

UNITED STATES

NUCLEAR REGULATORY COMMISSION

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BRIEFING ON ACCIDENT TOLERANT FUEL

(PUBLIC MEETING)

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THURSDAY,

APRIL 12, 2018

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ROCKVILLE, MARYLAND

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The Commission met in the Commissioners' Hearing Room at the Nuclear
Regulatory Commission, One White Flint North, 11555 Rockville Pike, at
9:00 a.m., Kristine L. Svinicki, Chairman, presiding.

COMMISSION MEMBERS:

KRISTINE L. SVINICKI, Chairman

JEFF BARAN, Commissioner

STEPHEN G. BURNS, Commissioner

ALSO PRESENT:

ANNETTE VIETTI-COOK, Secretary of the Commission

MARGARET DOANE, General Counsel

NRC STAFF:

VICTOR M. McCREE, Executive Director of Operations

MICHELLE F. BALES, RES

CHRISTOPHER J. FONG, NRR

MIRELA GAVRILAS, NRR

RAYMOND K. LORSON, NRR

ANDREW PROFFITT, NRR

ALSO PRESENT:

DANNY BOST, Southern Company

EDWIN LYMAN, Union of Concerned Scientists

BILL McCAUGHEY, US Department of Energy

THOMAS P. MILLER, US Department of Energy

NEIL WILMSHURST, Electric Power Research Institute

P R O C E E D I N G S

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9:00 a.m.

CHAIRMAN SVINICKI: I would ask the participants of the first panel to be taking their seats as I make some opening remarks.

So, the Commission convenes this morning in open session to receive an update on the status and issues associated with the path to licensing what is termed accident tolerant fuel, or you'll hear the acronym AFT today, for use in commercial nuclear power reactors.

We will begin with a panel of external participants providing perspectives.

We will have a brief break and then we will hear from a collection of NRC staff executives and experts.

I look forward to today's meeting. I think there's been a lot of activity in this space. I think the meeting is well timed. And, I think that we'll get into some depth on the issues which is always enjoyable.

Before we begin, I ask my colleagues if they have any opening remarks here.

Hearing none, we will begin, as I noted with an external panel that consists of a number of individuals.

I think what I'll do is just read the names and do a brief introduction of the panel and then we will begin to my left and they can -- if the participants could hand off to one another, we can move through their presentations and move to the question and answer period.

So, the panel consists of Bill McCaughey. Have I pronounced that correctly?

MR. MCCAUGHEY: McCaughey.

1 CHAIRMAN SVINICKI: McCaughey, thank you.

2 Bill McCaughey, Acting Director of Advanced Fuel
3 Technologies of the Office of Nuclear Energy at the U.S. Department of
4 Energy.

5 Joined by also Thomas Miller, Director, Office of
6 Accelerated Innovation of the Office of Nuclear Energy at the Department of
7 Energy.

8 In addition, we have Mr. Danny Bost who is Executive Vice
9 President and Chief Nuclear Officer of Southern Company and the Executive
10 Sponsor of the industry's Accident Tolerant Fuel Working Group.

11 Also, we have Mr. Neil Wilmshurst who is the Vice
12 President, Nuclear and Chief Nuclear Officer of the Electric Power Research
13 Institute.

14 And, concluding the panel's presentations will be Dr. Ed
15 Lyman who is the Senior Scientist at the Union of Concerned Scientists.

16 Again, I thank you all for being here this morning. I look
17 forward to your presentations and we will begin with Mc. McCaughey.

18 MR. MCCAUGHEY: Thank you.

19 Thank you, Chairman Svinicki, Commissioner Baran,
20 Commissioner Burns. I'm happy to set the stage here for this meeting on
21 accident tolerant fuel and brief you on the -- provide you with an overview of
22 the Department of Energy's Accident Tolerant Fuel Program.

23 I manage Advanced Fuels Technologies. This is one of
24 three offices under the Nuclear Technology Research and Development within
25 the Office of Nuclear Energy.

26 The other two are Advanced Reactor Technologies and

1 Materials and Chemical Technologies.

2 In addition to accident tolerant fuel, other advanced fuels
3 programs include the Tristructural Isotropic or Triso Fuels Qualification
4 Program for high-temperature gas reactors and metallic fuels for sodium-
5 cooled fast reactors.

6 These are the topics that I will address in my talk today, the
7 congressional direction and the development plan that set the stage for our
8 accident tolerant fuel program, the National Laboratory research and
9 development support we provide to the industry and to the -- now to the
10 Nuclear Regulatory Commission and also, a word or two about the
11 cooperation we have with the Nuclear Regulatory Commission.

12 Our direction from Congress originated in the Senate
13 Appropriations Committee report accompanying the fiscal year 2012 Energy
14 and Water Development Appropriation Bill.

15 And, at that time, Congress also asked us for a development
16 plan. That plan is 14 pages. It describes the vision, the mission, the scope
17 and goals of the program.

18 Regarding the attributes of accident tolerant fuel, it
19 emphasizes reduced hydrogen generation, improved fission product retention,
20 reducing the cladding reactor with steam and reduce fuel cladding interactions
21 in severe accidents.

22 The fuel, the plan goes on, the fuel is to be used in existing
23 reactors. And, in order to speed development, reactor design changes and
24 the need for significantly new and different fuel performance analyses should
25 be minimized.

26 So, that is that anything that we thought could not be

1 accomplished in the 10-year time frame that Congress directed for the
2 program.

3 The plan also contains -- states that the evaluation of
4 accident tolerant fuel concepts should consider, in addition to accidents,
5 accident conditions, normal operations, economic impacts and fuel cycle
6 impacts.

7 And also, the plan addresses the capability needs such as
8 the need for high temperature steam testing, irradiation testing, transient
9 testing, post-radiation examination, fuel fabrication and the regulatory
10 framework.

11 So, the development plan consists of these three phases.
12 We have Phase 1 was the feasibility assessment and down selection of
13 accident tolerant fuel concepts. This was completed at the end of fiscal year
14 2016.

15 Phase 2 is to take the most promising accident tolerant fuel
16 concepts that were identified in Phase 1 and further develop and lead to
17 qualification of those fuel concepts. And, that's what we are in now. We're
18 in the second year of Phase 2.

19 And then, Phase 3 will be turned over to industry for
20 commercialization of the fuel once we've supported the development and the
21 qualification, and the vendors would then ramp up with core reloads and actual
22 utilization of the accident tolerant fuel.

23 So, the -- a lot has happened since we put that development
24 plan together and we are updating it right now.

25 The plan was developed during the early phases of the
26 program. We have significant input from utilities and the Nuclear Regulatory

1 Commission.

2 And, it's now being updated to reflect the significant
3 interactions that began in Phase 2.

4 In addition, the utilities working with the fuel vendors and the
5 Nuclear Regulatory Commission have accelerated the development activity
6 well beyond what we had envisioned in that plan.

7 The most significant change relates to what we considered
8 to be our goal for the conclusion of Phase 2 in the plan which was one set of
9 lead fuel assemblies in one reactor by 2022 and that that would lead then to
10 the commercialization phase.

11 We actually have multiple accident tolerant fuel concepts
12 being developed by multiple fuel vendors. And, in addition, there are going
13 to be multiple lead fuel assemblies in reactors beginning as early as this --
14 beginning this year.

15 Next?

16 So, these are the three primary accident tolerant fuel
17 concepts that we carried forward into the development and qualification phase
18 at the start of fiscal year 2017.

19 As you can see, they are quite diverse. We believe that
20 that increases the chances of success for the program.

21 Okay, moving on to our -- a word about our-- the support
22 that the National Laboratories provide to industry and the NRC in addition to
23 the R&D infrastructure that the fuel vendors possess on their own and that the
24 utilities possess using Electric Power Research Institute, the National
25 Laboratories offer these unique capabilities and are very important for the fuel
26 development and qualification.

1 Probably the most significant addition has been the
2 refurbishment of the transient reactor test facility at Idaho National Laboratory.

3 It came online last year at a cost of \$55 million. And, the
4 accident tolerant fuel program will be one of the first significant experimental
5 programs in the reactor.

6 Advanced modeling and simulation is another significant
7 capability the National Laboratories and will be the subject of Tom Miller's
8 presentation who will follow me.

9 And, in addition to supporting fuel development and
10 qualification, these capabilities of the National Laboratories are also
11 supporting the industry in understanding the improvements that may be
12 gained in plant performance for accident tolerant fuel and are supporting the
13 Nuclear Regulatory Commission with providing the information that they will
14 require.

15 On that NRC cooperation, the -- it increased significantly at
16 the start of Phase 2. Our fuel vendor teams began discussions, licensing
17 discussions with the NRC staff.

18 And, the information exchanges between NRC our
19 laboratory subject matter experts increased in Phase 2.

20 In addition, we developed an accident tolerant fuel
21 addendum to the Memorandum of Understanding that exists between the
22 Nuclear Regulatory Commission and the Department of Energy. And, we did
23 that in October of 2017.

24 So, in summary, Phase 1 is complete. It was successful.
25 It resulted in several diverse accident tolerant fuel concepts that are
26 undergoing further development, hopefully leading to qualification and use in

1 reactors.

2 Phase 2 was expanded from what we had originally planned
3 and accelerated from what we had originally planned in our project plan.

4 The National Laboratories are supporting the industry teams
5 and the NRC.

6 And, the cooperation with the NRC increased significantly in
7 Phase 2 when we became more focused on the most promising accident
8 tolerant fuel concepts.

9 Thank you, that concludes my remarks.

10 CHAIRMAN SVINICKI: Thank you very much.

11 Next we will hear also from the Department of Energy. Mr.
12 Miller, please proceed.

13 MR. MILLER: Good morning.

14 Thank you for having me and giving me the chance to brief
15 you our modeling and simulation programs and their application to the
16 accident tolerant fuel concepts.

17 I will also, in my brief, touch on some of the initial
18 engagement that we've had with the NRC staff.

19 With me here today is Dr. Jess Gehin, Director of the CASL
20 Modeling Simulation Hub. He's going to back me up if there's any hard,
21 technical questions that come out.

22 Next? Next slide? Thank you.

23 The Office of Nuclear Energy has two modeling simulation
24 programs. They are complementary.

25 One is focused on light water reactors against the modeling
26 simulation won't, or more commonly known as CASL.

1 And then, we have the what's called the NEAMS program,
2 the Advanced and Simulation for Advanced Reactors.

3 Many of the researchers involved in these programs work
4 collaboratively and in both programs. So, they are -- the benefits of doing
5 their work and one also benefits the other programs.

6 And, we're seeing some of those as we look at accident
7 tolerant fuels.

8 The hub was started in 2009. It's in its second five-year
9 performance period and expected to complete in 2019. And, as I said, it's
10 focused on light water technology... SMRs, included particular NuScale.

11 The hub's VERA tool set, the VERA being the Virtual
12 Environment of Reactor Applications is a multi-physics modeling and
13 simulation code coupling neutron transport, subchannel thermal hydraulics,
14 power distribution, fuel performance and chemistry in a virtual environment.

15 VERA can also be coupled with other outside codes such
16 as system level thermal hydraulic codes like TRACE or RELAP.

17 The VERA suite of tools have been demonstrated on the
18 Watts Barr Units 1 and 2 reloads and the Watts Bar 2 startup.

19 The NEAMS modeling simulation program was started in
20 2010. And, as I said, it's focused on advanced reactors.

21 These modeling SIM programs provide a significant bridge
22 between research by the reactor and fuel vendors through the game program
23 for design and testing and analysis.

24 One note, in 2019, we plan to merge these two independent
25 programs into one program within the Department -- hopefully gain some
26 efficiencies there.

1 Next slide? Next one? No, I'm sorry, back up two. There
2 you go.

3 The main part of the VERA suite and NEAMS suite is fuel
4 performance. And, this is in the BISON code. It's -- well, I know folks have
5 used a number of different animal names to cover their codes.

6 So, it advances the code development for ATF and
7 extending the uranium zirconium to ATF fuel concepts addressing new
8 cladding and addressing the new fuel pellet designs doped uranium oxide and
9 uranium silicide.

10 The engineering scale modeling of the FeCrAl cladding
11 performance in BWRs is also being applied with BISON.

12 So far, we've engaged the industry to some extent, mostly
13 Westinghouse. The other two vendors, we understand are going to move
14 forward of their licensing under AFT concepts using their own particular in-
15 house codes.

16 Westinghouse is utilizing a VERA test stand and their
17 nomenclature is an in-house capability using the modeling and simulation
18 codes.

19 They're applying VERA with the BISON focus to their ATF
20 silicon carbide concept.

21 And, we're going to be working with them continuously
22 through that process.

23 Another industry engagement so far has been with NuScale.
24 They also have a VERA test stand. It's not intended for use for ATF, but it's
25 -- they are looking at it as a potential use of the modeling and simulation tools.

26 And, we've had some engagement with the Electric Power

1 Research Institute in how to apply our mod-sim tools in engagement with
2 them.

3 Next slide?

4 So, our ongoing engagement with the NRC, we've been
5 working with the NRC for some time now discussing how we can apply our
6 tools in their -- for their use and analyses for licensing actions.

7 And, we organized an addendum to our R&D Cooperation
8 Agreement with the NRC, so we have an ongoing addendum now.

9 We've had numerous interactions with the Office of
10 Research on use of these tools. I'm sure you'll hear about that today.

11 The initial engagement is to couple the fuel performance
12 coder of the VERA suite, BISON, with the TRACE thermal hydraulics code.
13 And, that is an ongoing effort to couple those two so it's a seamless transfer
14 of information.

15 My understanding is that's going very well. We continue to
16 support that until it's, you know, it's a working tool for you.

17 We've also conducted some initial training on the BISON
18 code and additional training technical support will be provided as required.

19 And, we're continuing to explore other modeling and
20 simulation code utilization by the NRC for the advanced reactors. We've had
21 ongoing conversations about specific technologies and how we might couple
22 those with the NRC codes.

23 So, in summary, we think our codes are available for ATF
24 and advanced reactor analysis. We believe there's still some work that needs
25 to be done in validation of these codes, particularly for those concepts. We're
26 going to continue to look to and work with the industry and use our test

1 program data to validate those codes with ATF.

2 We think there's a real value that can happen by this
3 continued integration and discussions between us and the NRC staff on what
4 that code needs to do in meeting that validation.

5 The extent to which you're going to drive the code and the
6 transients it's got to be able to accomplish.

7 The Office of Nuclear Industry endorses the use of these
8 modeling simulation codes, both by the industry and NRC.

9 And, that concludes my brief. Thank you.

10 CHAIR SVINICKI: Thank you very much.

11 Next, we will hear from the industry's Accident Tolerant Fuel
12 Working Group.

13 Mr. Bost, please proceed.

14 MR. BOST: Thank you.

15 Good morning, I thank you, again, Chairman Svinicki and
16 Commissioner Burns and Commissioner Baran. I really appreciate the
17 opportunity to be here today to talk about accident tolerant fuel.

18 I don't have a lot of slides. You know, let the technical folks
19 go through all the technical slides.

20 But, I do have some things that I think we need to consider
21 in order to be successful with accident tolerant fuel for our existing fleet.

22 I think one of the common themes we're going to hear all
23 day today from all of our presenters is potential. We believe there is potential
24 safety benefit from going and working on accident tolerant fuel.

25 And, what I believe is in order for us to gain that benefit for
26 the existing fleet, then we really have to look at having a very efficient and

1 effective program to get us there in the mid-2020s. And, it's just the way
2 things are going to time out.

3 I'll go over that a little bit more as I go through my
4 presentation, but I at least wanted to give that punch line up front because I
5 think what we do all needs to support that piece.

6 So, we can move to my next slide, please?

7 So, this shows how the industry is organized to work on
8 accident tolerant fuel. And, it's all done under the heading of our Strategic
9 Issues Advisory Committee which consists of the Chief Nuclear Officers in the
10 country working under NEI heading.

11 So, our working group that we put together is to guide
12 industry policy and our industry actions on accident tolerant fuel. And, that's
13 the group that I'm the Executive Sponsor for. So, I Chair that group and then
14 we report out to all the Chief Nuclear Officers. So, we're gaining alignment
15 across our industry as we go forward and work on accident tolerant fuel.

16 If you look at who our members are in this working group, it
17 includes utilities and, it also includes all of our key fuel suppliers. So, we've
18 put together those three task forces underneath that. And, I'll mention very
19 quickly what those task forces work on.

20 The one on the left, the External Affairs is focused on
21 ensuring adequate funding and communications.

22 The one in the middle, licensing, is focused on what's
23 needed to the license accident tolerant fuel and, ultimately, get it deployed.

24 And then, over on the right, safety benefits, is focused on
25 reviewing the safety and economic benefits of accident tolerant fuels.

26 And, if you look on over to the right, you'll see our -- the

1 research piece. And, we think that's essential to the progress on accident
2 tolerant fuel. It's all that collaborative research that EPRI's leading and
3 participating in and that's integrated across all of our teams.

4 And, Neil Wilmshurst will be covering that a little bit later in
5 the presentations here.

6 The last thing I'd like to mention on this slide is that we do
7 appreciate that the NRC staff has chartered a team to identify potential
8 transformative changes that we can look at for the regulatory framework so
9 that the Agency can be more agile.

10 And, when they're adapted to new and novel technologies
11 such as accident tolerant fuel or recognize this is a piece where that's going
12 to be looked at. So, we do appreciate that that team has been chartered and
13 is working forward.

14 We'll move to the next slide, please?

15 This is a little bit of an eye test and I do apologize for that.
16 I will trying to talk through the slide.

17 It does show what we believe is the path forward for
18 accident tolerant fuel. So, I mean, our overall objective, again, is to enable
19 initial deployment of accident tolerant fuel in the mid-2020s. We think this is
20 how we're going to get there.

21 So, if you look over on the left at the research and
22 development, that represents a collaborative effort between the utilities, the
23 fuel suppliers. You'll see EPRI, the Department of Energy and NRC. We
24 think everybody is in that R&D piece over there.

25 In the center, you see the licensee. That represents efforts
26 that we need to do to license and deploy accident tolerant fuel.

1 And then, on the right, that -- with that safety benefits piece,
2 focus on understanding the safety and economic benefits. And, charting the
3 course to capitalize on them.

4 One thing you'll see is, this is not a series operation. These
5 things are going on in parallel and we believe that that's very important in order
6 for us to get this deployed when we believe it needs to be deployed.

7 If you look at how are we evaluating the fuel. We're looking
8 at it across the spectrum. We'll look at it during normal operations.

9 We'll look at it in transient operations. We look at it for
10 design basis accidents. And, we look at it for beyond design basis accidents.

11 We look at it across the whole spectrum.

12 We expect to have a better understanding of the safety
13 performance and, therefore, the potential benefits later on in 2018. And, we'll
14 be much better positioned to work with the NRC staff to look at what are
15 corresponding changes that we think we need to get in order to go realize
16 these benefits.

17 Now, the initial work that we've done so far, and this is what
18 I think you're going to hear from everybody, the initial work shows there's a
19 clear safety and then that's going to drive, also an economic case to continue
20 forward. So, there's promise in the research and the results that we're
21 getting.

22 And, there are ongoing efforts to further evaluate and further
23 quantify what those benefits are.

24 If we can go to the next slide, please?

25 So, this is a lead test assembly that we want -- one of the
26 lead test assemblies that we loaded for accident tolerant fuel in the plant Hatch

1 in February.

2 We did gain a lot of experience, I'll say, as we went through
3 and put the lead test assemblies in plant Hatch.

4 And, one of them is, we need to have more, I'll say, certainty
5 in the regulatory framework for handling lead test assemblies.

6 We were able to work with the staff and get this done, but it
7 was a one-off. It was not an easy process. It was not an easy evolution.

8 The second piece I'll mention is, one of the styles that we
9 installed was the steel rods. And, that's about as technical as I'm going to get
10 with you.

11 But, it didn't have any fuel in it. And, it didn't have anything
12 to do with -- we want to put in fuel, we want to put in rods without fuel. It had
13 to do with shipping containers and licenses and can you get it here or not get
14 it here?

15 And, we worked with the staff, but it was not going to be very
16 timely. It was a very long and extended review process.

17 And so, what we chose to do with the vendor was, let's pull
18 the pellets out and let's install the rods. And, we're going to get -- we're still
19 going to get quite a bit of benefit out of this.

20 We're not going to get the pellet-clad interaction piece, but
21 we're going to get all the rest of the piece. Plus, it'll be much easier for them
22 to handle and evaluate and analyze after it's been in the core.

23 So, we think we're going to get a lot of benefits from it
24 anyway. But, we would have preferred to have the fuel in there.

25 But, it did expose, okay, shipping containers, we've got to
26 go look at this piece and make sure we're ready to ship all these lead test

1 assemblies that we're going to be needing at our facilities.

2 Heard a little bit about modeling and simulation in the earlier
3 presentations. And, I think those need to be leveraged in order to meet our
4 deployment schedule as well. I think there's been a lot of good work.

5 The role of modeling and simulation is key to I think
6 changing the structure of how we're licensing our fuel from being in a series
7 of tasks to being into more of a parallel process and looking at who's got this
8 and who's got that, rather than, I'm doing this and now I can hand the ball off.

9 But, we've got to be working together at the same time.

10 I do look forward to working with the DOE and the NRC staff
11 to ensure that the staff has the confidence they need. Certainly, they have to
12 have the confidence they need to rely on these capabilities, agree with that.

13 So, just to close, and I don't really have a closing slide, but
14 I will close.

15 I want to, again, thank the Commission for having the
16 opportunity to be here today to speak on accident tolerant fuel.

17 I think initial deployment to the fleet, I may have said this
18 five times, 2023 to 2026. I mean, we think that's -- that time frame is critically
19 important to the industry. If you was to look and see when current licenses
20 expire in the mid-2030s, you should see half or more of our licenses for the
21 current light water reactor fleet will be expired.

22 So, if you back off of that and people are looking at second
23 license extension, in order to take these benefits and use them in your
24 decision making process, it's going to have to be available in the mid-2020s.

25 So, that's what's driving that time frame for mid-2020s for
26 many in the fleet. And, it's strictly driven on, here's what their life span

1 currently looks like and when they'll have to make their decisions.

2 And, that is my presentation this morning. Thank you.

3 CHAIR SVINICKI: Thank you very much.

4 Next, hearing EPRI's perspective. We will hear from Mr.
5 Wilmshurst.

6 Neil, please proceed.

7 MR. WILMSHURST: Thank you very much, and again,
8 thank you to the Commission for the opportunity to speak about accident
9 tolerant fuel.

10 Ours and the Commission -- probably where EPRI had the
11 nuclear sector -- about half of our interactions are with non-U.S. utilities which
12 gives us a fairly unique perspective on what's going on in many fields,
13 including accident tolerant fuel.

14 And, that is probably one of the backdrops to my remarks
15 today is, we're having a U.S. focused discussion, quite understandably and
16 appropriately. But, there's other activities going on around us in this field as
17 well.

18 So, there is a lot going on in the accident tolerant fuel world.
19 And, to amplify what the previous speakers said, our assessment is, this is
20 shaping up to be a potential win for the public, for the industry, for the vendors.

21 We do need to manage our expectations, however.
22 There's been some belief that the benefits could be significantly more than the
23 benefits of the unseen.

24 That doesn't diminish the fact there's a positive benefit.
25 But, we need to keep our expectations grounded.

26 Also, we need to not minimize the challenge of hitting the

1 time frame that Danny talked about. Significant work, significant rethinking in
2 order to get to a mid '20s deployment of fuel.

3 What I would comment on, though, is we're in a different
4 world than when we last did something like this.

5 Modeling and simulation, how can we actually leverage
6 modeling and simulation to minimize the amount of testing that has to go on?

7 But, as a counterbalance to that, what is the testing
8 infrastructure left in the world to do any of that testing? What is the availability
9 of that facility?

10 And then, the context of this industry is more global. We
11 have to look at this whole development of global context.

12 So, that's the backdrop I'd offer.

13 So, my next slide, please?

14 So, as Danny mentioned, EPRI has been assisting the
15 Industry Working Group on looking at the value case for accident tolerant fuel.
16 And, we've been looking at it for some time. Started before Fukushima, but
17 like many people, those efforts ramped up with a greater focus post-
18 Fukushima.

19 The analysis we've done looking at the kind -- at the benefit
20 side of the equation shows that elimination of core damage is, frankly, highly
21 improbable. But, delay of onset of core damage is clearly possible.

22 The amount of delay depends on the technology, early
23 technology, somewhat less than the longer term technology. But, there are
24 benefits from delay of onset of core damage.

25 The challenge is to quantify the value of that delay, both in
26 terms of safety and in operational effectiveness and efficiency. And, that is

1 the challenge in that balance in my first slide.

2 So, next slide, please?

3 So, we've moved on to what we called Accident Tolerant
4 Fuel Evaluation 1.0, looking at the beyond design basis capabilities of the
5 accident tolerant fuel capabilities looking at things like TMI-2, Fukushima and
6 other accidents.

7 And, our conclusion is that some of the current concepts will
8 -- that would have potentially limited a TMI-2 like accident.

9 Fukushima wouldn't really have had any impact in a
10 Fukushima magnitude impact.

11 And, we're talking with the current concepts, the clad
12 concepts -- two to three hour delay in the onset of core damage.

13 So, there are benefits. But, one of the big asks going
14 through this was, if you change your focus to what are the potential operational
15 benefits of accident tolerant fuel?

16 Bringing in new materials which may respond differently in
17 expected operational scenarios, design basis accident or maybe the benefits
18 of the licensing issues being opened and things you could do different, that
19 might be the biggest side of the equation, the actual normal operation benefits
20 in addition to any of the beyond design basis effects.

21 So, we are now moving on to a second phase of our
22 evaluation trying to quantify just that, the operational aspects and cost benefit
23 balance between the deployment of accident tolerant fuel.

24 So, moving on to my next slide, please?

25 This slide is really to show that there's a considerable
26 amount of work that needs to be done. This slide starts at the top with some

1 of the early research we want to call the early stage options, coated zirconium
2 fuel shows that many of the aspects need minimal work all the way from
3 enrichment all the way through to disposal.

4 But, the more advanced we get moving down to non-
5 zirconium, new fuels, the whole cycle of fuel enrichment through to disposal
6 is going to need a significant or R&D in order to support deployment.

7 So, my -- they all appear to be valid things to follow. As I've
8 said, the more advanced fuels clearly have potential to give significantly more
9 benefit.

10 The message really is, there's a lot of work to be done and
11 there is a lot of people doing pieces of this work.

12 The entire stakeholder community needs, I believe, to
13 become more coordinated to drive this and coordinated to drive this and
14 coordinate and collaborate in order to drive this to a resolution.

15 So, move to my next slide, please?

16 So, how do we get there in a shortened time frame? The
17 top chart is what I'll call the traditional linear approach with testing and
18 following more testing, following analysis, following licensing.

19 If the entire community of stakeholders is to deploy accident
20 tolerant fuel in a shorter time frame to meet the mid 20s time frame Danny and
21 others have talked about, we need, I would postulate, to figure a way to work
22 collaboratively, to parallel path some of these activities.

23 And, this is where one of the global insights comes in.
24 We're working very closely with OECD, NEA led by someone who's known
25 very well in this building, Bill Magwood.

26 And, one of the challenges is, what is going to be the

1 acceptable acceptance criteria by regulators for these tests?

2 Is a world where the U.S. regulator has different acceptance
3 criteria than say the French regulator, the most efficient?

4 Will that drive a never-ending cycle of more testing to
5 answer more questions?

6 Is there an opportunity, maybe working through an
7 organizing like NEA, for some alignment between global regulators on what
8 an enveloping acceptable position may be on some of these technologies?

9 I know that is difficult, but let's not constrain our hope.

10 So, that is one of the issues because I would observe that,
11 if a vendor is going to make accident tolerant fuel for a U.S. market, it's a
12 different proposition than if they're making it for a global market.

13 And, if the entire community comes together and drives
14 towards that, it's got to benefit everyone.

15 So, move to my next slide, please?

16 And, the solution we're working on through this, is a
17 document we're referring to as the PIRT, the Phenomena Identification and
18 Ranking Table which will lead to an issue resolution report.

19 We have done this before successfully with all stakeholders
20 around the material issues in the industry.

21 It's a very similar approach, identify the issues, identify the
22 priorities, identify how they're going to be resolved and align all the
23 stakeholders around a common approach.

24 So, that is where EPRI is focused now on developing this
25 PIRT and the issue management.

26 So, my final slide, please?

1 So, the summary, we've completed Evaluation 1.0. It
2 shows there is benefit in deploying accident tolerant fuel.

3 We're started work on Version 2 to include more of the
4 operational benefits.

5 We believe this PIRT gap analysis approach is a path to
6 success and we concur with the previous speakers that there is a role for
7 modeling and simulation in this to speed up the deployment.

8 Thank you very much.

9 CHAIRMAN SVINICKI: Thank you.

10 And next, we will hear from the Union of Concerned
11 Scientists represented by Dr. Lyman.

12 Welcome and please proceed.

13 DR. LYMAN: Yes, good morning. On behalf of UCS, I'd
14 like to thank the Commission for inviting our views on this very important topic.

15 May I have the next slide, please?

16 So, just to be clear, we are strongly supportive of the general
17 development of accident tolerant fuels. And, this should be part of a
18 comprehensive program to strengthen reactor safety after Fukushima.

19 But, that said, I would hate to be in a position where we end
20 up opposing some of what the Commission is doing because we aren't happy
21 with the licensing process.

22 So, the goal should be to increase safety margin and
23 defense in depth, not to start out by looking for ways to relax safety and
24 requirements and what I've heard referred to as margin exchange.

25 I think it's extremely premature to even begin those
26 discussions.

1 And, although there may be ways to speed up the process
2 without compromising safety, and we encourage that, but we don't think the
3 NRC should weaken its licensing standards for ATF, either for the lead test
4 assemblies or for the batch loading just to make industry time lines which may
5 be unrealistic and are driven by economic factors which are not in your
6 purview.

7 May I have the next slide, please?

8 So, our understanding is that industry would like this sort of
9 blanket authorization for at least the nearer term ATF options, to demonstrate
10 LTAs without NRC review and approval, and, without seeking exemptions
11 from 5046.

12 And, the NRC staff sent a letter to the industry in June 2017
13 with what it set our preliminary positions which generally supported those
14 views. And, that letter prompted a Differing Professional Opinion which is
15 public only because it was referred to in an ACRS Subcommittee meeting in
16 February.

17 And, the characterization of the objections were that that
18 June 29th letter represented a significant departure from past practice for
19 licensing LTAs.

20 Now, in addition to the need for a license amendment, a
21 question whether NRC staff approved codes and methods would be used
22 would be required for licensing the LTA demonstration and also whether
23 exemptions would be needed from 50.46 for non-zirc-alloy fuels.

24 No, that's a mistake, it shouldn't say zero on there.

25 Next slide, please?

26 So, the NRC confirmatory testing is another issue.

1 The draft project plan from the staff on ATF states that it
2 assumes our priority of the NRC will not perform independent confirmatory
3 testing and that all necessary data will come from DOE, industry or other
4 organizations.

5 So, we're concerned about what the implications of that
6 blanket statement are for NRC's independence. And, we think, at a
7 minimum, it seems premature to make that kind of an assumption and that
8 issues may well arise and the NRC should reserve the right that it may need
9 confirmatory testing and make plans accordingly.

10 Next slide, please?

11 And, I've noted there's this incredibly insightful comment
12 from the NRC task force from the 2001 that circumstances can occur where
13 the NRC may find it necessary to reproduce experimental or analytical data
14 generated by the industry. And, I stand by that comment.

15 Next slide, please?

16 And, the one interesting example are breakaway oxidation
17 times for ZIRLO and NRC contractor testing by Argonne found different and
18 significantly shorter breakaway oxidation times for hydrided ZIRLO cladding.
19 These have persisted through attempts to understand them.

20 The conclusion is, it's not clear one is right and the other is
21 wrong, but it does illustrate that that phenomenon is very sensitive to the test
22 conditions and the conditions of the fuel and that may not have been apparent
23 if the NRC contractor had not done its own testing.

24 So, these are complicated systems and they need -- you
25 need to maintain a broad perspective on the need for evaluating these
26 phenomena.

1 Next slide, please?

2 So, in summary, on LTAs, we think the dissenting staff views
3 have to be taken seriously and, at least for the time being, the LTA licensing
4 practices of the past should be maintained until there's some rigorous
5 technical justification for changing them.

6 I think there's violent agreement that a one-size-fits-all
7 policy is not appropriate for the whole range of ATF concepts.

8 And, finally, NRC review of radiation plans, we think will
9 provide opportunities for early engagement that the industry says it wants.

10 So, by cooperating on the early LTA test plan, it'll help the
11 NRC evaluate the data we'll need for batch licensing and also what might be
12 needed for verification and validation of codes, as we heard about.

13 And, as represented to the public, you know, we think the
14 public and the NRC both need to know about experiments that are going on
15 in power reactors.

16 Next slide, please?

17 So, there's a lot of talk about transformation. We think the
18 most important way NRC can transform ATF licensing like today is just to
19 authorize issuance of the final 50.46c rule. The draft rule has been sitting out
20 there for more than two years.

21 It would provide, I quote, "a technology neutral performance
22 based approach for developing design specific criteria for compliance of
23 ECCS performance requirements."

24 And, that sounds like it's consistent with NRC's goals in ATF
25 licensing. So, we think that moving forward with that would be a big help, at
26 least regarding the design basis ECCS piece of this.

1 Next slide, please?

2 We're concerned about all the talk about the ATF economic
3 benefits. We think it's very premature to be thinking about those.

4 I quote, NEI's Framework for Regulatory Transformation, it
5 suggests that they were thinking about ATF affecting security and emergency
6 preparedness requirements and things like safety related electrical systems.
7 We think that's really jumping the gun.

8 And, again, caution that these fuels are very complex.
9 They're -- the behavior has to be validated with rigorous testing, some features
10 may not pan out.

11 These -- often making changes to the fuel has beneficial and
12 adverse effects. You need to look at the whole range of those. And, if
13 increased fuel density or increased enrichment is required, which it may well
14 be, that raises new safety issues that'll have to be evaluated.

15 Next slide?

16 And, in that context, to talk about risk is also premature.
17 And, I give a quote, I won't read it, but it's clear that because of the crosscutting
18 impacts of making changes to these systems, it's very hard to evaluate what
19 the risk -- ultimate risk may be.

20 And, again, until the properties are validated, until the PRAs
21 have been, you know, fully revised and validated with the new fuel
22 performance criteria, it's really -- you can't really talk about what changes you
23 may be making based on risk.

24 Next slide, please?

25 With regard to advanced modeling and simulation, I'd advise
26 caution. The NRC staff itself said it's not aware of any computational tool that

1 would obviate the need for experimentation. And, I think that's appropriate.

2 There are plenty of examples where current modeling tools
3 have failed to predict fuel behavior, even those that are based on actual data
4 and extrapolation from real data.

5 Finally, next slide?

6 So, the -- we're -- the ATF development time lines, these
7 abbreviated time lines that we've heard about, accelerating the schedule for
8 fuel development by 5 to 10 years, we're a little skeptical that it can be done.

9 The Hatch example, I think, you look at it a different way. I
10 think perhaps they were premature in trying to move that forward without
11 making sure that all the various pieces were licensed, including transport.

12 And, it would just be pointless to deploy ATF unless -- if it
13 introduces new safety risks and uncertainties. So, take the time to do it right.

14 Next slide, please?

15 And, finally, we have a modest proposal that, given the
16 potential limitations in test reactor capacity, including the possible Halden
17 shutdown in 2020, why not consider -- DOE consider buying one or two
18 reactors that may be shutting down prematurely for economic reasons and
19 devote them to aggressive testing of the wide range of ATF concepts.

20 We think that might be a better way to pursue a future test
21 infrastructure than building a new test reactor that would be fast spectrum
22 reactor with some moderation for thermal capabilities.

23 So, I'm just throwing that out there just to shock people.

24 And, I will stop there, and apologize for going over my time.

25 (LAUGHTER)

26 CHAIRMAN SVINICKI: Thank you very much, Dr. Lyman.

1 And, my thanks to each of the panelists for their presentations.

2 It's the practice of our Commission to rotate the order of
3 questioning. And, we begin today with Commissioner Baran. Please
4 proceed.

5 COMMISSIONER BARAN: Thanks.

6 Well, thank you for being here and for your presentations.
7 I've been looking forward to this Commission meeting for a while and I'm glad
8 we're doing it with a great external panel.

9 I want to start with a high level question, and Danny, you're
10 probably the best able to answer it on this panel.

11 As a licensee, what are you hoping to get out of accident
12 tolerance fuel from a safety point of view? From an operational flexibility point
13 of view in terms of potential changes to existing regulatory requirements, what
14 do you see as the ultimate goal of this technology?

15 MR. BOST: Thank you.

16 I see it coming in two areas for us. The first area is just how
17 the fuel itself performs. The things that our fuel must meet, the margins, as I
18 heard discussed, I see those getting better as a result of accident tolerant fuel
19 and the technology moving it forward.

20 And, I believe that buys us an awful lot of margin in the way
21 we operate our units, a lot of flexibility, and how we load our cores.

22 Just a tremendous benefit and improvement there.

23 Then, the second piece is, how much benefit are we going
24 to get from this improved performance post-accident? And, that would
25 certainly provide, number one, the safety benefit that Neil talked about.

26 But, number two, that could also drive some economic

1 benefits for the fleets as well if that delay -- onset delay is long enough, it
2 would drive different benefits.

3 So, we see it in two different areas in the industry.

4 COMMISSIONER BARAN: Ed says that UCS supports the
5 development of accident tolerant fuel if the ultimate result would be to increase
6 safety margins and defense in depth.

7 But, if I understand him correctly, he's concerned that
8 licensees might take the increased safety margin from accident tolerant fuel
9 and seek to relax other safety requirements so that the ultimate safety results
10 kind of net out.

11 How are you thinking about this?

12 MR. BOST: If we went through and changed our
13 technology so that something was not required, I mean, we would advocate
14 that we wouldn't want to require it.

15 And, I want to go out and say this, here's an example, but it
16 could be any of the requirements that we place on our units.

17 Now as a result of our technology, current light water
18 reactors, here are the postulated things that we must design for and respond
19 to. If those were no longer applicable because of our fuel types and our fuel
20 designs, then, yes, we would advocate that we wouldn't have those designs,
21 that's correct.

22 COMMISSIONER BARAN: Ed, you have any additional
23 thoughts about that or a reaction to Danny's comments on that?

24 DR. LYMAN: Yes. Again, I would stress, I think it's very
25 premature to be able to make that. It may be possible, but it's going to require
26 a lot more development.

1 And, again, we think the uncertainties generally are large
2 enough. Take coping time, so, if there's an increased coping time of two to
3 three hours, my review of FLEX plans in the past, I would think that there's
4 uncertainty in implementing those plans that's probably on the order of a few
5 hours.

6 So, I would see that, if that's the main benefit, I would see
7 that as just increasing defense in depth and I would not want to shorten that
8 margin by revising the FLEX plans.

9 COMMISSIONER BARAN: As several other presentations
10 mentioned, the development time line for ATF has really accelerated over the
11 last couple of years.

12 Looking back at DOE's 2015 report at that point, the goal
13 was lead test assemblies by 2022. And, of course, we've already seen some
14 of that in 2018.

15 And, it sounds like the new goal for industry is to have full
16 batch loading starting in 2023.

17 Danny, to meet this schedule, do you envision any changes
18 to NRC regulations or guidance?

19 MR. BOST: I think what we're going to have to change is
20 the way we operate many of our processes in series. And, I think Neil
21 probably put it best as he was going through and describing in his slides things
22 that were once done in series now being done in parallel.

23 We've got to get all the work done. We've got to get the
24 staff the confidence that the fuel's good and this is why it is and here's all the
25 backup and the documents that we have and the data that we have that shows
26 that.

1 But, I think we have to change the methods that we use to
2 get there.

3 COMMISSIONER BARAN: And, do you see -- and, part of
4 the reason I'm asking is, just trying to think if we're talking about a relatively
5 quick time frame, rulemaking isn't always that fast, even guidance, you know,
6 major guidance changes take a significant amount of time.

7 You know, as you're kind of looking at what you think would
8 be necessary for this all to happen, do you see rulemaking as being
9 necessary? Do you see major changes in guidance being necessary?

10 MR. BOST: I think changes in the way we implement the
11 rulemaking, but I don't see major rulemaking having to happen to support the
12 work that we're doing today.

13 COMMISSIONER BARAN: Okay.

14 In terms of the licensing reviews, and my sense is that code
15 development may be the long pole in the tent.

16 The NRC staff's draft project plan says that the estimated
17 time for code development for any given fuel type is three to six years.

18 And, the staff has stated that, since limited data will be
19 available and uncertainties may be large, independent confirmatory
20 calculations by NRC will be necessary.

21 It sounds like, based on the comments I saw from folks to
22 the draft project plan, that industry's view is that NRC doesn't need to develop
23 its own codes.

24 Is that right? And, if so, who's codes do you think we
25 should be using? Are these DOE codes?

26 I don't know if Danny wants to chime in or others.

1 MR. WILMSHURST: Okay, I'll start and maybe I'll let Tom
2 play cleanup.

3 I think there is a -- well, I know there's a growing discussion
4 in -- across all stakeholders that the objective probably should be to have the
5 best code. And, invest resources in ensuring there is the best code for which
6 ever -- whatever application.

7 But, independent stakeholders and independently making
8 sure they buy in to their own validation of that code.

9 And, I see month by month greater move towards that, that
10 there is just a need to get the best resources onto the best codes.

11 So, I do see a global move to that aligning around a limited
12 set of high quality codes.

13 MR. MILLER: From DOE's perspective, we see that the
14 code development is going to bring value, additional information, additional
15 detail to the information that comes out of the codes.

16 Do I think this is necessary for the schedule that they are
17 doing? I can't answer that question.

18 Where I think we are -- we'll be struggling is to assure we
19 have enough data from each of the concepts and that would cover those
20 conditions where the PIRT says you have less margin. Okay? Or, your
21 margin isn't as great.

22 Then, I think there's a place where we have to get the
23 validation of those codes and the associated data to make those -- the claims
24 like fuel is good.

25 I think that's where we're going to struggle a little bit.

26 COMMISSIONER BARAN: And, that's, I mean, I think

1 that's a good point because, regardless of whose codes are ultimately used,
2 NRC would either validate the codes or the experimental data.

3 How long, and this is a question, anyone can jump in on,
4 how long do you think it will take it will generate and analyze the necessary
5 experimental data for any particular technology?

6 I know that may differ, depending on the technology we're
7 talking about. But, if we're talking about one of the more near term
8 technologies, for example, there's code development and there's validation.

9 What kind of time frames are we talking about for that
10 experimental testing?

11 MR. MCCAUGHEY: Well, as far as data generation that's
12 necessary for validation, it's -- we have a range of concepts. We have some
13 simple ones such as code and ZIRLO like cladding with some doped UO2 fuel
14 where we have gathered a lot of data up to this point and it's available and it's
15 being used in modeling right now.

16 Then, we have other concepts that are more of the silicon
17 carbide cladding, the high density uranium fuel, the uranium silicide fuel which
18 is a departure from what we've been analyzing and testing over -- and
19 operating with over all of these years and operating with over all of these
20 years.

21 And, that requires -- that's going to require a lot more data.

22 So, but, we have the means for doing this. We have the
23 test reactors. We have invested at DOE a tremendous amount of money and
24 state of the art post-irradiation examination equipment that gets into the -- the
25 atomistic levels that we have never seen before which is used by the modeling
26 and simulation and the code developers.

1 So, I think we are moving on that path. We have these --
2 we have the infrastructure in place to support these time frames.

3 MR. WILMSHURST: It is a very good question. And, you
4 look at the data to support validation of codes. And, it gets back to one of the
5 points I made in my presentation about the global infrastructures to do that
6 testing.

7 If we just take, for example, the Halden reactor. Most or
8 say many of the current concepts are being tested at Halden.

9 There are some questions around the future of Halden.
10 What would be the impact of Halden not being there on this program? That
11 is a question I think the entire community needs to look at.

12 And, this really reinforces the point I was making about the
13 need for global collaboration. The way to secure Halden's future, one of the
14 ways, is to have a global picture of what the workload coming to Halden is so
15 they have security to continue to operate.

16 If there's a global community of stakeholders we don't form
17 that dance card, for no better term, for Halden. That facility may not be there
18 to support that validation data.

19 COMMISSIONER BARAN: Is there another facility
20 currently where you can do BWR fuel design basis accident testing other than
21 Halden?

22 MR. WILMSHURST: There are facilities. Some of them
23 are in countries like Russia. To get facilities, there are limited facilities out
24 there. I don't know if anyone else has got more perspective.

25 MR. MCCAUGHEY: Well, we've been -- not really, there
26 aren't. It's very limited, very limited. But, that's not the end of this story.

1 We have -- we can -- we do a great deal with separate
2 effects testing with out of reactor testing. And, we do have the capability of
3 simulating BWR conditions in those concepts in those kinds of tests and
4 experiments.

5 But, yes, make no mistake, Halden is, at this time, very
6 important to all three of our fuel vendors.

7 COMMISSIONER BARAN: You know, I'm a little --

8 MR. WILMSHURST: And for their development plans.

9 COMMISSIONER BARAN: -- bit over my time, but I just
10 wanted to ask Ed to kind of circle back around on the question of NRC
11 potentially using DOE codes or other codes and data from DOE or other
12 sources.

13 Do you have thoughts about that? You talked a little bit
14 about the data piece, the testing piece, but do you have views on the codes
15 and whether it's important for NRC to have its own codes versus using other
16 codes?

17 DR. LYMAN: Well, if the NRC actually has access to the
18 code and is familiar and knows how to, you know, knows its basis, knows what
19 the assumptions are and if there's flexibility so it can vary assumptions, that's
20 one thing.

21 If it's an industry proprietary code that gives one set of
22 results and NRC doesn't have access to the actual code or has other codes
23 that give different answers, that's a problem and that has happened in the
24 past, let's say MAPP versus MELCOR.

25 So, I think it really depends on how it's used. Clearly, you
26 know, there is -- it does look like it's inefficient if NRC has developed a

1 completely independent code on its own.

2 But, I think you do have to be mindful of the potential for --
3 to maintain its independence. And, do that, you know, proportionately to the
4 significance of the issue.

5 COMMISSIONER BARAN: Thank you.

6 Thanks.

7 CHAIRMAN SVINICKI: Thank you, Commissioner Baran.

8 Commissioner Burns, please proceed.

9 COMMISSIONER BURNS: Again, thank you for the
10 presentations this morning.

11 And, I want to start out by following up some of the
12 discussion in terms of the -- what Mr. Wilmshurst talked about this global
13 envelope or that there is.

14 And, we talked a little bit about Halden, and I know through
15 members' countries that are working, I think, with Norway. In terms of
16 Halden, it's not so much, I think, an issue of doing research, it's about ultimate
17 disposition of fuel and -- or ultimate disposition of the facility itself.

18 But, let me focus on a different thing because I think you
19 touched on and I'd be interested in your views and those of DOE.

20 Is that, the question of how one looks at accident tolerant
21 fuels from a regulatory standpoint worldwide.

22 This had, you know, recalls for me things like the
23 Multinational Design Evaluation Program in which the U.S. is a participant
24 along with other countries. And, again, looking -- the desire was to look at
25 different aspects of what were Gen-3-plus designs coming on starting out, you
26 know, with the Finland, France and the United States looking at the EPR, you

1 know, looking at how we are the same, how we are different.

2 Digital I&C was one of the big issues.

3 So, my question is, to what extent are we doing that at all
4 through the NEA context or some other context in terms of evaluating accident
5 tolerant fuels so that we do have a baseline to consider in terms of the
6 regulatory framework?

7 Again, understanding that the research and the results of
8 research are critically important and are really provide the foundation for that.

9 So, I'd be interested in -- I invoke your name, Mr.
10 Wilmshurst, so you can start off and I'd be interested in hearing from DOE or
11 anyone else on the panel in that regard.

12 MR. WILMSHURST: Yes. So, we, EPRI, are working
13 very closely with NEA on this. And, yes, it's a heavy lift. But, my
14 perspective, which is shared by my colleagues at NEA is, that in order to try
15 and assure a deployment, an effective deployment of accident tolerant fuel,
16 the vendors would be far more likely if there was a global market for it.

17 And, the issue as in the standard plant design, it's a smaller
18 version, as you say, for the fuels.

19 The concern is that, if every country has a different envelop
20 that they accept, are you ever done in the testing? Do you ever have a clear
21 design? What is it the vendors would be bringing to market?

22 So, EPRI, NEA are both aligned on this on the need for
23 some progress to be made in that area.

24 We're also focused jointly on understanding the global R&D
25 capacity. So, the conversations have started at NEA, but as you can no
26 doubt be aware, they're not easy conversations.

1 COMMISSIONER BURNS: No.

2 MR. WILMSHURST: There is significant energy within
3 NEA to try and move that forward. And, my desire is that as many of your
4 colleagues, your peer regulators come together and help in that. Because,
5 that will, I believe, help speed up the ultimate deployment.

6 COMMISSIONER BURNS: Okay.

7 Anybody from DOE?

8 MR. MCCAUGHEY: Well, our international collaborations
9 have been very important from the start with. When we started considering
10 accident tolerant fuel, one of the first things we did was formed an expert group
11 with NEA which was an international collaboration on defining the attributes of
12 accident tolerant fuel, the metrics we would use to determine viable accident
13 tolerant fuel concepts.

14 And, we used that in our program in that Phase 1.

15 And, in addition, there are many countries, even outside the
16 European community who are conducting research and development on
17 varies types of accident tolerant fuel concepts.

18 And, we -- that's very important to share the R&D to set up
19 these collaborations with other countries such as the Koreans, Japan and, of
20 course, the European Union.

21 And, as was noted that they have set up some very
22 significant programs at NEA now that are going to be very helpful in both the
23 collaborations on the experimental and testing and how you link the
24 experiments with the advanced modeling and simulation.

25 COMMISSIONER BURNS: Okay, thanks.

26 One of the things that's I think all the speakers touched on

1 is this issue in terms of the use or attention, that's at least how I see it, attention
2 between modeling and simulation versus actual experimentation.

3 Again, I'm going to use what I said last time, I'm not the
4 technical guy, I'm the lawyer. But, help me out on that. And, I think for all of
5 you, in terms of where you see that tension playing out?

6 I think, and partly, because I think I got to hearing from Mr.
7 Bost in terms of where the industry would like to get on this is that sort of a
8 balance between those things, getting the, you know, getting the bang for the
9 buck, if you will for modeling and simulation doing experimentation where
10 necessary.

11 But, you've got to blend those together is what I'm hearing.
12 So, I'd appreciate, you know, maybe start with the Department of Energy and
13 go down the line.

14 MR. MILLER: Modeling and simulation in modern
15 advanced modeling and simulation can give you a better set of information on
16 what the fuel is expected to do.

17 So, you can understand and determine where your safety
18 margin gets minimized during normal operation, during transients and beyond
19 design basis events.

20 I think that's -- and there's uncertainties associated with that,
21 based on what the code can do. I think it's that reduction or that knowledge
22 of the margin and where that margin is reduced or small or changing that gives
23 you a focus on what experimentation you might want to do.

24 COMMISSIONER BURNS: Okay.

25 MR. MILLER: And, that experimentation then helps
26 validate or improve the model and then so that in subsequent runs, you have

1 a better model now because you have the data in that uncertain area. That's
2 how I view it.

3 COMMISSIONER BURNS: Okay.

4 MR. WILMSHURST: I think Tom captured it pretty well.
5 You've got the whole modeling and simulation capability continues to increase
6 in its fidelity year over year.

7 So, the modeling and simulation techniques show those
8 areas you need to focus on to do the real R&D.

9 And, of course, the thing we often forget is, doing R&D,
10 you're testing something maybe once or twice. Using a model, you can
11 maybe test it thousands or tens of thousand times with different parameters
12 and work out the kind of -- the multiple different scenarios and the variability.

13 So, working the two together, the thousands of model runs
14 and then identifying the places where you need to do one or two experiments.
15 I think the ability to use modeling to refine down the experiments you really
16 need to focus on how they're done is and where we need to go.

17 COMMISSIONER BURNS: Okay.

18 Dr. Lyman, do you want to add anything?

19 DR. LYMAN: Yes. I think we've heard it's an iterative
20 process and that it can be slow. And, the problem is that the test data is very,
21 you know, it's hard to do these tests, it takes a long time and it, you know, you
22 don't get that kind of rapid feedback that you might need.

23 So, if you find -- well, you end up needing to extrapolate a
24 lot because you can't validate the code with every particular circumstance you
25 might need to understand it. And, it's that extrapolation I think is -- that's a
26 problem.

1 And, that's been the empirical fuel performance codes I just
2 reminded of one example with the M5 cladding where the growth under
3 radiation of the guide tubes of a particular fuel design exceeded what was
4 predicted and expected because -- and required not only the termination of
5 the MOx-Li test assembly experiment, but also batch loading of fuels in think
6 in a couple of reactors like TMI had to be taken out because of that unexpected
7 behavior.

8 So, you know, I think the fundamental materials
9 performance may be difficult. I'd like to see what the state of the art is with
10 regard to understanding materials performance, but I think that might be
11 lagging behind the more general neutronics in thermal hydraulics in the core.

12 COMMISSIONER BURNS: Thank you, Chairman.

13 CHAIRMAN SVINICKI: Well, thank you all.

14 And, we've covered a lot of ground already, there's a lot of
15 content here. But, I'm going to hold up Neil's red-yellow-green chart because
16 these are always really visual. A lot of us are visual type of people.

17 Our Commission, I'll characterize it, if my colleagues
18 disagree, they can correct me, we've been confronted by congressional
19 committees and others with questions along the general theme, they're not
20 propounded this way, but it feels this way when you're asked this.

21 Is well, accident tolerant fuels, NRC, who could be against
22 that? Aren't they game changers? And, why don't you get off the stick?

23 So, that's how it feels when we're asked that. And, I think,
24 in general, I would characterize our answer has been, there is potential that is
25 put forward to these fuels. There's a lot of work to be done. We've heard
26 that from the panel and there's a lot to be demonstrated.

1 And then, this chart, the reason I like this is, it says within
2 the gradations of what is even kind of going under the banner of accident
3 tolerant fuels. There's a tremendous degradation -- gradation there of
4 different potential improvements.

5 And, I think that Neil talked about, you know, a delay in core
6 damage by a couple of hours. Seems to me, the part of the chart that is the
7 red, meaning a lot of work to be done as opposed to modest -- more modest
8 levels of work to be done, I don't know if that could be a day or two days or
9 what. Like I don't know what the outer bound is. That's another area of
10 uncertainty.

11 And, we've talked some, a bit about the tension between
12 modeling and simulation and it's experimentation in the physical world.

13 I don't see it as a tension. I see as they have to coexist and
14 there's a balance. And, what we've seen happen is a massive rise in, of
15 course, the computational power that is available to researchers, but we all
16 come to this with our life experiences.

17 I had some years where I worked with DOE's National
18 Nuclear Security Administration over their stockpile stewardship program.
19 And, there was a case where the nation had decided not to do the fundamental
20 weapons testing. I'm not advocating for that here.

21 But, there was a circumstance where you had this explosive
22 growth in the analytical and computational ability.

23 But kind of what they struggled with in NNSA is that,
24 additional decimal places are not necessarily knowledge.

25 And so, that has to have its roots, all of the models have to
26 have and the simulation has to have its roots in your knowledge base in the

1 physical world. And, that's where we get to making those judgments about
2 what is that testing that needs to be done through validation?

3 There's been energy around whether the question of
4 whether or not NRC needs to have its own codes.

5 We heard from our colleagues at DOE, I think it was, that,
6 you know, maybe the model moves more to you improve the models
7 themselves, the codes themselves and the term fidelity has been used.

8 To me, that means how much does it adhere to knowledge
9 based in the physical world. A code that has high fidelity has a strong
10 foundation in a knowledge base perhaps that we've proved through physical
11 experimentation.

12 And then, the validation can be each users view of, did I
13 participate in validation? Did the aspects of validation that mattered most to
14 my applications of this code get done?

15 I mean, I think you can have multiple users participate in
16 validation.

17 So, I think what I view in kind of big data space and what's
18 happening with the -- through Moore's Law and other things.

19 You know, we've had more supercomputing capacity
20 available to more users. But, what I've seen happen is, let's have, I think Neil
21 called it, the best code. So, to me, that means the code that has the most
22 integrity, that has the most fidelity.

23 Users have confidence of vary levels, depending on what
24 kind of validation was done, how much their needs were reflected in that
25 validation.

26 And, I would see that what's happening with accident

1 tolerant fuel is maybe a push to bring that model that's used in other sectors
2 of research and bring that to bear here.

3 And, it is different than how we did it 20 years ago. And so,
4 I don't see it as better or worse, I think that it poses its new challenges. We
5 will have to learn new ways of approaching this kind of development that takes
6 all of the enterprise and peoples' needs are brought together in their specific
7 uses, in our case, independent safety validation.

8 We need to bring that and represent that in these
9 development programs. So, I think it will cause NRC to have to -- well here,
10 I'm kind of like the person who's seen the movie nobody's seen, I know some
11 of what NRC's going to say on the next panel.

12 I think we're going to hear about how they're approaching it.
13 And, they are recognizing that it's different and they're bringing that to this.

14 But, I find a lot to agree with in Dr. Lyman's cautions that he
15 offers us. You know, decimal places and more computing power is not
16 necessarily knowledge. It can appropriately validate it. It can really add to
17 your knowledge.

18 I agree with Neil's view that you can do an experiment once
19 or twice and Ed talked about how expensive and time consuming the
20 experimentation is.

21 And then, with models, you can run all these variations.
22 And, that's good if the experimental work you did was relevant to the, I'm going
23 to use this, it's trite these days, but the known unknowns and the unknown
24 unknowns, and if you really had some foresight in how you oriented all of that,
25 then that's useful to do. I did a hundred runs of variations. Well, that's great,
26 but it depends on what you're with as a foundation.

1 So, I'm encouraged that this is kind of an enterprise-wide
2 thing. And, to me, if I foreshadow into the future and we look at the
3 challenges that NRC may face, should advanced reactor concepts be brought
4 forward and submitted to us for review?

5 I see this ATF work as a stalking horse for enterprise-wide
6 approaches that I don't know how they wouldn't be absolutely essential to
7 doing a design certification of an advanced reactor in anything less than 10
8 years.

9 I mean, frankly, I know that's -- Ed talked about kind of
10 shocking people. People don't like to hear about time frames that long, but if
11 this kind of approach has benefits, I think that those benefits will be needed
12 for NRC's work on advanced reactor design certification should we get to that
13 point.

14 So, I've kind of unpacked a lot there. There does require a
15 lot of things in parallel.

16 I was intrigued as I was listening to some of the talk about
17 series versus parallel.

18 Did doing things in series provide advantages? I can
19 postulate a few, but I'll ask you instead of keep talking.

20 But, when you do things in series, there are certain benefits
21 to that. Do we lose some things that were beneficial in the way historically
22 that we did this in series?

23 Some of it could be the feedback loops and iteration. If you
24 do that in parallel, you sacrifice some of that.

25 And, why is it acceptable to give up whatever we benefitted
26 from in series? Neil, you've done some thinking about this, maybe I'll ask you

1 to react to that.

2 MR. WILMSHURST: I think part of it's driven just by where
3 the industry and the vendors are. Meaning in previous eras, it was maybe a
4 more of a national coordinated drive. Now, we're narrower, it's more
5 commercial and people need more certainty.

6 There is a time frame things are going to be delivered.

7 I think it's probably driven more by that. The commercial
8 realities that vendors are looking for certainty of a deployment time scale
9 rather than something which might just extend.

10 CHAIRMAN SVINICKI: So, doing things in series is kind of
11 a luxury of timing. And, given other existential circumstances, it's not relevant
12 here.

13 Given that there could be such a variability and
14 improvement on these different levels of kind of innovation and creativity here,
15 do you postulate that there'd be a down select at some point?

16 Like, some of these that, and this is all hypothesis, I'm not
17 talking about the specific vendors out there. I don't know enough, frankly,
18 about what's proposed to be foreshadowing any NRC conclusions. So, it's
19 not that.

20 But, if it delayed core damage by two hours, is there a point
21 at which the qualification of it is so intensive in terms of everybody's resources
22 that you just go, let's pitch that idea and look at the more innovated ones.
23 Let's just kind of switch tracks and you move to that because it delays it and
24 there's a lot more bang for the development and qualification buck?

25 MR. WILMSHURST: Well, my colleagues from DOE can
26 talk to that. Already some down selected have already happened through the

1 natural process.

2 But, yes, I think in any technology, be it Gen-4 reactors with
3 accident tolerant fuel, there does reach a point where some options just rise
4 to the top just by the -- as their knowledge increases.

5 The research goes on, roadblocks are found, other people
6 find a better path forward.

7 So, I think there will be a natural down select.

8 CHAIRMAN SVINICKI: But, specifically to the timing issue
9 which it seems, as an industry, imperative, maybe I'm adding another level on
10 what you just answered, thought, in saying, and again, this is all off the top of
11 my head.

12 If the less challenging to quality, one takes 10 years and
13 more challenging one to qualify takes 12 years, is there a point at which you
14 would just acknowledge that and say, this one that isn't really going to be that
15 innovative, let's just stop working on that one?

16 MR. WILMSHURST: I think it's a really good point. The
17 challenge we have, I think as whole community is, who makes that decision?

18 You know, because there's so many stakeholders in there.
19 So, I don't know how that decision for the down select would be made. I don't
20 know if DOE has any --

21 MR. MCCAUGHEY: If I may?

22 We think about this all the time. We are -- we request funds
23 every year for accident tolerant fuel program. Among other programs, we
24 prioritize.

25 And so, as far as factors going into down selection, I think,
26 number one, it's the performance of these accident tolerant fuel concepts in

1 our experimental programs.

2 And, we will look at the performance of coated claddings.
3 Is it holding up in prototypic PWR conditions?

4 Are we getting with -- through the PIE? Are we getting the
5 expected performance for thermal conductivity and that we expect? Those
6 kinds of things.

7 And, each of these concepts has technology gaps, current
8 technology that need to be addressed. And, I think at any point in time, we
9 might find that one or more of these concepts is just not performing the way it
10 ought to and it's not meeting the attributes of accident tolerant fuel.

11 And, we're ready, you know, that's number one.

12 Number two is, even if you have that, if the fabrication, the
13 manufacturing, the market's not there for it. If the fuel vendors are not going
14 to be able to produce this fuel in an economic -- and make a profit and the
15 utilities aren't going to want going to buy it, that's another. That's another
16 factor for down selection as well.

17 And so, we look to the industry constantly. I always -- every
18 meeting I'm at, that's usually one of my first questions, how is it looking here?
19 You know, what are you -- you know, we've got these concepts.

20 Is everything moving the right way?

21 And, at this point in time, what pretty much everyone is
22 saying is, yes, we'd like to have -- we like where we're at right now, where we
23 have multiple concepts right now so that it increases, like I had said, it
24 increases the probability of success.

25 But, we're always --

26 CHAIRMAN SVINICKI: Okay.

1 MR. MCCAUGHEY: -- reevaluating that.

2 CHAIRMAN SVINICKI: And, so what I hear you saying is,
3 the benefit right at this stage is to have different concepts along the continuum
4 of either innovation or challenge, or however you put it.

5 But, that in terms of the federal R&D investment and
6 justifying that, the DOE is in a consistent re-look at that because you've got to
7 justify your own federal participation in this R&D work.

8 So, I appreciate that. So, at least that dimension of it would
9 get re-analyzed on a routine frequency. And, I think that's helpful.

10 So, I would ask to my colleagues do you have any other last
11 questions?

12 Okay, well, again, thank you all so much for you
13 presentations. And, I believe at this point in the program, we will take a very
14 brief five-minute break while we reset.

15 So, I would ask that we reconvene at quarter to.

16 Thank you.

17 (Whereupon, the above-entitled matter went off the record
18 at 10:27 a.m., and went back on the record at 10:36 a.m.)

19 CHAIRMAN SVINICKI: If I could ask everyone to please
20 retake their seats, and the presenters will come to the table. I appreciate that.
21 I'm not pulling a fast one. It's not a quarter to two, but we have a clock that
22 stopped and I was looking only at the minute hand earlier.

23 So we've had our five-minute break. We now will proceed
24 with the NRC staff panel, and we will hear from a number of expert presenters
25 but they will be started off by our Executive Director for Operations, Mr. Victor
26 McCree. Please proceed.

1 MR. MCCREE: Thank you, Chairman, and good morning
2 again. We're pleased to be here today to report to you on the status of our
3 preparations to license and regulate accident tolerant fuel, or ATF, designs.
4 We have a full presentation this morning, so we'll move right to the next slide.
5 Slide two, please.

6 I'd like to start this morning by highlighting our commitment
7 to enhancing our regulatory infrastructure to facilitate the use of new
8 technologies. The qualities of efficiency, effectiveness, and agility, along with
9 our principles of good regulation and our values, are of utmost importance in
10 ensuring that we regulate with excellence as we move into the future.
11 Through the efforts that began in Project Aim and now continue with our
12 Transformation Initiative, we're looking to improve and learn while evolving
13 our culture along the way, and we're committed to enabling the safe use of
14 new technologies, including accident tolerant fuel, and appreciate the
15 opportunity to share details of our preparations in this area.

16 We've had a couple of recent successes that demonstrate
17 our leadership and our agility in enabling the use of new technologies,
18 including the licensing of molybdenum-99, moly-99, production facilities and
19 our activities related to cybersecurity at nuclear power plants. I believe we've
20 begun to lay the foundation for a similar outcome as we prepare to and actually
21 perform licensing reviews at accident tolerant fuel designs.

22 Slide three, please. With me at the table this morning to
23 provide you with the details of our progress and preparations to licensing
24 regulate accident tolerant fuels are Ray Lorson on my far right. He's the
25 Acting Deputy Office Director for the Office of Nuclear Reactor Regulation,
26 NRR. Ray will provide an introduction and overview of the agency's activities

1 in preparing to license accident tolerant fuel. Mirela Gavrilas to my right, the
2 Director of the Division of Safety Systems in NRR will walk us through how
3 the accident tolerant fuel project plan builds on the current licensing process.
4 Andrew Proffitt to my left, the Project Manager for Accident Tolerant Fuel in
5 NRR, will give a more detailed review of this plan, a brief description of the
6 public comments received on the plan, and NRC's response to those
7 comments. To Andrew's left, C.J. Fong, who is a team leader in NRR's
8 Division of Risk Assessment, will discuss the potential impacts of accident
9 tolerant fuel on licensee and NRC probabilistic risk assessments and on the
10 risk-informed programs licensees currently have in place. Finally, Michelle
11 Bales, to C.J.'s left, is a Senior Reactor Systems Engineer from our Office of
12 Nuclear Regulatory Research. Michelle will conclude our presentation with
13 an update on NRC's development of the capability to model and analyze
14 accident tolerant fuel.

15 I'm encouraged by the team work and collaboration
16 reflected in the staff's activities and decisions thus far as we prepare to license
17 accident tolerant fuel. I think you'll recognize that as we move through our
18 presentation this morning.

19 With that, I'll turn the presentation over to Ray Lorson.
20 Ray.

21 MR. LORSON: Thank you, Vic. Good morning,
22 Chairman. Good morning, Commissioners. I'm pleased to be here today to
23 talk about the preparations that we have undertaken to proactively prepare
24 the agency for efficient and effective licensing reviews of accident tolerant fuel
25 designs.

26 Our first step was the establishment of a cross-agency

1 steering committee and working group who have worked over the past nine
2 months to draft a project plan to regulate the use of accident tolerant fuel.
3 This comprehensive draft plan was published in the Federal Register for public
4 comment and is being updated over the next several weeks based upon
5 feedback received. The plan is intended to be a living document which will
6 evolve as we continue to learn, applicant plans solidify, and concepts mature.

7 The project plan was developed to cover the complete fuel
8 cycle, including consideration of the front and back ends, in addition to
9 covering the in-reactor regulatory requirements. The draft plan also includes
10 an acknowledgment of the consideration for associated operational flexibilities
11 that licensees may seek to utilize the additional safety margin provided by
12 accident tolerant fuel designs. We will elaborate on this topic in the updated
13 plan to be issued by mid-summer of this year.

14 Four major offices across the agency have worked diligently
15 to develop this plan, including the Offices of Nuclear Reactor Regulation,
16 Nuclear Regulatory Research, Nuclear Materials Safety and Safeguards, and
17 New Reactors, to develop a high-quality plan to prepare for accident tolerant
18 fuel. Upon finalization of the plan, it will address comments from a variety of
19 stakeholders, including those received during the public comment period for
20 the draft plan, feedback received from the NRC's Advisory Committee for
21 Reactor Safeguards, Metallurgy, and Reactor Fuel Subcommittee, discussions at a February 2018 public meeting on the project plan, and their
22 actions in various other venues including industry workshops, technical
23 meetings, and international conferences.

24
25 Next slide, please. Go back one slide, please.

26 The staff have truly shown their commitment and dedication

1 to the agency's values during the development of the plan and they have had
2 extensive engagements with our stakeholders consistent with our principles
3 of good regulation and statutory requirements. We've held numerous public
4 meetings with our stakeholders, including licensees, nuclear fuel vendors,
5 industry groups, non-governmental organizations, and our international
6 counterparts.

7 Our technical experts have heightened their engagement in
8 nuclear fuel technical meetings and conferences where academia, the
9 national laboratories, Department of Energy, and fuel vendors present cutting-
10 edge research and data related to accident tolerant fuel designs and concepts.
11 We have added accident tolerant fuel-specific addenda to our memorandum
12 of understanding with the appropriate stakeholders.

13 Our memorandum of understanding with the Department of
14 Energy allows us to engage with the department on plant testing of accident
15 tolerant fuel designs under steady-state and transient conditions, as well as
16 efforts to develop and validate material property correlations required to model
17 accident tolerant fuel. I would like to highlight that our engagement with
18 Department of Energy to date has been extremely productive, and we are
19 looking forward to a workshop they are planning for NRC staff in May at the
20 Idaho National Laboratory to showcase our capabilities associated with
21 accident tolerant fuel, including towards the advanced test reactor and
22 transient reactor test facility.

23 Our memorandum of understanding with the Electric Power
24 Research Institute can be used to facilitate data sharing and coordination on
25 expert elicitation.

26 Close engagement within the NRC and with our external

1 stakeholders, including groups such as the Union of Concerned Scientists, is
2 of the utmost importance as we continue on this journey to the licensing of
3 accident tolerant fuel for batch loading, typically considered one-third of the
4 core into commercial power reactors, and we recognize that is a truly a critical
5 piece of the project plan.

6 Next slide, please. Recent interest by the industry and
7 among our licensees in pursuing accident tolerant fuel designs has led to a
8 renewed focus on the use of lead test assemblies. These programs, which
9 have been implemented safely over the past several decades with no adverse
10 effect on public health and safety, have led to safety improvements in the
11 design of nuclear fuel. Some examples include improved resistance to
12 corrosion, improved thermal hydraulic performance, increased heat transfer
13 properties, and significant increases in fuel reliability. Licensees have
14 recently expressed interest in loading lead test rods or lead test assemblies of
15 near-term accident tolerant fuel designs into the reactor cores. In fact, Hatch
16 recently loaded lead test assemblies containing two accident tolerant fuel
17 concepts into their Unit 1 earlier this year.

18 These lead test assemblies assist vendors in developing the
19 full technical bases require to support batch loading into commercial power
20 reactors. We recognize that lead test assemblies are an integral part of the
21 research and development necessary to gain industry approval for batch
22 loading of ATF and are working to respond to feedback with concerns related
23 to the use of existing guidance for implementing LTA programs.

24 Lead test assemblies, in general, and especially those
25 which meet the standard technical specification language of limited number
26 which are placed in non-limiting core regions have very low safety

1 significance. With that being said, NRR has established a steering
2 committee separate from the accident tolerant fuel group to clarify NRC
3 expectations related to the use of lead test assemblies by issuing draft
4 guidance in early summer. As always, we will continue to engage our
5 stakeholders to address any concerns while we work through our processes
6 to improve clarity on our expectations.

7 I would like now to turn the presentation over to Mirela
8 Gavrilas to take us through the high-level objectives of the NRC's project plan.
9 Mirela.

10 MS. GAVRILAS: Thank you, Ray. Good morning. As
11 the Chair of NRC's Accident tolerant Fuel Steering Committee, I am pleased
12 to be here today to brief you on the overarching goals of the ATF project plan.
13 We are confident that the steps we are taking now will appropriately prepare
14 us for effective and efficient licensing of accident tolerant fuels.

15 The project plan presents the high-level strategy that we will
16 follow to ensure readiness when ATF topical reports or licensing actions are
17 received for review and approval. At this point, the strategy is concept and
18 technology independent. We did find concepts as a family of ATF designs
19 with largely similar characteristics. Examples include chromium-coated
20 zirconium alloy claddings, steel claddings, silicon carbide claddings, or
21 metallic fuels, as shown on this slide.

22 Variations within each concept may be implemented by
23 individual vendors of specific technologies. For example, the different
24 methods that are used to apply chromium coatings would be identified as
25 separate specific technologies. Concepts that are more near term in the
26 project plan include the coated claddings I just discussed that are intended to

1 reduce corrosion and the extent of metal- water reactions, doped fuel pellets
2 in which material is added to uranium dioxide to reduce pellet clad interaction,
3 and steel claddings such as the iron-chromium-aluminum alloy which is made
4 of materials from the steel family instead of zirconium. Longer-term concepts
5 include ceramic, silicon carbide claddings, uranium silicide fuel pellets, and
6 metallic fuels. In general, we expect that the safety benefits will be greater
7 for the longer-term ATF concepts.

8 Next slide, please. The first version of the ATF project plan
9 will be high-level and concept independent. As more information is
10 developed, the plan will be augmented with concept-specific licensing road
11 maps. The licensing road maps will then enable each vendor to pursue a
12 suitable licensing approach to obtain NRC approval for their specific
13 technology. This is important as there may be several vendors pursuing the
14 same or similar accident tolerant fuel concepts, but they may take a different
15 path to obtaining approval for batch implementation as shown on the right side
16 of the graphic. Because of feedback we received through public comments,
17 we will better describe their hierarchical approach in the first version of the
18 plan.

19 An important prerequisite in the development of concept-
20 specific road maps is the conduct of PIRT exercises where PIRT stands for
21 Phenomena Identification and Ranking Table. As the name suggests, a
22 PIRT exercise is one in which foremost experts in a particular discipline come
23 together to collectively use available data to identify and rank phenomena that
24 impact the safety of a system. Therefore, PIRTs are a systematic way of
25 mapping hazards associated with a fuel concept to the regulatory
26 infrastructure. This mapping will show where potential gaps exist and where

1 we refinements are necessary.

2 PIRT exercises are critical to the regulatory predictability
3 and stability envisioned by the project plan. Another important note on PIRTs
4 is that the experts can only correctly identify and rank phenomena if they
5 consider the full operational envelope expected for the particular fuel concept.
6 For example, if a coating is added to an approved alloy to enhance surface
7 wear resistance under normal operation, the new phenomena important to
8 safety may be limited. However, if a coating is added to gain operational
9 flexibilities, such as increased coping times during loss of coolant accidents,
10 then the performance and adherence of the coating under accident conditions
11 becomes important to the safety of the termination and should be considered
12 in the PIRT.

13 Next slide, please. The development of the technical basis
14 necessary to qualify a new fuel design is an extensive process both in terms
15 of resources and time. This graphic depicts the basic steps applicants take
16 towards obtaining the appropriate data and experience needed to license a
17 new fuel design for batch loading in a U.S. commercial nuclear power plant.
18 Even under ideal circumstances, the time and effort required to fully develop
19 the technical basis is substantial. This is due, in large part, to the irradiated
20 testing needed to fully understand and characterize how a design or material
21 acts under transient and accident conditions. These characteristics, together
22 with the ability to model and predict phenomena important to safety, represent
23 the critical path.

24 It is possible that the vendors and organizations
25 participating in the development of the technical basis for accident tolerant fuel
26 designs may be able to leverage advanced modeling and simulation

1 capabilities to expedite the development time line. Insights gained from
2 mechanistic computational tools could improve testing programs and thus limit
3 or eliminate failed experiments. This would allow for data to be gathered
4 more quickly.

5 We are currently unaware of advanced computational
6 capabilities which could altogether obviate the need to perform experimental
7 testing. However, we recognize the need to monitor advances in the state of
8 the art that could potentially contribute substantial time line constriction,
9 especially for longer-term concepts.

10 Before we step through the time line, it's important to note
11 that different accident tolerant fuel concepts are at very different places along
12 the time line. The technical basis for near-term designs, for example, may be
13 near the end of the time line, whereas longer-term concepts may be still in the
14 pink or orange boxes.

15 The graphic depicts the relative order of testing needed to
16 develop the technical basis. First, we have shown in pink un-irradiated
17 material testing, which is the testing necessary to fully characterize the
18 material mechanical, chemical, and thermal properties of a new design.

19 The second box in orange, test reactor irradiations and
20 testing, is where the vendor characterizes the evolution of those properties
21 obtained in the first box with irradiation and time spent in reactor. Lead test
22 assembly irradiations and testing shown in yellow provide the integral testing
23 to fully characterize the fuel and prototypical operating conditions. They also
24 provide donor material for the next step.

25 Transient irradiations and testing shown in green typically
26 use fuel segments harvested from LTAs to perform tests that mimic transients

1 and accident conditions. These are key to ensuring safety.

2 Along the bottom of the graphic is source term and other
3 non-fuel performance testing, which includes testing to characterize fission
4 product release, core melt progression, core relocation, mechanical and
5 chemical interactions.

6 Updates to the analyses of record involve the development,
7 calibration, verification, and validation of analytical models which simulate the
8 performance of the new fuel under normal and accident conditions. This also
9 requires the quantification of uncertainties and the definition of an application
10 methodology.

11 Next slide, please. The graphic on this slide contains a
12 simplified depiction of the development of the technical basis and focuses on
13 differences between activities under the old fuel licensing paradigm and those
14 enabled by the project plan. In the old paradigm, which existed prior to the
15 development and implementation of the strategy outlined in the ATF project
16 plan, the regulatory infrastructure was essentially developed before or soon
17 after commencement of the technical basis development activities, such as
18 experimental testing programs. This is because, over the past several
19 decades, most light water new fuel designs and characteristics have been
20 relatively minor changes within the uranium dioxide-zirconium alloy fuel
21 matrix.

22 Licensing activities, generally in the form of topical report
23 reviews, would then follow upon completion of the development of the
24 technical basis with little or no interaction with the staff along the way. This
25 lack of interaction produced a number of issues, including cases where
26 additional testing that required irradiation, was necessary prior to approval

1 which caused extensive delays.

2 Recent initiatives related to accident tolerant fuel are
3 leading the largest potential departures from the basic uranium dioxide-
4 zirconium alloy fuel matrix which has been utilized in this country and in
5 reactors around the world over the past 50 years. This potential
6 transformational technology being pursued by industry has given us time to
7 reflect on our fuel licensing process and determine where improvements to
8 efficiency and effectiveness can be gained.

9 The ATF project plan captures these new thoughts and
10 represents a significant paradigm shift. It enhances regulatory stability and
11 adds efficiency to the time line required for licensing activities following the
12 completion of the technical basis.

13 As you can see in this graphic, the success of the strategy
14 outlined in the project plan relies on conducting a thorough and meaningful
15 PIRT exercise for each concept and then maintaining the results of the PIRT
16 as the collective state of knowledge evolves. The outcome of the PIRT will
17 allow the staff to refine the regulatory infrastructure as needed for each
18 concept, which, in turn, will facilitate the development of concept-specific
19 licensing road maps. These activities will proceed in parallel with the
20 continued development of the fuel technical basis by the vendor.

21 The refinement of the regulatory infrastructure will be done
22 in real time and with significant communication with our stakeholders, such
23 that transparency is maintained and regulatory expectations are clearly
24 communicated to the vendor as early as possible in the process.

25 The process plan also envisions that licensing activities will
26 proceed in parallel with much of the development of the technical basis for a

1 specific concept. Data sharing and close engagement with the applicant
2 during this time will be critical to enabling the schedule efficiency shown here
3 on the graphic.

4 The staff will need to perform as much pre-work as possible
5 in preparing to conduct the most efficient reviews of accident tolerant fuels,
6 topical reports, and license amendments. It is the overall goal of the project
7 plan to develop and communicate our expectation for the technical basis in
8 real time. This will minimize the time between the completion of the technical
9 basis and the licensing of accident tolerant fuel designs to their full potential.

10 Next slide, please. In addition to efficiencies that are
11 already built into the project plan, the staff is continually exploring other
12 innovative and transformative ideas and solutions to further improve our
13 approach. Some of the examples we are currently pursuing are: The use of
14 NRC vendor inspection program to validate experimental testing and provide
15 certainty to vendors regarding the sufficiency of their data. This will also
16 expedite the technical review once a topical report has been submitted. The
17 development of an approved change process for topical reports which will
18 allow vendors to incorporate newly-acquired data or newly-identified
19 information into their empirically-derived models. This would improve
20 phenomena prediction and reduce uncertainty. Staff use of the Department
21 of Energy-developed or other advanced computational capabilities, where
22 appropriate, to enhance and expedite the staff's ability to perform confirmatory
23 analyses during the review of accident tolerant fuel designs. And, finally,
24 enhancements to our internal processes for issuance of regulatory guidance
25 such that efficiencies gained by augmented communication and feedback
26 between the NRC and stakeholders enabled by the plan can be realized in a

1 timely manner.

2 I would now like to turn the presentation over to Andrew
3 Proffitt to walk us through a more detailed outline of the plan and address the
4 major public comments we received. Andrew.

5 MR. PROFFITT: Thank you, Mirela. Good morning,
6 Chairman and Commissioners. We intend for the ATF project plan to be a
7 living document that remains up to date as applicants' plans and concepts
8 evolve. The plan implements the high-level strategy that the agency will use
9 to prepare for licensing accident tolerant fuel designs and is a concept-
10 independent document. The plan outlines the activities associated with this
11 preparation and will enable the agency to conduct efficient and effective
12 reviews of ATF designs.

13 We began the development of the project plan with the
14 current regulatory framework in order to optimize timing and resources, and
15 with the confidence that our regulations, in particular with regards to fuel,
16 provide the appropriate starting point and flexibility to accommodate ATF
17 designs. With that said, we are always looking for ways to further increase
18 efficiency and we will continue to engage our stakeholders on specific
19 suggestions.

20 The comprehensive plan, which is nearly 50 pages in length,
21 covers the assumptions made by the staff to inform development, an outline
22 of proposed stakeholder interactions, initiating staff activities, and a
23 description of the preparatory activities related to in-reactor performance, fuel
24 cycle transportation and storage, probabilistic risk assessment activities, and
25 analysis capability development. We will go into more detail on each section
26 of the plan as we progress through the next few slides. The plan also

1 includes preliminary estimates for lead times necessary to complete activities
2 in each area, which are identified in the activity tables in the front portion of
3 the document and included in each subsection.

4 The plan was issued in the Federal Register on December
5 21st, 2017 for a 45-day comment period which closed on February 5th, 2018.
6 We received nearly 80 comments from ten entities.

7 Next slide, please. We are confident that the constructive
8 comments we received will allow us to enhance the plan through clarifications
9 and augmentations of ideas or concepts which have been identified in recent
10 interactions with our stakeholders. We recognize that we cannot complete
11 the plan in a vacuum and truly value the feedback we have received.

12 There were several major themes to the comments on the
13 plan, and we have attempted to address them all during the appropriate
14 portion of our presentation today. But I would like to take a moment to walk
15 through some of the most prolific themes now, the first being concerns with
16 the regulatory requirements associated with the use of lead test assemblies.
17 To address these concerns, NRR has established a steering committee and
18 currently plans to issue draft guidance by early summer.

19 Many commenters highlighted the importance of
20 communication and coordination to the successful implementation of the ATF
21 project plan. The staff wholeheartedly agrees with this notion. We see
22 enhanced communication and coordination as the lynchpin to the success
23 envisioned by the project plan.

24 Several commenters also offered concerns with the terms
25 "evolutionary" and "revolutionary" as used in the plan to describe accident
26 tolerant fuel designs. We have committed to change our terminology to near-

1 term and longer-term when trying to designate between the two, and we will
2 also enhance the language in the plan to clarify that the acceptability of each
3 individual design will be based on its own merits.

4 Industry highlighted the opportunity accident tolerant fuel
5 presents to transform our fuel licensing process. We have sought to optimize
6 our process with the development of the plan and continue to hold
7 brainstorming sessions with the working group on further efficiencies. But,
8 again, we welcome specific suggestions.

9 Some commenters shared concerns with NRC's preparation
10 and licensing time line. In response, we are committed to efficiently and
11 safely licensing accident tolerant fuel designs in accordance with our mission
12 and the principles of good regulation. We believe that the project plan has
13 positioned us to do this well.

14 Lastly, in the comments received, there was a theme that
15 the staff should leverage the use of DOE or advanced computational
16 capabilities in our licensing reviews. Michelle will expand on our thoughts
17 related to this suggestion, but our overall response is that we will use and seek
18 to always use the most optimal means of confirmatory analysis in carrying out
19 our mission.

20 We plan to issue along with the finalized project plan a
21 companion document which contains our disposition of the stakeholder
22 comments that we received during the official comment period.

23 Next slide, please. We believe that the regulatory
24 framework for in-reactor performance is largely compatible with the current
25 near-term accident tolerant fuel concepts and the time exists to refine the
26 framework for longer-term concepts, so NRC will be prepared to license those

1 designs upon submission for review.

2 Additional work will be completed following the concept-
3 specific PIRTs to fully evaluate the applicability of existing regulations and
4 guidance for each accident tolerant fuel design. These exercises will inform
5 the development of the concept-specific licensing road maps detailed by
6 Mirela, which will clarify the regulatory criteria that need to be satisfied for
7 batch loading of accident tolerant fuel design and the regulatory options
8 available to applicants and vendors.

9 If required, we will identify policy issues and present them
10 for Commission consideration and initiate any rulemaking or guidance
11 development activities well in advance of licensing submittals. Some
12 examples of where the current framework may need refinement are Title 10
13 of the Code of Federal Regulations, Part 50.68, Criticality Accidents, which
14 prescribes a five-percent enrichment limit for fuel and an acceptable approach
15 for meeting General Design Criterion 35, Emergency Core Cooling, as 10 CFR
16 Part 50.46 is the means for which all currently-operating reactors show
17 compliance with GDC 35 and that is purely based on zirconium clad uranium
18 dioxide fuel.

19 Next slide, please. Our counterparts in NMSS have been
20 fully engaged with the accident tolerant fuel steering committee and working
21 group, including the development of the project plan, from day one. The
22 regulations that are applicable to fuel cycle activities found in Title 10 of Code
23 of Federal Regulations, Part 70.71 and 72, are general in nature and identify
24 performance requirements rather than design approaches or design
25 requirements. This type of regulatory language has been necessary because
26 of the broad spectrum of facilities and designs that are licensed under these

1 regulations. We believe that these existing regulations can accommodate
2 the accident tolerant fuel concepts under development.

3 Current review guidance addresses issues raised by
4 industry designs for fabrication, transportation, and storage of zirconium clad
5 uranium dioxide of up to five-percent enrichment. It is possible that some of
6 this guidance may need to be supplemented to address safety-related issues
7 that could arise from certain accident tolerant fuel designs or the facilities and
8 systems used to produce or manage ATF.

9 We will remain engaged in proactively establishing lines of
10 communication with relevant stakeholders to ensure we stay abreast of
11 applicants' progress in fuel cycle licensing strategies.

12 I would now like to turn the presentation over to C.J. Fong
13 who will highlight a few key areas related to PRA and our risk-informed
14 programs that are particularly important with regards to ATF. C.J.

15 MR. FONG: Thank you, Andrew. Good morning,
16 Chairman and Commissioners. I'm pleased to be here today to discuss the
17 NRC staff's plans for incorporation accident tolerant fuel into our PRA models.
18 My presentation will cover three subjects. First, I will discuss the regulatory
19 basis for enhancing our PRA models to account for accident tolerant fuel.
20 Next, I will describe the benefits that we will expect to gain by accurately
21 modeling accident tolerant fuel in PRA. Finally, I will outline the technical
22 information that is needed to perform these updates and why we believe that
23 more clarity on accident tolerant fuel performance is needed before we can
24 begin executing them.

25 Since their inception, PRAs have been periodically updated
26 to reflect newly-acquired data and to incorporate hardware and operational

1 changes. We plan on continuing this longstanding practice with accident
2 tolerant fuel.

3 It is important that, consistent with the Commission's PRA
4 policy statement, these updates are performed in a manner that uses state-
5 of-the-art PRA methods and data so that we can achieve the most realistic
6 results practicable. Doing so will provide several benefits that I will outline on
7 my next slide.

8 As the Commission well knows, PRA use has evolved since
9 the IPE and IPEEE days, and PRA models and the risk insights they provide
10 are now used to make day-to-day operational decisions across the fleet.
11 Examples include, but are not limited to, tools used by licensees to assess
12 and manage their day-to-day risk in accordance with the maintenance rule;
13 licensee PRA models used to support risk-informed licensing actions; and
14 NRC PRA tools used to support reactor oversight decisions and the
15 prioritization of generic issues.

16 PRA models that are unrealistic or that use overly
17 conservative assumptions can mask important risk insights which, in turn,
18 diverts licensee and NRC resources from those operational and design issues
19 with the greatest safety significance. We should avoid this scenario by
20 upgrading our models to incorporate accident tolerant fuel. The question is
21 not if but when.

22 Next slide, please. So when is the right time to update our
23 models? One aspect of PRA that is often overlooked is that accurate thermal
24 hydraulic calculations and/or test results are needed to predict plant
25 performance in the accident sequences modeled by PRA. Accident tolerant
26 fuel has the potential to change some of the key assumptions that are used in

1 PRA today. For example, many PRA models use a calculated peak cladding
2 temperature limit that is distinctive to uranium dioxide fuel with a zirc-based
3 cladding. We recognize that this temperature limit will not necessarily apply
4 to all ATF concepts.

5 The challenge is that we don't yet have the thermal hydraulic
6 calculations to support a different value, and until that data is available it
7 simply does not make sense to begin our model updates. The NRC PRA
8 staff and the Offices of NRR and Research will, therefore, continue to monitor
9 the industry's progress toward batch loading of accident tolerant fuel. As
10 stated in our project plan, we will update our models and guidance as more
11 information about ATF performance becomes available so that our risk models
12 will continue to provide credible insights following the first ATF batch load.

13 With that, I'll turn things over to Michelle Bales. Michelle.

14 MS. BALES: Good morning, Chairman and
15 Commissioners. I will be discussing our efforts related to developing
16 analytical capabilities for accident tolerant fuel and our next steps with regards
17 to PIRTs.

18 In the ATF project plan, four technical disciplines were
19 identified where a computational capability is needed to support safety review
20 of topical reports and license amendment requests. Those disciplines are
21 fuel performance, thermal hydraulics, neutronics, and severe accidents.

22 Fuel performance codes are used to demonstrate that
23 specified acceptable fuel design limits, or SAFDLs, are maintained and to
24 provide initial conditions for design basis accident analysis. Additionally, fuel
25 performance codes are used to support safety limits for loading and storing
26 spent nuclear fuel in storage casks.

1 Thermal hydraulic codes are used to demonstrate that
2 reactor design basis transient and design basis accident criteria are met.
3 Neutronics codes are used to demonstrate the criticality requirements for
4 reactor accidents and spent fuel transportation and storage casks are met.
5 They're also used to calculate decay heat rates, core power, and reactivity
6 values that are used in thermal hydraulic and fuel performance codes.

7 Severe accident codes are used to calculate the design
8 basis source term to establish the adequacy of siting for commercial power
9 plants and to ensure adequate radiation protection for control room and
10 technical support centers.

11 NRC has developed a suite of codes to analyze these
12 disciplines, and they have been used successfully to support regulatory
13 decision making. We believe that further development of these codes is
14 appropriate to ensure that we have the capability to analyze ATF designs.
15 Having tools that the staff can use to analyze ATF will be particularly important
16 because applicants will use computational tools to demonstrate their fuel
17 safety criteria are met and, in some cases, the ATF properties and models
18 within the computational tools will be based on limited experimental data.

19 Next slide, please. The schematic on this slide shows the
20 general elements of code development and it's relevant to all safety analysis
21 codes, whether we're speaking of those developed by the Nuclear Regulatory
22 Commission, Department of Energy, or the industry. One of the things
23 illustrated in this figure is that code development requires testing and data to
24 feed model development and validation. Developing codes to demonstrate
25 the accident tolerant fuel can be used safely includes updating codes with
26 accident tolerant fuel material properties and models, as well as the validation

1 of the updated code against relevant experimental data. It is the validation
2 exercise that ensures a code appropriately models key phenomena and
3 accurately predicts the parameters of safety importance.

4 The data sets used to develop models often come from
5 separate effects testing, while code assessment and validation often uses
6 data generated in integral test programs. PIRTs, mentioned earlier by Mirela,
7 are helpful for planning test programs and code development activities since
8 they help to ensure that all phenomena important to safety have been
9 identified and are considered in the plans.

10 In some cases, existing codes developed for current light
11 water reactor fuel have aspects of a zirconium cladding uranium dioxide fuel
12 system hardwired into their architecture. In that case, code architecture
13 updates will be needed in order to use the codes for accident tolerant fuel.

14 The diagram on this slide is relevant for all accident tolerant
15 fuel concepts, but we recognize that some concepts have limited new
16 phenomena and, therefore, the duration and breadth of each element will vary
17 for each accident tolerant fuel concept.

18 Next slide, please. Our independent confirmatory analysis
19 of topical reports and license amendments follow a graded approach which
20 varies based on the complexity of the application, the safety significance of
21 the issues presented, and the uncertainty of the key phenomena involved.
22 We employ a range of tools to verify the safety case made and presented by
23 an applicant. In some cases, staff can perform their confirmatory analysis
24 and reach a safety determination by drawing on previous knowledge,
25 accumulated expertise, and the information presented by the applicant. In
26 other cases, confirmatory calculations are performed by the staff and can

1 allow for more effective and efficient review.

2 We typically perform independent confirmatory calculations
3 to assist in reaching our safety findings in reviews where uncertainties are
4 large and margin is small. In some cases of large safety significance and
5 large uncertainty, we've actually pursued independent confirmatory testing
6 commissioned by the agency prior to reaching a determination on the
7 application.

8 When the staff does perform confirmatory calculations, we
9 have experience using both NRC- developed and non-NRC codes. NRC-
10 developed codes include the fuel analysis in steady-state and transient, or
11 FAST, code for analyzing thermal mechanical performance of fuel under
12 steady-state and accident conditions. Codes like NRC's FAST are
13 specifically developed and tailored to demonstrate acceptable performance
14 against the defined regulatory criteria.

15 NRC has also partnered with the Department of Energy to
16 develop codes such as SCALE, which performs reactor physics, criticality
17 safety, radiation shielding, and spent fuel characterization for nuclear facilities
18 and transportation storage designs. SCALE is also used by some licensees
19 to support licensing applications.

20 We also have experience using commercial tools to perform
21 confirmatory calculations, for example in the evaluation of structural
22 performance of components under seismic loading. It is important to note
23 that if we do elect to perform confirmatory calculations, the NRC staff member
24 performing the calculations must have a clear understanding of the
25 assumptions and limitations of the computational tools they use.

26 Next slide, please. NRC will take the most efficient and

1 effective approach to verify the safety case presented for each accident
2 tolerant fuel concept. A critical assumption in the ATF project plan is that the
3 data from external sources will be provided to the NRC in time to support the
4 steps we need to take to verify the safety case. The plan also assumes that
5 NRC will not need to conduct independent confirmatory testing.

6 In support of these assumptions, NRC has added addenda
7 to our memorandum of understanding with the Department of Energy and the
8 Electric Power Research Institute to facilitate data sharing. We also continue
9 to follow international multi-priority research projects, such as the Halden
10 Reactor Project in Norway where accident tolerant fuel concepts are being
11 tested.

12 When confirmatory calculations are warranted, we will
13 select an approach that weighs several factors. These factors include the
14 level of effort necessary to modify an NRC code and the level of effort needed
15 to understand and validate a non-NRC code. This information will be
16 considered as we develop concept-specific licensing road maps.

17 Based on the information that we have so far, we believe
18 that for near-term concepts, like chromium-coated cladding, it will be more
19 efficient and effective to use existing NRC tools which can be modified with
20 minimal effort. For longer-term concepts which require greater effort to adapt
21 NRC existing tools, stronger consideration will be given for the use of non-
22 NRC codes.

23 Next slide, please. Our next step is to conduct concept-
24 specific Phenomena Identification and Ranking Table exercises. One of the
25 things that became clear as we worked through the project plan was that now
26 is an appropriate time to conduct formal expert elicitation to determine if all

1 new phenomena of safety importance have been identified for accident
2 tolerant fuel concepts. We believe that an adequate body of evidence exists
3 and knowledge is available for most of the ATF concepts to enable a
4 systematic expert elicitation using the PIRT process.

5 NRC has significant experience utilizing the PIRT process
6 and will follow expert elicitation best practices, including assumption actions
7 to minimize bias. We have initiated discussion with our stakeholders and
8 expressed our desire to conduct PIRTs in coordination with applicants,
9 Department of Energy, and international partners. We expect the PIRTs to
10 be used by different entities for distinct purposes. Where applicants would
11 use PIRTs to develop their safety case, NRC would use PIRTs to inform
12 regulatory requirements and DOE would use PIRTs to prioritize research.

13 We all share a common goal of ensuring the safe use of
14 accident tolerant fuel concepts; and, therefore, coordinating on the PIRT
15 process will minimize unnecessary duplication of effort.

16 I would now like to return to Vic to close the presentation.
17 Vic.

18 MR. MCCREE: Thank you, Michelle. As you've seen and
19 heard through our presentation here this morning, we believe we are well
20 positioned in our preparations to license accident tolerant fuel and we're ready
21 to begin work related to concept-specific activities.

22 To summarize the key next steps, they include publishing
23 for public comment a draft memorandum from the NRR office director
24 clarifying the staff's position on the requirements associated with the use of
25 lead test assemblies and to engage our external stakeholders to ascertain
26 what, if any, additional guidance is necessary by June of this year.

1 Secondly, completing the incorporation of comments and
2 enhancements based on stakeholder feedback and to the ATF project plan
3 and finalize the plan by mid-summer of this year. Thirdly, continuing our
4 enhanced stakeholder engagement and interaction related to accident tolerant
5 fuel and, fourthly, beginning coordination of the PIRT process for near-term
6 accident tolerant fuel concepts.

7 Finally, I'd like to emphasize or re-emphasize that for NRC
8 to ensure that reviews of ATF designs are carried out effectively and
9 efficiently, as was outlined in the presentation this morning, it's imperative that
10 we receive reliable and predictable schedules from the industry on the
11 concepts they plan to pursue. To this end, we've begun interactions with a
12 wide variety of stakeholders, including the nuclear fuel vendors, to better
13 understand ATF implementation schedules in the near and long term.

14 In closing, I'd like to take this time to thank the many people,
15 some of whom are here in the room today, that have worked diligently over
16 the past several months to get us to this point.

17 Thank you for allowing us to brief you on this important topic.
18 That concludes our presentation.

19 CHAIRMAN SVINICKI: Thank you, Victor and to all of the
20 NRC presenters and to your NRC colleagues who have contributed to the
21 progress that you reported on today. We will begin again with Commissioner
22 Baran.

23 COMMISSIONER BARAN: Thanks. Well, thank you for
24 your presentations and for all the work that's gone into preparing the draft
25 project plan. Andrew talked about this a little bit but, based on what you know
26 now, aside from the 50.46(c) rulemaking which would move us to technology-

1 neutral performance-based standards for fuel designs, have you identified any
2 changes to NRC regulations or guidance that you think will be necessary to
3 prepare for the licensing and oversight of ATF?

4 MR. PROFFITT: I'll take that one. So as we mentioned
5 on the slide, obviously 50.46(c) is mentioned and then 50.68 criticality
6 accidents with the prescription of a five-percent enrichment limit. Other than
7 that, we really are awaiting to see the outcome of the concept-specific PIRTs
8 and fully understanding the use of the fuel to go any further. We could
9 speculate at this point, but I think to do it with more certainty following those
10 activities would be the better way to proceed.

11 COMMISSIONER BARAN: On the first panel, we talked
12 about code development a bit, and the draft project plan includes an estimate
13 that it would take three to six years to develop the necessary codes for any
14 given fuel type. But one clarifying question I had is whether that was an
15 estimate specific to NRC doing the code development or someone else doing
16 the code development or it didn't matter. Basically, I think it's three to six
17 years regardless.

18 MS. BALES: So the project plan, our quotes and our
19 estimates include time to await data and to do the validation exercises and, in
20 that way, all of the codes, whether they're NRC's or the industry's or DOE's,
21 are kind of all in the same place. We're all waiting for data to complete
22 validation experiments. Some of the mechanics of actually updating the code
23 to add new models are relatively simple, and so the estimates in the project
24 plan, I would say, reflect the time frames for all codes, whether they're NRC
25 or external.

26 COMMISSIONER BARAN: And that three to six-year

1 estimate, that includes validation of the codes?

2 MS. BALES: There are assumptions about when data will
3 be available and the time that it would take to conduct validation exercises.

4 COMMISSIONER BARAN: Okay. And I understand it's
5 early days on this and we're talking about a variety of different technologies,
6 but how solid are these estimates, you know, this three to six-year estimate,
7 and what has to happen to basically start the clock running on that three to six
8 years?

9 MS. BALES: So I'll speak to the schedule part and then I'll
10 turn it back over to one of my colleagues for the starting the clock part. So I
11 would say that the estimates are relatively well informed based on the
12 information we have of planned test programs, and we continue to need to
13 coordinate with Department of Energy and applicants to ensure that we're
14 always keeping up with updates to their schedule so that we can plan
15 accordingly.

16 MS. GAVRILAS: So what's important is having some,
17 having a clear idea of the schedule that the vendor has because, for example,
18 you update the infrastructure and the code on which you overlay material
19 properties and other detailed model specific to the technology that you're
20 studying and then you validate the code. So what you need is you need
21 sufficient data for your model improvements, so code modification cannot start
22 until you have the special effect data. And then the completion is when you
23 have all the data from integral tests that you can validate your tests, so that's
24 the integral part and it's highly specific. For example, for some of our fuel
25 performance codes, we have already started that effort with preparing the
26 infrastructure to receive the data, but those are early efforts that we can do for

1 chromium clad for example.

2 COMMISSIONER BARAN: On the first panel, there was
3 talk of a goal being to have batch loading starting as early as 2023. How
4 aggressive does the staff see that schedule as being and is it feasible?

5 MS. GAVRILAS: So we did a mental exercise and we
6 basically said, in an ideal world, for the near-term concepts, and our result
7 amongst ourselves is yes. But let me emphasize in an ideal world for near-
8 term concepts.

9 COMMISSIONER BARAN: Slide 21, talking about the
10 codes again, says that with appropriate control staff can use non-NRC codes
11 while maintaining independence, and Michelle talked about that a little bit.
12 What controls do you have in mind there?

13 MS. BALES: I can answer that. I think that some of the
14 controls are about the ability for the staff using the codes to really understand
15 the assumptions and limitations of the code. So that includes being able to
16 have time and information to do their own validation exercises in areas where
17 we're applying the code and as well as, in certain situations, have access to
18 the source codes that we understand that we know what is going on in the
19 code. And so those would be some of the controls, but I think it's really going
20 to be dependent on the situation and should be considered on a case-by-case
21 basis.

22 COMMISSIONER BARAN: And if we're talking, and
23 maybe we're not talking, we're talking about DOE code for example, with our
24 current, you know, interaction with DOE, do you think we're on course to have
25 the kind of access the staff would need to those codes to use them in that
26 way?

1 MS. BALES: I think so. I think that the interactions that
2 the NRC and DOE staff have been having at the developer level have been
3 very productive, and there is really great communication and a willingness on
4 both sides to come to a better understanding of what codes are capable of
5 and what the needs of NRC are. A lot of that is still ahead of us, but the
6 general demeanor of interactions has been, I think, very productive.

7 COMMISSIONER BARAN: Another conversation we were
8 having on the first panel is this question of balancing modeling with
9 experimental testing. Clearly, there's going to need to be some experimental
10 testing I think to validate these models. I think everyone agrees on that. As
11 slide 22 notes, the draft project plan assumes that independent confirmatory
12 testing by NRC would not be necessary. What will it take to ensure that NRC
13 gets the data it needs from DOE and applicants?

14 MS. GAVRILAS: So let me take that one because I was
15 taking notes during the first panel presentation and one thing that jumped up
16 at me was when Ed Lyman said techniques, experimental conditions, and
17 assumptions. We would have to be comfortable that the techniques used in
18 the experimental program, the experimental conditions of the experimental
19 program, and the assumptions made in the experimental program fully satisfy
20 our needs to reach our safety findings.

21 I want to also clarify that that's a planning assumption. The
22 staff has not made any decision a priori that no confirmatory testing will be
23 needed. If we have questions about these three elements, we will
24 reconsider, of course, doing confirmatory testing.

25 COMMISSIONER BARAN: So there are situations which
26 you can envision that NRC would need to do confirmatory testing?

1 MS. GAVRILAS: There could be. What we are planning
2 to do is working close enough with the entities that are acquiring this data so
3 that there are no surprises when it comes to techniques, assumptions, or
4 experimental conditions.

5 COMMISSIONER BARAN: So I understand, practically
6 speaking, the idea is if someone is going to go off and do an experiment, we
7 would engage with them ahead of time and say, just so you know, if you want
8 to satisfy our needs for data to make the regulatory findings we need to make,
9 we would need to see the following things in this experiment?

10 MS. GAVRILAS: That's right. You would need to acquire
11 this temperature reading, this pressure drop, and so on.

12 COMMISSIONER BARAN: Okay. And we talked a little
13 bit about the Halden Reactor on the first panel and really the lack of
14 alternatives for design-based accident testing for BWR fuel. Can the staff talk
15 a little bit, how confident are we that Halden will continue to be available to us
16 for this purpose?

17 MR. LORSON: I think the thing to keep in mind is we do
18 have active engagement with the international community on what is
19 necessary to ensure the continued viability of the Halden Reactor. Mark
20 Thaggard from the Office of Research is the NRC's lead person in this regard.

21 I would say that I'm confident from the perspective that I
22 think both internal and national external, excuse me, international and national
23 stakeholders understand the importance of the Halden Reactor. However, I
24 say that with the realism that, while individuals and countries may recognize
25 the importance and are committed to understanding the continued viability of
26 the reactor, at this point in time we're still under discussions about what's

1 necessary to ensure that the reactor will continue to operate and countries,
2 including the United States, they'll have to agree to the certain funding
3 requirements to ensure its continued success.

4 COMMISSIONER BARAN: And this isn't, I don't want to be
5 pessimistic and I don't want to get into a lot of speculation, but, in the event
6 that Halden were not available, do we have a plan about, you know, or does
7 anyone have a plan about where we would get that data?

8 MR. LORSON: Well, I would say that there are some
9 capabilities with the Department of Energy. We're going to be visiting the
10 facility in Idaho in the first week in May. It's not clear to us whether or not the
11 facilities there can completely replicate all of the individual capabilities that are
12 at the Halden test reactor. What I've heard from some of the experts in
13 industry and some from the NRC staff is that there is not currently an additional
14 facility to do that type of testing.

15 So if the Halden Reactor were not to continue to operate
16 beyond 2020, we'd have to go back and revisit that section of the plan to see
17 how it would impact schedules and time lines.

18 COMMISSIONER BARAN: Okay. And let me ask just
19 one more question. You know, a key part of all this planning and preparing
20 for ATF applications is having enough staff with the right expertise to do this
21 work. Where do we stand on staffing resources now and what are our plans
22 going forward?

23 MR. LORSON: We are keenly aware of the need to have
24 the right levels of staff with the right skills and developing the plan to this point
25 would not have been possible with high-performing staff that we have here,
26 like Andrew, C.J., and Michelle.

1 Having said that, there's really three components that we
2 are mindful of and keenly focused in as we look at our future staffing plans.
3 One is, I think Vic had alluded to the need to maintain continued close
4 engagement with industry so that we have a good appreciation for what work
5 is going to come in front of us and what's the time frame. Secondly, at NRR,
6 as you know, we're involved with the merger activity with the Office of New
7 Reactors, and so we're looking at what the overall organization looks like and
8 what staffing levels look like. As part of that integration, we're keenly focused
9 in on needing to maintain the right skill sets in the right technical disciplines to
10 be able to complete the work, so it's not only having enough staff but also
11 having them with the right skills.

12 We recognize that the technical skills that are in Mirela's
13 group are of critical importance to this effort and, in fact, in this year, even
14 though we've done limited hiring, we actually have brought in new employees.
15 So we are focused in on that aspect, and that's a keen area of focus for us
16 moving forward.

17 COMMISSIONER BARAN: Okay. Thank you.

18 CHAIRMAN SVINICKI: Thank you. Commissioner
19 Burns.

20 COMMISSIONER BURNS: Thank you again and thanks to
21 the staff, both those at the table and the others who have been working and
22 been engaged on this topic. I want to start off maybe a follow-up to an answer
23 Mirela gave to Commissioner Baran regarding this 2023 time frame in an ideal
24 situation. And being one who believes that we do not live in the best of all
25 possible worlds, what are the big, what are the things in terms of that narrow
26 aperture that would concern you most about that 2023 date?

1 MS. GAVRILAS: So there are, the development of the
2 technical basis has to somehow link to our licensing review. So the things
3 that concern me most is did we have enough exposure to everything that went
4 on in the development of the technical basis until now so that we don't find
5 ourselves having to iterate back to a previous box? That's the main concern.

6 So if we assume that what was done until now is acceptable
7 to the staff and that the boxes that I showed on my technical basis box have
8 indeed been completed without having to send back, then we can do it in 2023.
9 That's the uncertainty.

10 COMMISSIONER BURNS: Okay. Thank you. And
11 along those lines, I think Michelle put up a diagram, you put a diagram up and
12 Michelle put a diagram up and we saw Mr. Wilmshurst put a diagram up in
13 terms of, I think the one that the Chairman used during her remarks in
14 response to the first panel.

15 When you look at that diagram versus what you're looking,
16 you know, I can't necessarily, looking at it right offhand, see the fidelity
17 between the two, but it doesn't have to match 100 percent, but are both of you
18 comfortable that that's, we're sort of looking at it similar ways or close enough?

19 MS. GAVRILAS: So my answer would be, from a high
20 level, the color scheme looks right to the staff.

21 COMMISSIONER BURNS: Okay.

22 MS. BALES: Yes, I would agree. I think that the industry
23 slides implied a use of modeling and simulation that isn't captured in our
24 discussion so far, but I think, otherwise, there is alignment with the idea to do
25 parallel activities versus activities in series and to have a lot of interaction so
26 that you're sure the work that you're doing is the right work and that it's going

1 to lead to the outcomes that you want from a safety technical basis
2 development. So I would say that they're aligned.

3 COMMISSIONER BURNS: Okay. Thanks. And this
4 might be addressed to Vic. Since you're still the CNRA member or chair
5 actually at the Committee on Nuclear Regulatory Activities under the NEA
6 auspices, but I'll post to you, Vic, sort of the question, the similar question I
7 posed to the first panel with respect to efforts at international harmonization.
8 A lot of talk about Halden and, you know, experimental data, experimental
9 research, which is important, too. But has there been any engagement in
10 terms of what I'll call this, I guess you could call regulatory harmonization or
11 at least maybe the first step is understanding? And, again, I go back to the
12 multinational design evaluation program as a way we've tried to do that, you
13 know, in the new reactor, the Gen-3, I guess even Gen-4, we're moving to
14 Gen-4 there. So any thoughts or comments on that?

15 MR. MCCREE: Commissioner, thanks for the question. I
16 think it's a very good one. I think it's a very appropriate and timely initiative
17 that NEA has embarked upon and is engaging EPRI on. Suffice it to say, we're
18 in very early stages of moving in this area, as the CNRA, Committee on
19 Nuclear Regulatory Activities, has actually not taken this issue up yet. The
20 Committee on the Safety of Nuclear Installations, which has a working group
21 on fuel safety, in fact the CSNI tasks the working group, WGFS, Working
22 Group on Fuel Safety, with developing a research plan. And that plan would
23 identify those countries that perhaps have research and development facilities
24 that could be made use of or could contribute to R&D in the area of accident
25 tolerant fuel.

26 I do anticipate some presentation, conversation on that at

1 the June meeting, the CSNI meeting. And there will be a joint meeting on
2 day two, day three actually, where we'll have an opportunity to understand
3 where that committee is coming out in its research plan. But suffice it to say,
4 it's in the very early stages, but I look forward to the conversation.

5 COMMISSIONER BURNS: Okay, all right. Good.
6 Thanks. A couple of other things. One of the things, I know when, you
7 know, there has been some debate over approaches toward particularly the
8 implementation of lead test assemblies. One of the questions I would have
9 is, as you go forward, are you documenting sort of the legal and technical
10 bases for the decision-making you have? Because I know, as you say,
11 there's been some controversy over that. I can actually go back and think of
12 when the first steam generators were replaced. This is how old I am. And
13 there was controversy over whether 50.59 versus a license amendment ought
14 to be used.

15 So what I'm asking is, maybe it's a rhetorical question, are
16 you getting good fidelity in terms of your documentation about how you're
17 moving forward in these areas and what types of considerations, both legal
18 and technical, that you're putting into that type of decision?

19 MR. LORSON: Yes, I'll take that. In terms of the
20 documentation or guidance that we're planning to issue here in the near future,
21 it includes both the technical and legal considerations. We certainly won't put
22 out the draft guidance without consultation with the Office of General Counsel.
23 In fact, the Office of General Counsel was a member, has provided a member
24 of the steering committee, so we appreciate that so it can help us, you know,
25 make sure that we're not introducing potential pitfalls as we develop the
26 guidance.

1 We're also keenly aware of the need to ensure that the
2 guidance is technically sound, and I think that's a key focus area for the group.
3 And what we're doing is we're not really developing new guidance on how to
4 implement a change because the NRC change processes are well established
5 and licensees use them every day to make changes at their operating facility.
6 What we're really trying to do is we're taking a couple of the terms that we
7 believe the industry and perhaps NRC staff have had difficulty in terms of
8 interpreting, terms like limiting number, limited test location. And so we're
9 trying to define precisely, to the extent we're able to, better some of those
10 terms that will allow facilities to use existing change processes with better
11 clarification of some of the terms that are used throughout regulatory
12 documents.

13 COMMISSIONER BURNS: Okay, good. Thanks. And I
14 think my last, I'll end with the question, in terms of planning and, you know,
15 particularly resource planning as you come up, has the staff seen any areas
16 where resource constraints are challenging or would challenge the ability to
17 continue with the efforts that were ongoing?

18 MR. LORSON: I think we're okay for addressing the near-
19 term expectations that will be in front of us in terms of products that are going
20 to come to us for review, and that includes items such as topical reports on
21 some of the near-term fuel designs. Where I have the concerns is, depending
22 upon how the evolution of the testing occurs, if we were to get some type of
23 fuel design that's perhaps more radically different than what we're currently
24 experienced with, that could create a challenge and we'll have to figure out
25 how to address that, or if we get a lot more work through the front door then
26 what we're currently expecting based upon some of our informal discussions

1 we'll later formalize through, you know, formal interactions with the industry.
2 So those would be the two areas that I would be concerned about.

3 COMMISSIONER BURNS: Okay. Vic.

4 MR. MCCREE: So while I would echo what Ray said, this
5 is an area where our enhanced strategic workforce planning initiatives and
6 efforts come into play. I think it was noted that, you know, that we've been
7 able to capitalize on the great talent we have here and then other areas of the
8 agency, and there are certainly some areas where we can re-deploy, if
9 necessary, or train folks to make sure we have the right people in the right
10 place when the work comes. But we have done some hiring and it was, in
11 part, based on some strategic workforce planning discussions we've already
12 had and would pivot to Mirela to confirm those areas where we have brought
13 in new hires in areas specifically because of anticipated expected work on
14 ATF.

15 MS. GAVRILAS: Yes, we've been very fortunate. We
16 made two new hires. One is more of a generalist with fuel experience, but
17 one is a true fuel expert with experience in the field. So we've been very
18 lucky.

19 COMMISSIONER BURNS: Okay. Actually, I had one
20 other question that I want to ask. We talked a lot about codes, demonstrating
21 the fuel, etcetera and etcetera, but I think it was either Andrew or C.J. noted
22 the other things, like transport, fuel casks, and things like that. Can you give
23 me a little more granularity about what types of things we might be looking at
24 there and what are their regulatory type challenges we might have? I
25 presume, you know, for casks, you know, it's a different cask design or cask
26 characteristics in light of the larger, the greater percentage, you know, over

1 five percent in the fuel and all.

2 MR. LORSON: Yes. The plan includes support from our
3 Office of Nuclear Material Safety and Safeguards. And just a couple of items
4 we look at, as I mentioned, we were looking at the complete fuel cycle. So
5 whether it's fabrication of the fuel under 10 CFR Part 70, we have our
6 engagement with our stakeholders in the Office of Fuel Cycle Safety and
7 Safeguards. From the standpoint of transport of the new fuel to the facility,
8 that would require a license amendment under Part 71. Again, that would be
9 issued by the Office of NMSS. And then also, ultimately, kind of the storage
10 and ultimately disposal of that fuel would also include support from the office
11 of NMSS.

12 So that's all complete part of the plan, and that's something
13 we're looking at as part of both, throughout the licensing process.

14 COMMISSIONER BURNS: Good. And I think the
15 important thing is you all are talking to each other and engaging each other on
16 those issues because, as they say, our big focus and much of our discussion
17 today has been what that actual fuel looks and acts like in the reactor, but we
18 always have some of these secondary and tertiary issues.

19 Thanks very much. Chairman.

20 CHAIRMAN SVINICKI: Well, thank you all for your
21 presentations. And I just wanted to reflect that I compliment the staff on the
22 work they've done. I see a strong parallel in the approaches that you've
23 described in all the different areas to what your colleagues are doing in
24 preparation for advanced reactor reviews. I talked a little bit about these
25 parallels in my response to the first panel.

26 You know, I think through the development of plans that will

1 pace along with what the vendor's planning is, knowing those schedules, as
2 Victor talked about, but maintaining a certain flexibility of approach here. I'm
3 hearing from the technology development community that that's very
4 important, and I think we are confronted with both this diversity of innovation
5 in fuels but also, on the advanced reactor side, there's a lot of diversity, more
6 than what we're currently regulating in operational space right now.

7 So I think that having approaches that allow for a bit of a
8 stylized application of the regulatory process, a little bit of a stylized application
9 of the regulatory framework, is really essential.

10 And, you know, I kind of interpret this as an outgrowth of the
11 hard work we've done under Project Aim where agility was a component.
12 And what I see you all bringing to this is kind of work on enterprise-wide risk
13 management, which is, I see that in the flexibility of how you're drawing in
14 experts of various disciplines and from various organizations. So I think
15 you're to be complimented on that, and you realize that it's going to be
16 dynamic for you going forward. I think you're baking that in to your approach,
17 and I think that that will serve the agency well going forward.

18 Andrew talked about looking at the entire fuel cycle and all
19 the components. As Commissioner Burns mentioned, Mr. Wilmshurst had a
20 similar thing of all the different parts of the regulatory framework that get
21 impacted, and fuel is so foundational to that. So I think that the agency's
22 success in having a predictable regulatory time frames and a process that's
23 understood from the outside will be a key showing for us, a demonstration of
24 the kind of agility that we've been trying to build.

25 It's funny, as I look at the parallels with advanced reactors,
26 I'm reminded of, I still make references to Seinfeld, even though that makes

1 me seem very old because that show ended a long time ago. But Jerry was
2 buying a new car, and he's talking to Puddy who happened to be the sales
3 agent there. Some of you are nodding your head, and others are like what is
4 she talking about? But he's going through all the dealer add-ons, and he's
5 trying to explain why the price is so much higher and he's going, oh, you know,
6 the coatings and everything. And then he goes, "The keying charge," and
7 Jerry stops him there and he goes, "You're charging me for a key for the new
8 car?" and Puddy just looks up and he goes, "How are you going to start it?"

9 So fuel is foundational to everything to come, and I think that
10 the world of fuel has been static. I don't think that's because there's a failure
11 to innovate in the vendor community. I just think that some of the situational
12 imperatives weren't there.

13 So I do want to learn more. We don't need to do it today.
14 It sounds like with the Hatch LTAs there was some kind of obstacle in
15 transporting something to the site, if I'm understanding that, and, as a result,
16 they removed the nuclear material and inserted dummies. I don't mean that
17 as a pejorative, but they inserted things that were just the structure. We
18 heard from Mr. Bost that they'll still get useful information from that. As an
19 engineer, I understand that, yes, they'll irradiate some of the materials and
20 that that's valuable.

21 But I'm wondering if that had something to do with not
22 bringing along all components of NMSS, you know. I realize that they're not
23 really the pointy tip of sphere here, but it just points out that this is a big
24 integrated system. And so, again, I compliment you on the teaming and the
25 way you're drawing in people at the right times to work on the right things.
26 Again, I attribute some of that to the hard work we've done through the years

1 of Project Aim. Organizational agility was one of the central of the three-legged
2 stool of Project Aim. That was a key element for us.

3 Nevertheless, there are things that the proof will be in the
4 doing and they require a lot of exquisite discipline in our carrying them out.
5 One of them would be, as I listened to both Mirela and Michelle talk about
6 some of the research pieces, I know one of the elements that the NRC staff
7 talks about is integrated effects and that makes me think of, like, downstream
8 effects with GSI-191 on containment sump clogging.

9 And so as we look at the integrated system and every layer
10 that goes out, you could, in a research capacity, make that a very undisciplined
11 process. Mirela, do you have any quicky thoughts about the mechanisms
12 through which one keeps discipline in that process to achieve a level of
13 adequate certainty and not absolute certainty?

14 MS. GAVRILAS: So it goes back, in my view, to the PIRT.
15 The PIRT collates all the data that we have, all the knowledge, in a very
16 disciplined manner. It pulls the information together, and it says these are
17 the important phenomena. But that's a --

18 CHAIRMAN SVINICKI: Can I just on that, do you think in
19 the expert elicitation we do, do you think we're going to find good alignment in
20 the PIRT process of what are the phenomena of interest, because you could
21 just have an endless laundry list and an endless list of phenomena, and then
22 maybe more difficult is the relevance of the individual phenomena.

23 MS. GAVRILAS: So that's why we have actually some -- a
24 white paper. It might be more on how to conduct an expert elicitation. The
25 experts --

26 CHAIRMAN SVINICKI: I think somewhere in George

1 Apostolakis's ears are perking up because we know there's a disturbance in
2 the force there.

3 MS. GAVRILAS: So the important thing is the experts start
4 from a body of knowledge, and that's what goes into the phenomena, that
5 goes into the ranking. It's a body of knowledge. And they might say I don't
6 have enough data here, I don't have enough data. But their opinion is not
7 just their opinion. Their opinion is basically formed on a very solid technical
8 basis.

9 CHAIRMAN SVINICKI: Okay. So it's not just an accretion
10 of everybody, like this is the thing of greatest interest to me, I want to add it to
11 the list?

12 MS. GAVRILAS: No. And if we do the expert, if we
13 choose our experts carefully, we choose the experts who have the credentials
14 to be, you know, we look at things like what academia does, the citation index,
15 and that's the kind of people. And we had very good advice from the ACRS
16 recently who said, you know, get some skeptics, get some cynics, because
17 they, too, add value, they, too, will add value to the process. So we intend to
18 do all that in forming these PIRT panels.

19 CHAIRMAN SVINICKI: Okay. Thank you for that. Well,
20 like I said, I'm very excited about it and very intrigued I did see the thought
21 piece or white paper. I haven't had a chance to read that. I hadn't realized
22 you had an ACRS engagement on that. I may look that up, as well.

23 MS. GAVRILAS: With the subcommittee.

24 CHAIRMAN SVINICKI: At the subcommittee level. Okay.
25 Thank you for that. Michelle, I wanted to ask you, on slide 22, you
26 communicate that, based on the information we have so far, we believe that

1 for near-term concepts, like some of the cladding changes, it's more efficient
2 and effective to use NRC tools which could be modified with minimal effort.

3 Once you make that kind of, take that fork in the road, is that
4 something that, depending on how the development goes in terms of the near-
5 term concept itself, if you discover something about it, can you kind of switch
6 horses there and decide that you could use an industry code or, once you
7 decide that you're going to make revisions to an NRC code, is it best just to
8 stay locked into that approach no matter what happens with the technology
9 development on the ATF fuel?

10 MS. BALES: I think that goes more to how much effort it
11 would take to have a staff become an expert in a new code, and so not so
12 much whether the technology is a near-term or a long-term one. And so I
13 think if we have the ability to have staff available to gain expertise and they
14 have the bandwidth to do that, then, yes, like I said, it's more about the timing
15 and the staff availability to gain expertise than it is about, I think, a particular
16 concept. And I think that some of the work that we're doing now makes sense
17 because this is our current plan and just having those codes available to make
18 assessments in the near term makes sense now, but it could be revisited as
19 new information becomes available.

20 CHAIRMAN SVINICKI: Okay. Thank you for that. So it
21 is something that you'll just kind of assess that as you go along and it's not
22 locking in because there's been some concern that NRC is getting kind of too
23 in favor of the comfort of using its own codes. If we felt it was advantageous
24 to just develop the staff expertise on a code that wasn't ours, we're not
25 somehow resisting artificially doing that?

26 MS. BALES: No, I don't believe so.

1 CHAIRMAN SVINICKI: Okay. Thank you. And my last
2 question is going to seem complicated, and it's not really a trick question, but
3 it is a bit philosophical. I don't know. I was tempted to direct this to C.J., but
4 it would be like picking on him because he was kind enough to do a temporary
5 assignment in my office. I don't really want to pick on him, but he's the risk
6 guy and it's about risk.

7 MR. MCCREE: Chairman, you should feel free to --

8 CHAIRMAN SVINICKI: Free to pick on him? Okay.
9 Well, then maybe I will since the crew on this side of the table is the one
10 everyone is saying that they're going to really carry us to success on this, so
11 maybe I should direct it to that end of the table.

12 Is it a true statement that, if a current licensee comes to us
13 and says I want to make a modification at my plant and I invoke the appropriate
14 regulatory processes, our position in determining our review of that proposed
15 modification, it doesn't have to increase margin, does it? As long as it doesn't
16 have a negative effect on margin to an extent that we'd have a regulatory
17 objection, can people make changes to their plants, including to their fuel, and
18 we would say, well, it doesn't do anything that violates what we have, it doesn't
19 enhance margin. And the fact that it doesn't enhance margin, that's not a
20 basis for regulatory denial, is it?

21 MR. FONG: By itself, no, it's not. And I would point out
22 that if the change is risk informed, we do look at the safety margins to make
23 sure there's not a significant decrease in margin. But licensees are not
24 constrained only to changes that add margin.

25 CHAIRMAN SVINICKI: So if these weren't marketed in a
26 Madison Avenue kind of way as accident tolerant fuels, if they were called

1 advanced fuels, would we take a view that we will only approve them if they
2 enhance margin? Would that be legitimate for us to do?

3 MR. FONG: Well, as the risk guy here and since Vic
4 volunteered me, I would point out that, from a risk perspective, we look at the
5 Commission's safety goals, and so we look at how safe is safe enough and
6 we have subsidiary numbers that we use to help us make that determination.

7 CHAIRMAN SVINICKI: Okay.

8 MR. FONG: So we wouldn't try to impose a policy decision
9 beyond that --

10 CHAIRMAN SVINICKI: Okay. And I realize there's other
11 prongs here and I'm not trying to be cheeky about it. It was a congressional
12 initiative. Our DOE colleagues pointed out the fact that, you know, after
13 Fukushima, funding was provided to DOE to kind of kick this thing off because
14 there may have been a congressional expectation that this was an
15 enhancement to safety.

16 But laying all that aside, if the label weren't accident tolerant
17 fuels, would we have a basis to deny something just because it wasn't some
18 sort of significant enhancement to margin? I assert, obviously, from how I'm
19 asking this, I assert that we would have no basis to do that, and I'm not trying
20 to put it on you, but I know that there may be some sort of kind of expectation
21 about it, but I think these are going to come in under like the Westinghouse
22 XYZ fuel. I mean, the fact that they had their origins in something called
23 accident tolerant I don't think really is central to the finding that we have to
24 make.

25 So I think, I just want to be honest about that expectation
26 because we don't do Madison Avenue here. This isn't marketing, you know.

1 We will move forward under the framework that we have, and we will make
2 the findings that we're required to make under law and that's what we'll do.
3 So I know that's provocative. Victor, do you want to say anything or do you
4 want C.J. to respond?

5 MR. MCCREE: Well, I think C.J. has responded. I hired
6 C.J., so I thought we'd set him up that way. As you were asking, posing the
7 question, Chairman, I know nothing in our regulatory construct that would
8 require us to assert or affirm or even in our acceptance review that a design
9 adds margin, nor is there a Commission policy that would compel a vendor to
10 move in that direction for such a fuel design. Of course, there's policy in new
11 reactor space that indicates that it's the Commission's expectation that there
12 would be an increase in margin, safety margin, but I don't believe that
13 translates to fuel designs.

14 CHAIRMAN SVINICKI: Okay. Thank you. Well, I didn't
15 mean to end on such a dramatic note, but do my colleagues have any further
16 questions? You're tempted. Okay, all right. Anyone? No. Okay.

17 All right. Well, I thank everyone again and also the
18 panelists who joined us in the first panel. And, again, I compliment and thank
19 the staff for their hard work, and we are adjourned.

20 (Whereupon, the foregoing matter went off the record at
21 11:59 a.m.)