

**Nuclear Energy Advisory Committee Meeting (NEAC)
August 2, 2022
Hilton Washington DC National Mall Hotel, Washington, DC**

Committee Members Participating:

Richard Arnold	Maria Korsnick, Acting Chair
Lake Barrett	Kemal Pasamehmetoglu
Stu Bresler III	Raluca Scarlat
Michael Ford	Sonja Schmid
J'Tia Hart	

Committee Members Absent:

Edward Kee
William (Bill) Magwood, IV, Chair

Other Participants:

Luke Branscum, Special Assistant, Office of Nuclear Energy, USDOE & Designated Federal Officer, NEAC
Sam Brinton, Deputy Assistant Secretary for Spent Fuel and Waste Disposition, Office of Nuclear Energy, USDOE
Alice Caponiti, Deputy Assistant Secretary for Reactor Fleet and Advanced Reactor Deployment, Office of Nuclear Energy, USDOE
Michele Enders, NEAC Support Staff, Allegheny Science and Technology
Jac Goodman, Associate Deputy Assistant Secretary for International Nuclear Energy Policy and Cooperation, Office of Nuclear Energy, USDOE (virtual attendee)
Andy Griffith, Deputy Assistant Secretary for Nuclear Fuel Cycle and Supply Chain, Office of Nuclear Energy, USDOE
Kathryn (Katy) Huff, Assistant Secretary, Office of Nuclear Energy, USDOE
Steven Katradis, Recording Secretary, Allegheny Science & Technology
John Krohn, Deputy Chief of Staff, Office of Nuclear Energy, USDOE
Robert Rova, Office of Nuclear Fuel Cycle and Supply Chain, Office of Nuclear Energy, USDOE and Alternate Designated Federal Officer, NEAC
Apple Seibert, Office of the Assistant General Counsel, USDOE
Jennifer Wachter, NEAC Support Staff, Allegheny Science and Technology

Physical Room Attendees:

Brent Dixon, Idaho National Laboratory
Frank Goldner, USDOE
Sal Golub, Associate Deputy Assistant Secretary for Nuclear Fuel Cycle and Supply Chain, Office of Nuclear Energy, USDOE
Stephen Kung, Office of Materials and Chemical Technologies, Office of Nuclear Energy, USDOE
Bill McCaughey, Office of Advanced Fuels Technologies, Office of Nuclear Energy, USDOE (virtual attendee)
Justin Meyers, Nelson Mullins
Cheryl Moss-Herman, Office of Nuclear Energy, USDOE
Kim Petry, USDOE
Toru Nakatsuka, Japan Atomic Energy Agency
Vivek Thangam, General Engineer, Office of Nuclear Energy, USDOE
Jackie Toth, Good Energy Collective
Craig Updyke, ASTM International
Dan Wachs, Idaho National Laboratory

Virtual Participants: 64 participants attended the meeting via Zoom

Morning Session

Before the meeting, **Apple Seibert** of the USDOE's Office of the Assistant General Counsel remotely (via zoom conference) conducted the Committee's annual ethics briefing.

At 9:03 a.m., **Luke Branscum** opened the morning session of the meeting stating that Bill Magwood, who is the NEAC Chair could not make it to the meeting, and that **Maria Korsnick** has agreed to act as Chair for today's meeting. Then he introduced **Dr. Katy Huff** and turned the meeting over to her.

At 9:05 a.m., **Dr. Katy Huff** welcomed everyone and provided opening remarks praising all of the NEAC members for being present at today's meeting. She said that it takes a lot of paperwork and government approvals to get people with such great expertise to participate in this committee and that she was grateful for everyone's participation and that she did not for a minute doubt that everyone was carefully selected through a complex process where a strong effort was made to get representation from a wide variety of expertise. She added that, we've succeeded at that because we have expertise across non-proliferation, fission, fusion, academia, we have representation with perspectives from different cultures and academic fields and national laboratories and industry, and I think we have achieved a little bit more representation and makes us look slightly more like America, which is a high priority for this White House and this administration. This slate of individuals was reviewed, of course, all the way up through the White House and you have the confidence of myself, the Secretary and the President to advise the Office of Nuclear Energy in this endeavor, so I'm grateful to you. I'm especially grateful today for Maria stepping into the Chair's role, I cannot think of anyone more capable of stepping into Bill's shoes in this endeavor with no notice whatsoever and so thank you so very much and with that, I would like to turn it over to our acting Chair, Maria Korsnick.

At 9:07 a.m., Committee Acting Chair, **Maria Korsnick** thanked **Dr. Katy Huff**, stating that quite frankly I am very, very excited about our endeavor as a team here for the Nuclear Energy Advisory Committee. Maybe just let me start with a little bit of background to say this is such a precious time for nuclear energy. I personally have been in the nuclear energy field for about 36 years and it's unlike any time in that 36 years that I have been in. And when you say, well Maria, what are you thinking about, how you can imagine this, what are the forces that you're seeing. Really it's across the board, it's at the federal level, both from a legislative perspective as well as an appropriations perspective. It's at the State level, where five years ago, I would have told you that we had a handful of bills in state legislators that had anything to do with nuclear energy. That would be amazing, today, we have over 100 bills going through State legislators that have to do with nuclear energy. Okay, I mean that's just one data point, but I want you to feel the inflection point that we are at right now, for nuclear energy.

And it's, not just in the United States, it's also internationally. I've been doing quite a bit of travel, some of my travel has intersected the Secretary's and the Assistant Secretary's schedules, and so, I don't know, just read some of the headlines, the United Kingdom, France, Romania, the Czech Republic. I just came back from Japan, and they are working to start up their current fleet and also beginning to consider what about nuclear beyond their current fleet. Have been having conversations with folks in Ghana that are interested. And I forgot to even mention our closest neighbor Canada. And so again it's not just a conversation here in the United States and its private investment, it's R&D. And so it's really across the board, and then you ask yourself, well, what's this thing about nuclear all of a sudden. And if you step back for a minute, you begin to realize that this is because of a variety of factors.

Sure there's a lot of attention on the climate. Okay, so that brings up carbon and carbon-free as a conversation, people are interested in emissions-free, people are interested in reliable electricity, people want resilient electricity, they want electricity 7-24, they want to know that it's going to be there, they want to make sure that it's going to be there whenever they need it. It's energy security. Right now, unfortunately we're in a world today where we're looking across the globe and understanding, some people have a real focus on energy security, because where they were getting their energy. Someone is deciding whether or not they want that pipeline to even be full anymore and they're very dependent on a force that they would like to not have anything to do with. And so that brought energy security to the front line. Energy is also such a big part of the economy, when you start talking, energy security, you quickly get to national security. And then of course we step back and say well we're going to make this transition to carbon-free and to clean, we want it to be a just transition, that's very important, and so, jobs are very important. And when you look at that whole list that I just mentioned, nuclear energy answers every single one.

And that's why there's a conversation about nuclear energy today it's not just one of those factors, it's all of those factors, and as a result, there is unprecedented interest. Every year, I say this is the most interest that it has had and then the next year, it's even more. And that interest has been continuous. Over the last three to four years, we're at this almost exponential interest and attention in nuclear.

So, to say that we, as the Nuclear Energy Advisory Committee, have an important job to do, I cannot overstate that especially, with all of the different perspectives that you bring from all the different seats that you have and

from the experience that you bring to the table. To be able to advise this very important department, right now, at this time, is precious, absolutely precious. And we should take that on as an advisory committee that it's always an important committee, it's always important to provide this information, but now, it is special and we should wear that very carefully as we decide what we want to focus on, decide what we need to have as a priority and decide to move forward.

Just because there's a lot of interest and attention, it doesn't mean it's going to be easy. So, yes it would be nice if they came together, but not necessary. There's regulatory efficiency issues, they're siting efficiency issues, there's supply chain issues, there's many issues. Fuel is part of that supply chain issue, and there's also many workforce issues. How do we prepare the workforce for the future based on what we envision now? We already talked about international and then of course spent fuel. Whenever you talk about nuclear there's always a conversation about what to do next once you've used that fuel just once. I look at that, as a future resource.

So again, those are conversations we can have when I talked about the fact that there's all this interest, I guess, let me just also give you a view when we talk about interest. Maybe what's the potential for nuclear and so, in the job that I sit in I'm connected to the nuclear industry, we pull together the chief nuclear officers on a regular basis, and so we polled the chief nuclear officers and we said listen. Some of the companies are coming out with their integrated resource plans and they're talking about nuclear. Some of them are holding back just a bit because they want to talk within their company first. Let's do a poll and I'm not going to attribute it to any company, but just tell us what you're thinking about, just tell us what your company is thinking about, let's say, between now and 2050. So all the chief nuclear officers and these represent the companies that own nuclear power plants today. The feedback that they provided was between now and 2050 they're interested in about 90 gigawatts of electricity. Okay, we have about 90 gigawatts of electricity from nuclear today. So when the chief nuclear officer says, we're thinking about nuclear as we look forward it's about doubling the amount of electricity today that we get from nuclear. Now these chief nuclear officers represent about 40% of the electric system. So now, you can imagine all right, that was really a sampling, but it was a sampling really of only 40% of the market, and so, then, if you correct it up for that, and then you say well what today we're just talking electricity, but is that all that we're going to get from nuclear energy. Well, of course, not right we're going to get high temperature steam for some people that just want the high temperature steam to help them decarbonize what they're doing like in the manufacturing sector. And what about hydrogen. It's easy to use what we can from a nuclear plant to make hydrogen, so now we really need to think about nuclear is just an energy source, not just a producer for electricity. So let's go back to that CFO study if we were going to do all of that, with small modular reactors and get those 90 gigawatts you're talking 300 small modular reactors and again an under sampling of the system, if you will, because that's really only representing 40% of the market and only representing electricity in that market right and we just talked about nuclear can do much more than that. So we also commissioned a study it was by vibrant clean energy and we said, what would the market do if you just let the market do what it wanted and they did a market study and they also did a constraint study, and I'll just kind of cut to the chase, but what would the market get if the market could just choose as much nuclear as it could between now and 2050 instead of 300 reactors, the model would pick about 1,000 and then, if you constrained that and said well there's some difficulty, whatever that difficulty might be could be supply chain could be some other issue instead you're in the neighborhood of 350 or 400, so my point to you and saying this isn't that any of the numbers that I just shared with you are correct or accurate, it's really more to look at the trend, and so, whether or not we're polling folks that are involved with nuclear today, and you get a number around 300 or, if you do a model and you get a number somewhere north of three or 400, the point is that the market demand for reliable scalable nuclear power is absolutely there.

So really our challenge is understanding that how, in fact, do we prepare in regulatory space and supply chain space and work for space. How do we prepare for this, so that the market is able to choose this highly reliable carbon free source if it so chooses.

So, again it's a precious time for nuclear and I couldn't be more excited to be a part of this team and see what it is that we want to focus on to provide the best advice.

At 9:17 a.m., Committee Acting Chair **Maria Korsnick** asked everyone sitting around the table to briefly introduce themselves.

Lake Barrett is a former DOE and NRC employee. He is a Nuclear Engineer who started out as a contractor in nuclear submarine testing and design. He worked as a Refueling Engineer on the last refueling of the Nautilus nuclear-powered submarines. He has worked in Defense Programs and in Civilian Waste Management. Was the Acting Director and long-term Deputy Director for the Office of Civilian Radioactive Waste Management. He retired when the Yucca Mountain decision was made under the Bush Administration. Has been helping the Japanese with Fukushima and other matters.

Stu Bresler works for the PJM Interconnection, LLC, a Federally Approved Regional Transmission Organization responsible primarily for the reliability of the bulk power transmission system. Has been with PJM for

the majority of his career, starting out in bulk power systems operations and then kind of evolving into wholesale power markets. Has spent most of his career with PJM developing and operating wholesale electricity markets.

Nuclear energy is a very important part of the resource portfolio of PJM and we recognize the benefits of nuclear energy.

Michael Ford is a retired Navy Captain with a background in National Security space and the Operating Engineer's space. Served on active duty as a navy nuke for 30 years. Had command of a couple of ships and was a Senior Nuclear Engineer on an aircraft carrier and this exposure is what started his operational engineering experience. Has spent many years as a reactor operator and has performed his first reactor startup in the mid-80s.

After retiring from the navy, has spent 6 years pursuing academics at Carnegie Mellon University and at Harvard, as an academic researcher looking at energy development and economic analysis.

Has spent the last three years in the national lab system. Currently he is the Associate Lab Director for Engineering at the Princeton Plasma Physics Lab.

J'Tia Hart is the Chief Scientist for National and Homeland Security at Idaho National Laboratory. Has a PhD in Nuclear Engineering, with emphasis in researching the fuel cycle. Has been at a few national labs; Argonne, Idaho and a few others.

Also worked primarily for NNSA, DOE and also for the Intelligence Community. Served some time as a federal employee in the Office of Intelligence and Counter Intelligence where she was the intelligence briefer to the Secretary of Energy.

Alice Caponiti is the Deputy Assistant Secretary for Reactor Fleet and Advanced Reactor Deployment (NE-5). She manages the R&D and demonstration portfolio for the existing fleet for getting new reactors in the pipeline, as well as a lot of cross cutting technologies, important for both missions and this support that we have for universities.

Andy Griffith is the Deputy Assistant Secretary for Nuclear Fuel Cycle and Supply Chain (NE-4). Recognizes that the reactor is the workhorse of the nuclear energy system.

Bob Rova works in the Office of Nuclear Fuel Cycle and Supply Chain and he is also Luke's Deputy for this committee.

Sam Brinton is the Deputy Assistant Secretary for the Office of Spent Fuel and Waste Disposition (NE-8). He works on HLW and Spent Nuclear Fuel for DOE.

John Krohn is the Deputy Chief of Staff in the Office of Nuclear Energy. He will helping Bob and Luke to ensure that these events are successful moving forward.

Sonja Schmid works as a Faculty Member at Virginia Tech Department of Science, Technology and Society. She has an interdisciplinary background. She is not a nuclear engineer, however, she studies the history of nuclear reactor design choices and most recently, emergency response.

Raluca Scarlet is an Assistant Professor in the Department of Nuclear Engineering at the University of California at Berkeley. Her research is in the area of advanced reactors both fission and fusion and reactor safety and chemistry. She represents the university perspective on this committee, thinking through the role that the universities plays in knowledge continuity, in knowledge creation, workforce development and the infrastructure that it takes to provide that.

Kemal Pasamehmetoglu currently works at Idaho National Laboratory. Has spent his career in the national laboratories for 36 years, spending 18 years at Los Alamos NL and 18 years at Idaho NL. Throughout these 36 years he has been involved in every aspect of nuclear energy in one fashion or another, starting from nuclear waste all the way up to advanced reactors. Has been involved with accelerator driven systems for a while.

Richard Arnold brings "the old country boy" spirit to the team, in an attempt to add some sense and logic and bring proper perspective to the group. One of the interesting things is that the Tribes have at oftentimes being overlooked and excluded in many discussions, and due to this, he strives to receive more proactive and progressive types of interactions, which is greatly appreciated and needed.

He participates in the DOE's Nuclear Energy Tribal Working Group, along with the Tribal Radioactive Materials Transportation Committee.

Where he has interactions with the Tribes throughout the United States, one of the things he clarified was that while the Tribes can provide a travel perspective, he is not in this committee representing any one particular Tribe and that's something that happens on a government to government basis between the Tribes and the Federal Government.

He appreciated Maria's opening remarks that there is a big interest in electricity, people getting some and some people just wanting electricity, while some other people also don't have it, and so he think it's important to point out those kinds of perspectives in the group. Also, looking at the small modular reactors, there is a lot of interest in them in Alaska, in some of the remote areas. So when such discussions are brokered and where there are close interactions, these communications will be very helpful to the Tribal Communities.

It's nice to see everybody here and hear what all of the scientific foundations are doing. He hopes that a sense of consciousness be present in all future discussions, so that there exists "a science with a conscience", making sure that the right things are done moving forward.

Committee Acting Chair, **Maria Korsnick** thanked all of the speakers for their introductions and after stating to everyone that they had again reinforced to her just how much of an esteemed group this is, she turned the meeting over to **Dr. Katy Huff**.

At 9:27 a.m., **Dr. Katy Huff** provided a presentation on the "Office of Nuclear Energy Priorities".

Huff first thanked Korsnick and after praising what an incredibly esteemed group this is, she began her presentation stating that the critical component here is that in the next few hours you'll be hearing about what the Office of Nuclear Energy is up to. And we'll be looking to you to help us direct that ship, help us align our strategic missions and priorities with our actions. And all of your perspectives will be helpful here, everything is fair game, and that will be followed by lunch and then of course discussions that you lead. This is your committee directing what you think we need direction and advice for, so I hope you'll sort of listen to what I think our priorities are, you'll hear from our specific technology offices to understand what it is they're working on. And I look forward to your feedback and guidance in all of these areas so let's talk a little bit about the first slide.

The annual appropriations in the Office of NE, really drive what's possible it scopes the scale of what we can do. Right now, we have an incredible opportunity as Maria mentioned. This is a time when we have resources for the Office of NE that we haven't had in the past, and some of it has expanded past the Office of NE into a space of other offices engaged in nuclear equities, so our FY23 budget request was about \$1.7 Billion, which is one of the largest budget requests in American history for the Office of NE. If you look back in history, you can see how it's been modestly growing. And we're really excited about what can be possible here.

In addition to all of that the advanced reactor demonstration demos were funded through the bipartisan infrastructure law with \$2.5 Billion to support the Sodium reactor and the X-energy Xe-100 reactor full deployment. Those \$2.5 Billion are going to be over the course of the coming years, supporting those demonstration reactors in the Office of Clean Energy Demonstrations. So that's \$2.5 Billion existing outside of the Office of NE being managed by the Office of Clean Energy Demonstrations toward our mission. So we will be working closely with them and are already working closely with them within DOE to see those succeed.

Similarly, the civil nuclear credit program was stood up by the bipartisan infrastructure law was \$6 Billion over the next 10 years and that, too, will be operated within the infrastructure undersecretary outside of the Office of NE in the grid deployment office. And that \$6 Billion will help economically struggling nuclear facilities/plants that have struggled in difficult markets. And those plants will then have some opportunity to save themselves from immediate closure. We in the Office of NE, stood up that program and its first months and we are in the process of transitioning it over to that grid deployment office. But that's again a \$6 Billion amount that's operating outside of the Office of NE, the core to our mission. And so you can see how the department is sort of expanding that cross cutting nature of nuclear much like other clean energy technologies, find a place in that new infrastructure secretariat.

Additionally, the bipartisan infrastructure law passed \$8 Billion for hydrogen hubs, regional hydrogen hubs, there will be four of them, and at least one of those will be nuclear. I think the direction from Congress is pretty clear that we want to see significant nuclear participation in those hydrogen hubs. And so those regional hydrogen hubs, of course, also will be deployed in the Office of Clean Energy Demonstrations. Again, this is space where there'll be focused on the creation of hydrogen, but expansively considering different clean energy technologies, one of which is directed by Congress to be nuclear. Again an equity in our mission outside of this office but contributing, so we contribute through direct collaboration technically in that endeavor with the new office of clean energy demonstration space that's deploying these hydrogen hubs.

The inflation reduction Act has a lot going on in it, this is the deal that Senator Manchin and Senator Schumer have reached recently and we're hoping to see that move through Congress quickly. This inflation reduction Act has a lot of nuclear equities in it, but a few that all just note is that it does incorporate \$700 Million for HALEU, which we will need for advanced nuclear demonstrations and advanced nuclear commercialization of the second, third, fourth, fifth of a kind of these advanced reactors, hopefully, all the way up to 300. As Maria was indicating there's also an opportunity for a production tax credit, there's national lab infrastructure dollars, there's all kinds of things happening in this bill and we'll watch it very closely, as it moves forward.

We have a few key priorities so I'll talk through those they all have to fit inside this budget. Which is my daily task actually, we have a lot of focus, but it's critically important that we balance, the importance of responsibility with taxpayer dollars, our mission and our priorities.

The top priority is keeping existing plants open we do this through a number of programs and you'll hear all about some of them.

We focus on work to digitize our analog systems for existing control and operation of nuclear plants.

Providing technical analysis for continued long-term operation, i.e. license extensions for existing plants, the science that DOE R&D supports helps the NRC confidently decide on license extensions with data that they can trust from the national laboratories.

We're working on accident tolerant fuels alongside industry identifying new markets, as Maria was talking about, with regard to direct process heat, hydrogen production, advanced materials and fuels that can be produced through direct process heat even district heating.

And, of course, hydrogen production is a critical component, we have a number of hydrogen demonstrations already started in addition to the demos, which will come out soon.

So what it looks like here, and you may see the slide again because it sort of underpins a lot of our work in advanced reactors in the existing fleet, but today, most of our baseload is from (as this slide I borrowed from Alice shows) nuclear that provides electricity demand generation. But in the future, there could be a variety of different reactors, providing a variety of different products through both heat and electricity.

We hope to see clean water, come from this through desalination hydrogen production industrial applications, electricity generation that isn't just baseload but captures the capability of advanced storage systems attached to advanced reactors, as well as advanced reactors that have the ability to load follow with the critical reactor physics that are no longer tied to the fuel stress limitations or thermal stress limitations that previous reactors may have been, and all of that will allow us to work more effectively with renewables on the grid, with other clean and low carbon energy sources and the sort of fundamental restrictions of our 24-7 need for electricity that's reliable.

So we use hydrogen already in a number of applications out in the world, and there is a market already so there's an opportunity here for existing light-water reactors to begin to participate in that market. And we have four alongside EERE, we have four demonstrations at different reactors around the country that are already being stood up to begin producing hydrogen through various types of electrolysis. We've got two demonstrations with PEM, a high temperature steam electrolysis and so on at four different locations (Prairie Island, Palo Verde, Davis-Bessie and Nine Mile Point), which will soon be producing hydrogen with their existing electricity to reduce the times when the sun is shining you don't need as much nuclear electricity on the grid, and this will enable them to offload that to a valuable product hydrogen which they can then be fed back through fuel cells into the electric grid or sent out to the market as hydrogen fuel product.

So there's a lot of use cases we've talked through a few of these and I'm sure Alice will go through them, but there's remote applications and chemical processing locations, there's sort of shipping opportunities and dense urban requirements for batteries, is a great image from third way, and I think there's even more, as we think about the future, but it may be remote mining towns, it may be urban hospitals that require reliable power, instead of backup diesel contemplate a micro reactor.

Alright, our next priority is this, building advanced reactors, so, in addition to keeping existing reactors open and exploring new markets, advanced reactors play a role in the transition.

We have a lot that will be talked about in terms of fuel development and design and this priority is critical because we must advance with the many decades of knowledge that we've developed over the course of time. And since the last time we were building plants regularly, we know a lot more now, there are advanced fuels that offer incredible safety which is reassuring to the public whom we serve. It can help with our energy justice initiatives to ensure that the hosts of these devices feel safer.

For the more advanced materials and manufacturing should reduce the cost of these advanced reactors in the long-term, as they become more modular.

There's different sizes that we're exploring micro, small and large scale reactors all have opportunities in the market. We still have international interest in very large scale gigawatt reactors and very soon you'll see the two, Vogtle plants in Georgia, turning online.

But, additionally, small modular reactors are close to the size of a lot of existing retiring coal plants. This is an opportunity for us to bring along communities as this energy transition progresses. As we approach a clean energy transition here in the United States, we cannot leave communities behind. And small modular reactors offer an opportunity to replace retiring coal plants, leverage existing infrastructure like high voltage power lines, cooling water capability and other infrastructure, but also the workforce and the communities in those locations will also need to be brought along in that transition.

As many of us know a nuclear plant is very similar to a coal thermal plant. A lot of the auxiliary systems are the same, you need a lot of the same steam turbine like management and maintenance operators. You need boilermakers and electricians, welders, etc., and so similar needs and then micro reactors have very specific needs, applications that we can explore for specialized needs in remote areas or backup power. So we'd like to build a lot of these, and we have a real direction here where we'd like to see some of these plants built over the course of a long timeline. A lot of this will be talked about again, this is the analysis area, so our advanced reactors section will dive a little deeper, but this timeline presents a number of ambitions that we have about testing micro reactors in the coming couple of years, deploying SMRs through our demonstration program, reducing the risk of advanced reactors like

Kairo's design through risk reduction awards in our advanced reactor demonstration program and finding ourselves with multiple deployments in this decade. I hope to see TerraPower's new term reactor built in Wyoming, X-energie's Xe-100 built in Washington, the U.S. NuScale partnership building their carbon-free power project, NuScale Voyager six pack in Idaho and many more.

So Alice will talk a great deal about this as well, but we have a vision of enabling these advances in the long term, through infrastructure deployments at that Nuclear Reactor and Innovation Center. Alice will also dive into a network of capabilities that exists throughout the national laboratories, in our broader federal infrastructure to enable advanced reactor developers to innovate.

So, as we have this EBR-II Dome that will be ready for testing micro reactors. As well as other facilities which Alice will discuss later on.

But I would like to walk through some of the advanced reactors that we're supporting just so you have a notion of the landscape of his priority.

The advanced reactor demonstration program isn't, the only way we support advanced reactors and again Alice will dive deeper into this, but the two demo reactors that are now part of the Office of Clean Energy Demonstration mission are the sodium-cooled fast reactors from Natrium and the Xe-100 HTGR, which is a high temperature gas reactor with pebble fuel and these two devices, we hope, will be deployed in this decade, but a critical component of their success will be licensing and fuel. With the bipartisan infrastructure law we have secured release from another risk which is appropriate annual appropriations risk, I think there were sort of three major risks facing these two demos. The first being appropriations risk which is solved by this bipartisan infrastructure law injection of \$2.5 Billion, but the other two still remain. Continued forward movement and their licensing will progress and hopefully with collaboration through the NRC and DOE, we should see success in those timelines, but a final component will be fuel, which we'll talk about shortly.

In addition to those two demonstration reactors which are targeted to be deployed in this decade, we expect that in the next 10 to 14 years there are these five reactors that we're supporting for deployment in the longer term, that includes SMRs, like the Holtec SMR-160, as well as micro reactors, like the eVinci. We're really excited about all these reactors, the banner reactor from BWXT is another micro reactor design. The KP-FHR is the Kairos design, which will be a sort of experiment through the Hermes experiment leading up toward a commercial deployment and the molten chloride fast reactor, which is led by Southern Company, is also a TerraPower design.

And there are reactors even further from commercialization which still have some opportunity to advance through the advanced record demonstration program, and that includes these three from Advanced Reactor Concepts, MIT, and General Atomics, respectively, we expect those to be more ready by the mid-2030s.

These are just an example of the kinds of reactors that we support and the advanced reactor demonstration program is our biggest direction there, but there are lots of other ways that we support other companies. We have National laboratory collaborations at Idaho and other labs, Argonne, Oak Ridge, etc., that support the development of other commercial endeavors, supported by any both in kind, and through direct support of our national laboratory missions.

I will say one that's not on this list is the NuScale reactor, which is an example of a water-cooled small modular reactors that we do see as ready to deploy within this decade. The NuScale's small modular reactor, for example, is of great interest to the international community, because it does have design certification from the NRC, which is very helpful in the confidence that we see from international interests they are much more confident in this design because it has overcome quite a bit of the licensing risk hurdle.

There are additional water-cooled small modular reactors that may be ready to deploy within this decade, including, for example, the SMR-160, that we mentioned, but potentially also, the GE BWRX-300. There is a long list of reactors that through its history, DOE and NE has supported and we hope that to see those small modular reactors leverage the capability of factory fabrication and modular deployment for a reduction in costs and an improvement in their success on the markets that they'd like to deploy in.

I think it's really important to talk a little bit about our next priority, which is international nuclear cooperation. We would really like to expand our international nuclear cooperation in a context today where, as Maria mentioned, energy security is national security and it's recognized more clearly, broadly, not just in Europe but elsewhere and we have an opportunity to lead the world again in nuclear energy by partnering with our peaceful democratic allies and encouraging safe U.S. technologies abroad. Now, we have over time lost what was leadership in operational power by nuclear reactors, but we continue to have the largest fleet in the world and there is an opportunity for us to continue to have an incredibly large fleet. We do maintain that leadership across the world, but, there are a lot of other nations that now have this incredible growth of nuclear.

We see Asia going with incredible speed towards an incredible amount of nuclear. France, of course, has really big goals now with the recent announcements from the French President. We're seeing a real growth across Europe in the interest in these kinds of things, but these are all opportunities every country on this list is an opportunity to collaborate to expand our standards of safety and reliability, safeguards and security, and when we have nuclear

reactors of any kind deployed anywhere, nuclear leadership in the United States, it's really important for us to have a voice in how those reactors are operated and maintained.

And we have a lot of opportunities to cooperate internationally through academic collaborations or national laboratory collaboration, but also through corporate deployments and stuff like that. So this is actually another way to look at this graph. The world nuclear energy market has been projected to double by 2050. The International Energy Agency, for example, thinks it will have to double in order for all the nations in the world to meet their promises for the climate.

The U.S. exports could be gigantic, in the trillions of dollars, but today, Russia does dominate global nuclear technology exports, and I think it's a reminder for how we can take on an opportunity to provide a trustworthy partner for our international democratic, peaceful allies, where less trustworthy partners may have previously held their attention.

China is ramping up exports and there's the regulatory agency in the UK who recently began to evaluate China's Hualong One design and we do struggle to compete with financing backed by state-owned nuclear technology companies in nations like that. But, I think we do have an opportunity to lean on our nuclear leadership and cooperation to enable trustworthy partnerships in this endeavor.

There's a whole lot of engagements we can talk about here, but there's a lot of opportunities here to help growing nations and to engage in future deployments. And not all of the nations that we would like to collaborate with, have 123 agreements and there's an opportunity here for us to work within the Interagency from this office to enable those deployments.

One more piece on international nuclear energy cooperation gets to the workforce component.

This is a graph which academics will recognize as the degree count of nuclear engineering degrees in the United States over time, the orange is bachelor's degrees, yellow his master's degrees and gray is PhDs. You can see that in the early days of nuclear engineering degrees, there was a peak and enthusiasm and then, as the economics of nuclear dropped off in the 80s, we saw fewer and fewer degrees and degree programs across the United States.

But then, there's some magic that happens right about when I was graduating high school. Where there was a lot of interest in clean energy and that's spurred what is now the current generation of nuclear students and young nuclear professionals many of whom like myself are beginning to take on leadership positions and guide nuclear in a climate driven way and we've recovered, a great deal, but not all and not enough of the workforce that we will need.

But there's another line on this graph that I'd like to draw your attention to. There's also the research reactors deployed in the United States, this blue line is the number of operating nuclear research reactors in the United States, and what this shows is that as those nuclear engineering departments declined, their research reactors which accompany their programs and gave hands on experience to those students were shut down. But none have recovered we've had a monotonic decrease and that creates a widening gap, as interest in nuclear reactors grows. The available research reactors for hands on engagement with that technology has not grown with it. That's true for us but it's also true for our international allies, where they're envisioning a future of deployment of research of advanced reactors within other nations there's not necessarily that infrastructure for hands on engagement with the workforce that they're going to need to build up that's true here and it's true in the democratic, peaceful partners that we would like to help deploy nuclear reactors in. And so, I want to just draw your attention to this need not just here but everywhere, some of this can be satisfied by reactor simulators in those nations, control systems that mimic the experience of the operating room, the control room of an operating reactor and they can be more easily traded out for different advanced reactor types, but, it is definitely, how many of you in this room, have worked with a research reactor as a student. See it's like credibly important for those of us with had that experience if you've operated a real reactor, you have better intuition for it, better pride to design it and keep it safe. So, it's something that I'd like to note in terms of our international cooperation it touches on our academic and workforce development behavior.

The first priority I'll talk about is securing and sustaining the fuel cycle, the whole full circle, the front and the back, we must secure the front and sustain the back.

Right now, we have a critical issue with uranium supply and the United States, and you will hear some more about it from Andy, I think, but I'll just say that. Russia provides 20% of our enriched uranium for the existing fleet in the United States. Primarily, they do this through providing conversion and enrichment services. While mined uranium has a more diverse set of suppliers across the globe, Russia dominates the enrichment market and as we look towards sources of our fuel, not just for nuclear but other sources of fuel for other production types across the world, untrustworthy sources of fuel really undermine our energy security, including this one, and so here in the United States we've actually had a decline in our capability to fully support the front end of the fuel cycle. We have only one enrichment facility and currently a conversion facility that is not operating. The conversion facility congregation is restarting but will need to restart at a higher capacity than it was planning on if we are to have any chance of filling the gap left behind.

By this Russian fuel supply now all of this is in the important context of things like the energy justice questions around mining in the United States. And this administration has a really powerful mission to incorporate energy and

environmental justice in all of our decisions, including, for example, how we secure our supply of uranium. And so there's a nuanced approach that we will need to take to the supply and provision of uranium and the standing up of a more robust supply chain that will have to recognize the dark history of uranium mining, in particular in the United States, while simultaneously recognizing the existential crisis that could be created by lack of fuel supply for any of our energy sources. So, we have developed a uranium strategy in the DOE, which proposes to procure low enriched uranium from new capacity, including HALEU in the United States.

We don't even have appropriations or all the authorizations we would necessarily need to do this, but we are working through the White House and with our colleagues in Congress to develop support for that endeavor. In addition to this, of course, many of our advanced reactors, certainly not all but many of our advanced reactor deployments will require HALEU, up to 20%. For the existing fleet it's more like 5% but up to 20% and we don't currently have a capability here in the United States to do that on a commercial scale, the only commercial scale HALEU supplier in the world is TENEX in Russia. So we would like to stand up more of that capacity as well, and Andy will talk at some length about this, but we, we certainly have a demonstration capability that is being developed in Piketon, Ohio and part of our uranium strategy will incorporate additional capacity for this HALEU. I just talked through this a little bit, but, notably this \$700 Million in the Inflation Reduction Act will help toward this HALEU availability.

Here's some details about sort of what it is, it does allow for those smaller designs and longer lived cores. Better fuel efficiency and utilization and therefore smaller volume of waste, we do have a lot of endeavors here to sort of set up this capacity in the United States in a secured and sustainable way, but it does require new centrifuges and newly licensed facilities.

So, in the last four minutes, I'll touch on a topic which I know we'll talk a lot about, which is spent nuclear fuel. So, in addition to securing the front-end of our fuel cycle, we should find a sustainable way to manage the back-end. I am excited to have a new, Deputy Assistant Secretary leading this who has an incredible passion for this topic.

And what it's going to require is revamping our strategy we have restarted a consent-based siting approach to building an interim storage facility.

We are developing rail cars and performing R&D on the advanced types of fuels that will need to be responsible for and we're integrating Spent Fuel Management in some of our international approaches, we see here are a variety of casks out at Idaho National Laboratory.

So, as we think about this, the scale of the challenge is 2000 metric tons a year. That's the same 2000 metric tons per year that go in the front-end and they come back out every year in the back-end. And this number, is physically small but the communities that currently have those fuel casks at their reactor sites did not sign up for it. We in the DOE are required to begin removing that material from the sites, at which it currently sits.

According to the Nuclear Waste Policy Act and those communities didn't sign up for long-term storage and it is our duty to provide a solution that allows DOE to take responsibility and begin managing that spent nuclear fuel so restarting a consent-based siting process for this federal interim storage facility is critically important.

The Biden Harris administration has stated that the Yucca Mountain repository is not a workable solution as a final repository, but we do have federal dollars to move forward with our strategy for developing an interim storage facility, while we evaluate other options for final disposal.

What I will say is that it's dense, it is a big challenge, politically, but a small challenge physically because of this incredible energy density and so, there is hope, and I personally really love this cartoon which is just great fun.

I will say that there's a lot of other cross-cutting priorities that I would love to spend a great deal of time on. I will describe them briefly.

We do need to champion real climate motivated workforces in our nuclear space and foster a culture of inclusion and diversity. These are critical White House priorities that we have tried to incorporate across the office, and we look forward to ways to improve those.

This includes environmental and energy justice. I've touched on some of this throughout some of these comments, but there are an incredible number of ways in which we should be better incorporating energy and environmental justice, in particular, embedding that justice into both our processes.

And in our actual work deployments, etc., and finally, of course, jobs in the American workforce, it's going to be truly critical to put these processes in place, keeping Americans fully employed and engaged in a pipeline that's going to enable our clean energy transition.

A short break was declared at 10:00 a.m.

Dr. Katy Huff introduced **Jac Goodman** stating that he will discuss the international nuclear energy cooperation endeavors.

At 10:15 a.m., **Jac Goodman** provided a presentation for **Aleshia Duncan** on "Nuclear Energy in a Global Context".

Goodman begun his presentation by saying that Deputy Assistant Secretary Aleshia Duncan was at Oak Ridge National Laboratory this week hosting a Brazilian delegation and could not attend this meeting, although she and the entire delegation will be in Washington DC later this week for bilateral meetings.

Goodman provided a brief overview of his office's mission, focusing on the current landscape for NE-6 and the broader U.S. government's efforts to promote technological and industrial leadership in nuclear energy around the world. In particular, he highlighted the key opportunities and challenges that NE-6 is currently focused on in the international arena stressing that he was looking forward to getting feedback from the NEAC members, going forward.

Goodman said that NE-6 leads the department's international engagement for civil nuclear energy participating in the analysis, development, coordination and implementation of U.S. civil nuclear energy policy. They work with other program offices that contribute to bilateral and multilateral civil nuclear R&D with countries around the world that have advanced nuclear programs. They also coordinate technical expertise and support to better inform embarking countries on the safety and security issues that should be considered before developing a civilian nuclear program.

The NE-6 program employs the suite of tools, including workshops and other expert based exchanges to engage industry, stakeholders and foreign governments on issues such as nuclear energy as an integral part of a climate change and energy security strategy, nuclear infrastructure development financing for new nuclear builds, nuclear safety and multinational cooperation on the back end of the nuclear fuel cycle, including disposal. NE-6 also coordinates the Office of NE's financial support and technical expertise to international organizations, including the Nuclear Energy Agency, the international framework for nuclear energy cooperation and the International Atomic Energy Agency.

Despite the restrictions that were imposed on international travel during the 2020/2021 period, NE-6 worked effectively through virtual means to maintain a high level of engagement with its foreign partners. But, by the start of this year, NE-6 was looking forward to a return to normalcy in our international work. The COVID pandemic was and still is, of course, ongoing, but NE-6 was eager to a return to in-person engagements and, as will be discussed later, it has been preparing for very crowded schedule of multilateral meetings this fall focused on clean energy and nuclear power.

NE-6 was empowered by the Biden Administration's recognition of nuclear power's contribution to the fight against global climate change. Last year's Climate Leader's Summit in April of 2021 and the UN Climate Change Conference (COP 26) in November of last year, so the United States, highlighting nuclear power to a global audience and both top line messaging and conference deliverables announced by energy Secretary Jennifer Granholm, and Special Envoy for Climate John Kerry and our foreign partners. And, even with the gradually waning limitations on travel, we saw important advances in our efforts to build our close partnerships with both Romania and Poland and to expand our cooperation with Ukraine, countries with a keen interest in working with US industry.

But even with the intensity of the COVID Crisis waning, we saw a new crisis quickly emerge with Russia's invasion of Ukraine, which has included unprecedented threats to the safety and security of the country's nuclear power plants. For both DOE, NE at large and NE-6, specifically, the month since, have been heavily dominated by the impacts of Russia's invasion and ongoing war in Ukraine. Building on the cooperation networks that NE-6 built with Ukraine's three years of support for nuclear safety advancement in that country we work to coordinate supplies of emergency diesel fuel and consumables to those facilities that have remained under Ukrainian control to support their ability to safely operate.

Energy security is now twin with addressing global climate change and our top line international messaging on nuclear power in our engagement strategies, particularly in Central and Eastern Europe. NE-6, the Office of NE, the department's leadership and the broader Interagency has been actively engaged in the end, in Europe, at a high level since the beginning of the war in Ukraine. NE-6 supported Deputy Secretary of Energy's Turkish participation in the US trade mission to the nuclear trade mission to the Czech Republic in March. And we organized the nuclear energy focus meetings that were held under the Partnership for Transatlantic Energy Cooperation (P-TECC) in Prague in March of this year, and more recently in Bucharest in May and going forward will be working with industry within P-TECC on supply chain mapping to support countries looking to alternatives to Russia.

The crisis in Ukraine is having a transformative effect on global energy security with important ramifications for the prospects for nuclear power and US competitiveness in the sector. Russia has demonstrated itself through its actions in Ukraine to be an unreliable and irresponsible supplier and energy security concerns are increasingly dominating policymaker discussions on nuclear power and key regions of interest, particularly in Europe. And in the last few months we've seen important policy shifts that could have been important broad ramifications. Since the conflict began, we have seen Belgium opt to postpone the early shut down of two of its reactors. The Netherlands has rolled out plans for life extension and new builds. Even Germany a global leader in the anti-nuclear community is now considering delaying the shutdown of its final units, a development that would have been unheard of before

the current crisis and, most importantly, we are seeing countries and Eastern and Central Europe reevaluating their long standing relationship with Russia's nuclear supply chain. Early last month we saw the efforts by anti-nuclear activists to overturn the inclusion of nuclear energy in the European Union, sustainable energy taxonomy successfully thwarted in the European Parliament.

Questions still surround the specifics of the taxonomy's implementation, but this is a very positive development for efforts to deploy new reactors in the region and in the internal European debate on the role of nuclear power, going forward. But the fallout of Russia's actions and Ukraine for global prospects for nuclear power may not necessarily be limited to Central, Eastern Europe. Countries like Turkey and Bangladesh which have partnered with Russia on new reactor projects and other embarking countries in Africa and Asia which have been developing relationships with Russia as a nuclear supplier, may now be open to U.S. engagement.

However, the challenge for the United States, is how to take advantage of these opportunities in the face of competition from China, of course, and our other non-aligned competitors. So Russia's disastrous actions in Ukraine have clearly shifted the strategic situation for U.S. competitiveness in the global market for nuclear power technologies. And I am pleased to report that DOE and the broader U.S. Interagency has been working hard to pivot our international engagement and response. What we continue to hear in our conversations with other countries, is that they are ready to work with the United States, but, of course there are obstacles that will need to be overcome, to ensure we can secure U.S. leadership recognizing the need to better integrate industry into our effort.

The primary challenge remains the fact that we do not face a level playing field internationally. The nuclear industries and our major competitors, China and Russia, as well as France and the Republic of Korea are state owned, well integrated into the national R&D establishment and benefiting from generous state funding these industrial structures allow. National governments provide aggressive project financing and expansive and well integrated whole of government seamless coordination of technical support that we face challenges in matching.

We continue to see strong enthusiasm for U.S. technologies and appreciation for unmatched historical experience with operating the largest reactor fleet and also a positive view of the US Government as a trusted strategic partner. Indeed, our competitors are not securing projects, due to their technical superiority, but rather their ability to deliver an aggressive package of financial workforce development, training and political and economic support.

So the activities of NE-6 have shifted significantly in recent years as the U.S. Government has worked to address some of these disadvantages. And in doing so, this process has better informed us about what is needed to secure a successful international nuclear power project. Five years ago, you would not have seen our office engaging with countries interested in deploying use technology in the way that we have been doing through our very close strategic partnerships with Romania and Poland. Our work with both of these countries has demonstrated the importance of building the government to government and industry to industry relationships and the period leading up to the signing of actual contracts. The government relationships that have been facilitated by our partnerships with Romania and Poland have been critical for resolving the various political resource and technical problems and challenges that have arisen along the way, and also for providing the political cover for parties and stakeholders on both sides to help push the dialogue along are working, but both Poland and Romania has demonstrated the importance of sustained and relationship building that is needed to facilitate a new nuclear power partnership. The work starts from the initial bilateral meetings with key foreign counterparts in which both countries identify the areas of interest for working together. It has developed further, over time, that the negotiation of preliminary cooperation frameworks, like the memorandum of understanding for nuclear cooperation, which we have seen signed with a number of partner countries in recent years, and these confidence building efforts, support the groundwork for the more comprehensive intergovernmental agreements that we've seen with Poland and Romania.

Our successful work with our Polish and Romanian partners has also helped us to identify the challenges that will need to be addressed going forward.

Project financing remains the most critical challenge, and in this regard, we remain at a disadvantage to our competitors. We need to expand the financing mechanisms currently available to the U.S. Government to allow us to better leverage private lender financing for international nuclear power projects.

Just because a country has an operating nuclear power plant, does not mean it has the personnel and legal regulatory and organizational infrastructure in place to support an expansion or a new reactor project. This was a key lesson that has come out of our engagement with Romania.

This is an expanding country where we have seen as much need for technical support and infrastructure financing as Poland, an embarking country pursuing an entirely new program.

Multiple U.S. agencies and offices, including NE-6 provide funding and technical expertise for nuclear infrastructure development with partner countries.

In recent years, important efforts have been made to enhance support in this area across the Interagency, including the launch of the State department's foundational infrastructure for the responsible use of SMR technology or first initiative and the NRC's international regulatory support. But this is an area where U.S. government

collaboration and cooperation should and can be enhanced and would benefit from additional financial and human resources. Our competitors have the advantage of being able to provide an all-in-one package of financing, technical support, and supply chain. This reflects their government's full ownership and integration of their entire nuclear energy establishment, including R&D front- and back-end reactor designs, supply manufacturing and training and infrastructure development programs. Offsetting this advantage will require a concerted effort by both the U.S. government and industry to emphasize and demonstrate the strength and advantages of working with the U.S. as a technology provider.

Our work with Poland and Romania and other regions has demonstrated the importance of long term relationship building. Which requires a significant investment of time and effort by both U.S. government and industry in this regard. Our industry needs some coaching in this area as they're used to a more transactional way of doing business, which is not always translated countries were long period of relationship building are needed to do business.

Ultimately, in our own closest partnerships, we find that we have to serve in different roles serving as advisors, to the country on building relationships with suppliers, facilitating cooperation on regulatory development and support and other unexpected requests for technical assistance. Regardless, the type of relationship building that is required from both industry and government to offset these challenges, requires considerable resources. Adequate protection against potential nuclear liability claims is an essential element of every civil nuclear energy project, and many of us Nuclear Suppliers and investors will not participate in new international markets, without such protection.

The Convention on supplementary compensation for nuclear damage, the CFC is the only liability Convention, in which the United States is a Member and we must continue to advocate for more countries to join.

Encouraging additional countries to join the CSC and promoting nuclear liability as a key issue for international engagement must be and will be an important focus for NE-6 and the broader U.S. going forward. Nuclear liability has long been a challenge for us industry cooperation with India, even with the country's exception to the CSC and NE-6 has been working to overcome the remaining obstacles towards realizing the cold water project. Looking at the obstacles, we still need to overcome I'm happy to report that NE and specifically NE-6, has never worked more closely with our inner agency partners.

Although there are points of disagreement our communication interactions with our partners within the DOE, including the National Nuclear Security Administration and the office of international affairs, as well as the broader team USA, including the state and commerce departments, the U.S. Trade Development Administration and the U.S., have continued to be constructive. Most importantly, all of the key agencies and stakeholders are on the same page, on the need to support us global leadership on nuclear power. That said, we are working with DOE leadership the NE front office and the broader inter agency in several key areas, we are working to encourage our export credit agencies to ensure they maximize the use of all of their current authorities to support U.S. nuclear power projects abroad. In cooperation with our partners in the state's office of Defense nuclear non-proliferation, we are also working with the inter agency to ensure that the appropriate agreements and mechanisms are in place in a timely manner, so that we can be ready to engage key markets. Finally, we are recognizing that there are important opportunities for exploring how we can work better with partners like Japan and how we can overcome the obstacles to partnering, where appropriate, with our non-aligned competitors, France and the Republic of Korea and third markets.

Another important focus area for us going forward will be to identify how best to leverage multilateral engagement to address cross cutting issues leverage our limited resources and maximize our ability to impact particular regions or country groupings. This includes working with international organizations, where we are key funding contributors, like the IAEA and the NEA and others like IFNEC and the Generation IV International Forum, where the Office of NE holds key leadership positions. For instance, as I noted earlier, we are already engaging our partners in Central and Eastern Europe through P-TECC on ensuring viable alternatives to secure the nuclear supply chain in the region. One area where multilateral organizations can serve as an important partner for the U.S. Government is in communicating the advantages of nuclear power. We often see our foreign partners requesting support in the areas of public messaging and stakeholder engagement. So we see this area as an important point of overlap with our bilateral and multilateral engagements and a place where international organizations can have a significant multiplier effect for our efforts.

As I have already stressed U.S. industry remains a crucial partner international engagement efforts. With our Internet Interagency colleagues, we have been working to improve dialogue with the full range of U.S. companies via both the industry associations and individually to learn more about their international activities and engagements. As we work to establish new and expanded government to government relationships and cooperation frameworks, it is critical for us to understand what countries and regions are considered top medium and long-term market opportunities for U.S. industry. Fundamentally industry must play a central role as a partner in the U.S. government's international outreach efforts. Government can and must play a crucial role in helping to build the

long-term government-to-government ties that are essential for nuclear cooperation, but companies are in the best position to engage with and inform government and industrial counterparts in other countries on their own technical capabilities and to support the connections needed to establish a long-term supplier relationship. Fortunately, we are finding legislators and Congress from both parties, are paying close attention to the challenges facing U.S. industry in international markets and against maligned competitors. The Biden Administration at the highest levels is also interested in our mission space, the White House, The National Security Council, and the office of science and technology policy is keenly interested in enhancing U.S. international leadership in nuclear power, something that preceded Russia's invasion of Ukraine.

For NE-6 all of these challenges, represent a huge mountain to climb for our small office team, and we will be relying heavily on our partners within and outside of DOE to address these challenges. This fall will be particularly taxing as we will see a lineup of high profile clean energy and nuclear focused events that we will be supporting and involved in. And we are working within DOE and the USG interagency to develop a common messaging that will highlight the United States as a reliable and responsible supplier of advanced nuclear technologies, a sharp contrast to Russia.

The first event up this month is the review conference of the Nuclear Non-Proliferation Treaty, which is going on right now and will run through the end of this month. Notably, the program includes a deal we sponsored side event on nuclear energy and climate change that is taking place this afternoon in New York. The event, which includes the participation of Secretary Granholm and administrator Jill Hruby will highlight how the NPT framework has facilitated access to peaceful nuclear technology and how it brings benefits for economic development, energy security and climate change mitigation. NE-6 works to secure key speakers from Kenya and the United Arab Emirates, for the event. Next month, in September, we will see two big gatherings that the NE-16 is heavily involved in. The first will be the Global Clean Energy Action Forum, which is the combined clean energy ministerial mission innovation meeting, which will be hosted by DOE in Pittsburgh, on September 21st to 23rd. There will be multiple components of this event that will be focused on highlighting nuclear energy's benefits, including a dedicated business form of government, industry roundtable moderated by IAEA Director General Rafael Grossi and U.S. technologies exhibitions. The second event will of course be the IAEA Annual General Conference at which we will welcome the return of the Department of Commerce's U.S. industry program for the first time since 2019. The U.S. Government's presence at the GC will also see a U.S. exhibit booth in the Vienna international centers rotunda which will also be a welcome sight after a number of years. Most important for us in NE-6 and the Office of NE, at the end of October will bring the fifth IAEA International Ministerial Conference on nuclear power in the 21st century, which promises to be a key highlight of this year. The nuclear power ministerial will bring energy ministers and senior officials from embarking and expanding countries to Washington DC to deliver national statements, and to participate in technical panel sessions with U.S. experts and officials on nuclear power and climate change, creating an enabling environment for nuclear energy, supporting the existing reactor fleet, accelerating the deployment of a dance reactors and supporting an effective regulatory framework. Outside of the conference program itself, which will include a dedicated U.S. focus side event the nuclear power ministerial will provide ample opportunities for U.S. government and industry engagement on the sidelines with foreign counterparts from around the world. DOE played a very critical role in the U.S. government's bid to host a conference and follows on to previous events in France, China, Russia and the United Arab Emirates.

The nuclear power ministerial will be immediately followed by COP27, the next UN Climate Change Conference, which will be held in Sharm el-Sheikh, Egypt in early November. We are anticipating that with the lowering of COVID-19 restrictions, we could see a larger USG delegation this year, which should help support an even broader focus on nuclear energy over COP26. Last year's COPs saw some big nuclear energy deliverables announced by the United States, including the expansion of our strategic partnership with Romania to include small modular reactors, and we are hoping that we can do even better, this time around. There's going to be a heavy regional focus on Africa, at this COP which has been an important focus for DOE's Office of NE. And finally, we will end the fall with the first in person Ministerial Conference of the international framework for nuclear energy cooperation since the start of the pandemic and Kenya, at the end of November. We look forward to reporting out from all of these events, to the NEAC in the months to come, and to receive your comments and perspectives and what we can do better. And we also look forward to supporting a new international Subcommittee, thank you for giving me the opportunity to speak to you today, and I look forward to any questions or comments that you might have thanks.

Branscum thanked Goodman and suggested that questions to him be raised now to make it easier.

Korsnick also thanked Goodman for his presentation and insights. She raised a question in regards to the scope of work undertaken by Goodman's office and wanted to know, what level of help it was getting.

Goodman: I think a lot of it will be working more closely with the Interagency and we've been really building up our relationship with the State Department, enhancing our coordination with them, ensuring that we're not overlapping with what they're providing to countries, focusing on better coordinating what we're already providing,

but I think that in the longer term we need to focus in the area of training, that is providing training to the international partners. This is something that Russia and China have done very effectively and expansively by bringing students to each country in large numbers with partner countries they're working with, giving them an extensive hands on training that only gives them the technical expertise, but it also builds those relationships with the supplier country even stronger. I don't think this is something that the government can certainly do by itself, it's something, I think, that all of the stakeholders need to take a better looking at on how industry can play a role as well and help in building a kind of a framework that can support that kind of infrastructure. Currently we are at a disadvantage against Russia and China.

Scarlat: Asked how our liability compared to that of the international competition.

Goodman: I think that's the importance of the CSC, we are not members of the Vienna and Paris Accords on liability and our industry definitely needs the protection that is provided by our membership in the CSC, so we have been working to encourage more countries to join, both within and outside of the existing framework. India was an important development of progress in that area even though the problems still remain. But, we're hoping to look at other countries like the United Kingdom that might be considering membership as well, now that they're out, as a result of their risk withdrawal from the European Union. I think that will be an important focus going forward.

Ford: The EXIM Bank raised their authorization level to about 135 Billion total authorization CAP, a couple of years ago, and that he thought that this authorization has to be recertified in about the same time that we might be starting to look at exporting new technologies in the 2027 - 2028 timeframe. He asked if there was any undergoing work to raise that CAP, or, certainly at least keeping it high, because right now only about \$5 or \$6 Billion is authorized through EXIM Bank, so the question is there an effort being made to raise the CAP and make sure funds are available, or is there at least some direction.

Goodman: I know we have extensive engagement with EXIM Bank right now, they are not only focused on their ability to provide resources, but also on improving their technical expertise so that they will be able to consider nuclear power projects. These are points of intensive discussion in their agency.

Hart: Had a follow-on to Korsnick's question about international training and its current framework. She wanted to know if there was a good handle on this issue and if Goodman had a comprehensive summary of what we're doing in that area to see where we could grow, because I know there are a couple of different organizations interagency organizations that sponsor programs, like State has some programs in cooperation within NNSA concerning nuclear security and the NRC has safety.

Goodman: Yes, we definitely have an idea, the kind of support we provide, what I am talking about is much more, it's not topic-specific, that is actually where China and Russia actually bring in nuclear engineers from other countries and trains them in their country. This support is offered to countries like Turkey, since they are actually considering constructing nuclear reactors. I think this is something that needs to be explored and that would go beyond what is currently being provided by State, NNSA and NE-6.

Hart: Specifically I was talking about, I know there are some opportunities, where we have fellowships domestically and internationally, so do we have a good summary of those things that are ongoing and possibly things that we could expand into partnerships or make more robust. Is that something that we have a grasp on because I know in the national labs we have people out, so is this captured?

Goodman: No, I would say I haven't seen a comprehensive report that would kind of capture all that, and it would definitely be something that might be worthwhile, right now.

Hart: I would put that out as a recommendation to determine what people are doing, a call across organizations and then even maybe partnering with some of the commercial groups and seeing what they have, because I know people are doing things, but I am not sure we're having a good indication. We need to capture that and grow and find out the best practices.

Branscum thanked Jac Goodman and suggested moving ahead to the next presenter.

Dr. Katy Huff introduced **Alice Caponiti** stating that she will discuss the light-water existing fleet and our advanced reactor fleet deployments.

At 10:46 a.m., **Alice Caponiti** provided a presentation on "Supporting the Existing Nuclear Fleet and Developing and Deploying Advanced Reactor Technologies".

Caponiti begun her presentation stating that she is glad to talk today about the work being done to support the existing fleet and to also help the advanced reactors get to the pipeline. She quickly went over the programs that NE-5 manages. She stated what programs she manages within her portfolio, first mentioning that the advanced reactor demonstration projects are now going to be managed by the office of clean energy demonstrations.

Caponiti manages two offices that support the work of the existing fleet and advanced reactors, as well as another office that supports the cross cutting technology that's relevant for both reactors and fuel cycle and also includes the university support. She said she will describe the organization of all of these areas in more detail, starting by mentioning that NE-5 now has many new people and also people that used to be young that are now enrolls of leadership.

The Office of Nuclear Energy Technologies (NE-51) is led by Suibel Schuppner who has two teams. Melissa Bates is leading our cross cutting technologies area and Aaron Gravelle is leading our universities. Then we have our Office of Nuclear Reactor Deployment (NE-52), which is being led by Alison Hahn and she has two teams; Jason Tokey leading the reactor optimization and modernization team, and Janelle Eddins who is leading the advanced reactor development team.

The key goals of what we're trying to accomplish is to ambitiously achieve 100% clean energy on our grid by 2035 and net zero carbon emissions by 2050. We know these are ambitious goals, but we also know from many economic studies, that these goals, cannot be accomplished without the firm reliable clean electricity offered by nuclear. The key thing here is that we need reactors in a variety of sizes, operating differently on the grid and not just to produce electricity, but to also work much more effectively with other sources of generation, and not just providing electricity but producing other economic products and working in other roles to help decarbonize the economy. So, we have large plants and small modular reactors that are uniquely sized to serve needs on the grid, but we also have micro reactors and my micro reactors have unique attributes.

The lowest cost of electricity is not one of them, but they're going to be well positioned to meet the needs of users and communities where the cost of electricity is very high, so, for example in remote communities, the cost of electricity can be 1600 times higher than the national average and can consume more than 50% of the household's economic needs so micro reactors are going to operate very differently in terms of security, staffing and how they operate with regard to semi-autonomous operations. So, we have R&D, addressing the key attributes of all of these sizes and I'm going to start with what we're doing for the existing fleet.

So for our light-water reactor sustainability program, when this was originally stood up, it was largely looking at how to have the basis for materials to support license extensions, because that was seen as the key thing of keeping plants operating, but, what we know is that it's the economic sustainability of plants that is causing them to leave the grid. So since 2013 we've had 11 plants shut down before their licenses expired and primarily due to economics. And so, our light-water reactor sustainability program has a number of pathways that you can see here, but what I'm going to cover is some key ways that these programs are currently having an impact on the existing fleet.

So the first one that I wanted to cover is our integrated operations for nuclear ion program and, unlike a lot of competing industries, the nuclear sector has not modernized to the same extent and currently relies on a labor centric business model, and so our program is developing a novel and more efficient model of operation for the nuclear fleet that's going to be supported by the application of digital information and communication technology. And this approach is based on the proven transformation of methods that were demonstrated in the North Sea oil and gas industry, which that industry was able to transform at a time that they were being threatened by low natural gas prices and high labor costs relative to their peers and so using that as an example.

We are developing a business case analysis that's based on a generic two-unit plan and what we anticipate is by implementing similar methods that we can achieve a reduction in operations and maintenance costs of one third. That kind of reduction is achievable. So, right now, our program is working on the technical innovations necessary to implement this model and to achieve these cost reductions and the next phase, would be a full-scale pilot demonstrating the effectiveness of these modernization approaches with Xcel Energy.

And I'll mention as I go through a lot of our research programs, a lot of our research begins with our national labs. But because we are a highly regulated industry, the way that our research has impact is by piloting these methods with industry in close coordination with our nuclear regulator and you're going to see that as I cover a lot of our programs that we try to get out of the labs and into pilots with industry where they can have an impact on our climate.

So the next one that I wanted to cover is our nuclear safety system digital upgrade effort.

So this project is going to replace an analog safety related instrumentation and control systems at the Limerick generating station, with a new modernized digital control system. This pilot is going to de risk future projects by demonstrating the viability of streamlined approaches to licensing such as using NRC's digital interim staff guidance and part of this demonstration, will be able to prove the business case for future digital safety system upgrades and other plants. The estimated net present value of benefits of this project are 50 to \$80 Million over the lifetime of this station. And since this project began in 2020 the team undergoing this project is providing publicly available reports on the design concept, the license amendment framework and the business case methodology for other utilities and other sites to use for their own safety system upgrades. The current schedule calls for installation of the systems to be completed in 2024 and 2025 for each of the units.

Katy teed up our hydrogen demonstration projects we have been working collaboratively with the office of energy efficiency and renewable energy and jointly selecting projects for them that's going to integrate hydrogen production at existing plants using both high and low temperature electrolysis. So these production systems will range from 150 kilowatts electric to 20 megawatts electric, diverted from the grid.

And, by implementing these projects we're helping to break down the technical barriers and address the regulatory processes for integrating electrolysis with nuclear plants. And Constellation's low-temperature electrolysis project at nine Nine-Mile Point hopes to be producing hydrogen later this year and the others are expected to follow in 2024.

Next, I wanted to cover what we're doing for helping to optimize the use of nuclear fuel. Optimizing the poor leader core reload process and configuration of fuel assemblies in the core has the potential of reducing fuel and fuel reload costs which currently accounts for 20% of the operating costs of most nuclear plants. So our work here is developing a new software platform to both optimize this process and evaluate the benefits of accident tolerant fuel and the research has the potential to allow for smaller fuel batch sizes, while producing the same amount of electricity. This will reduce fuel costs and also provide significant savings on the back end by reducing the volume of spent fuel. And our projects are currently working on maturing these approaches, but we've begun initial engagements with Constellation Energy for potential application.

So that's work that we're doing to impact the existing fleet right now I am going to be covering what we're doing to support advanced reactors.

And I'll start with our advanced reactor R&D at our labs so we've got R&D programs to support a variety of advanced reactor types. In the high temperature gas cool reactor area, we are working on TRISO and graphite qualification. These have been sustained investments that we've been able to make over the years, to the tune of more than \$400 Million. And we see these investments paying off because we have multiple vendors that are planning to adopt the use of TRISO fuel, as well as structural graphite.

And the safety and degree of pedigree I think is illustrated in the fact that the Department of Defense, when they wanted to choose technologies for supporting their micro reactor demonstration, they specifically chose reactors that use TRISO fuel because of the safety and performance pedigree of the fuel that's been demonstrated, so that's being supported within this R&D Program.

We have gotten the first of high temperature structural alloy into the ASME B&PV Code, the first new high temperature reactor to be introduced in 30 years. With that sustained investment, we are also able to support building skilled facilities to develop empirical data to be able to validate performance approaches and codes, so our natural convection shut down heat removal facility was developed to investigate how air and water circulation can cool advanced reactors.

In our Fast Vector Research Program, under the atomic energy we operated many kinds of advanced reactors that we now have commercial developers approaching today, so we have an enormous amount of legacy data that we are working to make available to the commercial community and we've been applying quality pedigrees to that data so that developers can use that data to engage with the regulator.

We also have the mechanisms for engineering test loop facility or metal, which is a sodium flowing loop facility to be able to test components and prototypical environments and we are also helping to qualify the use of Alloy 709 and extend information for that material, so that it can be also updated into the ASME code and help direct the use of that material with developers as they approach the licensing cases with NRC.

And then I'm just going to do a quick commercial here, because the Secretary of Energy did visit Argonne National Lab last week, and as part of a revisit, she was there for a ribbon cutting ceremony for the long beam line building, which includes the activated materials laboratory that NE, supported under its NSUF Program, but while she was there, she also visited a lot of facilities relevant to our office, like the metal test loop that I talked about, supported under our fast reactor program as well as the natural convection shut down heat removals facility and she was able to visit a pilot scale electro-refining facility and got very excited about the recycling of nuclear material.

And then, for our molten salt reactor program, a lot of developers need to have more material, fundamental salt properties, to be able to use in their codes and design cases and we're also supporting a number of salt loops and other equipment to help develop the data that they'll need to support their designs.

For our micro reactor research program, there's a lot that needs to be understood, about the scale of reactors, and so we have a systems, integration and analysis area that's supporting the economic analysis and feasibility studies for deploying micro reactors.

We also have a step rise approach toward being able to demonstrate the attributes of these facilities. The first is a single primary heat extraction removal emulator or SPHERE facility, which is a separate effects capability to be able to demonstrate the understanding of a single heat pipe and performance. That capability is then scaled to our MAGNET facility or micro reactor non-nuclear experimental test bed. This is a non-nuclear test bed that's able to simulate core thermal behavior primary heat exchanger performance and passive decay heat removal from a heat pipe and gas-cooled micro reactors. And so, one key milestone for this facility is to be able to run a 37 heat pipe test which is planned for later this calendar year.

And then the next scaled facility that we are pursuing and our micro reactor program is MARVEL, and this will be a nuclear fueled test bed, that is going to be located in the tree reactor storage pit. This micro reactor test bed will produce heat and power as part of a test platform to demonstrate micro reactor operations and use applications. This is being developed in close coordination with industry and there's a lot of excitement about being able to demonstrate capabilities of micro reactors to inform their own designs. The design for this facility is planned for completion this year and we hope to have operations enabled in 2024.

We are also supporting advanced reactor safeguards and security, development. This program is addressing the near term challenges that advanced reactors face in meeting U.S. domestic material control and accounting, as well as physical protection systems. This program is in close coordination with NRC, which is the regulatory authority for U.S. license designs, but we also work in very close coordination with NNSA. And their responsibilities for international safeguards, because our developers want to know in safeguards and security by design, that they're going to meet the needs for both domestic and international safeguards requirements.

Regarding our advanced reactor regulatory development program, we have been working with industry to be able to develop proposed guidance for an NRC license application, through the Technology-Inclusive Content or Applications Project (TICAP). This is a kosher project with industry and it builds on previous licensing modernization efforts and at the outcome of this effort, the goal is to have a performance based approach and a structure that is a right size license application that's flexible clear and appropriate for industry applicants planning to use that approach. And our advanced venture development program is also supporting targeted R&D to reduce the technical and regulatory risks by providing the bases for establishing licensing technical.

Now I would like to cover what we're doing in cross cutting R&D. Our Nuclear Energy Advanced Modeling and Simulation or NEAMS Program is developing the predictive modeling and simulation tools to accelerate advanced reactor deployment, as well as improve existing fleet operations, so the tools developed under this program are multi-scale and multi-physics. And we are working again closely with industry and NRC and we see the payoff in these investments and that we have a number of advanced reactor developers choosing to use these tools to guide their designs, as well as the NRC is adopting the use of many of these tools to perform their own confirmatory analysis.

Advanced materials and manufacturing technologies program is pulling together a number of separately budgeted programs on materials discovery, data analytics as you build with advanced manufacturing methods, to be able to help accelerate the adoption of new materials in advanced reactors.

Regarding our advanced sensors and instrumentation program, many of these advanced designs are being operated in environments that are not typically supported by currently available advanced sensors. And so, this program is working with a number of our other programs, to ensure that the techniques and instrumentation can be reliable cost effective and proven in their designed environments.

Our nuclear cybersecurity research program, is working on developing specific implementation of methods and guidance for advanced nuclear reactors that are under development and we are using this research and we hope to demonstrate the use of these techniques, using a representative micro reactor, so MARVEL will be one example, that we can use to sell to demonstrate the technologies being developed and then that would in turn provide guidance for cyber security measures and more detailed design.

Our Nuclear Science User Facilities Programs offers a wide variety of reactors, hot cells, beamlines and analyses to support the study of irradiated materials and fuels. This program offers 50 user facilities at 19 partner institutions around the country, as well as one international affiliate. Our program also maintains the nuclear fuels and materials library, which makes pedigreed samples available to researchers to support their work at no cost to the researchers.

Now I would like to discuss how it is that we directly support industry to leverage the research and capabilities that I was just describing, supported in our national labs. And so we do this through a number of approaches. First, is the Gateway for Accelerated Innovation in Nuclear, which Kemal is very familiar with. This was stood up in 2016. It was recognized that, as we have a nuclear developer community, to be able to have a front door into our 17 national laboratories is a real challenge, so GAIN was stood up to help simplify the access to the expertise, capabilities and historical data by being a front door. GAIN is led by INL and it incorporates the work of a number of national laboratories. Through GAIN, we have been providing access to laboratories through vouchers, which has been a very successful approach for making this first partnerships with industry and our national labs.

The National Reactor Innovation Center was supported in FY20 as part of the advanced reactor demonstration program. Also, Idaho National Laboratory incorporates the capabilities at a number of national laboratories to provide support for demonstration of technologies, so within NRIC we are standing up to test beds, to support

nuclear fueled test reactors, experimental reactors, micro reactors and those test beds are currently being stood up. NRC is also working on an advanced construction technology initiative. We know from a number of studies that one of the factors that has been driving the cost and schedule of new reactor deployments isn't always the nuclear island, but it can be the civil works around it.

So under the advanced construction technology initiative we are demonstrating more innovative and effective approaches towards, construction and the NRC is very closely following this work, so it can be prepared to support license applications is that use these technologies from advanced reactor developers.

We have a funding opportunity that we call the Industry FOA, which was stood up five years ago, but it has been continuously open and has been a very important vehicle for supporting industry. We are in the final year of this Industry FOA, but you can see from the number of companies that have benefited these have often been the first steps for many of these countries, and we see the payoff project (which will be described shortly), these have often been the first opportunities to work in a cost-share partnership with the government and many of these companies are progressing toward commercial demonstration activities.

One of them is the carbon-free power project, which will be a first demonstration of NuScale technology at INL. Some of NuScale's earlier awards were through the Industry FOA. While this is a demonstration project that is not being transitioned over to the office of clean energy demonstrations, this is supported under a different funding line. The goal is to have this capability operational with the first module in 2029, and this is a light-water reactor cooled small modular reactor. It's going to use air-cooling which substantially reduces water use and so will be a perfect demonstration of how a small modular reactor can be cited in a much more flexible manner than our large existing plants.

Katy teed up our five, risk reduction pathway projects. Two of these projects are micro reactors which are using our risk reduction awards to help address the cost attractiveness of their products, so that they can be ready for commercial demonstrations.

We are supporting the Holtec light-water-cooled SMR, as well as the molten-chloride fast reactor experiment which will be our first operational liquid-fueled reactor experiment in many decades. This activity will be supported at one of the test beds being stood up under ARDP.

And again, these are three lower-technology designs that are being supported through our 20 awards.

And then, finally, I want to cover the work that we do in support of universities. This is our talent pipeline. Our university support is under a number of competitive research opportunities. Since 2009 we've awarded more than \$931 Million to universities and competitive research and I am going to predict that under Katy's leadership we're going to cross the \$1 Billion threshold very shortly, so that will be very fun press release when we get to deliver that to you.

And so we have competitive university research under the Consolidated Innovative Nuclear Research program. We also support Scientific Infrastructure upgrades. This includes reactor upgrades for safety and performance at research reactors, as well as enhancing the scientific instrument at the nuclear engineering departments. Beginning this year, we have a new Distinguished Early Career Program which is fulfilling a need that was surely needed, and the nuclear area to support early nuclear engineering faculty that had been missing, and this was corrected under Katy's leadership. And then, our new University Nuclear Leadership Program supports fellowships and scholarships for students pursuing nuclear engineer, engineering degrees. This has been a huge source of talent, not just for our nuclear energy portfolio, but also for our national security portfolio for the navy. So a large number of our PhD students have benefited directly from these scholarships.

And then, our Research Reactor Infrastructure Program is providing fresh fuel to our 25 U.S. university reactors at 24 universities. We also take that fuel back, and so this has been really important in maintaining the university reactors that we have.

One recent accomplishment is the restart of a trigger fuel manufacturing capability that supports (I believe) 12 of our trigger reactors. This is a capability that had been lost since 2012. This restart was supported from sustained investments from this program.

And then, finally, what you'll see in our FY23 request, is something that we're in the process of formulating which is a major revitalization to our university infrastructure through a new program that we hope to start, that would be a consortium-based approach to expand equitable access to education, training and workforce development in our universities. This program will substantially enhance the infrastructure to potentially include one or more micro reactors at universities to serve as research instruments. So, we are developing a request for information that we would use to launch this program if it's supported in appropriation, and so we are very closely watching our

FY23 marks and we're also very closely watching supporting authorization legislation that's out there to help for this kind of initiative.

Branscum thanked Alice Caponiti and suggested moving straight to the next presenter.

Dr. Katy Huff introduced **Andy Griffith** stating that he will discuss the fuel cycle in the supply chain. She noted that for many months this year, Griffith was our acting Assistant Secretary during some of the most chaotic times in our geopolitical space and we're all very grateful to him and his leadership from that time.

At 10:19 a.m., **Andy Griffith** provided a presentation on "Advanced Fuels and Nuclear Fuel Cycle & Supply Chain (NE-4)".

Griffith began his presentation by stressing that he will only provide some high points and while he will only be skimming the surface, there are a lot more details behind his slides.

He introduced a few members from his leadership team; Sal Galob who is his Associate Deputy Assistant Secretary, Stephen Kung who leads the Materials and Chemistry Technologies area and Bill McCaughey who leads the Fuels area, including the Systems Analysis Group. He said that they all play an incredibly important role in this program.

On the front-end, I'm going to cover accident tolerant fuel, this is kind of an acronym-packed outline, but it's the ATF for light-water reactors, low enriched uranium supply for energy security, which has come into focus, since February 24th and HALEU of our fuel program or availability program, important for enabling the fleet of advanced reactor deployment.

On the back-end technologies, I'll get into the recycling area with the APS Technologies molten-salt technology and off-gas and high-performing robust waste forms and finally I'll touch base on the virtual test reactor and then close with some path forward comments.

So, where we're at with the fuel cycle and supply chain program is we are really torn between balancing priorities.

Before 2020, even before that, when we had about a billion-dollar NE budget that was primarily going toward R&D programs primarily at the laboratories, but also with the universities, a little bit of industry engagement. Accident tolerant fuel definitely ramped up our engagement with industry on evolving that fuel forward. But then in 2020 when we made room and made the decision to deploy the advanced reactor and focus on advanced reactor demonstration programs and kind of leading the path for the future, that was an important step, and I think that was a necessary step, but what that resulted in is it pulled a lot of money away from R&D activities. And so as we're trying to support both the advanced reactor development program as well as looking to evolve and improve the supply chain for the LWR fleet, we are working to kind of restore that base R&D load or capability, because that will be really important for us to go into the future, especially as we establish the infrastructure, the fuel cycle infrastructure that's going to support the deployment of the advanced reactor technology.

So, this is my diagram, if you go along the top that, basically, is the open LWR fuel cycle and then, as you introduce used fuel recycling, then you start reusing that material either in a light-water reactor which we don't do in the U.S., but, France and Japan have done or you introduce that fuel material as feed material for advanced reactors and then you go into more recycling. This diagram is representative, it's not in detail, but it summarizes kind of the components involved. And then of course you've got the safeguard and security by design across the bottom, as well as the systems engineering, our systems, analysis and integration along the bottom, as well. What's not shown here is the international peace which Jac Goodman covered earlier this morning and that's also a really important element, because this technology is not just domestic it's also global, we need to be mindful of that and there's a lot of like-minded democracies out there that we can partner with to improve the deployment of this technology. But the other thing that's not covered on here is the infrastructure piece. Alice mentioned the treat reactor or the transient reactor test facility that's an important reactor that has resumed operations recently. And incredibly important to our fuel qualification steps is also the sample preparation lab, which is under construction and soon to be in place. When that is completed, that will essentially, put the U.S. as a clear leader in post radiation examination of irradiated materials and fuels. This is an incredibly important facility and I'm sure you'll learn more about the infrastructure piece as time goes on, but I just wanted to raise that. So, the key takeaway here is that, as I said before, the reactor is the workhorse of the nuclear energy system, however, it can't exist alone. Clearly there is interfaces, with the front-end, there's interfaces with the back-end and recognizing how ultimately the fuel or the waste has to be dispositioned, there's a lot of opportunities to fully optimize this entire energy system.

So I'll start with the accident tolerant fuel for like water reactors it really did come about with the events at Fukushima. Congress passed some legislation in 2012 that allowed us to go forward with this. At the time the light-water reactor fuel technology had evolved exceptionally well, we've gone from capacity factors of the 70s, to back

into the 90s, fuel failures were at an all-time low, and the existing technology got bought as far as it could go. But with the extreme conditions that Fukushima experienced, the opportunity came to ask if we can we do better, and so the program was born and it's really important for the existing fleet to move it forward.

Griffith then presented the Key U.S. ATF Fuel Milestones, stating that this slide was borrowed from Maria Korsnick. This slide really highlights how this program has evolved. The next evolution of improvement to the existing fuel is essentially coated cladding with dope ceramic pellets. This will allow the reactors to have the accident tolerance to survive extreme conditions like Fukushima experienced. It will also allow a higher enrichment, bumping it up to 6 - 7% enriched Uranium 235 and a higher burn up, which will allow the pressurized water reactors to go from an 18-month cycle to a 24-month cycle. Which minimizes the downtime, improves the capacity factors and will help the economics as well. So, there's a lot of, I think positive things here, in this next evolution.

The program has the objective of deploying batch reloads of this technology later this decade. But there are still a lot of challenges involved, including sufficient funding to demonstrate industrial production of this fuel and things of that nature. But things are progressing well.

The generation or the evolution beyond the coated cladding with dope pellets, that involves silicon carbide cladding and includes a steel aluminum chromium type of material and so there's other opportunities beyond this that could continue to make progress, to perhaps extend the lifetime of the existing fleet of light-water reactors even farther than is currently planned.

Moving on to the uranium strategy to both the low enriched uranium supply and the HALEU, I'll start with the DOE Tiger Team that was formed and the Secretary designated Dr. Huff to lead this effort, and I have to just say, frankly, that it's been an incredibly powerful teamwork activity with our colleagues in NNSA. We've been working on the HALEU piece for a year or more, but it really expanded when the Tiger Team was formed, especially in light of the events of February 24th, when the war in Ukraine began. So the DOE equities are clearly the commercial fuel supply for the existing fleet and as I said, the HALEU availability program we call it, that's going to enable the deployment of advanced reactors going forward.

The Office of Defense nuclear non-proliferation, they've got equities and fueling the research reactors that had been converted from HALEU production, as well as the medical isotopes in that area. And then also, they're responsible for the American Assured Fuel Supply, which is about equivalent of six reactor reloads and that was historically developed from the down blend of HEU. Also Defense programs, which are on a parallel path to develop their own enrichment technology for defense needs in the future, they need it for the tritium program and the defense, the strategic what strategic weapon stockpile and then, lastly, the naval nuclear propulsion programs that rely on HALEU for their naval fleet, both submarines and aircraft carriers and that they are relying on the defense programs to produce that material for them going forward. So, this has been a collection I'm not going to get into the details of where we are at, as Katy has already touched on it earlier.

We are engaged with the Interagency and the White House gaining a lot of support. We've had constructive conversations with Congress, but we still have to bring it to the finish line.

Focusing on the light-water reactors, the LEU for the light-water reactor fleet, as Katy pointed out, we rely on Russia for 20% of our enriched uranium product. Clearly, with the events in Ukraine, and Russia being an unreliable source, we now have to also look more globally and although there's other sources from other countries that want to get into reactor deployment and fuel those reactors deployed, we consider those sources unreliable. So, a gap remains on how we can pull in the needed capacity and incentivize the additional capacity needed so that we can replace the capacity from these unreliable sources. So, the LEU area is the overarching challenge for the light-water reactors. Incentivizing this new capacity and recognizing that 20% of it, that the U.S. relies on, is Russian uranium, it would be a big pill to swallow if we were to try to incentivize that solely by the government, so we're taking on part of that responsibility. Our proposal is to take on a partial responsibility and get things moving in a positive direction expecting that industry and, like-minded democracies would also step in and join us in the incentivizing of this new capacity. And in doing so, we must also look at our import policies and how could they manage and stabilize that market. Clearly with Fukushima, the uranium supply market to the existing fleet has been significantly disrupted by the surplus of uranium left after Fukushima and then with low-cost state-owned enterprises, making their uranium available has further complicated that. So now, we're coming out of that and we want to take a step in a positive direction, get that new capacity, primarily the new capacity up and running and secure it domestically and go forward from there. I guess, I should also add that in recent years, U.S. mining for uranium, has gone to essentially zero. However, when we do incentivize, we bring that back as part of our energy security approach.

We do want to be mindful of the legacy that Katy has pointed out earlier from the mining that was done back in the Manhattan project and during the Cold War, and although the technologies are different and in my view, much less impactful, we can't totally ignore the past.

Moving on to the HALEU area, clearly the stakes are high here. You've probably heard the chicken or the egg. Investors or interest in advanced reactors is limited because they don't have a stable fuel supply. On the other side of the equation, interest or investment in standing up a fuel supply for customers that don't exist yet is a challenge as well, and so the challenge is how we break this. Well, we started a few years ago, we have a demonstration program with a limited capacity that's been established at Piketon, Ohio. We're in the process of competing for the startup and operation of that facility. The proposals are due on August 22nd. And so we'll go from there, but the objective really is to stand up that capacity, show that the U.S. technology can produce up to 900 kg of HALEU, 19.75% enriched U-235 per year and that's something that we could potentially build on going forward. But we'll have to see, and that gets into fueling the advanced reactors.

The objective for the HALEU availability program isn't just to fuel the two demonstrations or the fuel qualification activities that are part of our advanced reactor demonstration program and there you see the family portrait in the lower right hand corner. I've got the whole LWR technology in there, they don't require HALEU, but everyone else does. The two demos, are a start, when you also need to accumulate sufficient quantities of HALEU, so we do risk anybody who orders in advance reactor, subsequent to those two demonstrations. Because operating two demonstration reactors does not spell success and is not going to achieve our climate objectives. Deploying those advanced reactor technologies beyond those two demonstrations, that's what's going to achieve our climate objectives and our energy security objectives and that's why this program is so important.

I point out the Energy Act of 2020. It has a broad spectrum of activities, you'll learn more about going for and getting deeper into this subject that helps, that was a great step in building the foundation of what we're building on today. And then the challenges going ahead are clear. We do have some material in inventory that we need to down blend and make available.

Gaining Congressional support for the big lift of establishing an industrial incentivizing and industrial capacity for this, is incredibly important.

On the National Environmental Policy Act, if anybody has been involved with me before, that's something that we have to be mindful of, and we need to make sure we complete all the analysis before any major decisions are made, and then we now have to implement.

Getting back into the back-end of the fuel cycle, and this is important in the ways I touched on earlier. There are two things to keep in mind, one is the environment and as stewards of the world, reducing the reliance on new mined materials is a benefit and making the best of what materials, you have recovered and you do have available is also beneficial. So recovering all that reusable fissile material and spend it for fuel or use it for nuclear fuel is something that we should all be mindful of. The other aspect of that is keeping that material above ground continuing to produce energy, electricity and applying that energy towards useful purposes and reducing the burden on any future repository. These are all good stewardship principles that I think are important to keep in mind. Now in my opinion, this technology is not yet ready for industrialization. Efforts have been made in the past and there are a lot of reasons why today might not be a ripe time for its deployment. However, I think we need to keep the conversation alive, and it has to do with policies driving the economics of the back-end of the fuel cycle, has to do with technology maturity. We are continuing to work on the accountancy for the material as it's in process so that the safeguards can be done most cost effectively. But again it's so important, we can't lose sight of the ultimate objective of making the best use of the material that we have, so I'll talk a little bit about the aqueous process a little bit about the molten-salt technology and then off-gas and robust waste forms.

The aqueous process, historically, has been associated with recycling light-water reactor fuel with the light-water reactor concepts that are ready for deployment, those advanced technologies that are ready for deployment that Katy mentioned earlier. We need to keep this recycling option available, there's been a lot of excellent work done, even with rigid reduction in funding. To call out the artificial intelligence and machine learning of applications toward ligand design, which makes the whole separations process more efficient, that's really important. Also call out the vapor extraction of zircaloy and aluminum cladding. This technology can pull away a lot of the bulk material early in the process, so that when you're separating the fissile material you're dealing with smaller volumes and making that process, a lot more efficient, as well as smaller volumes are easier to pull out the non-reusable material of fissile products that can go into waste. And also there's advances in making this a more simplified single step, rather than multiple steps that might recover 99.99% of the material, but then it's substantially increasing the cost, so pulling away by far most of the material, without getting it almost perfect, is still I think advancement in the right direction.

Moving on to the molten-salt technologies and there's a lot of synergies between this activity and the molten-salt reactor concepts that are that are being proposed, because they all propose the online removal of fissile products

as part of their approaches on. This has been developed over 30 years, it's closely aligned with the sodium fast reactor technology. We've made good progress in collaboration with the Republic of Korea as part of the joint fuel cycle study. And again this technology has the capability of recovering group actinides, transuranic material, as well as uranium and the fast reactor technology is well suited towards transmitting that material generating electricity, while not expanding the use of creating more material than you need to and that's an important part of recycling too because there's been a historic discussion, reprocessing versus recycling. Well, reprocessing is really only the first step in recycling. Recycling comes when you're taking that reusable material and putting it back into generating energy.

Moving on the off-gas and robust waste forms, there are off-gases that need to be captured. I think there's policy opportunities in the off-gas area because right now the regulation (10 CFR 190) driving that process, requires a high degree of capture for the off-gas. There is also a debate on how much of that off-gas is actually hazardous and needs to be captured, because when you go back and look at how that regulation took place, it was at the tail end of the Barnwell and West Valley projects and the input for that regulation was very limited and it's not very scientifically based so there's clearly some opportunities there for change in the regulation. It worth mentioning that we are developing this technology and it's making really good progress, and there is a lot of collaboration with our international partners, in some cases. And then on the robust waste forms, again if we can capture what waste materials result from recycling, so that they can withstand centuries of isolation in various geologies, it's going to make the whole energy system better.

Last point of content I will comment on is the Versatile Test Reactor. Unfortunately, we have not been successful in gaining Congressional support for funding this project. It was not included in the FY22 appropriations and currently it's not in either the House's or the Senate's mark. There's still a glimmer of hope left that it might emerge out of conference, but we'll never know. We'll find out when we get there, but allow me to just comment that this project has made incredible progress.

Even given the limited funding over the past several years, I mean Kemal was the program director, so no comment from Kemal you're not exactly objective but the team has performed phenomenally, it achieved Critical Decision 1, they built a solid path for fueling this reactor, which is similar to the Natrium concept. The Natrium reactor concept is a heat generating electricity, generating energy, generating machine. The Natrium concept is a much consolidated neutron generating machine for testing, for fast-spectrum neutron testing. It uses a different variant of the same prism based design and the progress they've made has just been phenomenal, unfortunately, the priorities of the RDP and the other reactors have taken precedent we acknowledge that. We hope that at some point in time, the funding will resume for the VTR project, and that it can pick up and carry on. The project ended on a very positive note just recently, with the issuance of the Record of Decision from the NEPA process for this reactor, which is the first reactor to undergo the NEPA evaluation. All the previous reactors were grandfathered in when NEPA was established so that's a huge accomplishment. The decision made was that the VTR will be located at INL.

Fuel fabrication options evaluated two different sites; one at Idaho and one at Savannah River, that's still pending, the rider did not include that but that'd be subject to future evaluation. The activities that could be carried on at some level of funding were provided for this and would deal with the risk reduction activities of dealing with some of the critical components of the reactor. It would allow the reactor to stay closely in touch with the Natrium project so that it would benefit from the lessons learned from the Natrium design maturation.

And also the fuel for this reactor is a plutonium, uranium zircaloy alloy fuel and so they would be able to work with the NNSA to better define how the plutonium fuel feed material would go from the surplus inventories into fuel fabrication for this project, so those are kind of the summary things that could be carried on if there was some level of funding. But we'll just have to stay tuned there and hope that something materializes with the conference bill or later. But, in the meantime it's going on a kind of a standby mode, they're completing everything and putting in a state, so it can be resumed at some point in the future.

So in summary, I talked about the balance between supporting the deployment of advanced reactors and supporting the existing fleet, but still restoring the base R&D activities that is going to continue our leadership and innovation going forward in the fuel cycle area. Continuing the partnership with industry, universities and our international partners is incredibly important to leverage what we do with information and collaboration that comes from our partners. Supplying the fuel for the existing fleet and the advanced reactors, if we don't get it right it's just going to make the future, a lot more difficult. And the last point is that the fuel cycle is really important, we need the advanced reactors, but we need the fuel cycle that supports their deployment. If we don't get the fuel cycle right,

their growth will be stunted and so we can't lose sight of that, we have to try to communicate that with others as well.

Branscum thanked Andy Griffith and suggested moving straight to the next presenter.

Dr. Katy Huff introduced **Sam Brinton** stating that they will present all of the many initiatives that we have for restarting our cleaner and more focused efforts towards progressing spent nuclear fuel management.

At 11:49 a.m., **Sam Brinton** provided a presentation on "Spent Fuel & HLW Management".

Brinton began their presentation by saying that they have only been on the job for a few weeks and that their office, NE-8, is responsible for the R&D, related to the long term disposition of spent nuclear fuel storage and, of course, it's associated transportation. Our mission is to develop and implement an integrated system to sustainably and responsibly manage the nation's spent nuclear fuel and high level radioactive waste. We of course work with each and every one of you, national labs, academia and industry, to achieve this mission and, as you can see, there are subdivisions of our work, one more responsible for the R&D, and the other responsible for that implementation.

Today, we've discussed a variety of different issues related to deploying nuclear energy as the solution or the decarbonization, but increasing that access to energy is going to also require progress on the management of spent nuclear fuel. Inaction on this issue has cost taxpayers nearly \$9 Billion with settlements and judgments and while it is safely stored across the country, the communities that have spent nuclear fuel never agreed to host that material long-term, so we cannot continue to defer this problem for future generations, intergenerational equity is key.

Management of the nation's spent nuclear fuel is the responsibility of the DOE and it is our responsibility to those communities to move the spent nuclear fuel to our interim storage facility and that time has to begin now. We're working to develop a comprehensive spent nuclear fuel strategy that will address the spent nuclear fuel and the high level waste and this system will include transportation, storage and disposal. In order to sustainably and responsibly manage this we're going to need to site both an interim storage facility and permanent disposal facilities and we need help in identifying those willing and informed host communities to be our partners.

Consistent with direction from Congress and funding, the department is not actively pursuing a repository site, we do expect to dispose of spent nuclear fuel in a repository in the future. We are thus conducting high level R&D for eventual geologic disposal, and that includes a variety of different geologies, include, as well as increasing the confidence in the robustness of our disposal concepts, so that when those concepts are placed out the communities can trust them.

As you've already heard from my colleagues Alice and Andy advanced reactors are on the way and we need to be ready for advanced nuclear waste, so accident tolerant and advanced fuels are being analyzed to understand what's going to be needed in their disposal, and in a geological repository as well as how to integrate them into an integrated waste management system. We are recognizing that we're going to conduct extended storage, R&D, aging management and, of course, transportation research. In all of this effort, we are leveraging our international collaboration and I want to highlight a little bit of that work before we get into the next stages.

We are doing a variety of international collaboration when it comes to nuclear waste management. This is spanning from IAEA activities with the Joint Convention on the Safety of Spent Fuel and Safety of Radioactive Waste Management which my colleagues just returned, from as well as joining with the NRC in our radioactive waste management committee at the OECD and NEA and of course we are an active member of the International Association for the Environmentally Safe Disposal of Radioactive Materials. This is an association of executives and chairs, just like me, a worldwide radioactive waste management organization. Most importantly, we recognize that these engagements are going to help us participate in information exchange with these countries, knowing the best practices and hope but identifying areas for joint R&D, so we participate in a variety of R&D projects, including bilateral collaborations. For example, one of my new favorites is our work with Germany on salt-rock, specifically.

So in all of this work, I want to try to capture a little bit of the international collaboration that we're doing in the different types of mediums. So through collaborative agreements, we are obtaining data from a variety of experiments. Data should be shared and making sure that we are reaching out and learning from those around us is critical. We are taking the lead in designing some of these experiments as well as benefiting from the others who will actually do the experiments in their undergrad and research labs. So, for example, the U.S. has led an experiment called HotBENT for bentonite project at the Grimsel Test Site in Switzerland. This experiment is focused on better understanding those clay buffers and near rock performances at high temperatures so three heaters turned on in 2021 and it will run for 20 years at over 200 degrees Celsius compared to our typical 100 degrees Celsius temperature range. This is going to allow us to better understand the different geologic media and validate our models. It's important to mention that we do have our own underground research facility in Salt Rock, which is

not pictured in the slides. It should be noted that the BATS Test is currently producing research and data that other countries are seeking specifically on salt media.

And last but not least, we're going to be participating in a variety of international collaboration projects in storage and transportation as well. So, for example, pictured here we have the multimodal transportation test, where we used a truck, a barge, and a train to make sure that we understood how the data could be collected on storage and transportation, and as we were transporting this cask around. There are a variety of other projects, but I will skip them because of time limitations.

Another important part of our work is the work focusing on the actual implementation. So we talked about the R&D, but now let's chat about the integrated waste management system as an integrated system. So we are doing a variety of different topics first, of and what, we will cover a little bit later is our consent-based siting process. Consent-based siting requires transportation, to a certain site, and so we are working on developments and plan activities such as rail car development, intergovernmental relationship building and training and, of course, existing infrastructure assessment, which involves going to the sites where this nuclear waste is currently housed to make sure that it is ready for pickup.

We also conduct a variety of systems analysis, you already heard Andy mention systems analysis. It keeps happening when it gets to spent nuclear fuel, to make sure that we are ready for all the different types of enhanced nuclear waste to come into our system.

And of course generic design of the facilities that are going to be part of that waste management system. We are making sure we are committed to a consent-based approach to siting that enables broad participation and centers equity and environmental justice. Consent-based siting is an approach to siting that meets the needs of the communities and the people we are serving and is central to that process so communities can elect to participate by working collaboratively through a series of steps and phases, to work with the DOE, as the implementing organization. And each step and phase helps the community determine whether and how they want to proceed in meeting those goals of the community itself. So they're intended to serve as a guide, not as a prescriptive set of instructions and we recognize that consent-based siting is going to look different in each community.

So the potential outcomes could include a negotiated consent agreement that could be defined by community in collaboration with the department or they could determine that they are no longer interested in working with us and on this process, both are successful outcomes. And we recognize it's a challenge, but we know that consent-based siting is not only the right thing to do, but is the most likely process to have a chance of success.

So, what are we doing on consent-based siting? First, we did recognize that NEAC may have a subcommittee on this topic, so I'm going to spend a little bit more time highlighting how we have progressed on this issue, and feel free to ask questions as we go further.

The first step, we did was a Request for Information, we have placed it in December, receiving a variety of comments that were going to help guide our process. We did receive some late submissions and we accepted them as well. While this RFI was not seeking volunteers to host sites, we did hear from the public on a range of different topics, including of course the consent-based siting process itself. The removal of barriers to more meaningful participation, specifically to the underserved communities that we want to make sure have a seat at the table and, of course how does interim storage (which we are hoping to site with consent-based siting), fit as a component of the nation's nuclear waste management system. Our special focus for this RFI, as in everything, was to focus on equity and environmental justice as the cornerstones of this process and, of course, as the cornerstones of the waste management process as a whole.

We received a lot of comments with 225 submissions, they are all posted in their entirety on our website. I, doubt many of you have spent the time to read all 1600 pages like I have, so I'm going to give you a brief summary of those comments as we're going forward. We did hear from a diverse set of commenters, of course, tribal and state and local governments, as well as NGOs, industry, academia and private citizens. A variety of individuals, told us that consent-based siting was important to them and they spent the time to respond to our RFI.

So what are some of those common feeds, common themes for the actual topic of consent-based siting in the RFI responses and again, these are brought in general and a full report on this topic will be coming out, and I will cover that very briefly. So there is general support for consent-based siting of facilities, there was in terms of defining what constitutes a community and consent. Differentiation with something that DOE needs to define these terms, while others insisting that consent should be defined by the communities themselves. And these definitions will vary between each community, so can there actually be one definition of consent-based siting.

We did hear a lot about the need for a fair and transparent process, as well as the need to rebuild trust. It is clear to us that the consent-based siting process needs to be flexible, adaptive and inclusive and there needs to be equitable distribution and intergenerational justice, as well.

Last but not least, we got really helpful suggestions and a whole list of them of what resources communities will need to get that informed consent, including funding for citizen panels and hiring trusted experts to conduct those evaluations.

When it came to the integrated waste management system, we did hear a series of concerns about how long an interim storage facility would last and the legality of interim storage under the nuclear waste policy act in the absence of a repository. So many commentators stress the need to establish a new, independent organization for nuclear waste management and fix the nuclear waste fund.

And again, I want to reiterate those comments were just high level overviews and we are analyzing all 1600 pages of those comments as we speak, to make sure that our findings are publicly available and representative of the diverse perspectives that were raised.

We are using the feedback from the RFI to inform our next steps in the process. I'm going to try to cover a variety of things that are all coming out very shortly and which we are working on, very hard.

We will publish the results of the comments analysis, it will be a comprehensive summary of the RFI and more than just a few slides that you got. The full summary will be published soon. We're also further developing the draft consent-based siting process. That process itself needs to be updated and edited based on the feedback from our RFI and that will also be coming out. I hope that you hold us accountable to get these out to you as soon as possible. And of course we're working on a funding opportunity, this is extremely exciting for the interested groups and communities who want to tell us more about what consent looks like. This report will not be asking for volunteers again it just aims at building capacity and providing the opportunity for stakeholders to learn about the process and, of course, to learn about spent nuclear fuel management. Once it is out, I hope you can help us make sure that it reaches as many communities as possible. And, last but not least, we are clarifying our broad strategy on integrated waste management.

As a whole, as you can see that's four major issues all coming out very, very soon. We are busy bees in spent nuclear waste management, and I hope that, again, you can get access to all of this information and that you share it widely once it is released.

I did want to mention that as we're moving forward into this space that we are making sure that our talents in the department that are getting all of those reports ready, are representative of the variety of needs, when it comes to nuclear waste management. So, for example, just this week, we have hired two social scientists who just started yesterday, which I am truly excited to say will help us integrate both the social sciences into our technical science work to address this monumental grand challenge.

So to briefly summarize, we are using a consent-based setting approach, we will use it and we will work with communities to identify sites that store the nation's spent nuclear fuel, we're going to restore public trust and we're going to build competence by opening a transparent consent-based siting process.

I did mention that we are implementing a federal consolidated interim storage capability for right now. Consistent with Congressional authorization we're going to conduct generic disposal research and once we've heard from stakeholders that there is a need for a clear pathway for disposal, the potential host may be reluctant to host interim storage due to the potential for becoming a de facto permanent solution. So we're going to recognize that challenge and we're going to make sure that a pathway for disposal is included in our integrated waste management holistic strategy and planning.

The lack of a repository in the near-term means that we have to address extended storage. And we are performing R&D in this area with a lot of great industry support to make sure that our actions can be done safely and efficiently.

And when, we've mentioned it before and we will say it again, advanced reactors are deployed, they will present a new challenge to waste management, due to the different types and forms of spent nuclear fuel, so what we are doing now is an opportunity to also address the nuclear wastes from the advanced reactors. We are conducting R&D in support of the future advanced reactor spent nuclear fuel and in close collaboration with Alice and Andy, and we are going to have a solution as soon as those advanced reactors start to produce advanced nuclear waste. And we are also making sure that in all of these efforts, we are recruiting a diverse set of perspectives, so it is of primary importance to recognize that none of us have the single solution to nuclear waste management and to solve this problem, we're going to need a large and diverse team to solve this problem.

Branscum thanked Sam Brinton and turned the meeting over to Maria Korsnick so she can start the Q&A Session and the Discussions.

At 12:08 pm, **Acting Chair, Maria Korsnick** thanked Branscum and Brinton for an energetic presentation and begun the Q&A Session that lasted up until the Lunch Break.

Korsnick stated that we're going to have Q&A now then we're going to break for lunch and then we're going to come back and have a discussion amongst the NEAC members on what we see as priority, so I just want to sort of have in your mind that we're going to have a couple of sessions here where we're going to have discussion. So, let's use this time, as you think through all of the information that we've learned over the last few hours. Use this time to explore, to make sure that you fully understand, whatever the issue was presented, or that if you have a sort of curiosity about something. And then, after lunch we'll use that time more for sharing and sort of thinking about next steps. I'm offering that just because I don't want them to sort of blur together. So let's use this time in the Q&A to just ask folks if you have curiosity or questions about information that was presented. She thanked everyone and opened the floor.

Ford: Had a question for either Alice or Katy. You talked in a couple of the briefs about the program and programmatic side of things about the advanced reactor demonstration program, quite a few of the programs. You touched briefly on a couple of the programs that have to do with advanced construction technology, advanced manufacturing. If you look at the history of cost overrun and cost of development of nuclear worldwide, most of that cost overrun is centered on construction management field work overruns and poor design that had to be reworked. But the last time I checked the budget for that, the budget is fairly limited. Think the advanced construction technologies was like \$5.8 Million. And so, if I do a comparative analysis of the thing that causes the overrun and most of the time versus the amount of money dedicated to doing research and how we simplify building these technologies, have you given any thought to what that would look like in terms of furthering engagement of things like Civil Engineers so the construction management things like that and project management, which seems to be the area that we're the weakest in and actually deploying the technologies, so I'd be interested in your thoughts on that.

Caponiti: So, first of all my undergrad was in Civil, so this is a topic near and dear to my heart. One thing about the advanced construction technology initiative is that's the government share, this is a cost shared activity with industry and it has a funding profile, I have to look to see what that is. What encourages me about this initiative is, first, that we're doing it, that we're getting started because construction isn't something that the Office of NE was doing R&D, and so it was important that we start doing that because it is so critical to new nuclear builds. The other thing that excites me about it is, that we have an MOU with NRC to have to be able to share our technical expertise to share data. As we learn things we want them to learn as well, we want them to be a ready and be a capable regulator. So this is one of the activities where they are embedding personnel in with NRIC to observe and follow these technologies, because we have a number of companies that plan to use these technologies in their designs in their license applications and NRC is working to be prepared to receive them. So, those are all really good assets of that activity. So more broadly, in our advanced manufacturing area where these are parts of our budget that we're trying to build up, and so we do have some work and advanced manufacturing around technologies that are relevant for components. In addition to what's covered in the NRIC budget we've got some activities in our nuclear enabling technologies budget that we put toward advanced manufacturing and also, you may see something called the transformational challenge reactor appear and disappear, but one of the components of that R&D program also includes advanced manufacturing and they have very tangibly demonstrated the relevance of these technologies to industry so with Kairos was one of them, I'm forgetting some others. Through that program they built components for those designs using these techniques, so that the companies can see how they can adopt these technologies in their own plans for component manufacturing. So hopefully that just hits on a little bit of your questions.

Ford: The other question is, have you considered as part of the university program or other education programs tied to the ability to train the workforces that might be needed, because people are actually deploying these, if you think you're going to have this massive build out, you need the people available to do that, so it can't just be people who understand how to design a nuclear plant or the specifics of a nuclear island, you have to have people who can actually deploy the technology broadly.

Caponiti: That's a really a good point. Workforce development we think about, but I will go back and look to see if we are missing something in that arena, because I fully agree with you.

Huff: I'll add to that to just say, while I recognize and fully acknowledge that there is R&D in like construction management and processes, there's also, I think lots of opportunities to just leverage what's happening outside in other fields, and when we look across offices, I'll resist the urge to speak for them, but the Office of Technology Transitions in DOE, the Office of Clean Energy Demonstrations and others, are all deeply involved in kind of that move, from our space in R&D, where we're really targeted at this focus on like sort of low to URL technologies. To now this opportunity for demonstration and deployment happening in those offices and so these technology transitions and commercialization endeavors are starting to kind of move in that direction, and so I think what we will see some opportunities for companies and specific deployments to leverage cross generational and cross

technology options for what's happening in other fields in this construction space, in particular, so I am hopeful that our interactions with everyone will help there. But it's also tied to skilled trades and a broader workforce issue like in a Union skill space to which is also broader issue for our clean energy jobs office.

Griffith: isn't it also tied to try to consolidate as much construction or fabrication as possible in a control factory environment minimizing that on the ground stick building type of approach, so I think that's also an element.

Schmid: I had a question for Sam. So beyond the experiments, you mentioned that are internationally coordinated, I was wondering if there is any thought given to international cooperation in waste management and disposition. Also parts going back to Andy's presentation in terms of recycling and reprocessing. There seems to be something going on, but is there is there, active, other active are the ideas actively being discussed in terms of how also to maybe engage international partners that may or may not be reliable, at the moment, or in the future, and how these connections might lead to leverage in future changing political circumstances, including this country.

Brinton: Making sure I understand your question is it about the recycling or international collaboration, or just, waste management, in general.

Schmid: Waste management, as well.

Brinton: Andy I'll start with the waste management question and then you can answer the other part. So yes, there is a clear, a perfect anecdote, for this. On the Tuesday, that I started, within an hour of being sworn in, I was already meeting with a delegation from CNE, which is the French, basically, I would call it, their review of nuclear waste management. As they try to figure out ways to actually collaborate and find out what we're doing that's working, what are some challenges that we've been having, we obviously commiserated over a wide variety of different topics, including recycling and advanced reactors and consent-based siting, so there is definitely an opportunity to expand that because, in general, there has been a question of what can the U.S. bring to the table, and we have astounding R&D capabilities here in United States that we need to start championing so that others will understand that we can learn from the past, to make an even better potential international future. Will that actually be simple, clearly no, and I think that there's going to be the need for more leadership to leadership conversations, on how experiments don't have to be duplicated, if there are ways that we could be doing research that others would be thinking that has been a conversation that many of my international partners already started to raise with me, is what research can we lead on in the U.S., as a way to I would call it regain some of the seats at the table. So those are some of the ways that we're doing it internationally and I'll turn it over to you Andy for the recycling.

Andy: It is important, and like I said there's a lot we can learn from our international partners, but, focusing on like-minded democracies and clearly with the sensitive nuclear technology of reprocessing, it's not something that we engage with everybody on. Clearly there's the experience of France, the UK, Japan, is very valuable and so they're probably our closest partners on developing this technology, allowing us to learn from them and them as well from us, because we've continued to innovate in these areas, even though we don't recycle nationally ourselves. The likelihood of going back to engagement with other countries, I would say it's not on the table, but we'll see.

Scarlat: Trying to understand a bit the balance between agility and stability in the programs that you've described, and this is a question for Katy or really for all the speakers. Alice gave the example of TRISO in graphite to development and as an egg success example and that funding level was about a half a billion. So that was, I guess, an example of stability, which was important to follow through and bring that eventually to market, so Katy, could you paint a picture of how the \$1.6 Billion budget is distributed across the programs we heard about and where is their stability, and where is their agility and how does that balance need to shift in the future.

Huff: This is a phenomenal question. As we plan our budget we're deeply constrained by the budgets of former years and the top line directed to us from our budget planning process and colleagues in the Office of Management budget, who helped to define what the available working ground is for our top line budget. So you can imagine a scenario in which we're given a top line number, and we have to fit all of our priorities within that number. If we were to achieve everything that's an important policy priority in the Office of NE, it will cost quite a bit more than what we have available, and so the president's budget request often reflects a real balancing act of what must be done and what we would really like to have done, and you see issues, for example, around like, for example, the versatile test reactor seen fluctuating support whether it's from the president's budget request or in Congress and a lot of that reflects sort of large projects that can be hard to manage within a constraint top line, particularly when their costs increase year on year. Most big nuclear projects don't start with their peak your cost and then drop down, which would be easier to manage in a budget request, but they start with a very small amount of dollars and creep up to a large peak, quite large and then fall down as we sort of progress in the building of a reactor, for example, that can be hard to plan, you're on here, but the budget process is annual. Nuclear projects are dedicated and so fundamentally any kind of new initiatives have to be enabled by other things that we put away. New funding or even the growth in this budget that you saw can't be spread like peanut butter over all of our initiatives so, for example, as we see things like the civil nuclear credit program and the potential for production tax credit, enabling the sustainability of our light-water reactor is perhaps there's room to reduce our sort of direct support of those reactors. In the future, all of this will depend, but, perhaps we reduce our support in that sector in future years, as we advance

nuclear with advanced reactors in one sense. So, what I'm trying to say is the budget is too small for there to be real agility in a way that you describe, and the stability is reflective of what it's like annually essential and forward moving projects, it can be very hard to make room for new initiatives in a budget that is constrained in this way.

Korsnick: As a follow-on question when you say it's too small for agility and you describe it as the got to do's and I'd like to do's, what keeps you up at night, what didn't you fund that you worry about.

Huff: I think it's really unfortunate that there are challenges in Congress with VTR or that we can't manage to support these bigger projects over the long-term and prepare our congressional colleagues for the possibility that we will have these really large scale increases. We've been successful, with the advanced reactor demonstration program, which of course started with appropriations, subject to future appropriations, but then included this bipartisan infrastructure law like injection and so it's really things like this, these big projects that have to grow over time, because what they do, unfortunately is eat away at some of our fundamental R&D scope. I think we recognize the importance of reducing the burden to the taxpayer and we can't grow to an infinite size program, but we do have a mission probably about twice the size of our current budget so we do have to manage these priorities and sometimes real fundamental R&D, close to my heart, suffers.

Korsnick: Did you have a follow-up Raluka.

Scarlat: I did I have follow-up, so, for example, the university reactor infrastructure was mentioned and is that something that falls within the agility of the funding, or is it something that is supported by previous initiatives and it's sort of a continuation of what exists.

Huff: I'll comment, and then I'll let Alice comment, that basically the Energy Policy Act of 2020 and Congressional direction itself can give us agility. And in this case we're directed to reach to the maximum extent practicable, use 20% of our R&D budget for university programs, by allowing it to be its own line item, which is happening this year. That activity can be a little bit broader, kind of happened last year too and we are allowing that activity to incorporate bigger vision for what the university program can be. I'll turn it over to Alice.

Caponiti: Yes, so having the dedicated university line I think is a blessing, but it was also a little bit of a curse this year. Because when we did have the flexibility to pull from different parts of the program we were planning to implement the university program at a level closer to the intent of as much as practicable to 20%. The line item that we were given in 2022, didn't really allow for that, it constrained us further than we would have if we were managing it. By taking it from R&D programs, however, what you'll see in our request is our intent to get that line to the level that we think it ought to be. And if we can get our request level supported than that would allow us to do, new things like a substantial revitalization program for infrastructure that could include, for example, one or more micro reactor projects getting started at universities. So our request reflects where we think it needs to be, and we think that Congress did the right thing by doing the dedicated line, we just have to bring those two things together.

Griffith: I'll just add, there is Congressional language that really limits us to spread funding around with more discretion and that's largely because of bad behavior in the past, but certainly, I hope that changes, but there should be some flexibility, but we have to be mindful to go back to the appropriators and inform them that there might be opportunities to improve that balance between stability and agility so that we can be responsive to emerging needs in between budget cycles. But that's proven to be a challenge.

Pasamehmetoglu: If you allow me I'm going to ask a few questions and hopefully very simple answers, like yes or no, in some cases, would be appreciated, so that. I can understand some of this before we go into the recommendations. A couple of those are for Alice on the hydrogen production. You show the last time I paid attention to it, it was only one project now we have four of them, but all of them appear to be around one to two megawatt electric level in 1,000 megawatt reactor. What is the limitation on that, is that the capital costs, is that how much they want to invest, is that the safety, security or why I'm paid demonstrating at a slightly larger scale, so they can start looking at their economics really in a meaningful way.

Caponiti: So, first, the first projects are going to be with smaller scale processes to be just to start introducing it and incrementally approaching how to implement these technologies in a licensed reactor environment. Our later projects are starting to scale up, and so, for example, we have a scope active in the industry funding opportunity right now. We've got one cycle remaining that we're soliciting projects that can help on progress toward that scale up, the last of the projects of the four that I mentioned is getting higher and scale so that was going to be using 50 to 20 megawatts electric for a demonstration. That award is still in the process of being completed, but so we're starting to see that progression of scaling up and ideally we're going to see more and then with the hydrogen hubs that are being supported we're going to even further see utility at scale technologies being demonstrated.

Pasamehmetoglu: That is why I asked this question, to see how are we going to jump from where we are to this hydrogen hub, so I thank you. The other question I have is for Andy and is a quick question on the uranium enrichment study. Are you also looking at the cases, because, at some point the utilities were also interested about 78% enrichment for higher burn up fuel. Are we looking at that, too, because I understand our current capability limit ends at 6% or something, so do we have to down blend for that as well.

Griffith: No, I'm actually the one U.S. enricher, Urenco, is in the process of increasing their enrichment ability to enrich up to 10% or so, that's a category three security environment, so the reason that they're submitted their license amendment to NRC to reach that, is because the prospect of accident tolerant fuel using in the 6 - 8%, not sure how far the goal is, but that's the range and certainly that helps set them up on the path to HALEU, so there's some strategic decision making going on there.

Pasamehmetoglu: Have a very quick question on the university program. Katy, you're probably the right person to answer it. I understand that there were some changes in terms of the line item versus how much money and all that, but, I understand the more meaningful change to the university programs is that we are going to give a little more freedom to universities to define their research and perhaps address the agility question as well. As part of that are you also looking or is it part of the thinking that we are going to give them a little more freedom to start doing some international collaborations of their own with other universities. The U.S. doesn't necessarily need to pay other countries for their universities, but there are some very good examples, especially in the UK in terms of the university programs that we can partner with, and I think it's going to be a big multiplier to what we are doing.

Huff: I'll let Alice elaborate, but yes, we've had historically and occasionally these like situations, for example, where work is reflected in the UK, for example, but UK, dollars and also in the United States and we're very interested in that kind of thing, and you are right that the biggest change is the thing that was most requested by the faculty. Which is the like reduction in the prescriptiveness of the work scopes, which has gotten more and more prescriptive over the last decade, so we are bringing it back to a place where it's a little bit broader and where the faculty can bring in creative ideas that are not yet already established by the programs. Alice would you like to add anything on the international piece.

Caponiti: Yes, so the UK is a really good example. We've had a collaborative opportunity with the UK for a number of years now, and that has been a very successful model, and we would actually like to expand that work. We're exploring the ability to expand that model to other countries that we would want to have such a partnership with. When we evaluate applications, there can be extra points scored for strategic partnerships to include international partners, so there are awards that include international partners, every year, beyond our partnership with the UK.

Pasamehmetoglu: I have a comment, but I'll stop here, Maria.

Branscum: I'll just note that we after lunch, before our 1-hour discussion, we can, maybe use a little bit of that time for additional questions at the beginning of the discussion and before we get into your priorities discussion.

Bressler: Had a comment in prioritization, so he will hold it until later.

Korsnick: I would like to get us to lunch and kind of give our mind a bit of a break and let it just kind of think about some of the conversations that you heard today. And then again when we come back as you're eating think about, we heard a lot of information and we could come back and we could imagine all kinds of different gaps and things that we think, need to be worked, but really let's keep our eyes sort of on the big picture, the deployment. That would be helpful on so many fronts, not only just here in the United States but internationally. We also need to keep a thriving, innovative pipeline, so we want to be thoughtful that we don't want to steal, if you will, the R&D of the future. Just because we want to sort of deploy what we know that we have now, so I guess, I just want you to think about of a continuing cycle, what is it that needs to happen now and then, what are the things that we need to do now that's really paving the way for the future. And just kind of think about that, while you're eating and then, when we come back I'll probably frame the discussion on what are some of the challenges that we see and then we will reflect back on those challenges with, then what work do we think DOE needs to do to help us navigate those challenges. So I'll probably frame it in sort of a negative in terms of what are the challenges that we see, but just give you some food for thought.

A break for lunch was declared at 12:36 p.m.

Afternoon Session

The meeting was called back into session by **Luke Branscum** at 1:30 p.m.

Branscum stated the afternoon portion of the meeting agenda calls for a "Discussion: NEAC Priorities" by the NEAC members followed by "Forming Subcommittees and Next Steps" and that we'll start where we left off with answering any remaining questions.

At 1:32 p.m., **Luke Branscum** turned the meeting over to **Acting Chair, Maria Korsnick** to start the Discussion on NEAC Priorities.

Korsnick began the afternoon session by stating that she would like to reflect on all the conversations that were heard this morning and then also just reflect on, based on your own experience, things that are going, and I would like to begin to focus this discussion on gaps and challenges. So it could be something you heard this morning that you think is a gap or might be a challenge, but let's start kind of thinking around it in those terms, because I think from that we will be able to distill some priorities. I am a little concerned that we stay focused, otherwise we can

have a lot of just conversation. We do have plenty of time we have essentially two hours between now and the next break and in that time we have plenty of opportunities for conversation. And then we're going to distill it and sort of decide which subcommittees do we think would be helpful to work, the priority issue.

Ford: I actually just have a follow-up question about the LDP programs, the ones that were not pulled off into the other organization to manage. Do these programs have clearly defined milestones and off ramps. This gets back to Raluca's question about flexibility and agility and how you might enable that in the portfolio and by having clear deadlines and points where they're going to be evaluated and perhaps be funded as off ramps. That's a way that you can incentivize behavior but also make decision points that might free up funding in a structured fashion so just curious if they've been given clear guidance and clear milestones that they're following.

Caponiti: Yes, so to answer that question it's very specific to the nature of the work being done. For some of the work being done in our labs they will be multi-year activities so when we talked about getting alloys 617 through code that was a very logical progression of activities to get to the point where a code case is being submitted, and we're done. The same with TRISO and graphite qualification, we had irradiations, we have PIE, we have preparation and technical reports, there's a tail down to those activities that we can consider that box checked. For some activities like the physical infrastructure that we're talking about like standing up MARVEL we're standing up the NRIC test beds, they also have very structured timelines and funding profiles. And we do have the ability to have an off-ramp if the cost of technical challenges is going to exceed what we feel that we can accommodate in the Program. Am I heading in the right direction?

Ford: I'm mostly interested in the ones where it's a significant public private venture, in other words, on the private side are they given so when we did this in the DOD, we had something called a joint concept technology demonstration program, you got three years of funding, if you could not demonstrate that you mentioned milestones than you were taken off funding stream. Because you're not going to lead to a commercialized double viable product, and that was a way of ensuring that you were always bringing new research into the mix on a recurring basis and not always locking in long-term funding. Just because that's what you've done in the last couple of years.

Caponiti: Yes, so for the culture rewards that were funded for the advanced reactor demonstration projects and the risk reduction awards, those have a set of milestones that are expected to be achieved through the entire duration of the award, but every year or within every budget period we go through an application renewal process, where we're reviewing to see the progress and we have the ability to choose not to continue the cooperative agreement. It is a cooperative agreement and the government can back out at any time if it feels that the objectives are not being achieved, and not award. So that's a rigorous review that goes on every time we go to continue the activities under the award looking at whether we're achieving the milestones and the cost and the schedule. So that's for those awards and I don't know Andy, you've got other awards with industry.

Griffith: Yes, our main award is on a HALEU site and the contract has termination clauses if they're not performing. And, as I mentioned we're awarding a new contract start-up and operate that facility and there'll be the same. On the funding opportunities that we have with industry on the accident tolerant fuel program there are similar to what Alice described.

Barrett: On the presentation this morning I commend you for having integrated presentations where you could see how they connected to each other. I am looking for your thoughts and can you take it to the next level of integration, where you can basically add a lot of the advanced technologies and try to change the perception of it's a waste facility for Sam for interim storage, it's an advanced technology recycling center that also has some fuel storage with it and try to build on some of the other successes and things that are going on, simultaneously. In the United States, for example, you have a very successful for decades, the research reactor take-back in NE. As you go into trying to market advanced reactors overseas, if you could do a fuel take-back, it would greatly enhance I think our market ability of advanced reactors, if we could do that, like some of the totalitarian countries can do, harder for us being a democracy, but you could maybe build on that and also tie that into current negotiations between the United States and Australia about, then have nuclear submarines, it would be sort of like a non-proliferation black box to HALEU fuel, of course, but they don't ever go inside it and it comes back after 30 - 40 years, somehow try to tie those together with the advanced technology R&D recycling to try to get a critical mass to have a host say, I want one of those and I think that's a wonderful thing to try to tie together, so your thoughts on the next upward level of integration. You're already integrated, but, bring it up.

Brinton: One way that we're thinking about that is through this hiring of social scientists to recognize that communities need to be at the table to help us with co-development. When they tell us what they want, we will have a better chance of integrating all these services to make sure that we're ready with the advanced technology center, as you say they need it. Part of that challenge is them knowing what they want. There is a limitation on what our community will know is even an option and that's why it's really going to be critical for Alice, Andy and I, to really make sure that all of our ducks are in alignment so that way if a community says well I'm really interested in advance nuclear fuels, I can connect them with some of Andy's team to make sure that those services are ready and if they say I love this to be co-sided with an advanced reactor, then great, let me connect you with my amazing team

over there with... I believe that integration has to be dependent on the communities themselves actually wanting that type of facility or other committees are just going to say, I don't want this to be co-developed. We heard this in the RFI. Some said we don't want anything else with co-development we just want it to be a simple parking lot for nuclear fuel for the time being, if that's what the community wants, then that's the integration that they will get. I hope that kind of answers that question.

Korsnick: One of the gaps that I captured in your question Lake, was fuel take-back because you're the only one that sort of teed that up in the conversation. And again I'm going to keep trying to focus less on just broad conversation and more on gaps. What is it that you are you not hearing that you think, in this case you're thinking from an international perspective it's a competitive edge for others that they'll say that they'll take back that fuel and U.S. today can't say that. This is a disadvantage for us, so I captured that as a gap.

Bresler: Yes, I thought we have taken a look at that somewhat and that can be accomplished as kind of a tiered agreement underneath the 123 agreement. It's possible, but it requires a multi-year persistent effort in its Interagency as well as Congressional involvement, but it can be done, it's going to take some motivation and I, know that there are some vendors that are considering that, as part of their possible path forward as well.

While I have the microphone, I just wanted to also thank the presenters for their presentations this morning, I thought they were all just extremely informative.

Bresler: I cheated a little bit and I asked Andy my question at lunch, but, I figured maybe I'd also ask it now, and let him answer for everybody, as well.

Because to me anyway from at least my perspective, it gets I think a little bit maybe into prioritization. That is, how critical is the fuel supply chain issue for existing nuclear plants. Is there a risk that existing plants will have a hard time fulfilling their refueling requirements and, if so, how soon. So from the system operator seat, am I going to start getting nuclear plants, sort of the rating their capabilities, because they have to extend the life of the fuel they currently have because they had to delay refueling all that sort of thing so. That was my question and I figured I will post it again to you in front of the group.

Griffith: I'll start now and let Katy clean up anything I mess up. I think there's a lot of uncertainty with the future in terms of how things unfold. One of the reasons why we're motivated to kind of put this out there and get started on a solution is to minimize the kind of disruption that could take place if restrictions are implemented in a way that aren't really fully thought. Clearly, if there is a supply disruption there could be some impacted reactors out there, some utilities are in a better position to kind of transition a disruption better than others. But, clearly, if there are gigawatts dropping off the grid that's a bad thing and then there's the possibility that the supply could be suspended unilaterally by the source at any given moment, and so I'm better prepared than caught flat-footed and we're working it we're working it with the utilities, with the suppliers, with NEI and we're trying to understand what options we have. But, really the solutions, they start with replacing capacity, like we're moving toward, we're trying to gain support for, as well as having an important strategy or import policy that stabilizes the market long-term because it's a good mark, as I've mentioned.

Bresler: I will just emphasize two things, gigawatts leaving the system is bad, especially in the face of the fact that we have so many retirements of current resources ongoing as this resource mix evolution continues, so it's just sort of a double whammy at that point. And, really, from my perspective, anyway, I think, step one is transparency, so at least, for the people at least in my position anyway, being able to plan for these types of contingencies is step one, then step two obviously, is addressing them so maybe the contingency can be avoided.

Huff: I do just want to add that, I think Andy said everything exactly right, the one thing I would maybe just add is that it takes time to stand up this particular kind of fuel supply chain and that time is interestingly fairly close to the amount of time that we have. And so there does require some real federal direction and investment to make sure that happens on a timely basis whether the market responds quick enough it's not really a question at this point, if there's a disruption, we need to have already been getting ready for it, so, that's where we're at.

Korsnick: I'll just add that on behalf of the industry, it really is a complicated picture. Half of the utilities don't do business with Russia. So it is really kind of a plant by plant kind of analysis, some plants have purchased fuel very far in advance, some have not. So it begins to be a very particular issue very quickly, I can say, and we have been working with the DOE as they've mentioned to sort of begin new and fresh and kind of get things moving. On both the conversion and enrichment and also to sort of better understand everybody's long-term supply. So that there are potentially some sort of loan options that are available for somebody that needs it sooner than somebody else. So there are some sort of I'll just say bridge options, but at the end of the day, that's how we should view it that they're sort of bridges and band aids. What these guys are trying to put in place is just to position the U.S. in a stronger place for both low enriched and HALEU. I have confidence that it will happen, what I don't have confidence is what's the time frame. So it's hard to answer your question because it's hard to understand what the time frame is. All I can say is today, there has not been fuel disruption, so it hasn't begun yet, but we're all concerned that it will.

Scarlat: What is the capability in the US for down blending?

Griffith: It's limited. We have identified, and this is for HALEU, a little over two metric tons of uranium nitrate at Savannah River, which is available for down blending and which is available for advanced reactor use. There's also about a little over 2 metric tons at Y-12 in scrap. Our colleagues in NNSA are identifying that as something that they are working on to down blend and make available for advanced reactor demonstration of product program. And, some of the challenges with that material (because it was from reprocessing fuel), is that the isotopes would contaminate the startup of their fuel fabrication capability if they introduce it as is, and so the initial thinking at the moment is down blending or diluting that material with freshly enriched UF-6 from the demonstration in Piketon, Ohio, until those isotopes are diluted down to the point where they're suitable for introduction to commercial fuel fabrication facilities. And then we're continuing to work with NNSA. If you've heard it in any of the discussions that we've had broadly with the community that we've engaged with, something called the couch cushions exercise with NNSA, where they are going into every nook and cranny and trying to pull out every kilogram or all quantity and then we're getting a little smaller but they're still going to be a challenge to meet all of our needs to maintain the schedules that are expected for the air TV DEMO, so it's challenging, but, we're continuing to work, the effort. Oh, and I should also mention that there's about 10 metric tons equivalent of VBr2 fuel, that one of my slides indicated, we're accelerating the processing of the VBr2 material and making that available, but then again that is contaminated material. We awarded the first five metric tons of that fuel to Oklo, years ago, before an RDP even existed and have been in discussions with them on standing up fuel fabrication capability on site at INL because the nature of that award was that the material would stay there, and so a demonstration reactor would have to be on site and Oklo is kind of pursuing that path, independent of the RDP.

Scarlat: And what is the timeline for ramping up for having HALEU enrichment capability?

Griffith: After award, after contract in hand, it's on the order of three to four years. And, clearly from an acquisition standpoint, we look at options to accelerate that any way, we could.

Pasamehmetoglu: I'm going to focus mostly on the presentations we've heard and what I might see as potential gaps, but I want to start my comments on basically trying to reflect where, what Bill would say in terms of gaps, if he was here, so I'll start with the international piece of it. Bill started under NEA, probably four or five years ago and under the NEA 2015 initiative, some of you might have heard Nuclear Innovation 2050, and so there were a bunch of experts around the world, from about 28 countries that got together and as a follow up to that they started their global innovation forum, where they had two workshops so far, and the two items that filtered up to the top for nuclear energy, from the global perspective, on what innovation would benefit the most in nuclear energy today, if we could do it today, were basically digital twin data analytics and artificial intelligence. The development of digital trends and data analytics and artificial intelligence, now, I don't see that explicitly in our program, in the NE Program, however, the pieces are in there. It doesn't appear to me that it is a big funding lift, to be able to put those pieces in such a way that we can easily assemble them and start doing that. And, and I also am aware that, about a year ago NNSA started a digital twin exercise primarily focusing on safeguards and security so it's another opportunity for NE and NNSA to collaborate, while they are focused on it. You need the same twin to do whatever it is you want to do, so, anyway, I thought it would be worthwhile to consider how we can reassemble the pieces that we already have to start addressing that because it was a global consensus that is a high priority for nuclear innovation.

Ford: I thought Scott Ritter, had a pretty good program out of Idaho on digital twin development, I mean I just had a brief from him at Princeton last week, and it was a pretty robust.

Pasamehmetoglu: Chris rather is doing that, but that is the NSA program over I'm. I'm referring to, so I think there's an opportunity to piggyback on what's already being done but also put some of the pieces that Alice is working on, especially in the area of instrumentation and sensors and the modeling and simulation and couple notes into it. As I said, I don't think it's going to take a big lift in terms of funding the pieces are in there, I think it's just a matter of repackaging it in their program and integrating it.

Caponiti: yeah so we are actively working on artificial intelligence machine learning and digital twins and we don't have a single program called that but we're implementing. All of those technologies in existing program so I'll just give you some examples in our light-water reactor sustainability program we have been working with some concert industry awards on applying artificial intelligence and machine learning to help reduce the cost of maintenance by harvesting data and having predictive maintenance, rather than scheduled based maintenance. And we've had some real successes with some companies that are making inroads and I was briefed on it or not long ago. The cost savings to industry so these young companies are working with existing utilities. And the cost savings like when we talked about fuel optimization and helping to manage fuel more smartly the cost savings, there is right. Right so we're already seeing like these early supported activities, making an impact in the existing fleet we also got university scopes kind of at the university side to help work on that digital twin was part of the transformational challenge reactor program from its inception. And we are pulling those elements from TC into our existing programs, like the advanced sensors and instrumentation and advanced manufacturing to survive TC or as a line item. So those are being incorporated into our based programs as part of those programs. Perhaps we can do a better

job at having a fact sheet that lays out all of the work that we're doing in this area across this funding lines, so that it can be more visible.

Pasamehmetoglu: Thank you Alice I really think it will be useful if it's a higher level than individual programs. Looking at it I think it will probably attract a lot more international attention, and you can probably find partners a lot easier, as opposed to looking at one specific type of reactor or one specific type of technology. It is something that I would recommend. The other thing I want to mention is Andy's HALEU, he is the only one who used the words chickens and eggs problem in nuclear, but unfortunately I don't think that is the only chickens and eggs, I think we are full of chickens and eggs in nuclear because we are always 15 years behind schedule and every time we need something we should have started 15 years ago, and when I look at the entirety of the programs from Andy's and Sam's analysis presentation, there is nothing in there that I would say, or that they are doing that is just a waste of money. However, I think it would really be good to clearly identify where that program is really useful and why just became a pick one piece of it and get rid of the other piece, and still get to the end objective of but Katy is trying to get. So I don't know whether it's a roadmap, it is, it is some sort of a high level strategic document that basically connects all those dots and show that they are all needed, but they are not needed for every program but certain specific objectives, I think that will really be good if we had the document along those lines and for all the pieces. I'm in there, for example, the instrumentation sensors are really important. I couldn't say that, why are we wasting money on instrumentation on sensors, but today, if somebody asked me well, how is that meeting Katy's objectives. I have to make it up.

Huff: I will just flag it you're absolutely right, the last public strategic plan from any was in January 2020 just before we left and while we have had internal strategic documents guiding our milestones annually, we haven't released a new public one, but it is our hope, and I hope we can engage this committee in sort of reviewing it soon, but yeah, it is our hope to release a public one sooner rather than later.

Pasamehmetoglu: Without revealing my biases or not, there is nothing in there, that I see why, why are we doing this, why are we wasting money on that. But I think Ben when we are talking about chickens and eggs, I think it's important to identify how the chickens and eggs are lined up to the get to the end objective. I guess that's what I'm trying to say. Because, as I said, unfortunately, we live in an industry where nothing happens overnight, everything is 15 years too late. And the last thing I want to mention, given that we are now in the fortunate situation compared to 30 years ago, where we were looking at zero budgets on nuclear energy research, that we have plenty of funding to keep our researchers and universities and everybody busy. I really think we can take better advantage of international partnerships under the different, again under Bill's leadership the NEA put together a very good framework on how we can do joint projects internationally. And it doesn't have to be all the NEA countries, it can be two countries, three countries, whatever it is. And, well, I mean let's just face it, we are running out of intellectual resources in this country as well, it takes time to develop those in the meantime, I think we can do a lot better in terms of partnering really under those joint projects and getting some of those people with their own funding do some of the work that we want them to do. I would encourage that in all our research, especially the R&D areas, obviously you're not going to build the reactor under OECD and yet, but we can build the sensors and test them and qualify them. So I would encourage that in all our R&D programs we look at how better we can utilize the international resources.

Korsnick: Okay that's excellent and capture that as a gap better advantage of international partnerships and actually that theme can go from not only R&D but it can go into funding actually it can actually bleed over into partnerships with the industry, having international partnerships as well, I mean it sets a really nice foundation and you mentioned universities earlier so it's actually really a broad issue.

Pasamehmetoglu: Belt those joint projects, I'm glad you mentioned that Maria. Those joint projects, the way NEA has set that up now, it is very easy to bring in industry, unlike the previous setting where the setups that we had on the OECD industry, but it was very difficult to partner with industry but now they can be part of that, as I said, it's not across the board for NEA, pick and choose your partners.

Korsnick: Yes, that's excellent comments.

Scarlat: I had a follow-up to Kemal. When the International Partnership or training, thinking through the role that the U.S. might want to have as a leader ties also to training the leaders of the next industry and the universities are well positioned to train the next leaders so, then the question is, how does one attract those students from international countries that are to become leaders in the global nuclear industry and maybe ties into funding mechanisms, or maybe ties into agreements with other countries for them funding students to come study here. I think that can have quite a significant long- term impact on the leadership that the U.S. has in the field.

Pasamehmetoglu: No you're absolutely right that is another program that they have started it's called the international nuclear energy fellowship program of OECD provides to basically participate in international projects. And, and I know we have one of those projects in the United States but, I don't remember now who's hosting it, one of the universities is hosting it for the students to come here directly. They get trained as well as they participate in the project. So those are the type of programs and that's why I made the comment earlier Katy that now that the

universities have a little bit more freedom on exactly what they can do with their money, I think we should encourage the universities to start establishing their own partnerships internationally.

Hart: So I'm going to jump on in the meeting, I wanted to point out that I think the Office does a great job with collaborating across DOE, and it has had a lot of success, especially with their outreach with the AI Working Group and some of the things that they do with nuclear cyber security in conjunction with NNSA and I think we should build on those things. Just looking at the budget and seeing how we stack up as NE compared to other offices, and there's a lot of scope creep, it'd be more impactful to make sure that we partner with other offices, so if you're talking about nuclear cyber security that the NNSA and Caesar and I know you already have those relationships, but just building upon that so you can maximize on the funding that you get and also coordinate with them with even more funding that they get that could have some synergy. But also, I wanted to talk about the nuclear energy in a global context. And one thing I think that this committee should do is to look at what we're doing I mentioned this during the NE-6 presentation, but to look at what we're doing across the government as far as international cooperation for nuclear energy, specifically, not so much R&D and then see if we can make that more impactful or make that more of a bonus. So if you work with the U.S., this is what you get as opposed to if you work with other people, and what does that look like. Because it's clearly not going to be the ease of funding that is going to have other countries wanting to work with us, but so we need to think about the intangibles that we bring to the table as the U.S. and organize and amplify those to potential customers. And I think we should also look at a framework on if we had a customer, how would we put those in place quickly and effectively as well, because I don't think we thought that through as well.

Ford: Can I dovetail with what you said on that if I listened to this it's a there's a model that's been out there for quite a while called built operate return. It's sort of what Russia does effectively, in some cases, and a lot of the components that I think you've been writing down Maria tie into that kind of a life cycle model of how we would go about ensuring that we have the financing available to build it, how we go about providing the support to operate it initially, how we go about building the capacity from human capital standpoint in the country to help operators in the future and train their workforce to be long term partners, in that how we take back the fuel perhaps. All those tie into that same kind of model that would then put us in a much more competitive space with some of the other countries that have state sponsored industries, but it has to be a whole of government approach to that. To do that, you got to have Exim Bank, you got to have the fuel cycle piece of it, you've got to have all of that consolidated and DOE can certainly play a role in some of that. I'll just also pile on J'Tia's comments about working across DOE, the fusion space is getting a lot of interest, I think we're missing becoming a fusion lab if I didn't mention this, and one of the big areas that's a significant need in the fusion space of materials research and so to the extent that we're not working across any FES advanced manufacturing, some of these other offices that do materials research we're missing an opportunity to perhaps do collaborative work that you can get bigger bang for the buck by bringing in a lot of the other offices into that mix and so I'd recommend that. The last thing is, if we haven't I know, Rachel Slave started at the Gemini Program and when she was doing R&D work and that had a lot to do with what Kamala talked about tied to intelligent assets and how we build those, and so hopefully we're gathering all that those lessons learned from RPE into the work that's going on here. And then the last thing is the whole of government approach internally is building that workforce I mentioned it in the project development side, and so I think there's an argument that you should be doing something with the Department of Education, the Department of Labor, etc., that's a whole of government approach to building with proper workforce that's going to be needed to build and operate these systems in the future. And so that kind of a whole of government approach would be, certainly in keeping with what we're already seeing at Princeton with an apprentice program we have going strong tremendous interest from the state and so they've got it they've used us. This is a good example of how you build apprentice programs. Those kinds of things, working with both the Federal Government and State Governments to help build the workforce of the future, I think, is going to be critical, and I can see NE having a big role in that. That, then, works across not just the nuclear industry but other industries as well.

Korsnick: Great, thanks Mike.

Caponiti: I just wanted to say something encouraging about our collaboration in the fusion area. It is from a research standpoint, we have been working in number of years to coordinate the work that we do, especially where relevant, like in the areas of materials in manufacturing and we also work with fusion energy science when they were given the mandate to start interacting with fusion developers and helping them pattern the way they interact with companies that we've learned through GAIN so there's been a lot of coordination between GAIN and the fusion energy sciences office on how to do that with industry and you'll be happy to note that even just yesterday I was meeting with the lead fusion coordinator for the Agency and discussing how best to support milestone based payments for major demonstration activities which they're interested in, as we are.

Ford: The other piece of that is that they actually model-infused after GAIN, so it's they've already taken on some of the lessons from the fusion space.

Korsnick: So we've talked a lot and I appreciate all the conversation that we've heard, I want to maybe just seed the conversation a little bit. We talked a lot today and heard a lot today about these advanced reactors and getting to deployment and in sort of all the work that goes on for that also, spent fuel that has a long road ahead of it, I guess, I would just challenge us let's look 15 years from now, and what it could we imagine in our mind's eye 15 years from now, and what I want the question I'm trying to ask us is, are we doing all the things that we need to do today to be prepared for what needs to happen then. My challenge is there's so much going on right now, I want to make sure that we're not playing off of tomorrow, because we're just getting what we need done today and a lot of it requires a lot of money. And so, then, do we begin to underfund, if you will, a pipeline that could be an infrastructure pipeline, it could be an R&D pipeline, I don't know. That's my challenge back to you, are we underfunding potentially something now that we're feeling good because we're going to get some things deployed. But we're going to find that we have a gap and it might be a while till it catches up, it might be a decade before we figure it out. It could be modeling, could be I don't know computing, could be you guys are smarter than me, so I don't know all the things that we have our fingers on from an NE perspective, but I don't know, so chew on that a little bit.

Pasamehmetoglu: Let me give you one example, and maybe that will also trigger some additional discussion. The TRISO fuel programs that we brag about today. That program itself, basically started in the United States, it started in 2004. That was the same year I went to INL from Los Alamos. It was part of the NGNP program with the title next generation nuclear plant. The program got killed three or four years later on getting traction in terms of cost shared by the industry and, on that, so the program didn't go anywhere. The temptation was to kill the TRISO fuel program nobody needs this feeling of remorse by our redeveloping it. Well, thank goodness we stuck with it. We finished the qualification, it took us 16 years to get to a point where we finally deployed, the final experiment and a qualification is not hundred percent finished yet, but it's almost there, so it takes about 16 years and out of that there were three or four companies that they didn't even exist at that time and the owners of couple of those companies were university professors at the time. They didn't even think they were going to be in the nuclear business and building nuclear power plants. So this is unfortunately our industry, it takes 16 years to trigger somebody to finally do something so your question is very well raised Maria. I think as NE, we have to be thinking about 16 years from today, what do we need today and not so much what it is that we need tomorrow. And on another thing I also wanted to request in our discussion, I think it will be really nice to come to a common consensus on what they call a demonstration, what we call a deployment and what we call commercial reactors. Really it would be nice because in my opinion, sometimes we tend to get confused with the terminology. So it should be clearly understood that just because we have demonstrated something it's nowhere near to achieving commercialization.

Korsnick: Yes, that's a good conversation.

Griffith: To highlight and kind of build on what Kemal said. We have been trying to get funding for an accelerated fuel qualification program focusing on metallic fuel, to start with. We haven't been totally successful, but I think we got some traction in FY22 so we're gearing up on it, but, it really brings a lot of the capabilities we've already discussed today into practice. It basically combines the advanced post radiation examination capabilities that we've been developing over the last 15 years or so, and brings them into focus. These are technologies that the silicon chip manufacturers basically put into practice 20 - 25 years ago and never looked back. We're finally there. Now we have institute instrumentation for fuel experiments which will further inform us on the evolution of material behavior while it's being irradiated. And then the use of high performance computing which is phenomenal I think you layer on top of that even the artificial intelligence technology and there's probably more opportunities to accelerate things, but we don't have to take 15 years to qualify fuel. We'd like to do it a lot quicker, we believe we can but we'd like to prove it and, and we are in search of funding to really fully fund this and move on, and this is something that industry is very hungry for as well and they're contributing as well. So, we have a big opportunity.

Ford: So I hear speed, and so the thing that I would couple speed with is scale. In other words we focus on looking what happens 15 years from now, but if we're still just building one or two reactors at a time, then that's a fail if we haven't done stuff to hold the supply chain in line and make sure that there's readiness in the manufacturing side to support a larger scale deployment. Then you're just going to continue to build plants, you're not going to have manufacturing infrastructure necessary to build the module multiples that will make them actually cost effective, because ultimately economics, are still the critical problem for nuclear. And if they can't bring the price down that means they have to have enough of them built and then it's still going to be a fail 15 years from now. The second part of that is there's risk in the existing fleet in that 15 years from now, are we still comfortable that those plants that have been operating now for 55 to 65 years are safe and are not going to cause another challenging accident that's going to bring everything to a halt, again. And so are we doing the proper amount of research in materials and understanding of the existing fleet to make sure that they are actually safe. I know we've grown comfortable with the master curve development for brittle fracture and things like this. But early on, from 40 to 60 year life, that was really well supported with testing and the existing test program with the existing fleet. I'm not so sure though that the 60 to 80 year life, is quite as well supported, just my personal opinion, and so I think that we need to make sure

that program continues in the light-water extension program, that we're doing the proper amount of testing to ensure that we don't have a problem 15 years from now, that brings everything to a halt again.

Caponiti: Can I respond to a couple from them on that. Let me just start with the materials that last point first that was one of the slides that I called. We still have an active materials component in our LWR program and, specifically, looking at supporting the licenses through 80 years. So that is still an active part of the program it's just not one of the things that I highlighted, but we can get you more information on that. The idea of demonstration deployment and commercial products and how to think about those things, and again the idea that it's a fail if you're only building one or two plants, I fully agree, I can tell you that when projects are selected for support of government cost share, we may be funding a cost shared first of a kind demonstration but part of what we consider in selecting those projects is what is their strategy, their business case, their plans for domestic deployment, their plans for global deployment, do they have a strategy. And so, not so the Office of NE can't afford to buy a half of every reactor. But these first of a kind demonstrations that we do are really important, because every step through licensing is paving the way for everyone else to follow so we're helping to pull down that risk. And we also have a very engaged loan program office who sees as very much part of their mandate and addressing supply chain and those kinds of elements that will be essential for broader scale deployment in the United States and abroad. And I'm comfortable with overlapping definitions so many of our first kind demonstrations are fully commercial products they are commercial. Some of them are going to be under DOE authorization because they're truly experimental but they're going to be demonstrating some fundamental concepts about the way that these designs will perform.

Barrett: Maria on gap analysis and issues that are not immediately urgent but important for the long-term over the years in the future, and this issue is not one of them. Is not \$1 resource matter from Congress, but it's an intellectual challenge for the department and the administration, and that is disposal of nuclear waste for current reactors and the future. I think we will work in the interim storage in the short term that we're doing okay that's kind of an urgent matter, but the longer term disposal of the materials, recycling or not, Okay, we need to have a path forward because right now, according to the administration, what we have in the law is not workable. Now understand that and we're not going to change that, but we need to. I recommend that NE who inherited the nuclear waste problem was taught a policy method for how we're going to achieve this, because I think the world and our nation is going to say, what about the waste, what is the waste solution and we have to have an answer for it and there are answers, they are not easy, but there needs to be a component that's a gap, we need to address in there. So I'll throw that on a table for you.

Korsnick: Yes, I would agree, and I appreciate Sam you did a wonderful presentation and Andy I think you mentioned it in yours as well, but there's definitely a common theme relative to waste. I don't think it surprises any of us, but in terms of sort of not only making progress today that we can point to, and I think like your point is, but it needs also sort of a vision for the end game and interim storage or consent-based siting for interim storage, it's a milestone along the road but it's not the end, so I think your challenge is to stay focused on the end game.

Scarlat: Questions on to build on Lake's point about waste, I was wondering about low level waste and also mixed waste, as we have advanced reactors being developed. We hope that there will be many demonstration projects built. And they'll learn as they go along and, at the beginning, they might hopefully they'll decommission also some of their initial units and that will produce low level with not just high level so I'm curious where we stand on low level waste facilities and associated costs. And then the other question I had was on infrastructure. We didn't have a lot of discussion on university and lab infrastructure, what does everybody see as the key gaps there.

Griffith: Yes, we need fast spectrum testing. But, I think other areas of the laboratory infrastructure are in fairly good health. I mentioned the introduction of the sample preparation laboratory at Idaho that'll help with non-alpha contamination, and it'll relieve the bottleneck for post radiation examination at Idaho. The hot fuels examination facility will also relieve some of that. And then the pending question all channels to Tracy Bishop, who is not with us today. That that we are going to have to think beyond the existing advanced test reactor for thermal testing or radiation capabilities. But I would start with the fast spectrum is a big gap.

Huff: And to go back to your LLW question and Sam can clean me up if I get this wrong, but there are low level waste facilities that are currently operated and licensed by the NRC operating in the U.S., there's Barnwell and Clive, Utah and a couple others. And so those manage low level waste material. And there's capacity for growth.

Griffith: The one area greater than Class C waste, the Office of Environmental Management is working on that and I think they're close to a solution.

Barrett: To add a little bit of a minor gap that exists, I think, in any world space, as you start to look at advanced reactors and some of the waste streams from recycling and processing, you will more than likely end up with commercial transuranic waste, which is greater than Class C waste, but it's a unique legal waste that we don't have capacity for such commercial true waste in the U.S. We have Defense true waste at WIIP but that's not going to work for us in any space, so this is a minor gap, but it's a gap that ought to be somewhere in the NE system.

Huff: On processing waste, we still operate under the policy premise that's still in place from the Obama era. Tracy Bishop deals on that infrastructure side, we could have spent a great deal of time in this introductory space on

her topic areas and what's happening at national laboratories in particular because nuclear waste processing is a large fraction of our budget. I think this will be an important issue to address in future NEAC meetings. I believe Tracy wasn't available today.

Brinton: Was your question answered?

Scarlat: Yes.

Schmid: Thank you, so I wanted to ask a few questions about this consent-based approach. But not just related to nuclear waste. Because I think when we start shifting our starting point to communities, lay communities, we may shift away from the priorities that the experts in this room have laid out for us and the priorities that have persisted over apparently a very long time, because when I saw the slide that perhaps showed us about the nuclear today and nuclear tomorrow and all the goals that were listed there, I couldn't help but remind myself that those were goals that were listed in 1955 at the first Geneva conference on the peaceful uses of atomic energy. That optimism is definitely comparable today. So I'm just wondering if we shifted our starting point to concentrate to community-generated goal, making and priority setting, would that shift the balance between the expert authority and what kind of technologies we actually want, what kind of infrastructure, what kind of organizations we actually want and need to be able to trust them to accomplish those goals. Some of those goals that I didn't hear mentioned, or only heard mentioned in passing today was, for instance, liability for nuclear accidents and not just at nuclear power plants but also anywhere in the fuel cycle. Jac Goodman mentioned international accords that this country is maybe not, a member of but also certain domestic legislation. What are the emergency response strategies that exist that are being developed and how new threats be integrated into those, for example, military conflicts involving nuclear facilities, this is something that is new because with all the insider threat considerations, with all the terrorism considerations, we have kind of hardened nuclear facilities against those, but military conflict at a scale that we're seeing now is relatively new because nuclear power plants have been built after the last world war, so this is a new situation that hasn't really affected at least nuclear power plants in the United States and in Europe. So how can we prepare for that and also how can we assist if that happens elsewhere, other than sending strongly worded cables. And then the other point that was mentioned that I just wanted to add on to, is training and workforce that is not just engineers, but also not just program managers. I realized this is a gap that that may need to be addressed but, but people who can hold complex goals at the same time in their brains so. For example, a more interdisciplinary comprehensive training where students are taught to think about power reactors and bombs, about safety and economics, about reactor designs and waste repositories, about energy security and international collaboration, about the interaction of nuclear crises with public health emergencies, military conflict regime change, etc., and how, how can we set up training programs that will deliver people like that. That can then not end up and maybe one small room at a hotel, but that actually can work in the industry and colonize the industry, ideally internationally.

Brinton: So I can start, even if it's consent-based not just waste, I think it's a really good catch, so in consent-based siting there's two major and you obviously know this already, but for the room there's two major issues at play, procedural justice and distributive justice and both have applications to other pieces not only just energy but nuclear energy, specifically as well. If you're talking about liability that's a procedural justice, if something goes wrong I'd be okay, will the system protect me, that is, something that we can learn from contemporary siting maybe if we do it if we're again, as the person who is currently hiring a social scientist. To try to do this work if we are able to take some of those issues and address other gaps that could, that is possible because we can concentrate on the waist and then apply it more broadly, and then your point onwards development is exactly why we have the challenge of hiring people with a specific area of nuclear waste of their background is extraordinarily difficult. Luke and I just actually came from a workshop where with education, it's extraordinarily rare, it's very difficult to actually find a lot of students and there's duster pipeline is not met, but it's because of your COMP points about complex schools, so yes, socio technological studies, social sciences. The hiring practices, who would be a better address and workforce development could be better address if we stopped looking for just nuclear engineering as a soul system, but that doesn't mean that we shouldn't have the infrastructure of those reactors at sites. Again I was a policy student who got to work at a reactor on my campus because that was giving me better training on to be holistic that I could understand the policies that I was going to maybe write one day what their effect would be on the reactor, I was working at. So I think that it's a good thing.

Caponiti: I was just going to respond to you had a lot there and I'm going to try to keep track of some of the things that I wanted to mention. So we mentioned that one of the benefits of having a line item for university support is allowing us to have much less prescriptive broader work scopes and one of the things that we definitely sought out in the work scopes that are going to be coming out soon. Is the ability to have multi-disciplinary projects that brings together, not just engineers and scientists, but other social scientists and others in a more multi-disciplinary approach for some of these scopes, and so we expect to be holding our webinars soon to be able to discuss the work scopes with the community and we'll make sure that you all get a chance to see them, and I would be very much interested in your reactions, do you see that opportunity and what we're laying out. On communities and engagement, beyond the consent-based siting for used fuel, GAIN has been working with local communities in stakeholder engagement

and capacity building and it's definitely an area that I think having communities, be able to tap into the resources of our national labs and the tools and knowledge that they have in that area, is something that we're looking at how can we expand to help on a more regional and local and community level engagement with the technologies.

And then on the international side just within our university programs. One of my staff reminded me that, even from 2019 to 2022 we had 27 projects with international partners. And we do interact with the NEA activity, the acronym is NEST, but we look for opportunities in our work scopes to build. The ability of international students to actively engage on the work that we're supporting, so I think that is helpful and I think it's worth taking these ideas and seeing what can we do more and better, as we continue to shape our programs moving forward.

Griffith: So yes, you had a lot to unpack there, but it was excellent, very challenging question Sam. Thank you for that was a really helpful response. It's kind of anecdotal, but I am seeing more partnership between engineering and social science departments at universities, so I think that's a positive trend, but I think there's more work to be done so, I totally agree with that. Regarding what risks or liabilities communities are accepting when they engage in this just on a purely relative and not really quantitative basis, I would say that the store just spent nuclear fuel and the disposal of spent nuclear fuel high level waste are very low risks. When you start doing chemical processes in more industrial activities, more R&D, it gets elevated and clearly before any community should consider something like that, they need to be fully informed of what those risks are involved, so I totally agree, that's got to be a really important part of the conversation, so thanks for that.

Ford: If we consider maybe part of our role is to help say how to help you set priorities or looking at prioritization or how you set that I guess the question would be, have you looked at some of the challenges you're facing with some of these technology options whether it's hydro production dissemination all these other things and evaluated them in the context of which have the greatest economic benefit to pursue sooner, and so, in other words cheering some of your research portfolio towards which ones are going to be the most viable near term alternatives for nuclear technologies to support work that I've seen done in the past hasn't had very good, especially in the U.S. outcomes from an economic standpoint for desalination, but it has for hydrogen, but if you could take it overseas maybe those flat flip flop right and so understanding the where the benefits, maybe for the technologies and that might help you prioritize some of the work. And then looking for gaps still Maria so to see this we haven't talked a lot about regulatory issues there's been some findings that are potentially beneficial certainly the most recent one about SMRs and siting and population zones was and looks like it could be advantageous but there may still be work to do there to look at what that means in the context of deploying in cities and in higher population regions, what does that mean. And what work is left to be done from an analytic standpoint to support that. Because there's still some question about the methodology, they may dictate, in the final regular regulation so thinking about that, with the useful work and then final thought is. Well it's not an issue for internal deployment if we're going to have an international market and there's I know concerns from one of the Academy studies is still going on, that was from briefings that were going on related to liquid-fueled and pebble-bed reactors in terms of accountancy and monitoring, and so, if you're going to try to deploy those technologies, how are you meeting the IEA standards. For accountancy and knowing that you've got the right technologies to monitor those is critical to be able to say that you have a valid case for deploying them and that you're going to get approval to export that technology from the U.S. Government. So just some random thoughts, there are things we haven't talked about.

Hart: So I know we're running out of time for general discussion, so I do want to speak a little bit about some of the cross cutting priorities that we talked about that I'd love to see, even an FOA opportunity for some of the cross cutting priorities. Improving diversity in nuclear engineering, the environmental justice and the jobs in the American workforce. Because they are, I would say, not the primary mission, but still important, I think it might be a good idea to outsource. Instead of trying to develop the capability to tackle those in house, set our priorities and what we'd like to see, and then open that up. I think that's also a great opportunity to pull in some small businesses, which is also always a name with DOE in government and also pull in some minority organizations. Personally I think if we're talking about improving diversity. People who look like the community that you're trying to attract are the people who should be implementing that so I want to get that in before we have to switch gears that that's something that's very important hard to tackle is a tightly staffed organization and that might be a way forward for that.

Huff: I will flag that Alice's group in the last set of IRP's for the university program included, for example, an IRP on supporting workforce gap analysis, it's to be done via like an interdisciplinary group and one on social relationships with consent-based siting energy justice sort of focused one.

Hart: So IRP I'm sorry I'm not familiar with that acronym.

Caponiti: It's an integrated research project, and these are ways of working with universities, where multiple universities can collaborate together and it's an extended activity, so it allows for a lot of work to get done in a stable way.

Hart: Thank you, so I should do more of that to your point, I agree, but sometimes I think you also have to put it out there to the business or community organizations as well, so I love the universities, I spent a lot of time in a few. Maybe almost half my life, but I do think also there is some community based organizations that we should be

tapping into because it's not all from the research side and if you're talking about the pipeline, if they're not getting into university maybe we need to start a little younger and thinking about how we can do that, or even charging other organizations with developing that capability on our behalf.

Pasamehmetoglu: I have a quick comment I know this is not a gap in the programs because you're not able to hear me talk about this. Also particularly interested in any NASA collaborations that lunar base reactor program is moving forward, as I understand it. I believe that NE has a lot to contribute in that area, I think NE should be heavily involved in that design and I do not know where we stand, right now, but unfortunately, in the past we have just important technologies from the space program, in the earth-based program and then we take that, but the constraints are so different that I'm worried just because something works well on earth it's not necessarily going to work well and NE has to be a very strong part of it, so in the next meeting I will be very interested in hearing from Tracy in terms of the collaboration is going and what is not an NE program, but certainly any resources should be utilized.

Huff: It's not even just NASA anymore, there's interest from space for us and DOD has interest in space reactor technologies and like. I do think that it's becoming a little bit broader in a way that NE can be a centralizing technological expertise locale.

Korsnick: I have a broader question. What's the expectation of NE in educating the general public, I guess, as I look ahead with all the things that we've talked about there's a job there, to get the public sort of educated and kept along the way. I don't know that they know a lot about today's reactors, but we listed a whole lot more than today's reactors in our conversation just sort of interested in the sort of broad public education.

Huff: It's the federal government's duty to communicate to the public how we're spending their taxpayer dollars at a fundamental level like that's our baseline. To do more and achieve our mission in addition to that, and succeed at nuclear energy, I think we do recognize that communications are critical. Right now, we have some open positions in our communications team, because we think that part of our team can be bigger than it currently is and can be a little bit more cross cutting. But I really do think that it goes beyond just public education and goes to a place of like non-deficit model kind of interactions where instead we truly get a little deeper into engagement with the public and it costs more and takes more time and is harder, but it's something I would like to see us do more of.

Korsnick: Do you think you have the funding you need or is that a gap?

Huff: Probably a gap.

Barrett: Was going to add into that. Years ago we had to train the trainers in the high school science curriculum for advanced technologies and energy and it was focused on waste, but does DOE and NE still have such a program where it's to go out to the teacher and teachers, unions and such.

Huff: Yes. We collaborated with discovery education and ANS. There is a program that you can use that has a bunch of curriculum and stuff for elementary school students that they use in the teacher training and we actually had to revive it this last year because they got subsumed into the discovery channel's paywall and we like retrieve it back from behind a paywall this year. With ANS itself, obviously. NEI probably funded that.

Hart: ANS used to have a collaboration with the boy scouts and girl scouts which I used to love. And they do that, every year, so there is curriculum done, but if that's something that we can collaborate on and even develop it for school districts and kind of do the train the trainer that you were talking about for school districts, or even a module that you could put into a course that's like a chemistry course or physics course so that you can introduce this side, this not nuclear engineering specific, but you can get that topic out there, because I think a lot of people, especially me, I was not a nuclear engineering undergrad it's something that I stumbled upon. Because I wanted a free trip somewhere, and here I am stuck gladly here, so we want to make sure that we can expand that exposure in ways that are sustainable to the capabilities we have, which I think is a great idea of the train the trainer concept.

Branscum: Flagging for a moment that we are a few minutes past where our schedule says we would transition to the "Forming Subcommittees and Next Steps" portion.

Korsnick: Thank you for that reality check. Called on Sam.

Brinton: Lake, I did want to say that we haven't completely forgotten. Part of as you, as I mentioned in the funding opportunity announcement is capacity building and education on spent nuclear fuel management now it's very clear that's one very tiny piece of a big nuclear puzzle. But it is a puzzle piece that gets a lot of attention so one could say that, yes, we are still definitely also doing education specifically Nuclear Fuel Management side, so you want to make sure that was also raised.

Korsnick: Yes, okay.

Scarlat: We talked about acknowledging the history of maybe the fuel cycle and some of the harms that were done. In specific communities, and I wonder if this ties into communication and education today and how the narratives are. Maybe still being solicited from communities as so that we don't have one narrative that we teach, but there are multiple narratives from multiple communities that could be facilitated, to be brought to the table and maybe that's also a way of opening the conversation and communities that are not currently part of the conversation. So maybe more specifically are we engaging with tribal colleges or communities that and not necessarily on the

stem education side, even in the history class is, are these are these narratives being written by those who experienced it or are they are being written by one voice.

Griffith: I don't I think trying to write it with one voice is probably counterproductive, because there are many vies of many experiences and they should all be kind of acknowledged. And I think this is kind of in Sam's area of pursuing consent-based siting and third party voices can potentially be more influential than our own voice. So inviting those into the discussion, I think, is going to be helpful, and I think looking to the energy community's alliance which is a group of communities that host laboratories and facilities. They've lived around nuclear stuff for decades and that's a voice that I think is really important. Having communities internationally, having the voices of foreign cities that host repositories is going to be an important voice the discussion. So I think I think the more voices, the better, because I think well, yes, there are critics out there there's a lot of people that have. Have experiences. With nuclear technology near nuclear facilities and why would we be asking communities to host a facility without talking to those the communities with experience.

Arnold: I just want to weigh in on a couple things. One, I think that in looking at any kind of collaborations or what have you that it's not necessarily cookie cutter and that it's not a one size fits all and as I've just learned through my "country boy upbringing" is, that you have to remember the audience and you need to remember who you're talking to, make sure that it's tailored and addressed to the people that have concerns, and I think we can look at many different levels but it's just really. Trying to address some things that maybe recognizing that everybody's filling out on the same level. Secondly, that that is having some consistent messages, but adapted to whoever whomever that we're that we're talking to and Most importantly, I think some of the dynamics in dealing with tribes, specifically because one of the things when we talk about stakeholders. Stakeholders is always the common term that's used, and so we want to talk to all stakeholders will stakeholders include the boy scouts, girl scouts, the environmental club and what have you. But there's a unique relationship between tribes and the federal government and so oftentimes tribes are listed as stakeholders, but there needs to be some consideration given there because I think it would be just analogous to like if we were talking about foreign countries and let's just talk about them as stakeholders as well. And wouldn't refer to them as nations and so there's some of that the dynamics that we think we have to consider is just building on some of the other conversations that were happening that I think with the back end of looking at the waist and what have you that we need to figure out those solutions, because I think from the tribal side that everybody wants to figure out a solution, sometimes we just can't come to an agreement on how we're going to move stuff from point A to Point B and we're agreeing upon where point B is located, and so, if we can't even come to terms with that or trying to work internationally. Realistically we could ask the question, do we really have all of our ducks in a row, and are we really prepared to say Okay, this is a great deal we're going to sell you this car without a warranty kind of thing as well, I don't know if I want to buy that so, so I think we just need to look at it. Again, and this is just the "old country boy logic" just looking at it and figuring out how we need to proceed cautiously but progressively I think in the future.

At 2:56 p.m., **Luke Branscum** advised that it was time to end the discussion on the NEAC Priorities and move on. He then turned the meeting over to **Acting Chair, Maria Korsnick** to start the discussion on "Forming Subcommittees and Next Steps".

Korsnick: Okay I'm going to try to guide us into a conversation again, with all that that we've just now sort of chewed on and tossed about. I'd like to transition to a conversation around subcommittees. This is challenging because it's not trying to scratch every itch that has been brought up, that's not the goal of the exercise, the goal of the exercise is on everything that we heard, are there some buckets that seemed to make sense that a smaller group of people could sort of pull that thread a little bit more, and so I would like to open the discussion with spent fuel, I think this has to be one. And Sam it doesn't mean we don't think you're not going to do a fantastic job. I just think there are just so many elements to it. Richard just brought it up, it's not just about engaging communities it's engaging them the right way, and she brought it up as well, so I think there's just going to need to be a lens on sort of what's this approach on spent fuel just for an ongoing conversation. I'd suggest that it's not only the interim storage, but it also is the long-term storage lake, which is a point you brought up and the commercial true waste, which is something that you that you mentioned, as we go down the path for hey Lou and I think we could probably toss reprocessing in. In terms of again, what do we imagine the end game to be in our question, as we would go through this committee, isn't that we're going to come up with all the right answers so much as, is, DOE and NE exploring things going down a path that looks right and has the right sort of long-term approach. I just think that road is so full of Barrett: The secretary spoke to this when she was at songs and she said something she was going to task this group. Luke could you tell us exactly what she said, so we can kind of make sure, as we define it we pick up whatever she said.

Branscum: Yes, absolutely. That is a subcommittee that we have technically, delivered a charge to Chair Magwood, for that's one of X number of subcommittees that will be established, so that's kind of the starting place that Maria started there because that one is maybe one foot ahead of any others that you all decide to recommend at this meeting,

Barrett: Just so we can define what this is, it would be helpful to know what she said.

Hart: There's actually in the letter from Andy I think about the consent site so...

Korsnick: We'll figure it out, let's not funny trail on it, but it's fantastic that we were directed to do what we just chose to do so, this is all hanging together very nicely.

Branscum: Yes, there is a copy of the letter that was signed by the Secretary, at the time, acting as Andy, on April 18 and that's in the back of the packet.

Korsnick: Okay. I'm going to throw out some concepts and what I ask is for your insight in terms of maybe the best way for them to hang together or if they hang together. From a subcommittee perspective, we talked a lot about international partnerships and you brought it up, others sort of brought them up, we talked about it in terms of R&D sharing Kemal I think that's what. What you suggested, I heard it also, I think, from Raluca on universities are there, opportunities for some international partnerships there. On the commercial side, I think I mentioned, if we got into this sort of rhythm of this International Partnership, I think it spills over to projects where internationally we're working together. Come on, it might even help us answer, how do we get. That versatile test reactor that we're all passionate about because maybe there's more International Partnership available for stuff like that right which is not only the R&D to get it done. But it's money and it's also a project, and then they could use the product is as well, so in in my mind, I came up with this sort of combination of things around international partnerships and I guess I'm tossing it out there for reaction and for you to chew on it, I don't know from a subcommittee if we would just sort of explore, are we thinking broad enough on international. I don't know exactly all the directions that would go it just feels like there's something there.

Ford: Partnerships is one way of looking at the other way, to look at is international competitiveness, in other words, that maybe bronze it into how do we. Look at all the facets, that would make us vendors competitive internationally yeah certainly the partnerships is an aspect of that, but then making sure that we've addressed all the things that would make us competitive from the technology itself etc., so that's that maybe a broader approach, because you can lose more things in.

Korsnick: I really like that a lot, so international competitiveness is what we're chewing on at the moment, so thoughts about making that be useful, from a subcommittee perspective does it feel like there's something worth sort of pulling the thread on.

Ford: I think that we've talked earlier about the Exim Bank talked about things like that that would right, how do we enable financing mechanisms to help compete against state owned industry and that's really what you're trying to do. You're trying to develop those things that gives you a whole of an approach that the U.S. can compete when the other people offer kind of a whole package deal, how do we put our package deal together, has got to be we've had to look at that.

Korsnick: And you started to use that whole of government set of words. Maybe its international competitiveness and a whole of government approach because that's kind of what we talked about too is there's any piece to this but it's also any leveraging. Sort of the broader government, and I think that might take us in some interesting directions.

Hart: So I am also interested in exactly what might put forth however I'm not sure if they exact approach we should be looking at this whole of government, because that has. been examined, but within that whole of government approach and the team USA approach that we have, what can we do specifically to sweeten the pot or to make that something more viable that can be again deployed quickly and effectively, because I don't want us to get into the habit of trying to solve everybody's problem, but kind of the serenity, let us handle what we can handle and accept what we cannot.

Korsnick: So I hear what you're saying is be careful, maybe that the scope doesn't get too broad. Maybe I would challenge that we think about it from a whole government approach and then bring it back to NE to say what can any do just so that we're not limiting ourselves too quickly. But I hear what you're saying we're not trying to give recommendations to the State Department.

Scarlat: Maybe also one element to be highlighted here is safeguards by design and the role that international leadership has in promoting international safe, first by design so maybe working together with NNSA there was really important.

Hart: I agree so like we're not going to send many nuclear engineers over there, to build a reactor, but we do have experts and safeguard, we do have experts in cybersecurity so can we put those elements together, because those are things that we have some leadership, but control or influence on, as do we, and that is world class and resides here.

Pasamehmetoglu: How many subcommittees are we thinking about I'm trying to see. Well, if you start going to that level of detail, it sounds like we're heading in that direction.

Hart: I think we're just grouping, so we can downsize so that's exactly right.

Korsnick: I don't know actually, I'm just thinking of a small handful. But right now I'm just trying to group ideas that I heard and see if that would make a useful exercise. It's also okay if we form a subcommittee you pull the

thread we explore it for a little bit and you say I don't know that there's enough applicability you got it so just because we invent it today doesn't mean it has to live for 10 years. I'm just trying to quickly synthesize from the conversation that I heard, but if you think it's a terrible idea you're allowed to just raise your hand and say I don't think there's anything there I'm not I don't have any pride in this I'm just trying to teed up thoughts.

Pasamehmetoglu: I'm assuming that the ad hoc subcommittees are still alone, like the old days that we will be able to put a subcommittee together for just for one task, and they would go do it, and then they would go away so I'm assuming those are still okay, Katy.

Huff: I don't see nothing preventing that.

Arnold: So it seems to me that international competitive, this is a good overarching theme for group for imprint committee and then then wherever. We go it sounds like consent-based siting with something else that kind of came up and different ones that emerged. I'm just thinking about it from my purview.

Korsnick: I agree so right now there's like two on the table, the consensus is to have one on spent fuel, which is the interim storage, consent-based siting, long-term storage, sort of wherever that's going to go and then the second one is on international competitiveness, those are the two that we will be considering so far, others.

Hart: So I'd like to propose a subcommittee on the cross cutting. Issues the diversity any energy in environmental justice are in jobs in the American workforce and what I'd like to promote propose what I'd like to propose for this committee is not to necessarily put together a plan of action, but maybe to guide, so we could give it to me to implement like. Should we work with community organizations and maybe put together, like some thoughts to guide how you will put that together, and also to gather some of the information, because I know you guys have already been working on that. And to provide us with that information, maybe we can synthesize it and talk to our organizations and best practices and guide that as an RFI or FOA or IRP or any other combination of letters that you'd like to throw together in a new acronym.

Ford: Do you see this covering the entire issue of workforce development or stayed tied to...

Hart: So I think that this needs to be narrowed down because there's a lot in that. And it could be narrowed down to the point where we get it to like this is what you should put an RFI that's not too broad and then we'll see what the best ideas are and fun those. I don't even know how that mechanism works or if you can do that, but maybe we can suggest some things to do some of the legwork for you all.

Ford: Right I'm just harking back to the discussion we had all day or other issues time to work for so you said, are going to be critical to supporting development of these technologies around the world.

Korsnick: Is your question should we have a separate one on workforce, I said he's that's where he said. Something that envelops it I think he's wondering if there's enough as a standalone right oh workforce, so I might be was putting them all together because.

Hart: Honestly, I think it should be an RFI and then see what we get back and see if there's enough for us to put out a full FOA on one of those or to see if there is enough for just a stand-alone one. So to gather information for that, but we need to start somewhere in there it's just so broad.

Huff: Yes, I hear what you're saying I do want to sort of just scope that like you can't run our programs for us and decide what FOA ways to run, but what we can do it, which I think might get to what you're suggesting is provide a lot more information about exactly what we are doing and implementing in diversity equity and inclusion, energy justice and environmental justice and jobs in the American workforce going full deep dive with the subcommittee. And then see what your recommendations are for what we should be doing.

Hart: We would like to provide advice about things that you may want to consider.

Korsnick: So is that an agenda item rather than a subcommittee? How would you look at that, because a subcommittee I imagine sort of lives a little bit longer, but it maybe it starts with more of an agenda item, where we do a deeper search and then we understand what's needed.

Hart: is that something that we want to involve the entire committee in doing I guess that so that. To me, would determine whether that's a subcommittee or if that was an agenda item at the next NEAC.

Korsnick: What is the suggestion? Others have any thoughts?

Arnold: I would think there has to be some maybe some discussion on it, and the reason being that for tribes, for example, if you look at the executive order for environmental justice and there's a calculus there for whether or not you qualify for an environmental justice or you don't and so, if you don't meet that then you're kind of not considered, but from a tribal point of view there's still a responsibility to deal with the tribe, whether or not you meet the standards of the environmental justice. So somehow we just need to gather the facts and then maybe kind of consider where we want to go from that, but I mean it doesn't mean that we shouldn't talk about environmental justice because it's important for those that meet the qualifications to be impacted.

Ford: So do we still need a workforce, the more broadly, it has to be diverse in etc., but that there's a broader question of just having the workforce available, more broadly, that we have to worry about how we're going about building that.

Hart: Has there been I thought there was a workforce report from NE okay that's

Huff: I think we're thinking of something maybe two years ago, I became out of, I made the rounds in academia, but I don't remember when it came up

Hart: Okay, so another concern I'll put out there and I don't know how to address it, but if we leave it to the next meeting that means it doesn't get addressed until the next meeting. Which is TBD.

Branscum: I think that's a very good point J'Tia and the other point I think that may be worth discussing on this is these are questions they're specifically hard for us because of their cross cutting nature and they apply to everything, including programs we're implementing today, as well as the questions that Maria brought up of in the framing of what is necessary in 15 years and so. I think you all might want to think about how you can address those two kind of I mean it's a continuum but. What question are you trying to answer and that might help determine what you want to do in terms of whether it's a workforce subcommittee or an agenda item, etc.

Korsnick: So I don't know if we know yet, let me just put it on hold J'Tia because it's still an issue, why don't we pull the thread a little bit more on workforce. And let's just try it on for size, a little bit like what are the kinds of things that we envision we would cover if we had a workforce one, then we can come back to your question.

Ford: Mike you had a comment earlier about workforce, what are your thoughts? Well, the issue, as we were discussing it earlier is, do we have sufficient workforce in areas that are going to be necessary. This is to your 15 years later question in areas that are going to be necessary, not necessarily just in actually development of the specific technologies, but in the broader issues of civil engineering. The workforce is going to be eventually regulated by the NRC since you are now populating a lot more actors out there, they're going to need a much broader workforce, and so are we doing the things necessary both specifically to broader larger fleet and then also. Developing the skill sets that are going to be necessary long term to help build capacity overseas let's say so, if you want to say what is one of the biggest risks internationally it's that there's no capacity and some of the regulatory side over and. In some countries that have never been nuclear in the past, so they don't have the Institutional readiness to do this, so do we need people that are experts in political science and regulatory affairs, things like that to help them. The IAEA likes this, so there's I don't know that necessarily in any remit, but there are questions that we think about more broadly, and so what can NE do to influence some of that to make sure that the proper workforces are available both to deploy in the U.S. and internationally.

Korsnick: Sonja and Raluca, both of you contributed conversations about the workforce what's your view as to whether or not we would need a work force subcommittee.

Schmid: I think what Michael said, that we're missing some of the skills. Not just the subject matter expertise, but the surrounding skills that make that subject matter expertise fly. And this is interdisciplinary. At least awareness that I mentioned, I think, is also something that's still missing.

Scarlat: We're going to go back to Kemal's poultry. The chicken and the egg problems. Yes, I think that it's not just nuclear engineers that would be working in the growing nuclear industry but it's also social scientists in. printers and artists and the entire spectrum, so it goes back to communication to the public, how do we engage, how do we make nuclear an exciting field to seek a career in for everybody involved and I don't know if it's too early or too late to be having a Working Group on this topic. But maybe to narrow it in a little. Going back to advanced reactor development and I guess I'm biased, since I work on advanced reactor developments, putting up that bias. Perhaps it would be interesting to think about workforce development for advanced reactors, specifically including advanced directive fuel cycle, so not just the reactor with everything that is related to it and then also thinking through innovation and what enables innovation and a faster innovation cycle. Not just the next innovation in a broad sense. So I think maybe try to work these first. That might be worth discussing.

Pasamehmetoglu: Yes, as we formulate that Maria, workforce development is very difficult to untangle from the infrastructure, I mean after all the workforce is part of it, it is the human infrastructure piece and if you don't have physical infrastructure, you won't have human infrastructure and vice versa. So maybe a way of looking at this, is the infrastructure needs for the future of nuclear energy or what area, something that because I'm not sure that we are very well equipped to worry about the workforce development for utilities of today. I think we have plenty of other entities out there worrying about it and trying to take care of it, but what we are worried about is the workforce for the future, whether that's under utilities or reactor developers or whatever resonates very well tangled up into the infrastructure pieces. So my recommendation would be something along those lines.

Korsnick: So you're saying infrastructure needs for the future of nuclear development or nuclear deployment.

Pasamehmetoglu: Infrastructure needs for the future of nuclear deployment. So it is a bit more than just R&D, so it does cover the deployment, but not necessarily worry about whether or not

Korsnick: So you're saying it would be more than human infrastructure, you would say that it would cast a broader breadth.

Pasamehmetoglu: Yes, because my experience has always been every time I get into that discussion is that they are so tied together that you cannot develop the human infrastructure, without the physical infrastructure and vice versa.

Korsnick: So get out of human for a minute, what other infrastructure in your mind's eye, if we named it that, what else would you imagine would live?

Pasamehmetoglu: University research reactors, test reactors and these PIE facilities.

Schmid: I'm a little concerned about extending it to the infrastructure, just because it's potentially never ending, because then why not add transportation, why not add fuel supply, why not add other technical infrastructure.

Scarlat: We're looking I'm sorry to broaden it even further. But it seems to connect with questions of maybe the Department of Labor may be thinking of in terms of also decommissioning, if you have communities that rely entirely on a decommissioning reactor for their jobs, than how are they re-trained, into what industries are they re-trained, so maybe not just workforce development but also integration with other industries or retraining. Don't know if that's at all within the scope of DOE.

Huff: We're currently calling this jobs and the energy transition.

Ford: I still think, I would still vote in favor of keeping it a little narrower. I don't disagree with the things you've mentioned Kemal, in terms of the absolute necessity for test reactors and things like this, but I still think we're going to keep it focused to a reasonable subcommittee. I still recommend keeping it, we're in the workforce development space as a more narrow and manageable thing. I think you can decide that what would potentially be necessary and just say if these things happen here's what we will need to put in place. So yes, you wouldn't develop the workforce, without having infrastructure that they're going to be working at that you can postulate, as everybody is postulating, that we're going to have these reactors in the future. A lot of this is a big postulation, you're saying I'm going to have this big fleet that I'm building, if it doesn't come to fruition and we don't need to have the university programs and other things, so there are assumptions built into a lot of the infrastructure side and on the fleet side.

Korsnick: So one suggestion is, we could do workforce, it does seem to have a lot of legs and has a lot of tentacles and goes a lot of places all on its own. Kemal, to address your item we could create one that has physical infrastructure to be separate from the human infrastructure and put things in there, like the university or research reactors. You talked about the PIE facilities, other things, so it's not that they're not related, but it just might be easier to explore them. Looking at physical assets, and I say physical loosely, because there could still be modeling and stuff like that, that's not exactly physical, but it's just non-human capital kind of things as opposed to the workforce. So again, let's just try this on for size, if we had a spent fuel subcommittee, if we had an international competitiveness subcommittee, and then we're talking workforce and I'm just going to call it physical infrastructure to differentiate it from workforce. Does that feel like it covers generally the conversations that we've had today that are sort of arising to the top? People feel like we're missing something or do you feel like we're being too heavy and we have too many...

Griffith: I just like to offer a point of feedback on the U.S. competitiveness or international competitiveness topic. One of the themes of our engagement internationally with our like-minded democracy partners is that this kind of goes into the discussions we've had internationally on the potential for U.S. reactor deployment globally in that we're not pushing U.S. technology. We're not pushing the notion that we can deploy all of our reactors and everything will be fine. It's that there's a potentially insatiable appetite for U.S. reactor technology and that we can't do it alone because we don't have the workforce today. It'll take time to build it and it will require the workforce globally. Clearly host countries would want to have as many of the positions filled by their workforce that's part of their buying the U.S. reactor technology. And that there's going to be a lot of components that will need to be fabricated and provided to build that reactor to locate it wherever it's hosted and so there's a lot of partnerships as part of the themes of our efforts to gain traction with the deployment of U.S. reactor technology. So making it about competition puts an edge on it that I'm not sure it's going to be welcomed internationally. But, that kind of continuing on with the intent I think here is that we've got a lot of U.S. reactor concepts that have great potential and that are likely going to be deployed domestically and globally, and so we don't want to dampen that and the tides are going to be lifting a lot of different boats. That said, establishing that hundred year relationship as part of this is also going to deploy globally our approach for safeguards security. The NRC is fully aware of this and they are engaging internationally with the regulators in those countries or in some of those countries where they don't have any reactors and don't really have a regulator yet, it's on their radar to engage with that country and do what they can to help. And so, yeah I think I've made my point but I think the attendance is still consistent with where we're at, the idea here is to deploy U.S. technology globally.

Ford: I want to make sure that if we say cooperate international cooperation or international partnership or things like that we don't lose sight of the fact that some of what we want to talk about is what things we do in the U.S. to enable our industry to be competitive. And so that's a slightly different focus than just worrying about who we partner with overseas. Those are different levers that we'd be pulling in different things, we would do in the U.S. to enable competition to balance the playing field a little bit better right and so that's it's not all about partnering internationally I don't disagree with anything say. I just don't want to lose that thread in just saying that the title of this is International Partnership.

Korsnick: Maybe what we'll do is just because the title has sort of so much grab, I would recommend that we just stay with the cooperation. But to the point you're making Mike, we can make a sub element of that, the competitiveness of the U.S. proposition, if you will, against the state owned enterprises, because that's definitely an element. But there's broader items, besides the competitive advantage when Kemal, you were talking, it was about shared R&D and sharing money, so I think there are other elements as well. Alright I'm going to try this, and we do have to come back to J'Tia. I think we are landing on a workforce subcommittee but it doesn't exactly scratch your itch J'Tia because yours, was the crosscutting items of diversity, environmental justice and workforce. So I guess want to come back to making sure we're addressing this item. I'm still not sure if it's a subcommittee or if it's a presentation that we figure out if enough is going on, or what we're hearing is sufficient, and we want to add additional guidance recommendation.

Hart: After the conversation in the workforce subcommittee, I think it might be better for us to get a good overview of activities that are going on, because it might be just a consolidate to take in the information that's already going on, and maybe make some recommendations, so okay I would be fine with that if anybody else has a different point of view on that.

Barrett: Conversely, I was going to reverse what I said earlier, only based upon your point, as far as waiting longer and so. But somehow we need to have a discussion, but maybe that could be flushed out.

Hart: I'll tell you, for me it sounds like either an ad hoc subcommittee would be required, but I do think that maybe I don't want to recreate the wheel here until we may say it's an ad hoc subcommittee and put that as an agenda item. I'm not sure at this point.

Branscum: One of the things that you could suggest for this potential subcommittee to do would be to do a sort of fact finding mission on getting some reports from DOE, NE and other potentially DOE outside of daily entities and saying, are there gaps here that would be useful for us to help identify questions that could be answered or not, and maybe the answer that that subcommittee finds is no, they're doing a great job or maybe it's yes, we've identified gaps and so next step is to dig deeper.

Hart: I like that idea, thank you for positing and putting that out there, I think fact finding and maybe a consolidation at the next meeting to present the facts that are found.

Barrett: I concur.

Korsnick: Excellent.

Krohn: I think, maybe one of the benefits of kind of decoupling, the work for us from the diversity and environmental justice question is to allow that ad hoc committee or group to kind of focus outside of the lens of workforce why that's incredibly important. One of the conversations that I think we heard here today, reflected from multiple voices were. What are the some of the historical elements of nuclear energy, and how does that perhaps will limit future involvement in our industry moving forward and perhaps that thread could be pulled a little bit more, and what are some of those narratives that we could take into account as we look for those future opportunities in this growing sector that meets a lot of challenges and where can these constituencies be engaged that might be something that would be a benefit of the decoupling of those two things.

Korsnick: Excellent. Okay, I'm going to try this on for size and then I'm going to take a negative poll. So, subcommittees that we landed on are: (1) spent fuel, (2) international cooperation with a sub bullet that talks about competitive advantage, (3) workforce and (4) physical infrastructure for future nuclear success. Does anybody not agree that those are the subcommittees that would be worthy of I'll just say being our beginning. We might do others in the future, we might end up with ad hoc, but that would be sort of our first foray.

Barrett: Spent fuel is just a word. Is at the back-end of the fuel cycle we're looking at, or is it just spent fuel meaning spent fuel I would say it incorporates recycling, for example. Okay, and how you might put this all together empowering all of our review committee that's okay with me, but it sounds better, given the people, one of the titles it's the back-end of the fuel cycle or leavers by spent fuel. I think I'll go either way.

Griffith: I bring that up as it was originally teed up, I think it was unconcerned a siting for radioactive waste management facilities, which includes in storage and disposal.

Korsnick: He wants to know if you want the change the title. The notes, I had were interim storage, consent-based siting, engaging communities and the long-term storage of commercial true waste and reprocessing. So what do you want to call it, do you want to call it the back end of the fuel cycle like in memo.

Barrett: The Subcommittee will address the department's mission for implementing consent-based siting approach for their own storage and disposal facilities for sustainable management, so I mean that's general terms and spent fuel in short term, which is fine with me, I just wanted to make sure we all agree included, as you just said.

Korsnick: Yes, that's the intent was included this stuff is good, if we want a monkey with titles, we can we can have somebody play with them,

Ford: I didn't hear is reprocessing that in the way it was worded for?

Griffith: So if you're talking about sustainable, it could fold its way into the conversation as a sustainable option to be considered, but certainly I wouldn't put it forward any stronger than that.

Hart: Would you suggest to the committee, that is something that should be investigated under this mandate or yes, no that's a great idea sure I think it should not limit itself in terms of the space, I think there will be considerations, for example in these facilities.

Schmid: I don't disagree with the subcommittee's we formed, so far the only thing that I am missing that we discussed was the international safeguards by design point. I don't know where that would fall in the form that you read back to us, and then the other question I had, and I just wanted you to know, perhaps, this is something for later. But if I were a member of the public, looking at the subcommittee's that are being formed, I don't know if they're going to become public, but I would wonder what about climate, what about nuclear facilities in armed conflict, what about accidents and what about liability. Those are just some challenges that nuclear is facing, and I wonder if it would be worth to at least address them somehow or maybe later.

Korsnick: I'm open if others feel strongly my goal wasn't that we were going to address every single item that was brought up I think we'll end up with 10 subcommittees and I think that that is my personal opinion. I think we should take a bite of this we should chew on it, we should figure out where that goes and then to the point, Sonja you're bringing up, if it doesn't get to those items and those items continue to be on the plate, then, we bring them up, if you want to advocate that you think those are more important than ones that we have. Then we can have that conversation. I think the international safeguards one I would assume would happen in the International Committee of the ones that we listed, but, but you went on, with some of them on liability and others. Yes, I heard that conversation but it didn't feel to me like it rose to the level of a subcommittee, this doesn't mean it never will rise, but I just feel like the stuff we talked about here had sort of more conversation on it, and I was just trying to draw threads to the conversation that I heard, but this is just one person's opinion, so I'm open if people feel differently. Do others feel differently, do we want to dive in?

Barrett: I agree with that, I think the liability is a subset of the competitiveness, so I think those all fit in their safety accidents, so I think it's included in that, so I support agree what Maria just said.

Scarlat: I do want to second the liability point, I do think it fits into the international cooperation, but there's also liability within the U.S. and it ties in maybe to some of the cross cutting points, so I would second elevating the liability.

Korsnick: Are you comfortable if we put it in international and then depending on what we learn, decide if there's applicability to domestic.

Scarlat: I'm not sure I don't have an answer right now, yes I guess it's Okay, I need more time to think about it.

Korsnick: We can begin it in international and then, if it has a broader applicability, we can address them.

Scarlat: And then another piece, I'm not sure I'm seeing is the front end of the fuel cycle.

Korsnick: So she has a question to these apart so first she's brought up liability, she was second in what Sonja had brought up we're going to ensure that liability gets covered in the international cooperation, one with an open mind that if it gets broader than that scope that it'll come back and we'll address that. But the second point she brought up is fuel supply, so we put spent fuel as an item but not fuel supply. So my thought there was just there's a lot going on right now on fuel supply that this is one that we would have as an agenda item that we would hear the progress that's being made from DOE, but maybe I'm too close to it, so let me just stop there.

Schmid: Yes, maybe we could put that into the physical infrastructure.

Huff: I was just going to suggest the same I think about some of this infrastructure stuff is touching on supply chain. But I would agree with you also actually Maria that it's so dynamic and so rapidly changing that largely the old need routine updates just to keep up with how chaotic it is.

Ford: Can I just ask about the liability I don't have the memo in front of me, wouldn't there be some liability aspects to the consent-based siting, naturally. I don't know if it was well addressed as an issue to address or if it was all just about siting.

Barrett: I think for domestic there is a system in place, if we find it needs to be changed, we'll bring it up, but, I think that's covered sufficiently.

Korsnick: And fuel international cooperation with a liability line item, an international safeguards by design line item, and a competitive advantage, just to name a few that will be more workforce and physical infrastructure for nuclear success, a sub bullet under that is fuel supply and then broader supply chain, among others. Anybody not agree to those four subcommittees again, this is just sort of our initial launch as this committee lives there might be other items that we choose to do this is just our initial footprint.

Barrett: One question, with the subcommittees is participation inclusive of everyone or subject matter experts have the interest?

Korsnick: Yes, at least that's how it has been done before, but I'm going to defer to the DOE folks here, it would at least be a few of us that are on this main committee, but we can then bring other subject matter experts on the subcommittees outside of who's on this advisory committee.

Bresler: Maria are these four, in addition to the consent-based siting subcommittee that was in the memo in the background, with those words that can say so I can send me sighting and spent fuel pool.

Caponiti: For these topics, like, for example, for security by design safeguards by design. Is it worth having a deep dive and what we're doing in that area and how we're collaborating opposite nuclear energy within our see within an essay.

Before group start thinking about what they wanted to do as a subcommittee

Korsnick: I'm seeing a lot of head nods, so can we make that an agenda item of a future or maybe we have one of those exploratory committees, and then they bring back the results or something. Okay anybody not agree with where we landed on subcommittees.

Scarlat: Can you clarify there's also consent-based siting subcommittee.

Korsnick: The consent-based siting we imagined was the same as the spent fuel subcommittee, now consent-based citing had some very specific, you will dos. What I'm going to challenge the team here is that spent fuel might have more than that, but you have to as a minimum, have what was talked about on the consent-based siting one, but we could bring in additional issues so I'm just thinking our Subcommittee actually might be broader, but as a minimum, it would answer the bell on the consent-based siting.

Krohn: I would add to this that subcommittees have historically been chaired by a member of the committee itself.

Korsnick: And I believe Katy that would be at her pleasure in terms of who she would suggest us sharing each of these subcommittees, or maybe it would be the Chairman, Bill Magwood.

Branscum: I think, from a procedural standpoint folks on this committee that are interested in being a part of these subcommittees, if they are agreed upon and recommended on, folks should express their interest to be a part of them and Katy would appoint a chair of each subcommittee, along with the members who express their interest and some potentially members who are not members of the full committee.

A short break was declared at 3:43 p.m.

At 3:53 p.m. **Luke Branscum** opened the meeting to "Public Comments", stating that we're going to first ask folks that are physically located in the room to make a public comment and then ask the same from folks that are virtually participating via Zoom.

Branscum then asked if anyone in the room was interested in making a public comment to raise their hand, at which point you will promoted as a panelist into the meeting so you can make your comment. He also noted that folks from the public are also welcome to submit written comments, and that they should be emailed to him and that they have 60 days, within which the DOE will still accept written comments.

The first person raised her hand and came up to the podium and introduced herself as **Jackie Toth**, from the Good Energy Collective.

Hi everyone. Just really appreciate the opportunity to sit in and observe today. It's been fantastic to hear everyone's thoughts and remarks and really get a great snapshot from the leadership here on everything going on. Very helpful from the Civil Society and to have to receive that kind of information and I just want to keep it super brief and just say I am really thankful and interested to hear how often the concept of social readiness work has come up and this focus on the social end of all the work that you're doing. I don't have any data to back this up, but I'm assuming that kind of part of this came up more today than it probably would have at past advisory committee meetings. So in particular really excited to hear about the spent fuel and waste disposition office having hired two different folks on social scientists. I mean that's really huge and from Good Energy Collective's perspective, we were really excited to see that the nuclear energy university program offered three different awards this past cycle on equity and environmental justice components. I think that was the first year that this happened and I think President Biden just in the past hour signed the Chips and Science Bill into law and it does explicitly give DOE the suggestion to put some university nuclear leadership program funding towards non-technical nuclear research in support of building community confidence and participation in nuclear as well as supporting some research into getting smart reactors through the licensing process. All to say really good to see that becoming a little bit more entrenched in an ease focus. I just briefly want to just touch on something, I think Mike you mentioned today, about build-on operate model that some reactor developers are exploring, certainly Oklo has been very forward leaning that they expect to offer that model. I understand that from the Department of State, they understand that when they go and talk to some folks through the first program, part of what the U.S. is able to offer, that some competitor nations aren't, is the ability to bring to bear local on the ground in those countries being able to build up the local workforces and necessary supply chains just to support these projects. And there's also a bit of a concern I think around making sure that those countries are able to build up the non-proliferation apparatus themselves without relying on us to do that and so, that's all I was saying. Thank you. Great conversation today.

Branscum: Thank you Jackie.

Branscum then asked if there was anyone else in the room that was interested to make a public comment. A second person raised his hand and came up to the podium and introduced himself as **Vivek Thangam**, currently at the Department of Energy (NE-31), under Tracy Bishop.

Hello. So I know a lot of what we talked about here is related to nuclear waste disposition, and I think, unfortunately, there are a lot of really high profile example failures. The easy example that comes to mind is the Hanford site. Of course, DOE does take that responsibility to the community very seriously and does invest significant resources and trying to correct some of our past failures. But I also think there are examples of success, and particularly some of the work that our department does with trying to make sure we meet our agreement to the Idaho settlement agreement. So I think trying to also emphasize some of the facts that we are capable of bringing communities into the equation and treating them with dignity and making sure that nuclear waste doesn't become a huge problem for them is really important. And I think those success stories ought to be told as well, so thank you so much.

Branscum: Thank you very much for that.

Branscum then asked if there was anyone else in the room that was interested to make a public comment. There were no other attendees in the physical room nor any virtual attendees on Zoom that were interested to make a public comment.

At 4:00 p.m. **Luke Branscum** closed the public comments session and returned the meeting back over to **Dr. Katy Huff** and to the **Acting Chair, Maria Korsnick** for their closing remarks.

Huff: Well, first, I just want to congratulate Maria Korsnick, our great Acting Chair. I really just have been totally stunned and impressed it all the comments that I know you are wealth of information and there will be a lot more where that came from, so I really look forward to all your contributions going forward. These subcommittees that you selected, I think, are going to be really bound to full source of advice for us they're really nicely aligned with our priorities and I expect lots of other components will be arising out of them were they maybe don't necessarily cover all of your interests, and I really am looking forward to it, I think the Upcoming next steps will be to determine when your next meeting is I expect maybe it's more likely to be virtual than this meeting. But, maybe that's a topic of discussion that can be handled procedurally, but I do just want to say it has been phenomenal being physically here with you. Hearing you and I know that it's a big effort in these pandemic times, as well as in particular for people of your stature and expertise in this world, so thank you for your precious time and thank you for your particular leadership Maria but over to you.

Korsnick: Thanks appreciate it. I think we've already performed pretty well as a team. I think we had some great conversations throughout the day. Very impressed by everything that was presented by the DOE and I think we're sort of off on a good foot, so I look forward to further discussion use if the next one is virtual. I think we enjoyed seeing each other, so I don't know if it has to be virtual, but I look forward to seeing everybody again and safe travels home, wherever home is for you. Thanks.

Huff: I don't know that it has to be virtual, but that is a reminder that I should thank Luke Branscum, Bob Rova and all of the team here for coordinating and for helping to coordinate in the future. Huff then stated that the meeting is adjourned.

There being no further business, the meeting was adjourned at 4:12 p.m.

Respectfully submitted,
Steven Katradis
Recording Secretary
August 2, 2022