construction permit/operating license route, which is going to be --

MEMBER CORRADINI: Okay.

MS. BRADFORD: -- on a following slide, they could. So, I don't want to imply that it is this or nothing --

MEMBER CORRADINI: That's fine.

MS. BRADFORD: -- because the Part 50

approach is still available.

MEMBER CORRADINI: Okay. So, then, I will just reiterate, I would like to hear the staff, as part of the action plans, or whatever the activity is called, I would like to hear the staff's opinion about what the DOE's option study proposed. Because, to my surprise, happily, they said 52 was not the way to go forward for advanced reactors that you ought to do 50. Otherwise, you are going to get yourself stuck in the mud.

MS. BRADFORD: And one thing we noticed was, when industry responded to the RIS that Mike Mayfield mentioned when they would respond and say what their plans are and their schedules, some of them wanted to do 52 and some of them wanted to do 50.

MEMBER CORRADINI: Okay.

MS. BRADFORD: And they had looked at their options and, for whatever reason, considered one better than the other for their business case, or for whatever. And so, they would decide which one they wanted to do.

MEMBER CORRADINI: Okay. Thank you.

MS. BRADFORD: Yes. So, on this I gave a little bit of details already. But this is the

conceptual design assessment steps, the one that I mentioned as kind of similar to what the Canadians do. This talks about, you know, they are not ready to submit an entire application, but they would like some feedback from the NRC. This gets a little bit to the different type of funding that a lot of these vendors have. They are not necessarily the big companies like Westinghouse, but, rather, smaller ones. And they are getting incremental funding. So, in their mind, it is useful to show progress, documented progress, from the NRC that they are not dead in the water.

It kind of gets to the FDA process that you were mentioning, Dr. Bley. We have heard that several times, "Why can't you do staged licensing like the FDA does?" You know, there is this stage, this stage, this stage, and you know when you pass that stage that you have completed that and you can move on.

So, this is not that, but it does provide earlier feedback to the vendors in terms of what we think issues might be that they still need to address in their designs. What is the research and development they need to do? Are there any kind of insurmountable hurdles that we see for potential

licensing of this design or certifying of this design, I should say.

This is the process four, which was the staged design review. We have heard a little bit about that this morning in terms of how do you tie all the portions together, and you will have to do that. The industry or the applicant and us will have to be comfortable that all those pieces hang together as one story and don't affect each other in a negative way.

So, it might not be a time-saver or a money-saver overall when you look at the whole picture, because maybe by the time you have done all these steps and, then, the big overall kind of tying together step, you haven't saved any money total. But what you have done is you have been able to incrementally fund it and incrementally get feedback. So, I think that is the advantage that industry sees to this, and this would be the steps for that. And notice it includes ACRS review.

Okay. So, this is looking at Part 50 as well as 52. Again, the yellow is things that exist. The green is I don't want to say "new" because there is a regulatory citation for prototypes. But, in terms of using that citation, it has not been

implemented.

So, the new step might be you just go ahead and build. You apply for a construction permit. You build it. We might have to put limitations on it because it is a prototype in terms of operating level, something like that, where it is cited, until we are comfortable that it is protective of public health and safety. So, we are putting that here as kind of an option because we are going to put out guidance about how our prototype regulatory citation could be applied and how would fit into our licensing and certification framework.

MEMBER BLEY: Is there any feedback from industry about this idea of the prototype? I mean, it makes sense to me.

MS. BRADFORD: Yes.

MEMBER BLEY: What are you hearing from them?

MS. BRADFORD: I think some of them, like I mentioned, when they responded to our RIS, think this is the way to go. Do the construction permit. Build it. You don't need as much of the complete design for the construction permit as opposed to a design certification.

MEMBER BLEY: But you accept some limitations?

MS. BRADFORD: Yes. So, I think some of them do think this is the way to go.

And then, there at the bottom, we talk about possibly, if there are resources and a need, just a whole new risk-informed, performance-based, technology-neutral regulatory framework.

So, like I said, if there is a need, if there are resources, we would try to move forward to that. We know there has been work done in the past on this, NUREG-1860 and some other approaches. So, we would want to take a look at all that work and go ahead and move forward as best we can.

Someone this morning -- I think it was Russ Bell from NEI -- mentioned policy issues. I just want to touch on those for a minute because many of the things that we are addressing for NuScale and SMRs do have at least some applicability to non-light-water. So, some of these things, in resolving them for SMRs, for NuScale, will pretty much be closed-out unless new information comes up also for non-light-water.

So, these things listed on these two slides are 17 issues that the staff raised in a SECY

paper in 2010 related to SMRs. And it is saying that we think we need to take a deeper look at these. All of the ones, obviously, with a checkmark and no further action, we think we have either satisfied ourselves that the regulations are applicable and we don't need a change or we have taken action since 2010 and we think we are in a place where no further action is needed on our part unless, again, industry comes forward with something that is out of the scope of what we kind of assumed when we resolved those issues.

The three that we are still working on right now are mechanistic source term. That is, obviously, for SMRs and non-light-water reactors. We are going to obtain some public input on that later this year.

We are looking at emergency preparedness, again, for SMRs and non-light-waters in terms of could the EPZ be smaller, based on the mechanistic source term.

And at some point, we want to look at insurance and liability just because of the quirks in Price-Anderson, whether or not it applies appropriately to smaller reactors.

MEMBER REMPE: Could you elaborate a

little bit more on your mechanistic source term and what you are doing? Because when you don't have a fuel and you have not tested it, I am just wondering what you are going to do, other than say, "Well, this is the dose at the boundary and I'll back out that the fuel has to perform in a way that doesn't exceed the dose at the boundary."

MS. BRADFORD: So, the title, we are calling this mechanistic source term, but it is kind of a misnomer. It is really the siting of these facilities. Could they be sited closer to population centers, closer than the large light-water reactors are, due to the fact that because of the small core, or their core will never melt, or whatever statements they are making, you can never achieve the doses to the public that the large light-waters do?

So, I say "mechanistic source term". It is not that. It is really the siting, and the mechanistic source term, of course, feeds into the siting.

MEMBER REMPE: Okay. There was a slide from industry that I have seen in the past that, basically, once a mechanistic source term defined for non-LWRs, which I thought was going to be very

difficult with what little data there are for a lot of the fuels, unless, again, you pick the dose at the boundary and you back out and say you can't go above that. And then, of course, there is the timing issue. And am I missing something?

MS. BRADFORD: No.

MEMBER REMPE: And can you do more?

MS. BRADFORD: No. And, actually, in the past the Commission has already said mechanistic source term approaches are okay if you have the data and can validate what it is you are saying.

MEMBER BLEY: If you want to pursue this further, let's do it toward the end.

MS. BRADFORD: Oh, yes.

MEMBER REMPE: Okay. Okay.

MEMBER BLEY: It has been a long five minutes.

MS. BRADFORD: Yes. I'm sorry.

MEMBER SKILLMAN: Anna, let me ask one question, please.

MS. BRADFORD: Yes?

MEMBER SKILLMAN: You have said where the bullet with no further action is checked, you are satisfied that there is either a regulatory position or that there is something that resolves

that?

MS. BRADFORD: Yes.

MEMBER SKILLMAN: Where can we find that explanation? I am particularly curious --

MS. BRADFORD: For each of these items, you mean?

MEMBER SKILLMAN: Yes. I'm concerned or I'm interesting in multi-modular risk. Where can we find what has been, if you will, the accepted resolution of that?

MS. BRADFORD: We sent up a Commission paper I think last year talking about readiness to review SMRs. And one attachment to that paper was a list of all of these items. And then, it provides a citation to the document that we think closed it out. So, say it is another SECY paper or it is we revised guidance; therefore, this is closed out. I can send that to you so you don't have to look for it.

MEMBER SKILLMAN: Would you, please?

MS. BRADFORD: Yes.

MEMBER SKILLMAN: Please send it to Mike, so that Mike can send it to us.

MS. BRADFORD: Yes.

MEMBER SKILLMAN: Thank you.

MS. BRADFORD: And, in conclusion, we developing new processes. We are in the initial stages. We are going to go out and try to get some input to industry. We don't want to go off in a corner for a year and figure out what we think conceptual design review or staged reviews are and, then, come out and industry say, "Well, this isn't what we need. This doesn't help us at all." So, we are going to try to get some public input; trying to avoid regulatory framework changes in the next five years, and then, longer-term possibly looking at a risk-informed, performance-based framework.

MEMBER BLEY: Thank you.

MS. BRADFORD: Sure.

MEMBER BLEY: Jan, when you go through yours --

MS. MAZZA: Yes?

MEMBER BLEY: -- the first eight slides, half of them are background.

MS. MAZZA: Yes.

MEMBER BLEY: Just highlight on those.

Committee, if you have questions about those, save them until the end and we will let you address them then.

But go through the background as fast as

you can and, then, focus on those last four or five slides about the future.

MS. MAZZA: Okay.

MEMBER BLEY: And then, we will leave time for people to continue this afterwards if they need to.

MS. MAZZA: Okay.

So, I am Jan Mazza, Project Manager in the Advanced Reactors Policy Branch, and I have been the lead PM on this non-light-water reactor design criteria effort. So, I was going to provide some background today and, then, the current status of the initiative and future activities.

As far as background, this started back in 2013, where NRC and DOE agreed to pursue the initiative. I guess what is important here is that the idea is to establish design criteria for non-light-water reactors similar to the light-water-reactor-focused GDCs in 10 CFR 50A.

10 CFR 50A states that the GDCs establish minimum requirements for the principal design criteria for water-cooled reactors, but, then, it also says that they are generally applicable to non-light-water reactors. And then, also, in the contents and application sections of 50

and 52, it is stated that principal design criteria must be included based on the general design criteria.

So, this slide basically talks about the purpose and what the outcome of the initiative should be. We used a phased approach. DOE was responsible for phase one of the approach, of the initiative. They developed a report that they issued in December of 2014 called "Guidance for Developing Principal Design Criteria for Advanced Non-Light-Water Reactor".

They sought a lot of stakeholder input, and I listed all the different stakeholders that they interacted with during their effort. What came out of their report is that they set out a proposed set of advanced reactor design criteria generally applicable to the six different technologies that are listed here.

They also set out a set of proposed sodium-cooled fast reactor design criteria as well as modular high-temperature gas-cooled reactor design criteria. And I think the thinking was that these technologies were the most far along and had the most information on. So, that is why they provided these.

They also had some technology-specific design criteria that they added that expand on the existing design criteria to address structure, systems, and components that are important to safety that are not necessarily included in the current GDCs that are light-water-reactor-focused. And some examples of this could be the intermediate cooling systems for sodium fast reactors and reactor-building design basis for modular high-temperature gas reactors. And they also expand on the criteria to address technology-specific hazards, such as sodium fires and, then, maintaining passive cooling geometry.

So, NRC has been responsible for phase two. We are considering the report, and we have developed our own set of advanced reactor, sodium fast reactor and modular high-temperature gas reactor design criteria. This is a big step. It took some time for us to develop a team. We had subject matter experts from across the agency. We have developed our version of the design criteria based on the DOE report, and we had put that out for public comment.

I am trying to get to these last slides.

We put these out for public comment in

April 2016.

MEMBER BLEY: You can slow down at this point.

(Laughter.)

MS. MAZZA: Okay.

MEMBER CORRADINI: And I just repeat what I think you said, just so that I have got it right? So, DOE provided you their document in December of '14?

MS. MAZZA: Yes.

MEMBER CORRADINI: And then, you provided for public comment a document in March or April of '16?

MS. MAZZA: Yes.

MEMBER CORRADINI: When I look at them, they look very similar. So, does that mean staff feels that pretty much you're on the same page?

MS. MAZZA: Yes. There was a lot of areas where we agreed with what the DOE's thinking was in many areas.

MEMBER CORRADINI: Are there particular things where you took a different approach or had a different view that were of sufficient importance that you could mention to us the examples?

MS. MAZZA: So, yes, I was going to

mention on another slide here --

MEMBER CORRADINI: Well, that's fine.

MS. MAZZA: It's coming up. It's coming up.

MEMBER CORRADINI: Okay. Good, good. All right. Fine.

MS. MAZZA: I'm sorry.

MEMBER BROWN: I'm sorry. Are you finished?

MEMBER CORRADINI: Yes, sir.

MEMBER BROWN: Is this the INL report that had the --

MS. MAZZA: Yes.

MEMBER BROWN: So, that is the only one I had to go down through the --

MS. MAZZA: Right.

MEMBER BROWN: -- various design criteria. So, that is what you are referring to in this case?

MS. MAZZA: Yes.

MEMBER BROWN: Okay. Thank you.

MS. MAZZA: So, we also developed our supporting technical rationale. I think you might have seen in the INL report that there was rationale for how they crafted the non-light-water reactor GDC

different from the current light-water reactor GDC. So, we did the same thing with ours. We came up with our own opinions and reasons why we deviated from the current GDCs.

We received over 350 comments from over 20 different stakeholder organizations. So, it is a lot of comments and it was a lot of hard work that, obviously, people put into putting these sets of comments together.

MEMBER BLEY: Where do you stand on going through those?

MS. BRADFORD: Well, it just closed June 8th.

(Laughter.)

MEMBER BLEY: Okay, June 8th. That's very good.

MEMBER POWERS: It doesn't change the question. What's holding you up?

(Laughter.)

MS. MAZZA: So, yes, we are considering the comments. The next couple of steps are going to be having some additional public interactions on certain areas.

Let's see here. One thing I want to mention here is that security design considerations

are something that was not part of the original DOE report, but we developed -- I have to find my slide -- we developed these because we felt they were important to the development of a design. Rather than putting security in at the end, that security is designed into the nuclear power plant.

So, these have lagged a little bit behind the non-light-water reactor design criteria, but we are reviewing them now and we are hoping to get them out for public comment in the next couple of weeks. And then, they would become part of our regulatory guide that we issue for design criteria.

MEMBER BLEY: Given the little bit we have heard about NuScale trying to integrate security in their design from the beginning, do you see this as likely being applicable to your review of NuScale when it comes in?

MS. MAZZA: Well, I think that it might be applicable to not only non-light-water reactors, but light-water reactors as well.

MS. BRADFORD: At least the ideas and the thinking behind them, not necessarily these non-light-water security design considerations.

MEMBER BLEY: Given the way at least it has been hinted to me how they are considering this,

it seems important to have something like that ready, although I don't know if that belongs to you guys or who.

MR. MAYFIELD: The discussion with NuScale is an ongoing discussion. The notion for the SMRs as well as the advanced reactors, they are early enough in the design development that they can, in fact, incorporate security considerations into the design and do so effectively, rather than it be something you try to add on at the end.

So, it is an ongoing dialog. We have told the whole vendor community from very early on, going back 2008-2009 that the expectation is that they would meet the same security regulations that the large lights meet. The way they meet them can be significantly different. And so, that is the dialog that is ongoing.

What we have got in these design considerations I think is consistent with the conversations, as I understand, that NSIR has been having with NuScale.

MEMBER BLEY: Okay. Great. Thank you.

MEMBER REMPE: I had a question about the philosophy for the advanced design criteria. In some of the information we were given, it was

talking about the Commission had an expectation that the new reactors would be safer. In fact, 10 CFR 52 required more with respect to instrumentation for beyond-design-basis events than the 10 CFR 50 information is. And for the AP1000 they actually evaluated a certain type of instrumentation for the performance during severe accidents.

When I was looking at what was in the document with the agreed-upon design criteria between DOE and NRC, I didn't get that sense that something else was being thrown in that wasn't there for the existing fleet. Anyway, I didn't see anything else to reflect some additional expectations of enhanced safety. Did that thought come across when you were looking at the design criteria?

MS. MAZZA: Yes, I think we always would go back to that advanced reactor policy statement and say, okay, this is what the Commission has said that these non-light-water reactors and advanced reactors ought to be --

MEMBER REMPE: So, if they took a 10 CFR 50, you do still expect them to have, down in the details you would expect them to have instrumentation that could survive

beyond-design-basis accidents?

MS. MAZZA: Well, if they went with 10 CFR 50, they would be expected to meet all the 10 CFR 52 requirements that have come about post-10 CFR 50, yes.

MEMBER REMPE: Okay, okay.

MS. MAZZA: Okay. So, here's the big slide that I think we have been waiting for. It is further engagement. So, we expect to have further engagement with stakeholders. We have identified several areas that would need further engagement. This is not a comprehensive list. This is one thing that the team is looking at right now. You know, from the set of comment, the 350 comments, you know, in their particular areas, are there other areas where we might need additional engagement? But this is just sort of a short list for now.

For modular high-temperature gas reactors, the concept of functional containment is an issue that the NRC staff has brought to the Commission in the past. The Commission has found it generally acceptable, pending demonstration of TRISO fuel performance, as indicated in SRMs to SECY-93-092 and SECY-03-047.

The NRC staff also provided feedback to

the DOE as part of the Next-Generation Nuclear Plant Project on this issue.

So, the DOE report utilizes this functional containment as sort of an umbrella definition, that it could be a traditional containment structure or it could be the several layers of TRISO fuel coatings that also achieve this, the dosage, you know, the onsite and offsite dose requirements.

MEMBER CORRADINI: Can I ask you a question here, just a thinking question? You don't have to answer.

We essentially now, with the orders and the rules, now have a functional containment for BWRs, Mark I and Mark II. They are vented, filtered, with their water containments. So, are they functional containments or containments?

MS. MAZZA: We'll think about that. That is a thinking question.

(Laughter.)

MEMBER CORRADINI: Because I am asking the question very specifically. Because it seems to me some of these advanced designs, and claiming that they only need a functional containment, not relying on the fuel, it is relying on the complete system,

as we are relying on the complete system in current plans.

MS. MAZZA: And the Commission has said functional containment might be okay if you can prove that you achieve those results.

MR. MAYFIELD: Like what DOE is talking about, what that segment of the industry is talking about, does not have a structure, a confinement, containment kind of structure wrapped around it, vented or not.

MEMBER CORRADINI: Okay. Okay. I wasn't aware.

MR. MAYFIELD: So, it is that is the distinction that has been drawn because for a large MHTGR it is just too expensive --

MEMBER CORRADINI: So, it is just a building --

MR. MAYFIELD: -- to put it around it. So, there is some sort of confinement. I have used that term, and it always elicits a very negative response. So, I'm not going to follow you down that path.

(Laughter.)

MEMBER CORRADINI: No, I figured you wouldn't. You're much more diplomatic than that.

MR. MAYFIELD: Well, I get to sit on this side of the table rather than that.

(Laughter.)

MEMBER CORRADINI: Okay. Right.

All right. You're on, Jan.

MS. MAZZA: All right. So, anyway, the DOE had utilized the term "functional containment" for all three sets of design criteria; whereas, the staff, we considered that and thought, well, you know, it could apply to the modular high-temperature gas reactors because of the TRISO fuel, but we would not agree to that for the sodium fast reactors or maybe all the other block of designs that are encompassed in the advanced reactor design criteria. So, we had a lot of comments on that because we made that change.

MEMBER CORRADINI: Okay.

MEMBER POWERS: Don't you run into just real difficulties with the concept of defense-in-depth?

MS. BRADFORD: I'm sorry?

MS. MAZZA: I didn't hear the beginning.

MEMBER POWERS: Don't you run into defense-in-depth difficulties with --

MS. BRADFORD: Sure, and that is

something we have to consider when we are looking at all of these. You don't want to chip away at the defense-in-depth at different angles to the point where you have nothing.

MEMBER POWERS: Yes, it seems to me that multiple layers around the fuel, they are not independent.

MS. BRADFORD: Understood.

MEMBER POWERS: Yes.

MS. MAZZA: So, another area where we will definitely need further engagement was for modular high-temperature gas reactors. They set the stage for acknowledging, on Design Criteria 10, we set the stage for acknowledging that some radionuclide releases will occur due to the nature of TRISO fuels. And so, the DOE introduced a concept of SACRRDL to replace SAFDL. SACRRDL is a Specified Acceptable Core Radionuclide Release Design Limits versus Specified Acceptable Fuel Design Limits.

So, this is something that I think we are going to have engage in further. It is something that has not been brought up to the Commission. So, we haven't really considered that fully, but that is something we will definitely need

further engagement on.

MEMBER SKILLMAN: To that point, on that design criteria, it isn't just the term "SAFDL". That new statement is that it is appropriate for AOOs for that type of reactor.

MS. MAZZA: Yes.

MEMBER SKILLMAN: And doesn't that really establish a need to describe what those AOOs are?

MS. MAZZA: Yes.

MEMBER SKILLMAN: And that is going to require a much more specific understanding of that particular reactor design.

MS. MAZZA: Yes, not just the technology.

MEMBER SKILLMAN: To know what the AOOs are, you need to understand this machine very thoroughly.

MS. MAZZA: Yes.

MEMBER SKILLMAN: So, it is not just SAFDL and the new acronym. It is understanding the basis for the AOOs for that new design.

MS. MAZZA: Yes.

MEMBER REMPE: When I read that, I thought, also, it would require some sort of

monitoring system, right?

MS. BRADFORD: Yes.

MS. MAZZA: Michelle, nod your head.

(Laughter.)

Okay. Another area which I didn't list here that we have gotten several comments on was removing single failure criterion. So, that is something that we are going to have to consider and discuss in the future.

MEMBER POWERS: I just can't help but remark that every reactor that I have ever worked on has been at one time or another described to me as impossible to melt or catastrophically release, and that includes PWRs prior to 1979, even after 1979, BWRs prior to Fukushima, and RBMKs prior to 1986.

MS. BRADFORD: And so, the reason these particular issues are on this slide is because we know they are going to require more discussion and more thinking internally. And some of these we did not adopt DOE's proposal, for these various reasons. So, I don't want to suggest that, oh, yes, we are going to go ahead with what DOE suggested, but we are going to get some more public input. In many cases we are not, but the conversations needs to be held in terms of is there something else we need to

think about or they need to think about, so that we can make sure we are in the right place with these.

MS. MAZZA: Okay. And then, electric power systems is another area where, for onsite and offsite power, that has been a topic of discussion for the large light-water reactors and SMRs due to their passive design. So, it is no surprise that the non-light-water reactor community is going to have some of the same concerns in that area.

MEMBER REMPE: So, in the discussion for that, when I read it, there is a phrase in there about the Subcommittee meeting, that the Subcommittee had a favor response. And the Subcommittee doesn't ever speak. And so, when you update this, I think you might want to take that phrase out.

MS. MAZZA: Okay. Thank you.

MEMBER REMPE: John does that discussion better than me, but I try.

(Laughter.)

MS. MAZZA: In our rationale?

MEMBER REMPE: Uh-hum.

MS. MAZZA: Okay. Thank you.

Any other questions on No. 17?

(No response.)

All right. And then, Nos. 34 and 35 for the advanced reactor design criteria and for the sodium fast reactor and the module high-temperature gas reactor design criteria, they cover residual heat removal and emergency core cooling. We got a lot of comments on those.

These tend to be a very technology- or design-specific design criteria. So, there were a lot of comments on: what if we have a sodium fast reactor that doesn't have an intermediate cooling system? What about localized sodium boiling? That might be okay in some cases. So, lots of comments there that we have to work through.

Also, there was a lot of comments on the chemical, on the non-reactive chemicals between the sodium and the cooling fluids versus being chemically-compatible. So, that is just sort of a smattering of some of the comments we got on these two.

And also, No. 35, emergency core cooling system may not be applicable to a lot of non-light-water reactor designs. And so, there were some comments there as well.

And then, finally, of course, the security design considerations are something new,

and we feel like we will probably get some, need some additional interaction on those as well.

So, for future activities, we are going to review and consider the informal comments on the non-light-water reactor design criteria. We are currently reviewing and considering all these comments and trying to determine where we need the further public engagement, and putting our schedule together for when we will have the comments done, and get our draft Reg Guide together.

We plan to have some public meetings either late summer or early fall to discuss these issues. We are going to issue our security design considerations for an informal public comment period. And then, we plan to have issue our draft Reg Guide for a 60-day formal public comment period early 2017. And then, we will have our ACRS review and interactions along the way on the draft Reg Guide or, if you all feel that we need additional interactions before that on specific topics, we would be glad to come back. And then, final Reg Guide issuance is planned for some time in 2017.

MEMBER BLEY: The third bullet is the only one that doesn't have a date assigned to it. When are you thinking about that?

MS. BRADFORD: Yes, we're thinking in the next couple of weeks.

MEMBER BLEY: Oh, okay. So, it is close?

MS. BRADFORD: It's close. It has gone through several iterations.

MS. MAZZA: We're just trying to polish it.

MR. MAYFIELD: Because we are breaking some new ground here.

MS. BRADFORD: Yes.

MR. MAYFIELD: This isn't something that we have put out as GDCs before.

MEMBER BLEY: Right.

MR. MAYFIELD: You might expect that is some significant interest from Deputy EDO and others. So, we are sort of in the last throes of aligning to make sure that they are comfortable with what we are going to put out.

MEMBER BLEY: Okay.

MR. MAYFIELD: So, it is something that has attracted a fair bit of, I think understandable, high-level management attention. So, that has delayed these a bit longer, and there is still some hesitancy about putting a specific date on it. But

I do believe we are close.

MEMBER BLEY: Okay.

MEMBER SKILLMAN: Let me ask this question, just so I'm clear on what we are dealing with here. When we did the designs under Part 50, we used Appendix A to 10 CFR 50. And in the course of time, the Regulatory Guides came out and we in many cases had to adapt what we had done under Part A, the General Design Criteria, with what we learned from the new and evolving Reg Guides. That is 1969, '70, '71, '72, '73.

What I have read in this documentation is that what you are going to produce for the advanced reactor design is a Regulatory Guide and the "must" and "shall" that is regulatory embedded in Appendix A will now show up in a Regulatory Guide. And the user of the Regulatory Guide, once adopting the Reg Guide, submits to the "shall" and "must".

So, the new design criteria are actually going to be a Reg Guide. Is that accurate? That is what I have taken away from all of my homework on this. The product for the advanced reactor design criteria will be a Reg Guide. And then, those who buy into the specific design will use the Reg Guide,

and the Reg Guide, then, becomes a substitute for Appendix A to 10 CFR 50.

MS. BRADFORD: Not quite.

MEMBER SKILLMAN: Okay.

MS. BRADFORD: I mean, it is going to be a Reg Guide, you're right. And we discussed what the right vehicle was or what the right document was to put these out.

If you look at, like I think Jan mentioned, the first part of Appendix A, it specifically says these GDCs aren't applicable to non-light-waters. They are generally applicable or provide general guidance, something like that.

MEMBER SKILLMAN: Okay.

MS. BRADFORD: So, in our discussions with OGC, we came down to let's do a Reg Guide which will provide guidance on how we think non-light-water designers could meet kind of the intent of the GDCs, the safety purpose of those GDCs, but it is not -- we expect that people will come in and it could vary from those ARDCs that we are talking about in that document, because we are putting these out. Like all of our guidance documents, you can use this approach and we can discuss how you have stated that you are meeting

that approach or you could propose a different approach. But I don't want to say that these are now a regulatory requirement the way that GDCs and Appendix A are because they don't have that pedigree; they are still guidance.

MEMBER BROWN: I went off and looked at one of the -- I guess the INL group. I didn't have the other one with the comments, responses. And I looked at stuff I am interested, GDC 20 through 29. And they are in the rule right now.

And I can't foresee that somehow the application of those requirements, which are pretty broad and top-level, are now going to be incorporated into a Reg Guide of some kind where people can kind of pick and choose and now say, "Well, we've evaluated this, and based on our performance-based review, we don't need any of these," and therefore, suck it up and live with it.

I'm not exactly exaggerating because we faced that when we were doing our first Part 52 reviews, and the vendors, the licensees were saying, "We'll give you a block diagram that shows detectors, a protection system, and a scram, and that's all you need to know. We'll follow all your Reg Guides, and you've got to be happy with that."

And that lasted for a couple of months before they decided, figured out they weren't going to live -- we weren't going to accept it.

So, I have a hard time -- I don't know if Dick does or not -- but I have a hard time seeing nothing in the rules, and it is everything in a Reg Guide where people get to pick and choose and argue with us all the time. That is not a way to get a design done, in my opinion.

MEMBER SKILLMAN: Well, let me respond to that. But, also, let me provide the explanation for what I said several minutes ago.

I'm in the invitation for public comments, and on page 5 these are the words: "The proposed safety ARDC, SFRDC, and HTR GRDC also utilize the words `shall' and `must' for consistency, but any Regulatory Guide that ultimately incorporates the design criteria will be guidance and not regulatory requirements. The `shall' and `must' language will apply only to those applicants that commit to use the Regulatory Guide. The NRC is not currently planning a rulemaking on 10 CFR 50.

MS. MAZZA: Right.

MEMBER BLEY: We can have a discussion

on this.

MEMBER SKILLMAN: Okay.

MEMBER BLEY: I understand what you want.

MEMBER SKILLMAN: I just wanted to point out what it says.

MEMBER BLEY: I'm sorry, but that's what it says.

MEMBER SKILLMAN: Okay.

MEMBER BLEY: And I suspect -- you know, these are guides for all non-LWRs and probably over time there might be something set for specific ones. Who knows?

You need to finish up in one minute. I know that is not much time. I'm sorry, Jan.

MS. MAZZA: It is just my summary.

(Laughter.)

MEMBER BLEY: And I think you have covered all that, but if you want to say anything more, go ahead. And then, we are going to stop and do a couple of other things. And then, we can come back and have discussion.

MS. MAZZA: I am just summarizing that we are moving along with our project. It continues to progress. I think we have made some good

progress.

Security design considerations were developed to help designers resolve security issues through the facility design. Further engagement is expected on key issues, and future activities include developing the draft Reg Guide, some ACRS interaction, public meetings and comment period, and developing the final Reg Guide.

That's it.

MEMBER BLEY: And thanks very much.

I am going to stop right now. I want to ask a question. At this time you brought this to us for information. You aren't looking for a letter on anything at this point?

MR. MAYFIELD: Not at this point, no, sir.

MEMBER BLEY: Okay. I would expect at some later point the design review process, as it leaves the conceptual stage and becomes a little more firm, we will be talking about that.

MR. MAYFIELD: Absolutely.

MEMBER BLEY: The non-LWR design criteria, we will really want an opportunity to comment on that.

MS. BRADFORD: Yes.

MR. MAYFIELD: Absolutely.

MEMBER BLEY: And the "when" is sometime in the future. I guess we can't really pin that down, but the sooner the better on that one because I think that could have a lot of discussion for us.

And I was curious about when you see the likely first interactions with us on the implementation action plans that Mike talked about.

MR. MAYFIELD: We owe the draft of those -- well, I guess really it is not the draft. We owe the plans for the near-term actions to the EDO by September 30. Whether we are going to be able to bring those -- now that is just the zero to five-year piece -- whether we are going to be able to bring those, just timing, for the Committee to engage on is, I think, debatable, just because it is summer schedule.

What I would rather do is defer that until we owe the action plans on all of the strategies by February 15th of '17. My preference would be to bring that package to the Committee in advance of submitting the complete set to the EDO.

MEMBER BLEY: Okay.

MR. MAYFIELD: Well, and --

MEMBER BLEY: That sounds good to me as

long as you come soon enough that --

MR. MAYFIELD: Well, yes, to try to do something on the near-term actions between now and September 30 I think, for you to actually be able to weigh-in in any significant way, I think is probably not viable. However, to do something with the complete set and give you adequate time to review and comment, I think to do that before February 15th is doable. And that is what I would propose to the Committee.

MEMBER BLEY: Okay.

MEMBER POWERS: Yes, I think, Mike, I wouldn't hesitate to come in even if you were in a fairly primitive state on those 15 things, just because these things you are largely looking for stuff that is not there.

MR. MAYFIELD: Right.

MEMBER POWERS: And you need to think about it a while. I mean, it is like Dick's "will" and "shall", things like can an inspector cite against it and things like that come to mind, but usually not in a presentation or even in reading things the first time.

MEMBER BLEY: Okay. I'm going to quickly go around the table, get some comments. And

if we want to have more discussion, Mike and I will leave and the rest of you can --

MEMBER MARCH-LEUBA: There was a request to call the phone line.

MEMBER BLEY: Say it again?

MEMBER MARCH-LEUBA: There was a request to make comments on the phone line earlier.

MEMBER BLEY: Oh, you're right, there was.

Okay. Well, you and I are leaving at noon, and we will have to turn it over.

Mike, we'll make our own comments right now. Or do you want to make any comments before we leave?

MEMBER CORRADINI: No, I guess I want to thank all the parties here who gave presentations.

But I really do think that DOE tried in the spirit of trying to think through this with this option study, and I really think that is at least on the table as a workable document to comment against. So, I really would encourage the industry and the staff to look at it, particularly because they had a complete section of objections. Joy has the section memorized. Seven, was it seven? On licensing that suggests how one might go forward, and I really

think they have some reasons for that based on schedule, cost, and efficiency and effectiveness. And I think it is worth thinking about.

Other than that, my only other comment is I take it from the staff's presentation that a lot of the lessons learned from NuScale, since some of them are technology-neutral, will be applied here.

MEMBER BLEY: Okay. Okay. Thanks, Mike.

I don't really have anything beyond the things I have already said, except to thank you for coming. It has been a good discussion. We look forward to more in this area.

At this time, Mike Snodderly, could you get the phone line open?

And while we wait for that, is there anyone in the audience who would like to make a comment at this time? If so, please come to a microphone. Thank you.

I hear no crackles yet (referring to the phone line). He says it is open?

MEMBER KIRCHNER: I hear a click.

MEMBER BLEY: Okay. There were people on the phone line who wanted to make a comment. If

you are one of those, please announce your name and where you are from and make your comment at this time.

MR. MERRIFIELD: Yes, Jeff Merrifield, former NRC Commissioner.

MEMBER BLEY: Commissioner, go ahead.

MR. MERRIFIELD: Yes, thank you very much.

As Dennis Bley mentioned, I chair the NIC Advanced Reactor Task Force, and in my role at Pillsbury Law Firm, actually, also represent several advanced reactor companies.

I certainly appreciate the invitation of the ACRS to come visit you today. Unfortunately, my schedule was such I could not attend in person. I have been listening to the entirety of the meeting and would welcome the opportunity to come back to Washington to meet with the ACRS on these issues in the future.

In listening to the conversation, there was, I think, some very good dialog, and I appreciate the ACRS's focusing on this. I was a bit puzzled by some of the questions that have been expressed today about the need to narrow some of the technology choices. There are a variety of

technology providers out there, I think as others have mentioned. I think the market itself will narrow that.

When looking at the NRC and its statutory responsibility, the Atomic Energy Act clearly asked the agency to license designs that it determines are safe and which meet the adequate protection standards. For its part, ACRS's role, as you all know, is to review safety stuff and facility license applications that are referred to it by the Commission and to make reports regarding their hazards and the adequacy of proposed reactor safety standards.

There is no statutory language under U.S. law which mandates any sense of a down-selection of designs for the advanced reactor community, either by the Department of Energy or by the NRC. And so, I am a bit concerned about the focus so much on the need to narrow. I think reactor developers should not be discriminated against in any way. They certainly have to meet the NRC standards, and the role of ACRS in helping define those is appropriate and important, and one which I think you all will continue to focus on.

I do want to say I think the NRC staff

has made great progress in preparing itself for advanced reactors. Its recent publishing of some of the proposed advanced reactor design criteria is helpful. As mentioned, those were focused on fast reactors and high-temperature gas reactors, along with some generic standards.

Certainly, I think it is the view of NIC that additional focus on other criteria, such as molten salt or bismuth may be useful.

A couple of final comments. I think many of the advanced reactor technologies, although not all, do have significant reduced source term, some of which operate in atmospheric pressures, so the issue of focusing on source term is one that we think does make a lot of sense for some of these designs.

It would be very helpful for ACRS to work with the staff to appropriately review and balance these licensing requirements. And in the absence of specific designs -- and some of them will be coming sooner than others -- I think focusing on some of the generic designs, focusing on a group of high-temperature reactor issues, a group of pebble-bed issues, a group of molten salt reactor issues, and others, may be very useful in the

process.

Finally, I think the issue with all of this is that for these developers of advanced reactor designs, having an ability to understand what that streamlined process may look like prior to having to put that information in a formal application would be very helpful in helping them to tailor their application to meet those requirements and not result in unnecessary implementation and burden to meet requirements which are not applicable.

So, those are some comments. I appreciate your listening to me. And as I said before, I look forward to meeting with the ACRS in the future.

MEMBER BLEY: Thank you very much.

I am going to turn the meeting over to Dr. Joy Rempe.

MR. LEWIS: Marvin Lewis --

MEMBER BLEY: Marvin, just a minute. Just a minute. I'm turning over the chairmanship of this meeting to Dr. Rempe at this time, and the conversations can continue.

Marvin, now you can go ahead. Thank you.

MR. LEWIS: Thank you.

Okay. Dr. Rempe, I guess I'm up.

I just want to remind you that there is a place in Simi Valley called Santa Susana, I believe. And it has a bit of history, probably the largest discharge of radioactivity from an accident that nobody ever noticed. An interesting history.

I hope the NRC, I hope the Department of Energy will try to look at these previous incidents. I call them "incidents" because, by law, I'm not allowed to call them "accidents" unless CMSC so specifies.

And I hope that it will get into your viewpoints and your look-see about Santa Susana and Clinch River back in the fifties, I think it was, and a place called Fukushima across the Pacific.

Thank you.

MEMBER REMPE: (presiding) Thank you, Mr. Lewis.

Is there anyone else out on the phone line who wishes to make a comment?

(No response.)

And not hearing anybody, I'm going to ask Mike to make sure that the phone line is closed.

And I would like to go around the table

and ask those members who are still present to make comments.

John, are you getting ready to leave and we should let you go first? Okay.

So, then, let's start with the new member, Matt Sunseri.

MEMBER SUNSERI: Thank you, Dr. Rempe.

I just want to extend my appreciation to all the presenters today. I found the presentations to be informative and the dialog to be useful.

Thank you.

MEMBER REMPE: Okay. Dick?

MEMBER SKILLMAN: Thank you.

I appreciate the staff and the other presenters, and I have no further comment. Thank you.

MEMBER REMPE: Dana, do you have any comments?

MEMBER POWERS: Well, one could make a lot of comments about the presentation by DOE on what their thinking is, but that is not really our job. So, I'll pick on the staff.

You're taking on the tough challenge here, and I think Mike is right when he says it is the implementation. Great ideas and lots of bullets

have to come together. And I think it would be useful to get us involved quickly, even in a preliminary stage. You don't have to have everything polished, and whatnot.

We do have the flexibility to do off-the-record Subcommittee meetings to allow ideas to be kicked around maybe a little more. Because I think we are really getting into the heart of whether we believe in adequate protection and how fervently believe, and do we believe in defense-in-depth and how fervently do we believe when we get into these things?

I reiterate that we are seeing an era where computer codes are taking the place of experimental engineering to a greater and greater extent. And that is probably all to the good, but there is a point where we are going to have to demand experimentation. And that is going to be a problem for the less-well-funded vendors, and they are going to be resistant to that.

And so, we have to have a fairly firm conviction and a defensible conviction on where we need experimental data to persuade ourselves that the contentions are correct. And that is going to have to be a conviction that can stand up to a fair

amount of intra-agency and interagency and political pressure. So, it has got to be one that we are absolutely convinced of. It can't be we just think it is a good idea to have experiments. It is we absolutely need to have experiments to validate these computer outputs.

Again, I come back over and over again to our experience with high burnup where a relatively-modest change in the burnup of the fuel produced a fairly dramatic change in its response to off-normal situations that was not anticipated by any computer code because the material changed its properties. And we have to keep reminding ourselves of that.

MEMBER REMPE: John?

MEMBER STETKAR: I don't have anything else to add. I don't want to rant on.

I am interested, I think it is a very good idea to have the staff come before us sooner than later, even if you don't feel that some of the concepts are fully polished. I think that perhaps getting some of our insights on what is not there, rather than what is there, might be quite useful.

MEMBER REMPE: Jose?

MEMBER MARCH-LEUBA: Thank you.

First, I want to thank you all for the presentation, and DOE and the industry, because it was very informative.

But I want to show my skepticism of the whole process. Two weeks ago we were in a vendor's facility, and they were showing us the results of the new fuel, a fuel that if you look at it, there is just the old one hanging from the wall. You don't see the difference, and it is the same fuel. And we asked them, "How long did it take you to get it ready?" Twelve years.

And we are here saying that we are going to develop a brand-new reactor, completely different technology, without experimental data, in 13, and unfocused. So, let me just get the necessity of the exercise. That was comment No. 1. That was mostly for DOE and the industry. I mean, you guys need to focus because it takes 12 years to do an evolutionary piece of fuel that you cannot see the difference from the other one. Okay?

Now this comment is for both of you. I am really concerned that there is no emphasis on developing methods and codes. The staff should insist that whoever wants to build this reactor start developing the methods and costs now. And

start validating them now because, when you try to validate them, you find out what are the holes in your experimental database.

So, when you try to say, is this code any good, you will have to have benchmark data. That benchmark data will lead into the experimental needs, and it will tell you where you are.

And the reason for this is that the total mix of this reactor is going to be driven by how close you can get to operate it to limits. You cannot have an economic reactor less than limits because, if you can have 20-percent more power, you will have 20-percent more free money. Okay? So, you are going to operate on limits. You have to have methods that are accurate to determine those limits. And to have methods that are accurate to determine the limits, you have to have benchmark data and validation. That should be the No. 1 thing that we should be pursuing, and it should come from the start because they are not going to do it unless you request it.

Finally, I have a third comment for the staff, that we need to streamline the review of those methods and costs. I mean, this is the first time I sit on this side of the table. I'm always on

that side of the table. Okay? So, I know exactly how it works.

And we have enough time. Let me give you an example of, I mean, the way the review process from the staff typically works is like walking my dog to the park. And I'm trying to go straight through there and she keeps going left and right because she sees the squirrels.

And whenever they send this review in, you are going to find a squirrel. They are going to call it a red herring. And you are going to spend 18 months following that squirrel to completion while you forget the main path.

So, we need to have an emphasis from the staff on streamlining the review and keep your eye on where the end of the path is. Don't follow every single squirrel. Otherwise, we will never review these things in the two-three years that you are expecting to.

And, yes, that's what I have.

MEMBER REMPE: Walt?

MEMBER KIRCHNER: Thank you.

I have no comments other than to thank the presenters today.

MEMBER REMPE: Okay. So, then, it's me.

I want to thank everybody who presented. I actually want to compliment the staff as well as DOE on their efforts with the design criteria because, in my opinion, it is the devil is going to be in the details, and it is a step forward, just as with the NuScale program as it resolved a lot of issues or will resolve a lot of issues that will apply with the advanced reactors.

And so, having a couple of case studies and seeing what the issues are I think helps this process big time. Although it isn't our role to comment on other industry or DOE's focus, on the other hand, $5 million which has been proposed is a lot of money. And so, the staff needs to, if they want progress to be made, there needs to be a prioritization so the staff can apply the most emphasis on what the near-term issues are.

And Mike mentioned, yes, we know what is coming in soon. So, I think just general honesty across the board by everybody who is talking to other folks would be helpful, that these are the nearer-terms and we are prioritizing what the nearer-term issues are, so we can make progress. And so, I wanted to emphasize that point.

With that, I think it is time to close

the meeting and thank everybody.

(Whereupon, at 12:05 p.m., the meeting was adjourned.)

U.S. DEPARTMENT OF ENERGY | Nuclear Energy

DOE Initiatives on Non-Light Water Reactors (Vision and Strategy)

Craig Welling
Deputy Director, Advanced Reactor Technologies
U.S. Department of Energy

Advisory Committee on Reactor Safeguards
Future Reactor Designs Subcommittee
July 6, 2016

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Advanced Non-Light Water Reactors Overview

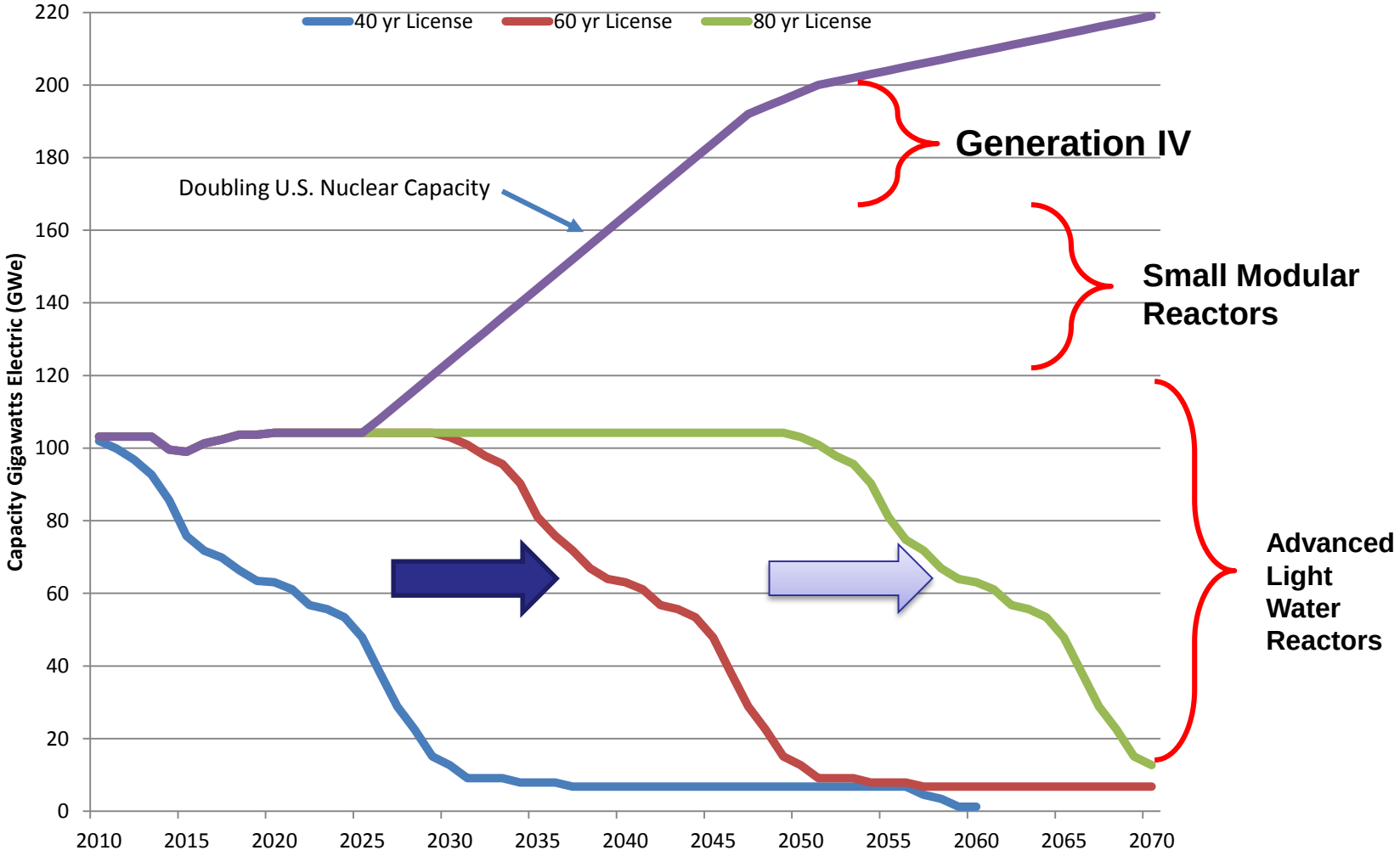
There has been increasing interest in advanced Non-light water reactors and benefits they can provide toward clean energy and energy security needs.

- **DOE initiatives have included:**
  - Development of a vision and strategy for advanced reactors
  - Establishment of the Gateway for Accelerated Innovation in Nuclear (GAIN)
  - Conduct of a Test/Demonstration Advanced Reactor Planning Study
  - Providing cost shared support for reactor concepts.
- **These initiatives support the need for new nuclear capacity that will be needed in the 2030 to 2050 time frame.**

U.S. DEPARTMENT OF ENERGY

Nuclear Energy

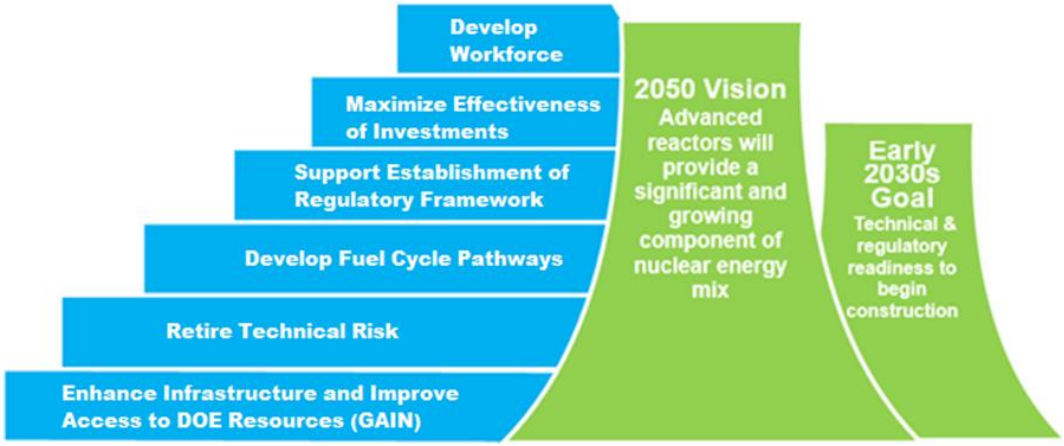
Nuclear Power Capacity needed to meet Clean Power Goals



U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Vision and Strategy for Advanced Reactors

- **To meet the challenge, DOE has developed the *Vision and Strategy for Development and Deployment of Advanced Reactors***
  - Final draft publically available at http://energy.gov/ne/downloads/draft-vision-and-strategy-development-and-deployment-advanced-reactors
- **The Vision and Strategy will complement DOE efforts to:**
  - Support the current Light Water Reactor fleet
  - Pursue the construction/operation of Generation III+ reactors
  - Support the development/licensing/deployment of Small Modular Reactors



Vision and Strategy for Advanced Reactors

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Vision and Goal

VISION

By 2050, advanced reactors will provide a significant and growing component of the nuclear energy mix both domestically and globally, due to their advantages in terms of improved safety, cost, performance, sustainability, and reduced proliferation risks.

GOAL

By the early 2030s, at least two non-light water advanced reactor concepts have reached technical maturity, demonstrated safety and economic benefits, and completed licensing reviews by the U.S. Nuclear Regulatory Commission (NRC) sufficient to allow construction to go forward.

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Strategic Objectives

1. **Enhance the innovation infrastructure for nuclear technologies and vastly improve access to DOE expertise and capabilities through the Gateway for Accelerated Innovation in Nuclear (GAIN) initiative**
2. **Demonstrate performance and retire technical risks for advanced reactors**
3. **Support the development of fuel cycle pathways for advanced reactors**
4. **Support the establishment of an efficient and reliable regulatory framework for advanced reactors**
5. **Effectively leverage public/private sector resources and policy incentives to aid the private sector in accelerating advanced reactor deployment**
6. **Address human capital and workforce development needs**

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Enhanced Nuclear Innovation Infrastructure and Improved Access

- **Continue to enhance experimental, testing, and simulation capabilities while vastly improving access to DOE expertise and facilities. Key activities include:**
  - Implement the Gateway for Accelerated Innovation in Nuclear (GAIN)
    - Provides greater access to experimental, testing, and modeling and simulation capabilities
    - Facilitates use of the DOE nuclear technology database
    - Promotes broader engagement with industry to understand technical needs.
  - Restart the Transient Reactor Test Facility (TREAT)
  - Use the results of the advanced test/demonstration reactor planning study
  - Explore options for adding international collaboration elements to GAIN and the Nuclear Science User Facilities (NSUF) program

TREAT Facility

GAIN Gateway for Accelerated Innovation in Nuclear

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Retiring Advanced Reactor Technical Risk

- **DOE will pursue a multifaceted set of efforts to retire technical risks associated with advanced reactors including:**
  - Soliciting industry input on R&D needs
  - Supporting cost-shared, industry-led R&D for concept-level development and conduct research on advanced reactor technologies to reduce risk, enhance safety and security and improve economic competitiveness.
  - Activities to support advanced reactor development
    - Laboratory directed R&D and relevant research projects selected through the DOE's Nuclear Energy University Program
    - Potential consideration to develop a test/demonstration reactor(s) to further enhance testing capabilities and support the timely deployment of advanced reactors
    - Pursuing technical solutions to support the changing role of nuclear energy as part of a diverse electricity generation mix and for non-electric uses

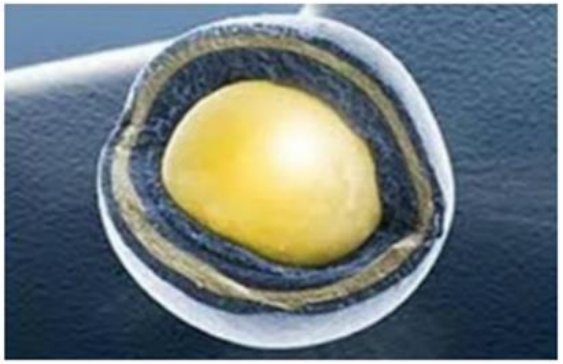
Mechanisms Engineering (Sodium) Test Loop at ANL

High Temperature Test Facility at Oregon State University

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Fuel Cycle Pathways for Advanced Reactors

- **DOE will pursue R&D to develop improved fuels for existing reactor technologies and suitable fuels for advanced reactors. Working with industry, these efforts will likely focus on:**
  - TRISO-coated particle fuel for high temperature reactors, metallic fuel for fast reactors, and transmutation fuels for longer-term applications
  - Identifying and characterizing fuels and separations/enrichment technologies.
    - DOE would assess the need for and/or provide for the deployment of fuel cycle facilities.
  - Addressing the back end of the nuclear fuel cycle
    - DOE is pursuing R&D to develop the technologies and capabilities needed to enable the safe storage, transportation, and disposal of used nuclear fuel and wastes generated by existing and future nuclear fuel cycles



TRISO coated particle fuel

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Supporting Regulatory Framework Development for Advanced Reactors

- **DOE and its stakeholders will collaborate with the NRC as the NRC develops a regulatory framework for advanced reactors. Potential efforts include:**
  - Providing assistance to the NRC as it develops
    - design criteria for advanced reactors
    - potential staged licensing and preliminary licensability review processes
  - Assisting the NRC in resolving key policy issues by
    - co-hosting joint workshops
    - exploring options for new fuel and fuel fabrication facilities
    - modifying existing guidance (such as the Standard Review Plan) to accommodate advanced non-light water reactor designs

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

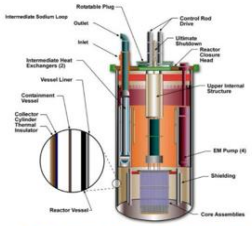
Maximizing the Effectiveness of Public and Private-Sector Investments to Accelerate Advanced Reactor Deployment

- **DOE will explore new ways to work with the private sector to accelerate advanced reactor deployment and support further development of advanced reactor concepts.**
  - DOE would use public-private partnerships and technology-specific working groups to identify opportunities for government investment that could help advance multiple reactor concepts
  - DOE and the Administration will explore the use of other appropriate policy or financial incentives to support advanced reactor deployment

- PWR
- BWR

- AP1000
- ESBWR

- NuScale
- B&W mPower
- Holtec SMR-160
- Westinghouse SMR



- Sodium Fast Reactor
- High Temperature Gas Reactor
- Lead Fast Reactor
- Gas Fast Reactor
- Molten Salt Reactor

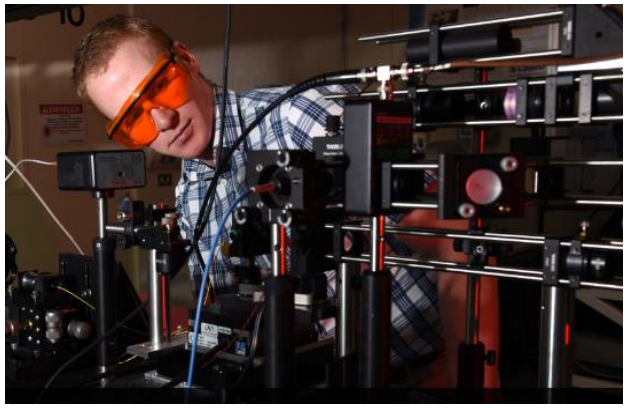
GEN II	GEN III +	SMR	GEN IV Advanced Reactors
Leveraged Support	NP 2010	SMR Licensing Technical Support	Cost Shared and Potential Future Support for Advanced Reactors

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Developing the Nuclear Energy Workforce of the Future

- Continue funding nuclear-related research projects and scholarships and fellowships through its Nuclear Energy University Program (NEUP) and Integrated University Program (IUP)
- Promote advanced reactor technology training opportunities through workshops, curriculum development, and joint laboratory, university, and industry projects
- Seek opportunities to engage academic institutions in enhancing research efforts relevant to the development of advanced reactor technologies

NEUP Nuclear Energy University Program
U.S. Department of Energy



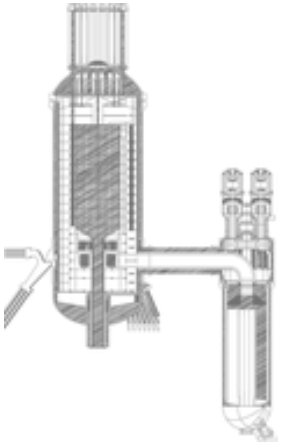
U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Industry Collaboration – Cost Shared support for reactor concepts

- **DOE made multiple awards totaling $16.5M in FY 2013 and FY 2014 for cost shared industry-led R&D to address specific technical R&D needs of advanced reactors.**

- **With FY15 funding DOE is providing $12.5M for cost-shared further development of two performance based advanced reactor concepts. Awardees are:**
  - X-Energy (Pebble Bed High Temperature Gas Reactor)
  - Southern Company Services (Molten Chloride Fast Reactor).

- **These awards reflect DOE's interest in collaborating with industry and Congressional support for advanced reactor development.**



X-Energy Xe-100

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Advanced Test/Demo Planning Study

- **FY15 Omnibus Spending Bill**
  "$7,000,000 is for an advanced test/demonstration reactor planning study by the national laboratories, industry, and other relevant stakeholders of such a reactor in the U.S. The study will evaluate advanced reactor technology options, capabilities, and requirements within the context of national needs and public policy to support innovation in nuclear energy."
- **The objective of the study is to provide options for a test and or demonstration reactor(s) to be built to support innovation and long term commercialization**
- **Draft report has been provided to the Nuclear Energy Advisory Committee.**

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Summary

- **Achieving our vision of a substantial role for nuclear power for a clean energy future and in support of national security requires:**
  - The continued long-term operation of the existing fleet of nuclear power plants
  - The deployment of new nuclear plants, including a mixture of
    - Large LWRs
    - SMRs
    - Advanced Reactors
- **Through the Vision and Strategy for Development and Deployment of Advanced Reactors, GAIN and other initiatives DOE will work with key stakeholders, the NRC, and the private sector to lay the foundation for advanced reactor deployment.**

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

Future Plant Designs

Michael Mayfield, Director
Division of Engineering, Infrastructure, and Advanced Reactors
Office of New Reactors

June 7, 2016

Agenda

- Nuclear Energy Institute
- United States Nuclear Infrastructure Council
- Department of Energy
- NRC Activities
  - NRC Vision and Strategy: Safely Achieving Effective and Efficient Non-Light Water Reactor Mission Readiness
  - Regulatory Readiness: Review Process Options for Non-LWR Designs
  - Advanced Non-LWR Design Criteria

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

NRC Vision and Strategy: Safely Achieving Effective and Efficient Non-Light Water Reactor Mission Readiness

Mike Jones
Project Manager, NRO/ARPB
July 6, 2016

Background

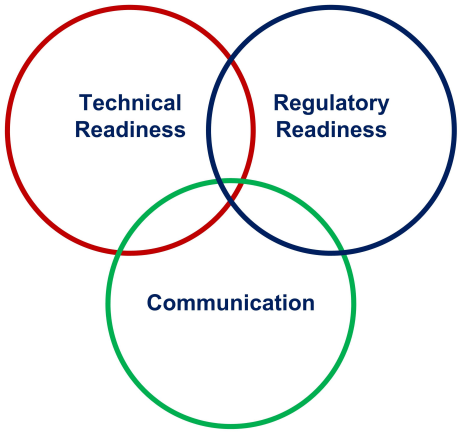
- Previously Licensed Commercial Non-LWRs
  - Fermi 1 (sodium-cooled reactor) licensed by AEC
    - OL in 1963, shutdown in 1972
  - Peach Bottom 1 (HTGR) licensed by AEC
    - OL in 1966, shutdown in 1974
  - Fort St. Vrain (HTGR) licensed by AEC
    - OL in 1973, shutdown in 1989
- The NRC recently issued a CP for “SHINE” facility
  - Moly-99 medical isotope production facility
- The NRC could review and license a non-LWR today, if needed
- The NRC needs to be efficient and effective as it conducts its safety, security, and environmental protection mission

Non-LWR Vision & Strategy

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

ML16139A812

NRC Vision and Strategy:
Safely Achieving Effective and Efficient
Non-Light Water Reactor
Mission Readiness

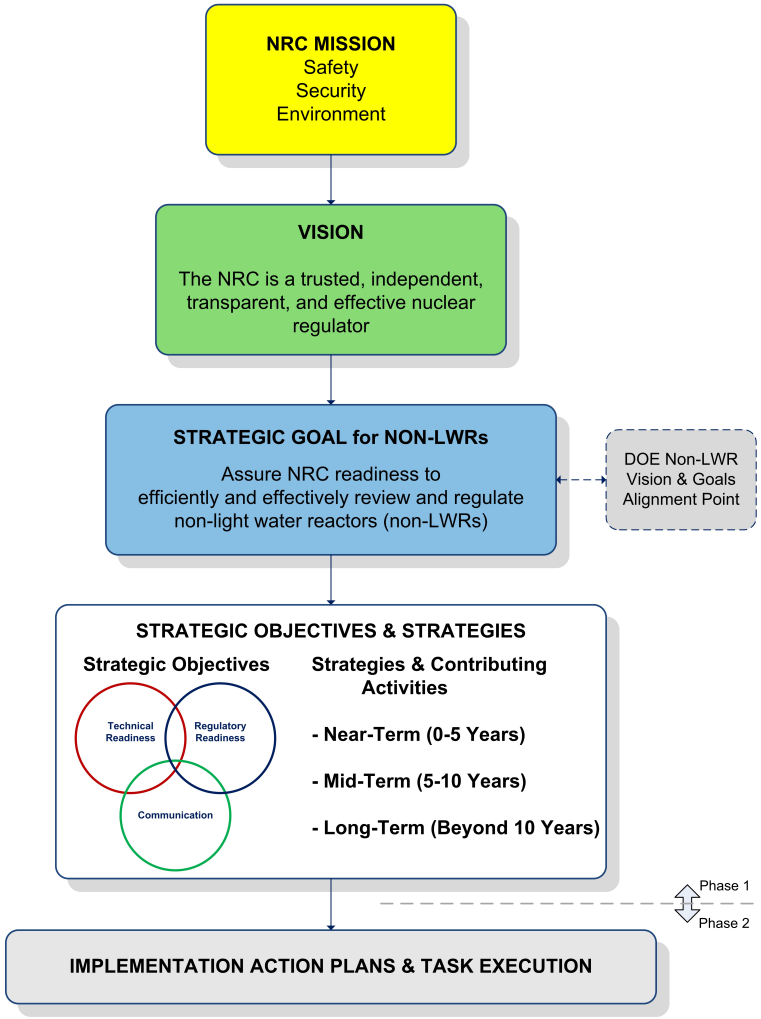


DRAFT

- Draft NRC Vision & Strategy made public at DOE-NRC Workshop on June 7-8, 2016 (ML16139A812)
- Phase 1 (Draft) Complete – Identification of Mission, Vision, Strategic Goal for Non-LWRs, Strategic Objectives and Contributing Activities
- Currently being processed for 60-day public comment period
- Phase 2 (Creation of Near-Term Implementation Action Plans) began in June 2016 with a target of September 2016 for draft completion

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

NRC Non-LWR
Mission Readiness Roadmap



Strategic Goal for Non-LWRs

Assure NRC readiness to efficiently and effectively review and regulate non-light water reactors

- Strategic objectives and contributing activities support this goal

- Aligns with DOE's vision and strategy
  - Goal: By the early 2030s, at least two non-light water advanced reactor concepts have reached technical maturity, demonstrated safety and economic benefits, and completed licensing reviews by the NRC sufficient to allow construction to go forward.

Near-Term Strategies (0-5 years)

- Acquire/develop sufficient knowledge, technical skills, and capacity
- Acquire/develop sufficient computer codes and tools
- Establish more flexible, risk-informed and performance-based review process
- Facilitate industry codes and standards needed to support the non-LWR life cycle
- Identify and resolve technology-neutral policy issues
- Develop and implement a structured, integrated communication strategy

Mid-Term Strategies (5-10 years)

- Identify and resolve technology-specific policy issues that impact regulatory reviews
- Acquire/develop sufficient technical skills and capacity to perform regulatory reviews/oversight
- Initiate and develop new non-LWR regulatory framework (if needed)

Long-Term Strategies (10+ years)

- Finalize a new non-LWR regulatory framework (if needed) that is risk-informed, performance-based, and that features staff review efforts commensurate with the demonstrated safety performance of the non-LWR NPP design being considered
  - A new regulatory framework could be helpful
  - The current framework was developed to support licensing LWRs
  - Non-LWR designs use different fuel types, coolants, passive safety features, and other design features
  - Non-LWRS exhibit different behavior during plant transients or accidents
  - It would better integrate risk-insights, address technological differences, and align with various industry and international standards

Implementation Action Plans

- Development of IAPs will include:
  - Identification of detailed tasks to be performed
  - Preparation of cost estimates (jobhours, FTE)
  - Estimated work durations
  - Expected participants by organization
- Execution of IAPs depends on:
  - Resource availability
  - Maturity/readiness of non-LWR technologies/vendors
  - Specific non-LWR stakeholder needs

Conclusions

- The NRC could review and license a non-LWR today
- The NRC has a vision and strategy for non-LWR mission readiness
- Our strategic goal to assure NRC readiness to efficiently and effectively review and regulate non-light water reactors aligns with DOE's vision and strategy
- We have a number of near, mid, and long term strategies and associated contributing activities to support our goals and are currently developing implementation action plans

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

Regulatory Readiness: Review Process Options for Non-LWR Designs

Anna Bradford, Acting Deputy Director
Division of Site Safety and Environmental Analysis

July 6, 2016

Introduction

Why we are developing options for regulatory review processes:

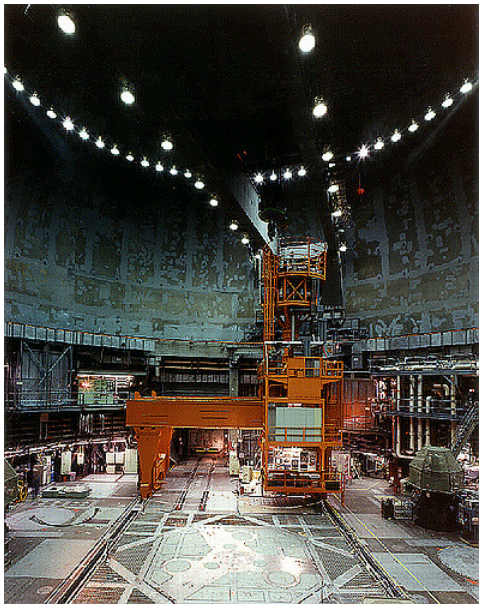
- To respond to non-LWR industry needs
- To provide flexibility for stakeholders
- To become familiar with new designs and technologies
- To gain information on industry plans early

Non-LWRs Have Been and Can Be Licensed in the U.S. under the Current Regulatory Framework

- Examples include HTGRs and SFRs

Fort St. Vrain in Colorado 1974 - 1989

EBR- 1 at Argonne National Lab 1951 - 1964



Fast Flux Facility at Hanford 1980 - 1993

Review Processes

Our current work on review process options utilize the NRC's existing regulatory framework:

- Design Review Processes
- Licensing Review Processes

In the future, we may develop a new regulatory framework.

NRC Design Review Processes Being Considered

DR Process 1 – Letters/ White Papers / Technical Reports / Topical Reports – Provide varying degrees of feedback on regulatory or technical topics

DR Process 2 – Pre-app Readiness Reviews, Pre-app Audits – Provide feedback prior to submitting an application

DR Process 3 – Conceptual Design Assessment – Provides early design phase regulatory feedback on potential technical risks and regulatory challenges

DR Process 4 – Staged Design Review - Utilizes elements of the Standard Design Approval to package discrete sections of the application for review by NRC

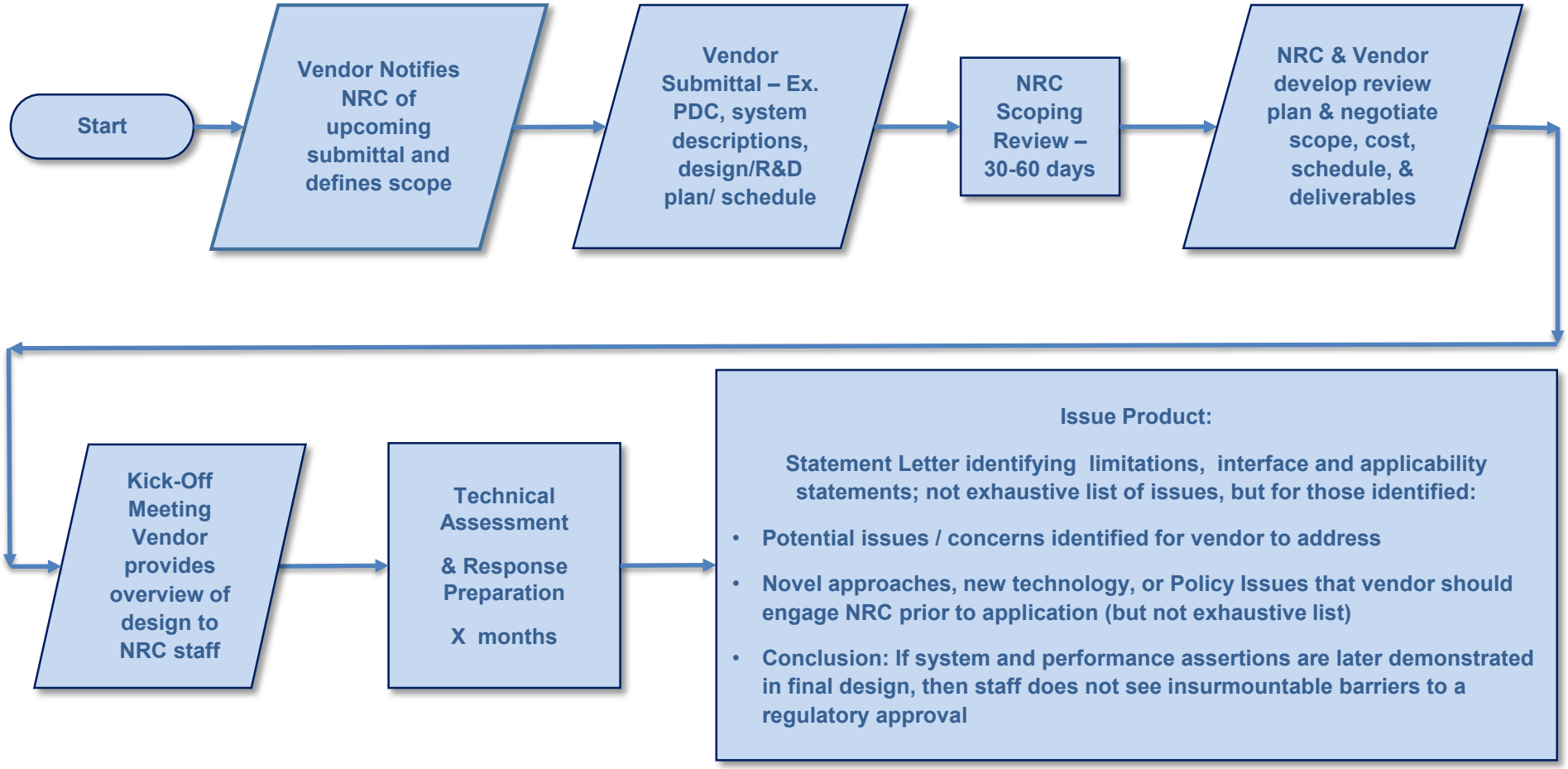
DR Process 5 – Preliminary Design Review – Pre-application SER similar to PRISM, SAFR, HTGR, etc.

DR Process 6 – Standard Design Approval – 10 CFR Part 52 Subpart E

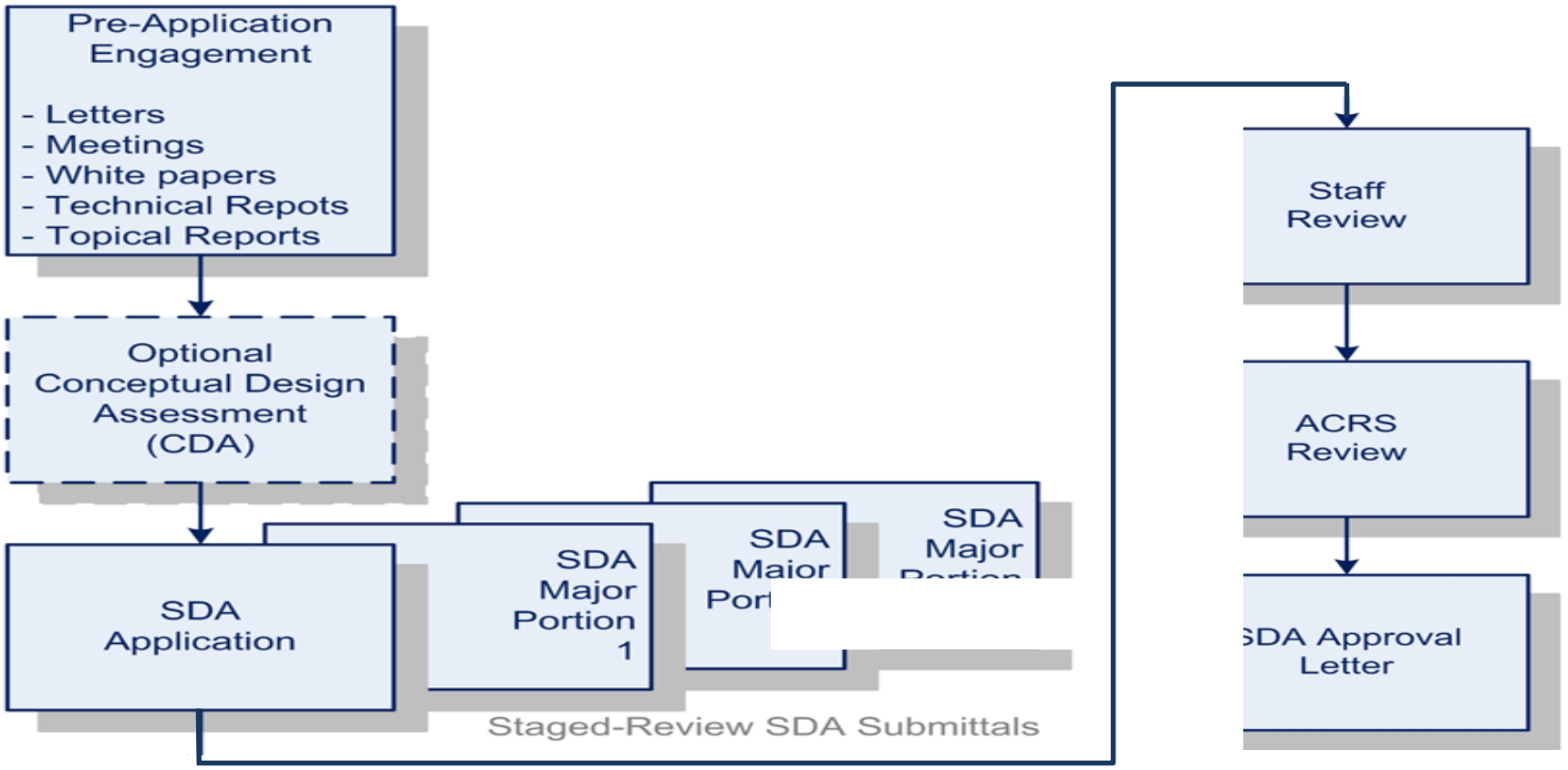
DR Process 7 – Standard Design Certification – 10 CFR Part 52 Subpart B

Key: Green: New Process Yellow: Existing Process

DR Process 3 – Conceptual Design Assessment Approach Under Consideration



DR Process 4 –Staged Design Review Using Standard Design Approval (SDA) Under Consideration



NRC Licensing Review Process Options Under Consideration

LIC Option 1a – Part 50 (CP and OL, LWA) Application

LIC Option 1b – Part 50 (CP and OL, LWA) Application for a Prototype Reactor

LIC Option 2a – Part 52 (COL, DC, ESP, LWA) Application

LIC Option 2b – Part 52 (COL, DC, ESP, LWA) Application for a Prototype Reactor

Future New Risk Informed Performance Based (RI/BP) Technology Neutral Framework (if/when available):

LIC Option 3a – New "Part XX" RI/ PB - Application
LIC Option 3b – New "Part XX" RI/ PB – for a Prototype Reactor

Key: Green: New Process Yellow: Existing Process

Licensing Options Under New RI/PB Framework

- NEW FUTURE process codified by NEW regulation
- Fully risk-informed/performance based
- Technology neutral for both LWR and Non-LWR technologies

Resolution of Key Policy Issues Proceeding

Issue	No Further Action	Path Forward
Prototype Reactors	✓	
Licensing of Multi-Module Facilities	✓	
Manufacturing License	✓	
Defense-In-Depth	✓	
Key Design Issues	✓	
Control Room Staffing	✓	
Operational Programs	✓	
Installation During Construction	✓	
Facilities Using Process Heat	✓	

Resolution of Key Policy Issues Proceeding (Cont.)

Issue	No Further Action	Path Forward
Security and Safeguards	✓	
Aircraft Impact	✓	
Decommissioning Funding	✓	
SMR Variable Annual Fees	✓	
Multi-Module Risk	✓	
Mechanistic Source Term		Obtaining public input
Emergency Preparedness		Proceeding with rulemaking
Insurance and Liability		Assessing the need for action

Conclusion

- NRC is developing new processes to respond to the needs of stakeholders
- Near term processes utilize the existing regulatory framework to respond to near term needs
- Future long term risk-informed performance-based technology neutral process is envisioned

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

Advanced Non-Light Water Reactor Design Criteria

Jan Mazza, Project Manager
Advanced Reactor and Policy Branch

July 6, 2016

Overview

- Background of the initiative to develop non-Light Water Reactor (LWR) design criteria
- Current Status of the non-LWR design criteria initiative
- Future Activities for non-LWR design criteria

Background

- DOE and NRC agreed in June 2013 to pursue a joint initiative to formulate guidance for developing principal design criteria (PDC) for non-light water reactor designers
  - NRC Regulations 10 CFR Part 50 Appendix A establish General Design Criteria (GDC) specific to LWRs and "generally applicable" to non-LWRs
  - Applicants must establish PDC based on the GDC (10 CFR Part 50.34(a)(3),10 CFR Part 52.47(a)(3), etc.)

Background cont.

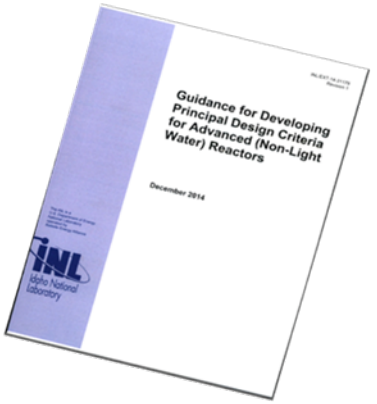
Purpose

- Establish clear guidance for the development of the PDC for advanced non-LWR developers
- Guidance will provide the following key benefits:
  - Reduced regulatory uncertainty for advanced non-light water reactor developers
  - Improved guidance for NRC staff reviewing future advanced reactor license applications
  - Improved timeliness and efficiency of licensing activities for both applicants and NRC staff

Background cont.

- Phased Approach
  - "Phase 1" – DOE and DOE lab expertise was utilized for research, review, evaluation, and documentation.
    - DOE sought and received stakeholder input:

      American Nuclear Society, AREVA, Argonne National Laboratory, Flibe Energy, CBI Federal Services, General Atomics, General Electric, Gen4 Energy, Inc., Hybrid Power Technologies LLC, Japan Atomic Energy Agency, Korea Atomic Energy Research Institute, TerraPower, Toshiba, X-Energy
    - DOE report, "Guidance for Developing Principal Design Criteria for Advanced (Non-Light Water) Reactors issued December 2014



Background cont.

DOE report included:

- A proposed set of Advanced Reactor Design Criteria, generally applicable to:
  - Sodium-cooled Fast Reactors (SFRs)
  - Lead Fast Reactors (LFRs)
  - Gas-cooled Fast Reactors (GFRs)
  - Modular High Temperature Gas-cooled Reactors (mHTGRs)
  - Fluoride High Temperature Reactors (FHRs)
  - Molten Salt Reactors (MSRs)
- A proposed set of Sodium-cooled Fast Reactor Design Criteria.
- A proposed set of modular High Temperature Gas-cooled Reactor Design Criteria.
- DOEs technical justification for adaptations of the original GDC

Background cont.

- DOE also developed technology-specific design criteria for SFRs and mHTGRs to address design features not encompassed by the LWR-focused GDC:
  - Expands existing design criteria to address new structures, systems, and components important to safety.
  - Expands existing design criteria to address technology specific hazards.

Background cont.

- "Phase 2" – NRC considers the DOE report and develops regulatory guidance
- "Phase 2" activities include:
  - Form a team from across the agency to review and consider DOE report and references
  - Develop a proposed NRC version of ARDC, SFR-DC and mHTGR-DC
  - Develop a draft and final Regulatory Guide commensurate with an official NRC staff position

Current Status

NRC staff reviewed the DOE report, "Guidance for Developing Principal Design Criteria for Advanced (Non-Light Water) Reactors" and developed the NRC versions of:

- Advanced Reactor Design Criteria
- Sodium-cooled Fast Reactor Design Criteria
- modular High Temperature Gas-cooled Reactor Design Criteria

Current Status cont.

- The NRC version of the Design Criteria sent out for 60 day informal comment on April 7, 2016
- Public Meeting held May 17, 2016
- Informal public comments received June 8, 2016
  - Over 350 comments received from over 20 stakeholder organizations

Security Design Considerations

- Security Design Considerations (SDCs) were developed in addition to the non-LWR design criteria
- SDCs help designers identify opportunities for resolving security issues through:
  - the facility design
  - engineered security features
  - formulation of mitigation measures
  - reduced reliance on human actions
- NRC is working to issue these for informal public comment
- Security Design Considerations will be included as part of the non-LWR design criteria regulatory guide

Further Engagement

- The NRC expects further engagement on key issues in design criteria for non-LWRs
  - mHTGR-DC 16 Functional Containment
  - mHTGR-DC 10 Reactor Design
  - ARDC 17 Electric Power Systems
  - ARDC 34, SFR-DC 34, mHTGR-DC 34 and ARDC 35 Residual Heat Removal and Emergency Core Cooling
  - Security Design Considerations

Future Activities

- Review and consider informal comments non-LWR Design Criteria
- Public meeting(s) during the summer / fall 2016
- Issue Security Design Considerations for an informal 45-day comment period
- Issue draft regulatory guide (RG) for 60-day public comment period early 2017
- ACRS review/interaction on draft RG
- Final regulatory guide issuance planned for 2017

Summary

- The initiative to develop a regulatory guide for non-LWR design criteria continues to progress
- Security design considerations were developed to help designers resolve security issues through the facility design
- Further engagement is expected on key issues in design criteria for non-LWRs
- Future activities include developing draft Reg. Guide, ACRS interaction, public meetings/comment period, and developing final Reg. Guide