UNITED STATES

NUCLEAR REGULATORY COMMISSION

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MEETING: UPDATE ON RESEARCH AND TEST REACTORS

REGULATORY PROGRAM

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THURSDAY,

FEBRUARY 22, 2024

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The Commission met in the Commissioners' Hearing Room, at 9:02 a.m. EST, Christopher T. Hanson, Chair, presiding.

COMMISSION MEMBERS:

CHRISTOPHER T. HANSON, Chair

DAVID A. WRIGHT, Commissioner

ANNIE CAPUTO, Commissioner

BRADLEY R. CALDWELL, Commissioner

ALSO PRESENT:

CARRIE M. SAFFORD, Secretary of the Commission

BROOKE P. CLARK, General Counsel

EXTERNAL PANELISTS:

AMBER JOHNSON, Secretary, National Organization of Test, Research and Training Reactors and Director, Nuclear Reactor and Radiation Facilities, University of Maryland

RUSTY TOWELL, Director, Nuclear Energy eXperimental Testing (NEXT) Lab Abilene Christian University

CALEB BROOKS, Director, Illinois Microreactor RD&D (IMRD2) Center University of Illinois at Urbana-Champaign

ANDREW BOULANGER, University Fuel Services Program Manager, Department of Energy (DOE)

JOANIE DIX, Deputy Director, Office of Conversion National Nuclear Security Administration (NNSA)

NRC STAFF:

SCOTT MORRIS, Deputy Executive Director for Reactor and Preparedness Programs

ROB TAYLOR, Deputy Director for New Reactors and Advanced Reactors

JOSH BORROMEO, Branch Chief

REBECCA OBER, Security Specialist (RTR)

HOLLY CRUZ, Senior Project Manager

AMY BEASTEN, RTR ExaminerCONTENTS

PROCEEDINGS

(9:02 a.m.)

CHAIR HANSON: Good morning, everyone. I convene the Commission's public meeting on the NRC's Research and Test Reactor Regulatory Program, including medical isotope facilities and their interface with advanced reactors.

We sometimes refer to facilities under this program as non-power production or utilization facilities, or, colloquially, NPPUFs. Ensuring a robust NPPUF program is important to our nation on many levels, including development of future nuclear workforce, supporting neutron research, medical isotope production, as well as acquiring data to support new reactor and other technologies.

I look forward to engaging in a fruitful dialogue and receiving feedback on our regulatory program this morning.

We have two panels today, and we will hear from our external panel first. Following that, we'll have a short break, and then we'll hear from the NRC staff.

Before we start, I'll ask my colleagues if they have any remarks they'd like to make.

Okay. So with that, we'll begin with our external panel. We'll proceed in the order you all are listed on the public notice of the meeting. We will begin with Ms. Amber Johnson, who is Secretary of the National Organization of Test, Research, and Training Reactors, and the Director of Nuclear Reactor and Radiation Facilities at the University of Maryland.

Ms. Johnson, the floor is yours.

MS. JOHNSON: Perfect. Okay. Cool. Good morning, Chair, Commissioners, my fellow panelists, and all that are participating either virtually on in person. On behalf of the National Organization of Test Research and Training Reactors, I would like to thank you for this opportunity to provide an overview of the existing facilities, including our regulatory and operational experiences.

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The National Organization of Test Research and Training Reactors, or TRTR, represents the shared interests of research reactors operated by the government, national labs, universities, and industry. TRTR membership includes directors, managers, and operators at research reactors, along with educators, administrators, regulators, research scientists, and engineers.

TRTR's primary mission is to coordinate the sharing of operating experiences related to the use of research reactors for education, training, and research.

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As a member of TRTR, you gain access to a shared knowledge base of best practices and expert advice. We have a quarterly newsletter that is sent to our email Listserv and published on our website that tracks inspection reports, along with any violations or findings, reportable occurrences, and follow-up corrective actions, and also relevant communications from agencies with scientific and technical expertise in the nuclear field.

So member facilities may request an audit or peer review of their operations by contacting our Executive Committee, who will convene a group of experts to identify and propose program improvements. Our members also work hard to develop and refine ANSI ANS Series 15 standards that cover topics like the selection and training of personnel and the format and content for safety analysis reports.

But perhaps our most important forum for the exchange of information is our annual meeting. Each year TRTR members gather near a host facility to share our skills, procedures, and experiences in operating our non-power reactors.

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So research reactors provide excellent educational and training opportunities for staff, students, and researchers, as well as radiation protection and regulatory personnel. These reactors offer well-understood environments for experiments designed to study the behavior of materials through the interaction of neutrons and other forms of ionizing radiation.

In addition to enabling critical research in many disciplines, research reactors are crucial for workforce development through reactor operations, engaging the public on the peaceful uses of nuclear power, and the development of advanced reactor technologies.

With 30 research and test reactors currently licensed by the NRC, we make up about 25 percent of active NRC licenses. Certainly, this is a number we would like to see increase. We also hold approximately 350 operator licenses, almost 10 percent of current licensees. And a large portion of these operator licenses are held by undergraduate students. These students gain valuable experience with nuclear safety culture and working in a regulated environment, making them well-equipped to join the nuclear workforce of the future.

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So TRTR appreciates the support of the NRC staff from the Division of Advanced Reactors and Non Power Production and Utilization Facilities to advance our shared goals of applying the minimum amount of regulation necessary to provide adequate protection, public health and safety, to promote a common defense and security, and to protect the environment from the Atomic Energy Act, as amended.

So I would like to highlight a recent collaboration that produced guidelines for 10 CFR 50.59 implementation at non-power production or utilization facilities and led to endorsement in a regulatory guide.

Building upon the success of this document, the working group has drafted expanded guidelines to include digital I&C, which is currently under review. Prior to this, the only guidance that existed was for powerplants and not at all applicable to research and test reactors.

We also maintain an open line of communication through the use of quarterly calls that track the progress of NUREGs, rulemakings, and other items of shared interest. And for issues of particular significance, additional public meetings with a specific focus on research reactors have been requested and were conducted.

I would also like to acknowledge the use of Phase 0 meetings to ensure INPO staff and licensees have a clear understanding of the licensing request prior to submission of any documents. And, finally, I would like to emphasize the importance of NRC Day at our annual meeting. This is an opportunity for TRTR members to engage with our project managers and inspectors in a collegial environment, and we hope to see everyone at our meeting next fall.

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So a rulemaking that is of considerable interest to TRTR members is the non-power production or utilization facility license renewal, or NPPUF rule. This rulemaking has been with the Commission for almost five years, and we would like to understand what additional questions or concerns prevent its approval.

The NPPUF rule would create a more efficient and responsive renewal licensing process by removing the 20-year license renewal terms and requiring that facilities submit an updated safety analysis report every five years. Finally, this rulemaking would establish an accident dose criterion that takes into consideration the low-risk profile of research reactors rather than an arbitrator 10 megawatt thermal power threshold.

The items in this rulemaking consider that research and test reactors present a limited risk to the public and environment through our relatively simple but robust designs, low nuclear material inventory, small physical size, and low power levels.

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I look forward to today's discussion. Thank you.

CHAIR HANSON: Thank you, Ms. Johnson.

Next we'll hear from Mr. Rusty Towell. He is Director, Nuclear Engineering eXperimental Testing Lab, the NEXT Lab, at Abilene Christian University.

Dr. Towell.

DR. TOWELL: Good morning, Commissioners. I appreciate the opportunity to be with you and to talk to you about the role of research and test reactors in development of advanced reactor technologies.

Next slide, please.

NEXT Lab at Abilene Christian University stands for Nuclear Energy eXperimental Testing. It's a lab whose mission is to provide global solutions to the world's needs for energy, water, and medical isotopes by advancing technology of molten salt reactors while educating future leaders in nuclear science and engineering.

What's shown on this picture is summer workforce from this past summer at ACU. It was about 80 people -- undergraduates, faculty, staff -- working together. However -- next slide -- we're not doing this alone. We're working as part of a research alliance.

So Abilene Christian University, along with the University of Texas, Texas A&M, and Georgia Institute of Technology, are all brought together by Natura Resources to essentially be the research and development arm of that company to develop the molten salt reactors.

So, in 2022, we submitted our construction permit for the molten salt research reactor, and we have a goal of making it operational by 2026.

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The molten salt research reactor is -- has safety built into it by its technology. There's many layers, starting with the salt, which will retain the fuel and most of the fission fragments. Then that's surrounded by a primary fueled salt loop pressure boundary, and then there is -- outside of that there is a reactor thermal management system with a catch pan, so if there is any -- if it ever leaked that would catch the leak of salt.

And outside that there is a reactor enclosure, another pressure boundary, and following that is the reactor cell, which is a concrete containment for biological shielding. Of course the whole system is low pressure. It shuts down via a drain from the core, and passive heat removal during shutdown, so it's inherently safe in its construction.

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The molten salt research reactor is very, very similar to the molten salt reactor experiment that was built at Oak Ridge in the '70s. Shared concepts include the same salt, the same fuel, graphite-moderated, loop design, trench-based radiation protection, short lifetime, and low pressure.

We have simplified it in several areas to make it even easier to license. We have dropped from high enriched uranium to below 20 percent. We dropped the power down to 1 megawatt thermal, used nuclear qualified 316 as the primary construction material, removed the free valve, just using pneumatic pressure to keep the salt and the fuel in the core, and we have -- therefore, the control rods aren't safety-related and there is no water in the system. So all this together simplifies the reactor.

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The plan is to install the molten salt research reactor in a facility that was just constructed at ACU. It's the Science and Engineering Research Center. It's a 28,000-square-foot facility that has a research bay. The 6,000-square-foot research bay has a major feature a trench that's 80 feet long and 20 feet deep that's a primary spot for deploying advanced reactors.

So this facility is truly the nation's first advanced reactor test bed site, and we are very excited to have it open on the ACU campus.

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So I gave you that background so that when I'm talking about research and test reactors you know I'm kind of biased to the one that I'm helping lead. But I think what I have to say is applicable to all research and test reactors in how they help prepare for advanced reactors.

The first thing I would say is that you really can decrease the risk for advanced reactor deployment if we start with smaller, safer research and test reactors. And several ways we can decrease the risk, there is of course the risk to -- of a regulatory risk. Can we get a license for a reactor?

And that's a risk that is maybe not as big a concern for this room, but it's a concern for people to want to fund the technology. So investors and financers are very concerned on whether or not we can -- we can license it. So demonstrating that we can license a research and test reactor will give them confidence that the NRC can license a non-light-water reactor.

And then when we think about licensing a commercial reactor, where the source term will be higher, we need to have better data. And so to move beyond the sort of minimal requirement required for a research reactor means we need to collect better data on materials and fuel and the way the reactor operates.

Ms. Johnson mentioned the current research reactors are well-defined environments, and that's true. The current research reactors are very, very well understood. The research reactor we're building is not so well understood, but that's the point of building it, so we can understand it, collect the data, and use that data to help deploy advanced reactors. And that's precisely the reason why Natura Resources is sponsoring the work, so that they can collect the data and move on to commercial deployment.

The second area of risk is risk to the supply chain. Obviously, if we build something, it tests the supply chain out. Can we get the materials, the raw materials? Can we get the components? Are vendors willing to design new components? And if you demonstrate that there's a need for it, that's helpful.

And then a third risk I would mention is a risk of, do we have a qualified nuclear workforce? And also, as mentioned in the previous talk, these reactors, these research and training reactors, do just that. They train the future generation of reactor workers. So whether we're talking about qualified nuclear workforce for being regulators or reactor designers or operators, we need more sites where we can train advanced reactor operators.

And so we're -- that's another purpose for -- of building starting with research and test reactors before moving straight to commercial reactors.

And the final thing I would say is that by actually building some of these advanced reactors, we will be able to see that nuclear reactors can do more than just produce electricity. I think in the past we have used -- commercial reactors have primarily been used only to produce electricity, but new higher temperature reactors, like our molten salt research reactor, will be able to produce high temperature process heat that will allow us to serve the needs of many different industry partners that need that high process -- high temperature process heat.

We will also be able to produce medical isotopes and isotopes for nuclear batteries and other purposes, and so we'll be able to show and demonstrate the multi-functional purpose of advanced reactor.

And so because of these -- because of all -- because we can achieve all of this with a smaller source term, then that means we are -- it's a -- there is less risk involved through the whole process to start with a research and test reactor.

Next slide, please.

I'll show this slide from Idaho National Lab. It shows the deployment of advanced reactors. I modified it by adding the ACU SERC on the very bottom left. That's the first of the test beds, followed by Dome and Lotus at Idaho. But what I'll see on this is that many -- many, if not all, reactor developers have come back off of their desire to first deploy a commercial reactor and have come with a smaller reactor.

So TerraPower is coming in with MCRE to gain the data and experience. Kairos is developing Hermes. Natura has always started with a desire to build a research and test reactor. So you see the molten salt research reactor on this deployment path.

So I think that research and test reactors have a huge role to play in developing advanced reactors.

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I thank you for your time, and I look forward to discussion.

CHAIR HANSON: Thank you very much, Mr. Towell.

Next we will hear from Mr. Caleb Brooks. He is the Director of the Illinois Microreactor RD&D Center at the University of Illinois at Urbana-Champaign.

Mr. Brooks?

MR. BROOKS: Thank you, Chair Hanson, and the Commission, for the opportunity to join you today. At the University of Illinois, we believe that advanced reactors need advanced research reactors to lead the way towards expanding safe, peaceful uses of nuclear power.

Our project is a partnership with Ultra Safe Nuclear Corporation, USNC, to deploy a commercializable advanced reactor on our campus as an advanced research reactor. This MMR technology is a prismatic, gas-cooled reactor, TRISO fuel, is encapsulated into annular pellets of silicon carbide to provide superior performance and fission product retention.

The reactor will sit below grade as shown in the rendering, adjacent to the existing campus power plant. Heat generation from the reactor is transferred to a closed molten salt thermal storage system. From this integrated thermal source system, energy can be dispatched in the form of steam through a steam generator. This thermal storage system effectively decouples the reactor operations from the process heat side.

In our case, steam from the molten salt steam generator will feed the main steam header of our existing campus power plant demonstrating the ability to integrate advanced reactor systems with existing fossil fuel infrastructure. The campus power plant feeds the university-owned and operated utility system, which demands roughly 60 megawatts of steam and 55 megawatts of electricity.

Our mission -- next slide, please.

Our mission is to de-risk advanced reactor technology through education, research, and at-scale demonstration. New advanced nuclear can enable a paradigm shift in all aspects of nuclear, how we build it, how we operate it, how we regulate it, and utilize it. But it will require deployment in a setting that can bring all stakeholders together.

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We have two core missions and a cross-cutting mission. Our first core mission is education, training, and public engagement. New research reactors are needed to train the advanced reactor workforce, but also, maybe more importantly, new -- a new nuclear workforce will be required at the interface of new nuclear and new end use applications.

Furthermore, I believe that university reactors are underappreciated for their role in public engagement. For nuclear power, all roads go through public engagement. This project has and will continue to work towards redeeming public perception of nuclear power.

Our second core mission is research and development. Here we are focused on the research needs that will enable a paradigm shift in advanced nuclear deployment, including technology optimization, improved modeling and simulation, new approaches to operation, including instrumentation and controls that can address the operation and maintenance challenges of the current nuclear fleet.

Our focus here is largely in the critical enabling technologies around the reactor that can maximize safe economic deployment of advanced nuclear power.

Lastly, our cross-cutting mission of at scale demonstration is really under the umbrella of education and research. This focus is to perform the necessary role of demonstrating the capability of advanced nuclear power to address new markets that require clean energy, including micro-grids, hydrogen generation, decarbonizing existing fossil fuel infrastructure. Bottom line is the world needs decarbonization without disruption.

And for many heavy energy users this can only be done with nuclear. Moving nuclear power beyond just putting electrons on the centralized grid will require education, research, and at-scale demonstration.

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These mission areas were inspired by the definition of research in the Atomic Energy Act, which provide the guiding allowable activities for a 104(c) license. The mission areas, as described, align with four of the five definitions of research in Section 31.

I highlight Item 4, which includes the "demonstration of advances in the commercial or industrial application of atomic energy," which is the foundation of our cross-cutting mission for at scale demonstration and was outlined in a white paper submitted to the NRC staff.

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Lastly, here I summarize our pre application engagement to date with NRC. Our safety methodology report has been delayed, but that is the last of the plan documents to put in front of NRC for review. We have had some delays, mostly due to design changes on our side.

Overall, our engagement with NRC has been very positive. We found it to be very appropriate in the level of communication. Requests for additional information have been reasonable and very clearly stated. Flexibility in scheduling and availability of the staff for public meetings has been exceptional.

We have seen some turnover in our engagement from the NRC staff, and in those cases it was very well executed.

Overall, I look forward to continuing interaction with NRC on this project and hopefully submission of the construction permit application this year.

Thank you very much.

CHAIR HANSON: Thank you, Mr. Brooks, very much for your presentation.

And next we'll hear from Mr. Andrew Boulanger. He is University Fuel Services Program Manager at the Department of Energy.

Mr. Boulanger?

MR. BOULANGER: Good morning, and thank you for the opportunity to provide an overview of the DOE's -- or Department of Energy's University Fuel Services Program. My name is Andrew Boulanger. I am the University Fuel Services Program Manager under the DOE's Office of Nuclear Energy, and I'll be providing an overview of university fuel services, or UFS, followed by the operations and impact the program has had across the U.S.

I'll be providing an overview of the role university fuel services has -- and by touching on a few topics, such as the connection to isotope production, advanced reactor fuel services, security postures, possession-limited challenges, all of which are relevant to this program.

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From a high level, the University Fuel Services Program provides the U.S. government -- U.S. government-owned fuel to 25 NRC-licensed university-based research and test reactors at low or no cost to the university. Typically, spent nuclear fuel is returned to the U.S. government for disposition through the program, and some of the fuels -- fuel services may also include transfers between universities as needed. For example, this past year Penn State University transferred fuel to U.C. Davis where it could be used more readily for their research.

University fuel services indirectly supports some domestic isotope production. For example, University of Missouri at Columbia produces medical isotopes, which can -- which depends on fuel procured through the program. And UFS is aware that other universities have expressed interest in radioisotope production, which has usually been in the research level quantities.

So for some clarity I'd like to highlight the activities that are beyond the scope of the University Fuel Services Program. Listed here under the last bullet, the program does not currently develop new fuel types for NRC review and approval for advanced reactors. The program also does not provide reactor operating equipment, such as consoles. That kind of upgrade is usually performed through -- either privately through the university or through other competitive funding opportunity grants.

UFS does not provide enriched uranium directly to universities. That is performed through other mechanisms outside of this program. And, finally, we do not provide universities with components related to fuel fabrication or assembly. For example, UFS would not provide casking equipment for making their own dispo fuel.

And so to summarize at a high level, the University Fuel Services Program is primarily a procurement program of commercially available research reactor fuel, and UFS disposes of the fuel after universities are done with it.

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Currently, the university fuel services are contracted through the Idaho National Lab, or INL. This arrangement for fuel service has been implemented through INL since 1977 under different names over the decades. A recent name change occurred on the program, was in 2022, to help clarify the role of the program at a glance. The previous name was called the Research Reactor Infrastructure Program. Functionally, the purpose has not changed, which is to provide fuel to existing university research reactors across the U.S.

INL has subcontracts with all 24 universities to supply the fresh fuel and dispose of the used or spent fuel. Half the fleet, or 12 of the reactors, use TRIGA, or Training, Research, Isotopes, General Atomics fuel. The next largest portion are eight reactors which use a plate-type fuel, and the five remaining reactors are a mixture of different types of reactors and fuel types.

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The program recently delivered 30 newly manufactured TRIGA elements to Penn State University in September 2023. This marks the first delivery of fresh TRIGA fuel in about a decade. Since 2013, the DOE has been supporting the restart of the TRIGA manufacturing line. We anticipate fuel production to continue over the next decade, which should provide enough fuel for the 12 university research reactors until their respective decommissionings.

The intention is to store the newly manufactured TRIGA fuel at INL to avoid encroaching on nuclear -- on existing nuclear material possession limits at each prospective university. UFS works with universities to stay within these possession limits, and, by extension, their respective safeguard categories by moving fuel to other universities or disposition locations.

Although these movements are within the operating scope of the program, it will become more challenging as fresh fuel deliveries increase over the coming decades. The restart of the TRIGA fabrication line means several hundred more TRIGA fuel elements will be -- that are intended to be produced that will eventually be distributed to universities.

The increasing fuel or nuclear material quantities across universities will decrease fuel movement flexibility and may conflict with university specific security postures based on the quantity of specific materials onsite. This scenario will need to be addressed as we move forward to continue to support university research reactors while maintaining compliance with the appropriate regulations.

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Advanced research reactors at universities have a significant potential to be -- for it to be good opportunities for several items, including workforce development, teaching tools, the potential production of isotopes, and research opportunities, both federal and private.

Recent changes in congressional authorization show promise in supporting advanced research reactors. Specifically, the CHIPS Act of 2022 authorized the establishment of no more than four research reactors. And, more recently, the National Defense Authorization Act of 2023 amended the Energy Policy Act of 2005, which clarifies that fuel services shall be expanded to research reactors.

In order for UFS to provide new fuel types for new research reactors, the reactor must be licensed. The DOE would need to receive adequate appropriations. A fuel supplier must be authorized and/or licensed to provide the fuel. And, finally, there must be a plan for disposition of the spent fuel. Despite these challenges, DOE is excited and looking forward to working towards the benefits of advanced research reactors that will bring to the research communities.

And with that, I conclude my presentation. Thank you very much.

CHAIR HANSON: Thank you, Mr. Brooks.

We will conclude this first panel with Ms. Joanie Dix. She is the Deputy Director for the Office of Conversion at the National Nuclear Security Administration.

Ms. Dix.

MS. DIX: Good morning, Chair. Good morning, Commissioners. Thank you very much for having me here today on this panel. I am going to go ahead and talk a little bit about both research reactors as well as medical isotope production from our side of the house.

So next slide, please.

As a quick overview of what our office works on, we do fall within the Office of Defense Nuclear Nonproliferation. So we are a nonproliferation-focused office. However, there is a lot of intersection between the work that we do and the NRC.

My office's objective is to modify or convert facilities to eliminate the need for or production of weapons-usable nuclear material in civilian applications while maintaining critical mission performance of those facilities. We do that in a number of ways. Those are listed here on the left of the slide.

But for my presentation here today I'm really only going to focus on the conversion of research reactor fuel from highly-enriched uranium to high-assay low-enriched uranium, or HALEU, the qualification and fabrication of new high-density HALEU fuels, and the production of non-HEU-based Moly 99.

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So to start with, I wanted to talk a little bit about our efforts on Molybdenum-99 or Moly 99. This is a critical medical isotope that is used in over 40,000 procedures each day here in the United States and even more globally. Historically, the U.S. has always imported its Moly-99 from international producers, which was traditionally made using highly-enriched uranium.

This is why my office got involved in the matter was to help assist these global producers to transition from using highly-enriched uranium targets to HALEU targets. We have made significant progress and had a great achievement. Just last year all major global Moly-99 producers now only use HALEU targets, which is a great success.

With this, there was a joint secretarial certification between the Secretary of Energy and the Secretary of Health and Human Services that certified there was a sufficient global supply of Moly-99 that is produced without the use of highly-enriched uranium to meet patient needs here in the United States. And what this certification supported the U.S. government and the NRC in doing is that we no longer can export HEU for the use of medical isotope production.

So for my office, that's a big deal, and maintaining that supply while being able to do this is kind of an amazing achievement.

Simultaneously with our international efforts we also have domestic efforts here in the United States to help support the establishment of commercial production of Moly-99 without the use of HEU. We have provided financial and technical support to a variety of U.S. companies over the years, and these industry partners have made significant progress in establishing production infrastructure.

However, recently they have experienced severe challenges with both financing and commercialization. These issues reflect a combination of both project-specific issues by individual companies but also market-wide challenges. NNSA is continuing to support our remaining cooperative agreement partner while also working with other U.S. government agencies to assess whether policy changes are needed to make domestic production of Moly-99 more commercially sustainable.

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Changing over to the reactor conversion side, similar to the international work that we do on Molybdenum-99, we are really focused here on converting the research reactor fuel from highly enriched uranium to HALEU. We do this both domestically and internationally. And to date we have -- 109 facilities no longer use HEU fuel or targets.

On the international reactor conversion front, we are engaging with a number of international partners. This includes Belgium, France, Germany, Italy, Japan, and Kazakhstan. And as these conversions continue, the use and exports of HALEU fuel are expected to steadily increase. So we greatly appreciate the NRC's role in these exports of HALEU to make sure that these international research reactors and medical isotope producers can continue their missions and continue to provide the medical isotopes that we need here.

On the domestic front, NNSA is working towards converting the six high performance research reactors from HEU to HALEU fuel. The first three conversions will be those that are regulated by the NRC, which include the Massachusetts Institute of Technology, the University of Missouri research reactor, and the National Bureau of Standards reactor at the National Institute of Standards and Technology Center.

All of these what we call U.S. HPRRs, the high performance research reactors, are a challenge for my office as no existing fuel can be used to convert these reactors while maintaining their mission space. So our office has been working over the years to develop, fabricate, and qualify a new fuel so that these reactors can convert to a HALEU fuel while maintaining their mission performance.

So we have begun and will continue to carry out a comprehensive set of irradiations over the next four years for the new uranium Molybdenum monolithic fuel, otherwise known as U-10Moly, to demonstrate its performance and safety and to, therefore, allow the subsequent conversion of these reactors.

NNSA and the NRC have signed an MOU to help facilitate qualification of this new fuel, and the subsequent review and hopefully approval of the license applications to convert these three reactors. We are hoping to provide this U-10Moly qualification report to the NRC in 2028, which will follow in 2030, hopefully, by the MIT reactor as the first reactor to submit a license amendment request.

So thank you very much, and I look forward to your questions.

CHAIR HANSON: Thank you very much, Ms. Dix. And thank you all for your presentations this morning.

We'll begin questions with Commissioner Caputo.

COMMISSIONER CAPUTO: Good morning. Thank you all for being here. It's a very interesting and engaging topic, research reactors. It has been quite a while since I sat at the panel one, so it's interesting to see the developments that are going on now and the technologies that you folks are pursuing. So very exciting development here as you all push for the advancement of nuclear technology understanding.

So given the advancements that are going on, non-power utilization facilities are definitely receiving more attention now than they have for a while, and of course this agency issued a construction permit for Hermes. We have the application undergoing review for Abilene Christian and ongoing work with Illinois.

So we're also seeing a number of papers and some policy issues that are coming up involving NPPUFs and advanced reactors. One of the recent ones we've gotten is a paper on micro reactor licensing with an option for micro reactors to be developed under a manufacturing license using Part 50 construction permits and operational licenses.

We also have Part 53 where staff is proposing the same sorts of reactors should only be allowed to be licensed at their ultimate sites using combined licenses, and then restrictions in Part 52 against using combined licenses for non-power utilization facilities.

So I'm struggling a little bit. I recognize that this is perhaps at the periphery of this meeting, but I'm struggling a little bit with just the nature of how I think in pursuing multiple different efforts we now have a slight inconsistency in terms of our policy and approach.

So this is something that I definitely think the staff should conduct a holistic review of the -- of advanced reactor projects to make sure that our policies in this area are aligned going forward.

On a separate issue, this is also pending before the Commission, has to do with the use of PRA in construction permits. And while that is also at the periphery of the substance of this meeting, I do want to raise a question considering we have an applicant at the table who is pursuing a construction permit.

I'm a strong proponent of using risk information design in licensing, but I'm sort of struggling with how appropriate it is to delve into requiring a PRA in construction permit space.

So, Dr. Towell, as a Part 50 applicant undergoing that process now, how would you envision such a requirement impacting the nature of how you pursue your permit and any complications you might foresee?

DR. TOWELL: Thank you for the question. I think that we believe that research reactors, and specifically our molten salt research reactor, is -- has a safe enough profile that it's licensable in many ways. But I think that the requirement to do a PRA for it is something that we don't feel necessary. It's currently -- we're currently not pursuing that, and so we're content to file through the Part 50.

I guess I wouldn't speak for others and think of -- and try to decide if that would be helpful to them.

COMMISSIONER CAPUTO: So how -- given the nature of pursuing a construction permit, how simple would it be for you to develop a PRA? And what benefits would it really have given the fairly simple technology that you're pursuing and the ability to simply pursue it from a deterministic standpoint?

DR. TOWELL: We see no benefit in doing that -- the PRA forward. And so we haven't pursued that, and I think that would just be -- it would be another burden on us I think sort of bluntly. So we would prefer not to have to do it.

COMMISSIONER CAPUTO: Okay. Well, as it stands now, it's not -- it's not currently a requirement for NPPUFs. But I also don't think that it's without -- it's going to have complications. I think one of them is certainly the lessons that I learned in watching Vogtle 3 and 4 proceed is once applicants are into construction space, there are changes that happen during construction space. And the nature of trying to maintain a PRA in that context I think would be fairly complicated.

And as you have outlined, not necessarily a benefit if there is a fairly simple profile that can be addressed deterministically. So as we seek to expand our use of risk, I do think it's important to have a balance in terms of risk and use of deterministic practices. So thank you for that.

I have no further questions.

CHAIR HANSON: Thank you.

Commissioner Crowell.

COMMISSIONER CROWELL: Thank you, Mr. Chair. Thank you to all the panelists. This has been educational for me, and it's good to see some of you again, meet some of you for the first time.

Ms. Johnson, it's good to see you again. I will keep my promise to you to come visit at some point. I made the same commitment to Dr. Towell the other day. And, Caleb, since you're sitting here, I'll do the same.

(Laughter.)

COMMISSIONER CROWELL: And I've been to Forestal many times, so I'm not going.

(Laughter.)

COMMISSIONER CROWELL: So, you know, you Ms. Johnson, you mentioned that you want to -- hope to see the number of research and test reactors expand in the coming years. What do you see on the horizon over the next 5 or 10 years in terms of potential expansion of -- or new RTRs looking to be developed and licensed?

MS. JOHNSON: Do you mean like my panelists next to me?

I'd certainly love to see Abilene Christian and UI-UC join us.

COMMISSIONER CROWELL: Like ones we haven't heard of maybe that are --

MS. JOHNSON: Oh.

COMMISSIONER CROWELL: -- like on the horizon or something that is at its infancy that you expect to see the number grow from 30 to something large.

MS. JOHNSON: Oh. I would -- wow, I haven't given that much thought. So I'll have to think about it and put that in the next newsletter.

COMMISSIONER CROWELL: I thought that's what you were implying when --

MS. JOHNSON: Oh. I wanted to see --

COMMISSIONER CROWELL: -- when you said you do look to grow.

MS. JOHNSON: So I do want to see at least two more join us, so I'm happy to see two in the -- in the pipeline --

COMMISSIONER CROWELL: Yeah.

MS. JOHNSON: -- I suppose.

COMMISSIONER CROWELL: Okay.

MS. JOHNSON: And so referencing back to previous Commission meetings in 2014, it's nice to see new people at the table. I want to see them continue to be at the table, so --

COMMISSIONER CROWELL: Great.

MS. JOHNSON: -- that's fine.

COMMISSIONER CROWELL: And a somewhat related question I think for you, or whoever, but maybe Dr. Towell as well. On workforce issues, how -- obviously, we -- all parts of the -- you know, workforce is an issue for all of us, whether you're at the production stage, you know, research, tests, whatever.

How transferable are the training and skills your students are learning from some of the novel technologies to other technologies? I mean, is it going to be a very technology-specific workforce? Or is it going to be a workforce that can mix and match with different new technologies?

MS. JOHNSON: Oh, I certainly think it's applicable across the board, the skills they learn operating a research reactor. We certainly do see a lot of our previous operators to the NRC for employment, and that's great, but we also see them with those skills -- certainly like the nuclear safety culture is broadly applicable to many industries.

COMMISSIONER CROWELL: Yeah. Mr. Towell, did you want to add anything?

DR. TOWELL: I agree completely. You know, I think that if you teach someone problem solving and critical thinking and do that in a safety culture, then I think that's applicable to any advanced technology. And I think that maybe the Navy's nuclear program is a great example of the way we take their operators from one type of reactor and we're able to employ them in commercial reactors.

So I think that the skillset is very transferrable.

COMMISSIONER CROWELL: Okay. So there will be good competition amongst your map of projects. Yes. Okay.

Mr. Brooks, you mentioned something that I'm very interested in, which is I think you all roads go through public engagement. I like that term. You happen to be based at a -- at a university in a research reactor that is in a highly populated area. So I think that is even more of an importance to do public engagement.

Can you tell us a little bit about how you guys do public engagement and the value and how broad it is, whether it's just the university community or far it expands outward?

MR. BROOKS: Yeah. Thank you for that question, and I think it's -- it's worth highlighting because that will be maybe the challenge for advanced reactors to realize their full potential.

And so the University of Illinois, since becoming public about our intentions to deploy an advanced reactor on our campus, we have seen various levels of engagement. We have held many different public settings and forums for the community and for the students.

We have regular monthly meetings that are open to the public to come and ask any questions or get any insight into the project or the status of the project. It's really quite a coordinated effort, and it goes all the way up to the communications office within our university to put a strategic plan together to make sure that all of the stakeholders have an opportunity to provide input.

We do kind of countless engagements with media outlets to make sure that people feel like they understand the overall timelines, and in particular what is new about the technology, because I think that's where it has been really fun to engage the public.

What most people think of with nuclear power is 1970s technology. And just like our phones, we have come a long way, right, since 1970. And even like our phones, we don't just make calls, or maybe we don't even make calls anymore with phones, right? And I think advanced reactors are similar in that, you know, the smartphone analogy really works.

We've come a long way in the technology, the way we'll deploy the technology, how we'll use the technology, and so it has been -- it has been exciting to engage the public, share those advances, but unfortunately we have stumbled I think as a -- as an industry in rolling that out, putting that -- those advancements in front of the people, so they can really witness and see the benefits of advanced nuclear.

COMMISSIONER CROWELL: Let me --

MR. BROOKS: So I think --

COMMISSIONER CROWELL: Can I press you on that point --

MR. BROOKS: Yes.

COMMISSIONER CROWELL: -- a little bit? Unfortunately, this speculates somewhat, but how much does your public engagement at the university level in the research stage -- do you think it will translate to broader public acceptance of these types of reactors at the commercial phase?

MR. BROOKS: Yeah. So our project from the beginning has been focused on deploying a commercializable technology as a -- as an advanced research reactor. I'm an academic. I can fall into the trap of having yet another paper reactor. But from the very get-go, we decided against that.

And, particularly, we want to deploy a technology that will be deployed commercially around the -- around the country, around the world, so that people can come and see that technology, see how it operates, see its benefits, right, see its transformation compared to what they're used to with current -- the current fleet of nuclear.

And the role of advanced -- of research reactors around the country to demystify nuclear for the general public is well established, and I think is underappreciated, but advanced reactors are going to and can enable a new wave of that engagement with the public to just see, you know, how far we've come in over 50 years now.

COMMISSIONER CROWELL: I'm going to ask you an unfair question, and you can pass it to either person your left.

(Laughter.)

COMMISSIONER CROWELL: How much do you highlight the spent fuel conundrum of -- at research and test reactors?

MR. BROOKS: Yeah. So engaging the public, just to tie these two questions together, engaging with the public, the questions that come up, of course the safety questions I think are -- we have -- we have been able to address those quite clearly. That's every -- every nuclear engineer has developed in this environment of utmost importance on safety, and the advanced reactors have been designed to address those safety issues.

With waste, unfortunately, I think that's largely a policy -- a policy question. But it highlights the benefit of the university pathway. In the case of the university research reactors, the university never owns the fuel. It's on a lease agreement with the Department of Energy, and so the ultimate -- the ultimate path for the fuel beyond its useful life in the reactor is to go back to DOE.

Unlike commercial reactors that still have questions about what is the location of that final fuel, DOE has never not come and picked up the fuel after its use in a university research reactor. So the university I think provides a precedent for a pathway that addresses, I mean, both the safety concerns of the public with nuclear, the waste concerns of the public with nuclear, and then ultimately hopefully the scheduling and cost concerns of the public.

COMMISSIONER CROWELL: Okay. Thank you.

With the little time I have left, Mr. Boulanger, can you talk a little bit more about the hurdles for DOE when they pick up the fuel and finding places to safely accommodate it?

MR. BOULANGER: So currently there is two locations where we dispose of or send the fuel for disposition. They are currently the Savannah River Site in South Carolina, and then Idaho National Labs for -- and that was decided or established in the 1990 -- NEPA action for 1995, which was done under an environmental impact statement and a record of decision.

Currently, the way that's divided up is aluminum clad spent fuel is sent to Savannah River, and stainless clad is sent to Idaho National Labs. If we're talking about new reactors, DOE would have to perform what we call a NEPA action and establish -- either amend the existing record of decision, environmental impact statement, or create an entirely new one.

So there are challenges that are involved in establishing these new fuel types and fuel forms.

COMMISSIONER CROWELL: Would it potentially be a site other than Idaho or Savannah River, or would it be one of those two sites?

MR. BOULANGER: I couldn't comment on that. I would have to get back to you on that.

COMMISSIONER CROWELL: But something in the DOE complex.

MR. BOULANGER: That would -- potentially. I don't know at this time, but I can get back to you and -- on that topic.

COMMISSIONER CROWELL: Great. Thank you.

Thank you, Mr. Chair.

CHAIR HANSON: Thank you, Commissioner Crowell.

Thank you all for being here this morning. It's a real pleasure to hear from everyone. And, you know, I have a lot of favorite parts of my job, but I think one of the favorite favorite parts is actually going around to universities and meeting students and getting to see test reactors and understanding better how these facilities are being used to educate students to -- you know, particularly as Ms. Johnson, Dr. Towell, and Mr. Brooks all mentioned about, you know, getting students into nuclear safety culture, getting them to understand, you know, the basics of nuclear reactor physics and other kinds of things.

And, you know -- and whether that's something new, you know, Dr. Towell, when I was out at Abilene Christian, that was a great visit, and getting to see how students were working with the molten salt and how that worked at high temperatures and that test bed in that ancillary facility.

I haven't been out to Purdue yet, but I'm interested in that, and as a demonstrator for some digital I&C type equipment there and the role that they have played. I was out at Kansas State just about this time last year, and they had modified their TRIGA to have a neutron beam off the side. And they were doing neutron -- they were, you know, working with students to do neutron activation experiments, which I thought was a really great modification to that to get additional use and additional educational benefit out of that facility. And I really enjoy seeing this kind of thing.

I do want to dive in on a couple of issues, and I think it kind of has to do around with the fuel, and so forth. I don't know if it was Mr. Boulanger or Mr. Brooks, you mentioned -- so, you know, University of Illinois has this agreement with USNC. USNC has their own -- I think has their own propriety fuel that they are going to manufacture or contract with someone to manufacture themselves.

How does that work between you guys, USNC, and then DOE in terms of, you know, is DOE going to buy that from USNC and give that to you guys? How does that -- how is that going to kind of work?

MR. BOULANGER: Well, I'll tell you how we expect it to work based on --

CHAIR HANSON: Okay.

MR. BOULANGER: -- precedent.

(Laughter.)

MR. BOULANGER: We'll see how it works. I mean, everything -- I mean, the fine print of it all is it pens appropriations. Maybe that's the fine print of everything here is penning appropriations.

But what we expect is that the stock material would be supplied to USNC under that lease agreement and shipped to USNC at USNC's fuel fabrication facilities. That's when -- that's where they would fabricate the TRISO fuel. And then they would take the TRISO fuel and they would form their FCM pellets, which is an annular fuel form with -- encapsulated in the silicon carbide. And those pellets would then be loaded into the assemblies, and then assemblies would be shipped separately to site to be -- to be put into the reactor.

So based on past precedent, the expectation from our side is that through appropriations and through the University Fuel Services Program, they would supply the stock material, they would supply the cost of shipping and manufacturing to the fuel form, just like they do for all other university reactors, and then ultimately put into the reactor for its operation.

In our case, we'll have upwards of 20 years of operation with our reactor without the need of refueling.

CHAIR HANSON: Ah. Okay. Thank you. That's very interesting.

If I could, I want to -- I'm interested in exploring, Ms. Johnson and Mr. Boulanger, this -- I was glad to see DOE getting back in the TRIGA -- or the U.S. just getting back into kind of the TRIGA fuel manufacturing business at

Idaho.

And, you know, as I visited a couple of these facilities, you know, they are now in some cases 50-plus years, and the TRIGA fuel that's in that is kind of reaching its life and so there is -- it seems like to me, maybe I'm misunderstanding, but there is a lot of refueling that could go on, not necessarily whole course but partial course coming up.

And I guess I'm wondering, Ms. Johnson, if the -- if the RTR organization has kind of mapped out fuel needs and kind of married that with production at DOE, and how that's going to kind of happen.

MS. JOHNSON: Oh, yes. We worked very closely with the Risk --

CHAIR HANSON: Okay.

MS. JOHNSON: -- Service, and we are so excited to be on their list. So I'm sure Andrew has this all in priority.

CHAIR HANSON: Yeah.

MR. BOULANGER: If we're talking about specifically TRIGA fuel, it's manufactured in Romans, France, under --

CHAIR HANSON: Yeah.

MR. BOULANGER: -- a joint agreement with General Atomics and Framatome. And so, yes, we do actually -- we follow up with the university needs, and we have it mapped out for currently the -- through their respective decommissionings or when that anticipated date could be.

Right now we are planning on -- the intention is to acquire all of the fuel that's needed over the next decade or so, and then from there we would distribute it to the universities. So the fuel would come -- the intention is for it to come to the Idaho National Labs and be stored, and then when the need comes we will transition it to the university as it's needed.

CHAIR HANSON: Okay. Got it. Thank you. No. I was just -- I'm interested in that whole process because I think it would be a real shame if a university kind of came along and said, well, we're not really sure, you know, if they kind of gave thought to maybe not continuing with the reactor program because there was some hiccup along the way.

And I don't think that's exclusively related to TRIGA. Mr. Brooks, while you were talking, I thought, ah, okay, we need a transportation package for that TRISO fuel to get from wherever it's going to be produced to Urbana-Champaign.

You know, there is one more need in there, somebody to both make it but also then come to the NRC to get the certificate of compliance for that as well. So there's a lot that's implied here.

I want to pick up on one thing that Commissioner Crowell brought up in terms of spent fuel. And, Mr. Boulanger, you mentioned, you know, aluminum clad fuel going to Savannah River and steel stainless going to Idaho. A few years back there was a concern I think at Savannah River about capacity in what was known as L Basin in terms of the ability to continue to take either foreign repatriated spent fuel or domestic research reactor fuel.

I don't know if this is a question for you or maybe a question for Ms. Dix about how NNSA, or since you guys are now in charge of -- now that NNSA is in charge of Savannah River, how is that problem being resolved, has it been resolved, et cetera.

MR. BOULANGER: So the fuel that gets shipped to Savannah River, we work closely with the DOE EM, or environmental management. To kind of simplify it, we effectively drop it off at their door.

(Laughter.)

MR. BOULANGER: But there's more -- there's more intricacies other than that. But I think Joanie might have a little bit more than myself.

MS. DIX: Unfortunately, I don't have a lot more to offer than Andrew. It's outside of the scope that we work in. We essentially make sure that we can fit the converted fuel into the same requirements, so that there is a disposition pathway of that fuel.

So we work kind of within existing constraints, but we don't handle the return of the -- the foreign returns is another office within our Department.

But I can certainly get that information to the Commission and to you later, but I don't have that answer now.

CHAIR HANSON: Okay. Thank you. But it's a great transition because I have some questions for you.

You know, you mentioned the uranium Molybdenum monolithic fuel type. And, you know, trying to reach back into the recesses of my brain on the conversion program, the three reactors that you are kind of focused on first -- MIT, University of Missouri, and our friends at NIST -- are all pretty different reactors, right? They are designed to do really different things.

Is it a single fuel type that you're looking at for all three of those? And how does that work?

MS. DIX: Yes. It's a single fuel type for all of those reactors. It will also be used for the advanced test reactor at Idaho National Lab. The high-flex isotope reactor down at Oak Ridge will take a different fuel, so that fuel will be a silicide form, so that's kind of a separate fuel development/ fabrication/qualification activity that we have ongoing.

Really, the challenge is the fuel itself. Of course, each of the reactors has a different form that their fuel is arranged in, so we work really closely with the reactor operators and with all of our national labs to make sure that the fuel that we develop will meet their requirements and that it can be fabricated in the form that works for their reactor.

CHAIR HANSON: How is the irradiation testing going? Where is it --

MS. DIX: Sure.

CHAIR HANSON: Where is that happening now, given, you know, we've heard a lot I think on the Commission and other places about the dearth of in pile or even -- or irradiation testing kind of across the -- across the world, really. How is that how is that going? And how engaged are you with NRC staff on the data that's coming out of that?

MS. DIX: So the irradiation testing is going really, really well. We're at a really exciting point actually in our testing progression. We have been doing what we call kind of mini-plate irradiations. So they're smaller forms of the fuel meet and cladding.

We are transitioning to full-sized plates, so that's a -- that's a big transition. Fabrication is going well. Irradiation is going really well. We do irradiation in two places. We do it at the advanced test reactor out at Idaho National Laboratory, and then we also do some testing out at the BR-2 reactor in Belgium.

CHAIR HANSON: Oh. Okay. All right. Thank you.

I just wanted to clarify one last thing. You had said 2028, a product to the NRC. Is that going to be a topical report that then kind of approves that fuel form? That then MIT can reference in their license amendment request in 2030? I just -- I want to translate this a little bit into NRC speak, so staff know what to expect and we can hold them accountable to that.

MS. DIX: Yeah. So I know there has been conversation kind of at the -- at the staff level in terms of what was the right way to submit the correct documentation. When I asked my team about this, they said that the -- kind of the single most important activity for the NRC to help prepare for this is of course to have your experts available and ready to review the base fuel qualification report and subsequent reactor-specific conversion application.

So I don't know one for one how it specifically translates to the exact documents, but I'll try and do the translation between our two agencies and figure out what the document is called.

CHAIR HANSON: Thanks. Well, it might -- as you said, each one of these reactors, the three, are all really different.

MS. DIX: Yeah.

CHAIR HANSON: And so it's not going to be even physically a single form, even if potentially the uranium content is the same amongst them.

MS. DIX: Right. So, yeah, it would be two submissions. The one in 2028 would be strictly for the fuel itself.

CHAIR HANSON: Got it.

MS. DIX: This will be the first fuel that -- new fuel that we've had developed in quite a long time. So that will be the new fuel itself, and then each reactor will do their license to adjust to that fuel after that. So --

CHAIR HANSON: Great. Looking for to it. Thank you. Thanks for the extra time.

Commissioner Wright.

COMMISSIONER WRIGHT: You're welcome.

Thank you, Chair. It's been fun so far. Right?

(Laughter.)

COMMISSIONER WRIGHT: So thank you for your presentations. You know, I really find the RTR world exciting. It's unique. It's just -- and very interesting, and this is a really -- it's an important time to be in this space. So, I mean, you're on the cutting edge of pretty much everything, right? Plus on top on that you -- you're in the unique position of being able to inspire a whole new generation of people to get into the nuclear space and find their way and make a difference. So I really appreciate you being here today.

And the advantage of going last is that I always find that I might have some questions to follow up on, you know, because some of the ones that I had possibly have been answered, right?

So I wanted to follow up quickly on the conversation that the Chair had started with you. And he was questioning Mr. Brooks and Mr. Boulanger, so I was coming to you, because I had -- there is a question about HALEU. You know, how do you see the need for HALEU for research reactors interplaying with the need for HALEU for advanced reactors? Do you think there is -- I mean, are these complementary efforts? Or do you think there may be competition for what people may think is going to be a limited supply of HALEU?

MS. DIX: That's a really great question. It has been a very interesting couple of years as this area has expanded within the community. The interest in HALEU originally was pretty much limited only to research reactors and medical isotope production. So we've had kind of this little niche area in HALEU that now is seeing a huge growth with advanced reactors and small modular reactors entrusted in it.

I think people will see it as a competition at the very beginning because it is a limited resource at this point in time. But, in reality, I think they are very complementary and very beneficial, what -- you know, with the expansion of advanced reactors and SMRs, we will see the growth of the

HALEU supply chain, and that is only beneficial for the research reactors and medical isotope producers.

Right now, where HALEU comes from is form our work down-blending highly-enriched uranium that we own at DOE and NNSA. So that is a -- that is a limited stock, a limited resource, so that has been focused on being -- down-blending and providing it to research reactors and medical isotope producers. We are very confident in that supply.

Similar to a question that was asked earlier, twice a year we update our analysis for what the needs are for all of the different reactors for their life cycle, so we have a good handle on that. But, simultaneously, the entire Department -- and this includes nuclear energy as well as NNSA and others in the Department -- have really been working to help stand up the supply chain for HALEU, and that's going to benefit everyone in this room for research reactors and isotope producers, but also for all of the new advanced reactors, SMRs, whether they're at universities or whether they're strictly commercial. So --

COMMISSIONER WRIGHT: Okay.

MS. DIX: -- I'm excited to see where it goes.

COMMISSIONER WRIGHT: Good. Thank you for the answer. Thank you.

Dr. Towell, the -- one it's good to see you again. You know, I had the opportunity to go to Abilene Christian in December, and it was a great visit and I spent the full -- I had -- gave a full day, stayed -- toured the facility, met with students, met with staff, talked with faculty deeply about some different, you know, issues that were of concern to me and of concern to them, right, about the whole NRC process. And then I got to go to the basketball game. That was highlight.

(Laughter.)

COMMISSIONER WRIGHT: That was a lot of fun. Texas is a great state, and it was a real treat to get to spend some time with you and the President and the rest of the team down there. And I highly recommend the visit. Highly recommend it.

So my question is a follow-up, all right, to Commissioner Crowell's question to Mr. Brooks, right? He was asking about the public engagement, and he was asking about the disposition of spent fuel. Did you have any comments? Did you -- maybe you could follow up on the same kind of question. I'll give you that opportunity. Right?

DR. TOWELL: Thank you. Thank you for your visit. We appreciate it anytime a commissioner is able to come. And so we're two down, two to go. The invitation is there.

(Laughter.)

DR. TOWELL: Obviously, public engagement, I couldn't agree more with everybody Caleb said. It's important. It's a -- you know, if you want the -- if you want the public to accept advanced nuclear, you need to educate them and teach them about the advantages and demystify it and explain the benefits.

And so, yeah, a lot -- safety and waste are usually the top two concerns, and so, you know, you go through the safety profile and explain how we're keeping it safe, and then you have to address waste. And so, you know, like Caleb, we hope that the Department of Energy will both provide our fuel and then take our spent fuel at the end of the day.

I will say, you know, with the technology of liquid fuel, molten salt cooled reactors, the amount of waste you produce is drastically reduced, and, in fact, at some level there is nothing that goes to the waste stream because any leftover fuel goes into the next reactor. And so that's an advantage, and that's something that we talk about, but public engagement is very, very important.

And we have spent a lot of time -- a lot of the things Caleb talked about we're doing in Abilene also, and so the -- you know, never pass up a chance up to talk to the Kiwanis Club or Rotary Club or any group that wants to know what we're doing in that big building.

COMMISSIONER WRIGHT: Right. So thank you for the answer. I wanted to stay with you, too, for a second, Caleb and Rusty, because I think the next couple of questions maybe you both could answer about your own experiences.

First, is our staff appropriately, in your opinion, implementing the AEA directive on research reactors to impose only the minimum -- "minimum amount of regulation" needed to -- for reasonable assurance of safety as you had on our slide, but I'll let you comment on it as well.

DR. TOWELL: So we of course understand the challenges of bringing the first research reactor for construction written in decades, and the first, you know, non-light-water reactor to think about as being a research reactor. So we understand the challenges there, and we're very thankful for the careful review.

Are there places where some of the questions are probably leaning -- are there times where we probably get into issues that should be pushed off to the operating license or pushed off for a commercial reactor? I believe so. We're continuing to answer those questions because that's the fastest path to getting a permit approved.

So I think it's a challenge for all of us, and we're -- we appreciate the opportunity to be in the dialogue, especially in audit space, and to have the dialogue back and forth. But it's a challenge for all of us.

MR. BROOKS: Yeah. So our engagement to date with NRC has been very good on that question. I think they have stuck to that additional piece of research reactors that has minimal regulation. We have seen a good response from industry on that. And I think it highlights the fact that NUREG-1537 does provide guidance that's maybe more prototype-friendly to allow for advanced reactors to efficiently get through NRC licensing process.

So I would say, you know, even going back to the PRA question, right, we are providing an opportunity for a faster path, we think a more efficient path, a clearer path, to licensing with NRC where then you can get the data, you can get the understanding for that leap to commercial operation, get the data needed for the PRA, in order to make that -- again, it's a very powerful tool, which currently is in the -- is in more of the technology development side, but PRA becoming a very valuable tool even on the regulation side.

So I think we're -- what we're trying to provide here, and I think the NRC staff and our project gets that, is that we can work under a guidance framework that is much more prototype friendly than we would see with a direct commercial type of application.

COMMISSIONER WRIGHT: Okay. And with the time I've got left, I'm going to ask one more question here, because I'm going to stay kind of on this topic. As you know, the staff has been using core teams, right? And this is a major strategy that we have -- that they have implemented on trying to -- for these reviews, right, and for the advanced reactor licensing.

So what are your views on how the core team is working -- and I'll come to you first, Rusty, and then back to you, Caleb -- considering what you just told me about, you know, the -- maybe getting beyond the scope a little bit, right? Can you address that?

DR. TOWELL: Well, I should say we have appreciated the partnership -- I shouldn't -- we've appreciated the collaborative desire to reach a positive resolution of a safe approval. So we have been working well. I don't want to -- I don't want to mislead anybody that things aren't progressing well. It's just challenging because of --

COMMISSIONER WRIGHT: Sure.

DR. TOWELL: -- first of a kind, in that nature. Core teams is a great concept. I mean, when you have inherent safety built into a technology and you have -- you know, as I understand the concept of a core team, you have a core team that understands that and can help guide people that are less familiar with that technology do an appropriate level safety evaluation. It feels like there is room for growth there.

Partly, we have also had a turnover. We've had three different technical reviewers leading our construction permit review. So part of it is the turnover of people that might be working against this. Part of it is just the first-of-a-kind nature. I think we're on a good path, but I guess there is also always room for improvement.

COMMISSIONER WRIGHT: Sure.

Do you have any --

MR. BROOKS: Yeah. I haven't seen friction come from this model. Of course, we're not deep into the construction permit application review.

COMMISSIONER WRIGHT: Right.

MR. BROOKS: But so far the request for additional information that we have received on our topical reports have been -- have been reasonable. They have been very clearly communicated to us. I think we have seen consistency across topics of our topical reports that have also been reviewed from other applicants, like was mentioned with Kairos.

There is a wake that is being formed, and I think we are all moving nicely in that wake as applications move forward. But maybe I'll reserve my full answer after we're in the construction permit review. Thanks.

(Laughter.)

COMMISSIONER WRIGHT: All right. Thank you so much.

CHAIR HANSON: Thank you, Commissioner Wright.

All right. We have reached the end of the first panel. We're going to take a short break. We will convene -- oh, I don't know, the two clocks are different. I think it's triggering my OCD a little bit. But let's say 10:25.

For those of you who find yourselves underfed or undercaffeinated, I am pleased to announce that we now have a coffee bar/coffee stand here in the building. I think you will find it off to my right, down the hall, and they have your -- everything to meet your caffeine or sugar needs.

So that's my plug, and we'll be back shortly. Thank you.

(Brief recess.)

CHAIR HANSON: All right. Thank you, everyone. Welcome back for our second panel. We are going to recommence with the NRC panel. We'll be led off by our Deputy Executive Director for Reactor and Preparedness Programs, Scott Morris. I look forward to another good discussion. Scott, the floor is yours.

MR. MORRIS: Thank you, Chair, Commissioners. We are pleased to be here today to provide an update on the Agency's research and test reactor activities.

As you heard in the first panel, RTRs are important tools in the advancement of nuclear research and development. They increase the understanding of nuclear technology, create opportunities for training the future workforce, provide services for various applications and are key in the development of advanced reactors.

So I will go a little bit off script here and say there is a lot of what you will hear today will echo some of the sentiments expressed this morning with a little bit of, obviously, the staff perspective.

The very low risk presented by these facilities is recognized in the Atomic Energy Act, which we also have talked about in the first panel, and has been demonstrated by many decades of safe operation.

The Act directs the Commission to impose the minimum amount of regulation to RTRs that will provide a reasonable assurance of adequate protection in public health and safety and promote the common defense and security and protect the environment.

As such, the NRC regulates these facilities by applying technology appropriate requirements commensurate with the risk to the public and the environment.

This technology neutral, risk-informed, regulatory framework is also being used in the licensing of new technologies and is informing the way we regulate advanced reactors.

May I have the next slide please? So I will now introduce the panelists, who will talk about some specific agency activities related to RTRs. Our first speaker this morning will be Rob Taylor, Deputy Director for New Reactors in the Office of Nuclear Reactor Regulation, or NRR. And he will provide the Agency's strategic vision for regulating RTRS.

Rob will be followed Josh Borromeo, to my right, Branch Chief in the Division of Advanced Reactors and Non-Power, Production and Utilization Facilities, commonly known as DANU. And Josh will describe the staff's risk-informed licensing and oversight approach for RTRs.

Next Rebecca Ober to my left is a project manager in DANU with experience in nuclear security and will share information on RTR security considerations and some recent policy issues.

Next will be Holly Cruz, to Rebecca's left, Senior Project Manager in DANU and her overview on licensing activities for medical isotope facilities and advanced RTRs, including best practices and challenges.

And finally we will conclude the panel presentations with Amy Beasten. She is an RTR examiner in DANU, and her presentation will focus on the oversight and operator licensing activities for RTRs.

This concludes my opening remarks. So I will now hand over the presentation to Rob, and we will take the next slide.

MR. TAYLOR: Yup. Thank you, Scott. Good morning, Chair and Commissioners. Today I will provide you with an overview of the Agency's strategic vision for the regulation of non-power production and utilization facilities.

Next slide, please. Nuclear research and test reactors, also called non-power reactors, are a type of non-power production and utilization facility, also referred to as NPUF. The primary use is for research, training and development to support science and education and nuclear engineering, physics, chemistry, biology, anthropology, medicine, material science and related fields.

These reactors are designed with significant safety margins and have supported the NRC's licensing of over 100 RTRs and overseeing over 50 years of safe and secure operation.

Even in the rare case of an event such as the 2021 fuel melt accident at the National Institutes of Standards and Technology, or NIST, the design safety margins and regulatory approach ensure the protection of public health and safety.

These reactors are very different from their large lightwater counterparts. The smallest RTRs are 5 watts, which is the equivalent of an LED light bulb. The largest, NIST, is 20 megawatts. Further, more than 80 percent of the operating facilities are less than 2 megawatts, which is considered low, even by RTR standards.

For perspective, NIST is approximately 88 times small than a typical large lightwater reactor such as the Canadian Nuclear Power Plant and 170 times smaller than the newest lightwater reactors, the AP-1000s at Vogtle.

The difference is in size and purpose provide an opportunity to apply a graded risk-informed approach for applicable licensing and oversight requirements of each NPUF.

It is important to state that our mission for the licensing and oversight of these facilities remains the same, reasonable assurance of adequate protection of public health and safety. But our approach to achieving that must be different.

While the major regulatory processes of NPUF licensing are similar to power reactors, such as construction permits, operating licensing and the 5059 change process, given the design differences, only a subset of our regulations are applicable, which Josh will discuss further in his presentation.

Next slide, please. There are a total of 30 RTRs licensed and currently operating in the United States. RTRs are regulated in accordance with the Atomic Energy Act, which requires the Commission only apply the minimum amount of regulation necessary to ensure the safe operation of these facilities.

The NRC's regulatory infrastructure employs a graded and risk-informed approach that allows flexibility for various technologies to provide reasonable assurance of safe operation.

The current operating fleet of RTRs is primarily composed of open pool and tank designs. Trigger reactors are training research isotopes, general atomic reactors are an open-pool type design utilizing various fuel types and mostly operate at low power.

AGNs, or aerojet general nucleonics, are a tank design and are even smaller, which operate at 5 watts.

There are also a handful of one-of-kind technologies currently licensed. And the NRC has also licensed about a dozen aqueous homogeneous reactors.

Staff continues to look for opportunities to make improvements in the security and oversight, which Becca and Amy will discuss further. While maintaining safety, the NRC staff uses a performance-based approach to regulating RTRs commensurate with their risk and reflective of their resources and infrastructure.

The staff also communicates regularly with the RTR community to share information, address concerns and optimize the licensing and oversight programs.

Next slide, please. RTRs are vital for the nuclear workforce in the country and support the future of advanced reactors. The NRC supports building this workforce through the grants program, led by the Office of Nuclear Regulatory Research. This provides us with an opportunity to gain insights from the technology and move forward in the advanced reactor field.

The Agency is optimizing the integration of RTR and advanced reactor staff so the past informs the future.

Furthermore, leveraging international engagement in RTRs is critical to continue supporting the RTR's safe and secure operation around the world. Holly will elaborate on this international engagement.

I will now turn it over to Josh Borromeo. Next slide, please.

MR. BORROMEO: Thanks, Rob. I will be highlighting the key aspects of the safety of these facilities and how our regulatory framework is structured to ensure the reviews are risk-informed and right-sized to accomplish the NRC mission.

Next slide, please. There are a variety of type of RTRs and more broadly NPUFs that implement different technologies to achieve their operational objectives and include design features to ensure they are low risk to the public. This safety provides the foundation on how we regulate these facilities.

One of the primary design features that contributes to the safety of these facilities is their low power levels. The lower power translates into low system temperatures and pressures, which reduce the severity of and the equipment requirements to mitigate potential accidents.

For example, most of the research and test reactors should not require an emergency core cooling system to mitigate a loss of coolant accident because the lower power and the fuel are designed so that air cooling is sufficient to preclude any fuel damage.

Additionally, the low inventory of nuclear material needed for operation contributes to a small source term for these facilities. This results in accident consequences that are very low.

These design features contribute to the facility have simplified structures, systems and components, large margins to safety and limit the risk to public health and safety.

Both the licensing and oversight framework are tailored to the risk of these facilities and provide the flexibility to adjust when necessary.

One of the primary objectives of licensing is to ensure the design features demonstrate significant safety margin. This is achieved in part by the evaluation of a maximum hypothetical accident. This is an accident that is intended to bound all credible accidents for the facility.

Many RTRs have sufficient margins that engineering safety features are not required even for their maximum hypothetical accident.

Oversight of the RTRs ensures that the systems and programs credited during licensing are appropriately implemented and the licensee continues to meet the required regulations.

Next slide, please. To implement the direction from the Atomic Energy Act, only a subset of the power reactor requirements in 10 CFR Part 50 are applicable to NPUFs. These requirements are also applied with a graded approach. For example, an NPUF over 10 megawatts is currently defined as a test reactor.

The regulations require a test reactor to meet the Part 100 setting requirements, have an independent review by the Advisory Committee on Reactor Safeguards and a mandatory hearing during licensing. However, these requirements are not applicable for lower power research reactors.

Our guidance documents complement the regulatory requirements to ensure all areas that could impact safety are addressed and provide guidance to further implement a graded approach. This allows for a regulatory framework that is flexible and adaptable to various technologies and the risk for each facility.

For licensing, our primary guidance is found in NUREG 1537 titled, Guidelines for Preparing and Reviewing Applications for Non-Power Reactors, which provides guidance for both the review of construction permit and operating license.

NUREG 1537 was a frontrunner in the guidance that is technology neutral. Because the potential hazards may vary widely among NPUFS, the guidance provides a roadmap for applicable regulations and acceptance criteria that is broadly applicable to different designs.

We use this document in licensing of a variety of technologies in our operating fleet and are successfully using it in our review of new advanced NPUF technologies.

Like licensing, our oversight of the RTRs is implemented using a graded approach. The guidance uses the power level to determine the base frequency of inspection activities for each facility. Reactors above 2 megawatts are inspected annually. Below that, and if they are operating, reactors are inspected every other year.

However, the guidance provides provisions for the staff to adjust the frequency of inspection activities when performance deficiencies are identified.

Finally, RTR operator licensing regulations and guidelines are also commensurate with the risk of the facility. 10 CFR Part 55 contains specific requirements for licensing RTR operators. Most of these reactors are located on university campuses and are significantly smaller than power reactors and can be staffed by one or two licensed operators, which may consist of students.

Next slide, please. The staff continues to make improvements in how we regulate NPUFs. Some of these improvements were developed to improve the review efficiency for new technologies. Others provide benefit and clarification to the operating fleet of reactors and lessons learned from events.

The staff has recently issued a key guidance document to support our licensee's 10 CFR 5059 change process reviews. This guidance has been tailored to be specific for NPUFs, and the staff has observed improvements when our licensees exercise these evaluations.

Additionally, the staff developed and has implemented guidance to streamline license renewal reviews based on the risk to the facility.

The staff has developed enhancements to our current guidance to improve the efficiency in the review of new technology. Holly will highlight some of the key updates to support the licensing of the SHINE Technologies medical isotope facility and molten salt RTRs.

Moreover, the staff is furthering our risk-informed regulations of these facilities in our development of new regulations. The staff has made substantial progress in right-sizing rules for security which Becca will highlight in her presentation. And the final draft NPUF rule that is currently with the Commission will provide efficiency improvements in how we regulate NPUFs.

We have recently identified enhancements to our oversight of NPUFs following our introspective review of the NIST fuel damage event.

While the staff did not identify any significant gaps in the current program, the staff is adding emphasis in several key areas that will support increased observations of risk significant activities, enhanced training of the staff and add provisions to formalize assessments at the program.

One area the staff is focusing on to make improvements is how annual fees are assessed for NPUFs. In the near future, there will only be two licensees that are required to pay annual Part 171 fees. So if we don't recover all of our budgeted resources, which now includes large licensing projects, the financial burden for these two facilities can be significant.

The staff is actively working on mitigating solutions and is planning engagement with the Commission on a proposal to resolve this issue.

Next slide, please. The non-power production or utilization facility license renewal rule, or commonly referred to as the NPUF rule, establishes a more efficient, effective and focused regulatory framework and it incorporates innovative and transformative approaches which are consistent with the principles of good regulation.

The objectives of the NPUF rule clarify regulations affecting applicants for new non-power advanced reactors, medical isotope facilities and existing RTR licensees, including clarifying terminology and definitions.

A few of the key changes include a new performance-based accident dose criteria or 1 rem. This criterion was established based on the Environmental Protection Agency's protective action guidelines and will provide regulatory clarity for new and advanced non-power applications.

This criterion will also serve as the transition between a research reactor and a test reactor, which allows this critical difference in classification to be directly driven by the risk of the facility.

Additionally, the rule eliminates license terms for research reactors and clarifies the license renewal process for commercial NPUFs and testing facilities.

This will provide resource savings for both the licensee and the staff. The staff will be able to maintain an awareness of facility changes important to safety through required periodic final safety analysis report update submittals and a reasonable assurance of adequate protection can be maintained even without license terms.

These improvements and other established in the NPUF rule will bring clarity and reduce resources while promoting increased risk-informed regulation that still protects public health and safety.

I will now turn the presentation over to Becca. Next slide please.

MS. OBER: Thank you, Josh. Next slide, please. The first security requirements applicable to RTRs were established in 1979 to address the theft and diversion threat to special nuclear material used onsite at RTRs.

This update also provided an exemption for SNM, which is not readily separable and which has a dose rate in excess of 100 rem per hour at a distance of 3 feet without intervening shielding. Also known as a self-protecting exemption.

Both of these updates accounted for differences in infrastructure and the associated risks as well as the safety of RTRs.

In 1993, regulations were added to manage potential radiological sabotage risks for RTRs with a power output equal or greater than 2 megawatts. Studies had determined that there was no significant radiological sabotage if an RTR operates under 2 megawatts.

This was the first time RTR security requirements were based on the type of facility instead of the type and quantity of SNM used or possessed.

After the terrorist attacks of September 11, 2001, the Commission directed staff to reevaluate security requirements for all facility types. Additional security measures were implemented for power reactors and fuel cycle facilities with Category 1 or 3 quantities of SNM using orders.

Because there were no power reactors or fuel cycle facilities with Category 2 quantities of SNM, no evaluation was completed and no additional security measures were developed.

Additional security measures for RTRs were implemented using confirmatory action letters although most licensees have since incorporated them into license conditions.

In general, these additional security measures included enhancements such as vehicle barriers, personnel background checks, coordination and communication with local law enforcement, vehicle and personnel searches and visitor escorting.

Recognizing the unique safety and security attributes of RTRs, the Commission directed NRR to assume the lead of security for RTRs. This direction continues to support effective licensing and oversight of RTRs as well ensuring RTR security requirements are right-sized for the threat environment.

In addition, many RTR licensees have worked with the Department, through the National Nuclear Security Administration's voluntary security enhancement program to fund security enhancements that are consistent with and supplementary to the NRC's regulations in 10 CFR Part 73.

In this program, DOE and NSA conducts an onsite assessment of a facility, funds any security related updates and offers response force training. As appropriate, some RTR licensees voluntarily updated the physical security plans to reflect these enhancements.

The close coordination between NRC and DOE and NSA ensures that any changes to RTR technology, material possession or threat environment are efficiently and effectively addressed.

Next slide, please. In 2013, SHINE Technology submitted an application to construct a first of the kind medical isotope facility utilizing Category 2 quantities of SNM.

Staff proactively began assessing the potential threats to this type of material and facility to allow early engagement with SHINE on appropriate security measures for its facility prior to and during the construction.

Ultimately, staff developed a list of risk-informed supplemental security measures that were approved by the Commission. Some of the supplemental security measures include, but are not limited to, timeliness of detection, increase of communication capabilities and robust response capabilities.

Appropriate supplemental security measures are determined using a methodology that implements the requirements needed for the commensurate risk.

Recently, multiple non-lightwater reactor applicants have submitted plans and applications for various types of facilities that will use or possess Category 2 quantities of SNM.

Building on its experience with SHINE, staff has engaged with prospective applicants and licensees such as Abilene Christian University and Kairos Power on security considerations through discussions and site visits. This engagement will support a timely and efficient review of security information because the applicant is aware of potential supplemental security measures and can account for that during the design and construction phases as well as during the development of license Applications and security plans for proposed non-lightwater reactors.

In parallel, staff is proactively looking to implement a process that can be applied more generically to new applicants looking to use or possess Category 2 quantities of SNM instead of needing to complete security assessments on a case-by-case basis.

The staff is committed to preparing and implementing technology and threat specific security measures to facilitate timely licensing of new facilities demonstrating an ongoing ability to readily adapt our licensing framework to advanced technologies.

I will now turn it over to Holly Cruz to discuss licensing activities. Next slide, please.

MS. CRUZ: Thanks, Becca. Next slide, please. NUREG 1537 includes performance-based guidance that is technology neutral, the regulatory infrastructure is sufficiently flexible to licensed advanced RTRs and medical isotope facilities. Additionally, since many 10 CFR Part 50 regulations include specific entry conditions that are only applicable to power reactors, the NRC doesn't have as many prescriptive requirements for advanced RTRs. This contributes to the flexible regulatory infrastructure.

For example, to support advanced reactor development, the staff used NUREG 1537 for the recent Kairos Hermes construction permit review. Since the NUREG is technology neutral and provides the flexibility to consider unique design aspects, the staff was able to apply it in the review of the functional containment approach, which is a design feature that is not explicitly included in the guidance.

The staff has expanded this guidance and exercised regulatory exemptions were necessary just to support these reviews. However, since the RTR licensing framework is flexible, the NRC hasn't needed to grant many exemptions.

To date, the NRC has granted exemptions allowing applicants to submit environmental and safety assessments supporting a construction permit application independently and allowing an applicant to begin construction of their target fabrication facility prior to this middle of an Application. Staff is also exploring opportunities to use exemptions to streamline the environmental process using shorter yet equally effective documents, such as environmental assessments in lieu of environmental impact statements.

In 2012, the staff issued an interim staff guidance augmenting NUREG 1537 for licensing radioisotope production facilities and aqueous homogenous reactors. In 2020I the staff also endorsed an adaptation of NUREG 1537 prepared by Oakridge National Laboratory as guidance for use by applicants for non-power liquid fuel molten salt reactors.

In addition, the staff is currently preparing a revision and update of NUREG 1537, which would incorporate guidance developed for molten salt reactors, aqueous homogenous reactors and production facilities and provide guidance for preparing environmental reports.

Next slide, please. Advanced RTR reviews are affirming our approach to commercial advanced reactors. As an example, the technology inclusive in advanced reactor content of application projects emulate the flexibilities of the NRC approach to RTR reviews and oversight. This technology-inclusive, risk-informed and performance-based guidance will inform upcoming advanced reactor application preparation and NRC reviews.

The staff is also gaining valuable insights into the advanced reactor technologies such as molten salt fuel and TRISO fuel.

These RTRs serve as a proof of concept for advanced power reactors and their design, licensing, construction and operation can provide data that will be used to support the reviews of advanced reactors such as characterization of fuel performance and containment, model verification in the area of neutronics and thermal hydraulics, information on performance of safety systems, information relevant to the design and development of instrumentation and controls, operating experience and data that informs identification of research and development activities.

Designers may choose to construct and operate a small facility, such as a research or a test reactor prior to a full scale commercial facility  based on factors such as data needs, cost, safety and time.

Data obtained from a research or test reactor could be used to fulfill the testing requirements in the regulations during subsequent application for a license approve or certification for a commercial reactor.

Any data obtained using a research or test reactor and subsequently used to support a commercial nuclear power plant design would need to meet the quality assurance requirements set forth in 10 CFR Part 50, Appendix B.

The staff plan to gather information from a licensing, construction and operation to aid in the efficiency of future advanced power reactor reviews.

Next slide, please.  Medical isotope facilities will be key to ensuring a domestic supply of critical medical isotopes.  Current RTR licensees such as the University of Missouri research reactor have used neutron capture to produce diagnostic medical isotopes.

The University of Missouri has also announced an initiative for a new reactor dedicated to the production of medical isotopes.

Oregon State University has performed experiments for medical isotope proof of concept and other RTRs are pursuing other methods to produce therapeutic medical isotopes.

SHINE Technologies will produce vision-based molybdenum-99, the parent isotope of technetium-99, which is used for diagnostic imaging.

SHINE is also pursuing therapeutic medical isotopes.  The facility consists of eight accelerator driven, subcritical irradiation units in a production facility containing hot cells used for isotope separation from the irradiated special nuclear material target.

The staff employed several novel approaches to the SHINE review, which allowed flexibility and will help to ensure safe operations such as the following.

We granted an exemption to SHINE allowing them to submit their environmental and safety review applications separately, leveraged review insights from fuel cycle facilities to support the review of the production facility, identified conditions for the licensing of operators and approved a phased approach for the facility start up.

These approaches not only allowed the staff to address aspects of the review unique to the SHINE design, but also meet the schedule and complete the review within the established budget.

The staff is using lessons learned from the SHINE application to inform the review of the Kairos Hermes, University of Illinois Urbana-Champaign and other advanced RTR applications.

Other applicants have also initiated pre-application engagement for construction permit activities related to the production of medical isotopes.

Next slide, please. The NRC is engaging international and setting the benchmark for other countries looking to establish new or expand existing RTR programs.

There are currently 225 operating research reactors in 54 countries with another 20 on the horizon. The NRC staff has participated and provided presentations at various international Atomic Energy Agency workshops to share our best practices while affording member states the opportunity to ask questions applicable to their programs.

The NRC also participates in missions with the IAEA to provide member state recommendations for safety improvements as well as periodic reviews of IAEA safety standards and other IAEA publications.

The staff continues to engage with our counterparts at the Canadian Nuclear Safety Commission to share knowledge supporting advanced reactor reviews. These interactions allow for us to share our processes with our counterparts, promote international collaboration and support an efficient review process.

I will now turn the presentation over to Amy. Next slide, please.

MS. BEASTEN: Thanks, Holly. Next slide, please. The staff has made many improvements to the RTR inspection and examination program from updating inspection guidance documents to leveraging electronic tools to support operator licensing examination, development and administration.

Notably, we have developed an RTR specific reactive inspection guidance to augment Management Directive 8.3, Incident Investigation Program for Event Response and Reactive Inspections.

This guidance includes considerations of the unique set of circumstances and associated risks for the event when recommending the level of response, improvement in documentation of the recommendation to include the basis for the level of response and enhanced clarity for documenting the decision-making process for a reactive inspection.

The inspection staff is updating guidance to streamline the level of detail in inspection reports consistent with other NRC programs.

This effort is also being coordinated with implementation of the program into the reactor program system also known as RPS to allow the use of the report generator tool, which will increase the efficiency and timeliness and issuance of inspection reports.

The staff routinely reviews inspection procedures and guidance documents to enhance guidance for inspectors based on lessons learned during inspections and events at RTR facilities.

The staff plans to formalize this review process following feedback from the recent OIG inquiry. The observation of risk significant activities is being reemphasized in the inspection scheduling to ensure direct NRC oversight of activities such as reactor operations, fuel movements and significant maintenance activities.

The operator licensing staff is implementing improvements to modernize the program, including efforts to provide the ability to conduct electronic examinations using the collaborative learning environment, CLE.

The CLE is an existing training tool used by the office of the Chief Human Capital Officer. Operator licensing staff currently use the CLE to develop living exam question banks for each RTR facility to allow for more efficient exam development. And the staff plans to transition the capability to perform electronic written exam administration and grading.

Both the oversight and operator licensing teams are leveraging the use of RPS to allow for enhanced tracking of activities and management of performance.

Next slide, please. During the COVID-19 public health emergency, staff maintained oversight of RTR facilities through a combination of onsite and remote inspections. Inspectors maintained awareness of local health conditions and various positions and policies taken on campuses in response to the public health emergency and adjusted accordingly to ensure the agency continued to successfully meet the mission for RTR oversight program.

The operator licensing staff continued to conduct exams and issue licenses, prioritizing facilities identified as critical infrastructures.

Although we continued to issue operator licenses during the public health emergency, there were delays with the issuance of the associated certificates, which created a backlog of unissued operator license certificates.

The staff has eliminated this backlog while ensuring a new backlog was not created, which addressed an ongoing concern of our licensees.

Consistent with actions taken for power reactors during the public health emergency, the staff utilized a streamlined exemption process to allow facilities to maintain compliance with regulations.

Inspectors and examiners worked closely with RTR facilities to identify areas of responsibility and requirements impacted by the emergency and then pursued exemptions that permitted continued safe operation without undue risk to the public.

Inspection guidance and policy continued to recognize and accommodate the wide diversity in range of existing and future NPUFs. Event tracking has improved through efforts with the operating experience group to increase awareness of RTR events.

Enhanced cross-communication among staff and the community of the National Organization of Test Research and Training Reactor, TRTR, improves the effectiveness of event response and provides an opportunity for staff and the TRTR community to incorporate lessons learned and do training and procedures.

Additionally, the staff and TRTR community have enhanced approaches for identifying and addressing safety culture issues observed in events through the increased communication among all interested parties.

Next slide, please. The oversight and operator licensing teams are placing emphasis within their respective programs to transfer knowledge of the RTR program to other areas of the agency.

Both the inspection and operator licensing program staff are focused on including a wide diversity of backgrounds and experiences, including hiring staff with previous RTR experience and power reactor inspection experience.

Additionally, staff has conducted knowledge management training on various RTR related topics to encourage greater familiarity with inspection and licensing processes and procedures and cross-training for interested individuals is encouraged.

In response to recent RTR events, the staff plans to enhance the oversight program through improvements to training and guidance to include knowledge and chances of recognizing precursors that could lead to fuel element damage.

The staff is utilizing these activities to support the development of programs for advanced reactors.

Next slide, please. The inspection and operator licensing teams have enhanced communications with both internal and external stakeholders. Internally, the oversight operator licensing and licensing staff coordinate and share information on a routine basis.

Additionally, the RTR staff ensures regions are informed of oversight and operator license examination activities that occur at facilities within respective regions.

To improve communications and access to RTR information with external stakeholders, the staff developed an RTR inspection report link within the NRC's public website, increasing transparency and communication with the public and other external stakeholders.

The staff issued Information Notice 202303, Recent Human

Performance Issues at Non-Power Production and Utilization Facilities, to share operating experience and highlight recent events at RTRs that identified issues related to safety culture.

The RTR staff and management conduct routine meetings with the TRTR community to discuss regulatory and operational issues. The staff has increased communications with state and federal agencies and has hosted state representatives and the Department of Energy RTR fuels program management on inspections at RTR facilities.

The NRC staff has taken steps to increase the sharing of information with RTR licensees by providing access to the IAEA operating experience database known as the Incident Reporting System for Research Reactors, IRSRR.

The IRSRR allows the NRC and international organizations to share operating experience in a single database. Enhancing communication domestically and internationally and provides opportunities to identify commonalities among events reported globally.

The staff utilizes various forms to share information on RTR events through participation in various forums such as the American Nuclear Society conferences and the NRC hosted Annual Regulatory Information Conference.

I will now turn it back over to Scott for closing remarks.

MR. MORRIS: Thank you, Amy. So in conclusion the staff recognizes the vital role that RTRs play in training the future nuclear workforce providing services for a variety of applications in the advancement of science and technology.

They have relatively low source terms and are designed and operated with significant safety margins. Accordingly, our regulatory approach to licensing oversight of RTRs is graded and risk-informed. The staff continues to make progress developing regulations and guidance to provide further enhancements in how we regulate these facilities while maintaining their safe operation.

That concludes the staff's remarks and we look forward to your questions.

CHAIR HANSON: Thanks, Scott. And we will begin again with Commissioner Caputo.

COMMISSIONER CAPUTO: Thank you all for being here this morning and for the very thorough presentations.

It is quite timely given the current licensing work with advanced reactors in this area and the policy issues that are being presented to the Commission with regard to research and test reactors.

I also want to point to current paper pending before the Commission on microreactor licensing that proposes to use some research and test reactor processes with regard to testing fueled, manufactured microreactors at a factory.

This is the type of innovative thinking that I am really excited to see happening within the Agency. Of course, the devil is in the details as to how this is going to work.

So once aspect is how we formalize a disciplined process for considering potential changes to regulatory requirements for licensees.

For non-power utilization facilities, it is fairly straightforward for a majority of them. As we have discussed a couple times already this morning, the Atomic Energy Act tells the Agency to impose the minimum amount of regulation on these licensees for research and development licenses under Section 104.

For other utilization facilities, we have formal requirements under the backfit rule the Agency uses when it is considering imposing regulatory changes.

There is, however, a longstanding interpretation that the backfit does not apply to non-power reactors. And that interpretation is generally not an issue because most of them qualify for the minimum regulation provisions. However, things are beginning to change in this area.

So one of these changes already is the existence of a licensee for a non-power medical isotope utilization facility under Section 103 rather than Section 104. And there is the prospect of potential additional licensees.

So if we continue with the interpretation that the backfit rule only applies to power reactors, such facilities would neither have the backfit rule nor the minimum regulation provision under Section 104 when it comes to scrutinizing potential regulatory changes.

So former Chairman Svinicki expressed these concerns in her vote on the Paper 1962 regarding non-power utilization facilities and licensed renewal. And I share those concerns. But that's not the end of it.

As I mentioned earlier, microreactor licensing, the paper pending before the Commission proposes an option for licensing microreactors under 103 and treating them as non-power utilization facilities for the purposes of operational testing.

So given my focus on having discipline processes for considering regulatory changes, this raises additional questions under the application of the backfit rule. So there are some aspects of the design of a manufactured reactor that would be controlled under the backfit rule during the testing.

A microreactor itself would eventually be controlled under the backfit rule once it is licensed as a power reactor. But if we treat it as an NPUF during operational testing, portions of the facility as a whole that are not part of the manufactured reactor design would be an NPUF licensed under Section 103 without the minimum regulation requirement.

So it strikes me as an untenable situation for manufacturers of microreactors and medical isotope non-power utilization facility licensees if we persist in this interpretation that the backfit rule only applies to power reactors given that NPUFs have no explicit controls on regulatory changes under Section 103. So the backfit rule itself does not include a limitation to power reactors anywhere in the text and it would be simple to apply to additional facilities.

I believe the staff should re-examine the applicability of the backfit rule to all production utilization facilities licensed under 50 and 52 and harmonize the interpretation of the wording of the regulation in order to provide improved regulatory certainty for all NPUFs and avoid establishing barriers to entry for potential microreactor manufacturing licensees.

I believe this could be accomplished through some form of an interpretive rule or generic communication and should be followed by making durable changes to NUREG 1409.

Scott or Rob, can you just give me your views on the issue?

MR. MORRIS: I will just start and then I will hand it off to Rob.

So I think you are correct. There is nothing explicitly written into the rule that would preclude RTRs being covered. But as you pointed, historically we haven't.

So with that as -- so we could. We just haven't. But given the context that you just described, maybe Rob, you can share what we've been thinking about in this arena.

MR. TAYLOR: Yeah. So I think your point about the principles of good regulation and clarity and reliability in our regulatory decision is a very good point. And I think that if that's something we need to add to assist the development of these technologies, we certainly could explore that.

I think in practice, the staff's position is that we're not going to move forward with proposing or implementing or forcing changes on NPUF facilities licensed under 104 without going through a very rigorous process akin to the backfit rule.

We recognize the stability and importance of our decisions. And absent a substantial safety issue or an adequate protection issue, I think we would apply the same rigor. If it is important to put that into durable guidance or requirements, I think we can certainly pursue and consider that.

CHAIRMAN CAPUTO: Well, I think putting it into durable guidance is probably important just for the sake of clarity and reliability for applicants.

Just to be clear that they will not be put in a situation where our regulations are perhaps influx in a way that was not anticipated. Thank you.

CHAIR HANSON: Thank you. Commissioner Crowell?

COMMISSIONER CROWELL: Thank you, Chair. Thank you to all of our panelists today. I always learn something from these discussions. I'm going to ask a couple of questions, and I will just preface that any of you are welcome to use Scott as your lifeline and have him answer it if you don't like the sound of it.

Rob, I'll start with you. So in listening to your presentation and looking at some of your slides, it's clear that power level plays a key role in the level of risk and in regulatory oversight you apply for RTRs.

But even to someone as simple as mean, it seems a little bit basic to just look at it through that framework. And there is a pretty wide variety of technologies in the RTR world. So tell me why power level is so central but also what other considerations are made so that I can have faith that it's a fulsome risk evaluation.

MR. TAYLOR: Thank you for the question, Commissioner. You are correct that the regulations were built, and our guidance was originally built, on power levels. That was a convenient way to do it.

I think if you look at what we're trying to do it today, we're more consequence oriented. What's the risks to public health and safety? And the power levels are less important. And we're happy to look at how to adjust those as we go forward to remove arbitrary thresholds on power level that may not be reflective of the diverse technologies, right?

It should be really based on the relative risk of the facility and the source term that's there. And that's what we should really be making our decisions on.

So, yes, we have a framework that was originally based on that 30, 40 years ago and stuff. But I think we're moving all of our thinking towards a more dose-oriented public health and safety consequence framework.

COMMISSIONER CROWELL: Josh, I'm going to go to you next. You know, unless you have an RTR in your backyard or maybe you went to a university that had one and you're aware of it, you know, most folks generally aren't too familiar with these types of reactors or even their existence.

But those outside of the groups that I mentioned who may be familiar with it, are probably familiar because of the event at NIST. And from the presentation, it doesn't sound like we changed too many things as a result of NIST overall in looking at safety and oversight.

So just tell me how you would communicate to someone who doesn't have familiarity with reactors and research and test reactors, why they shouldn't be concerned that if one were established in their community that an event like NIST is going to happen there?

MR. BORROMEO: So is your question relative to, you know, what we changed or the risk to the facility or a little bit of both? I can answer both ways.

COMMISSIONER CROWELL: Both. But if I'm in, you know, rural Alaska, and that's not a great example, and there was a proposal to build a research test reactor there, and I'm like, well, then we're just going to have an issue they had at NIST. Why is that not (simultaneous speaking)?

MR. BORROMEO: So somewhat to what Rob was mentioning, right, and what you asked about power level, right? We've used power level as a surrogate for risk for many years, right, the 2 megawatt threshold for our oversight, you know, has really kind of been something that has driven the amount of inspection that we have to do.

And so the lower power translates into low source term, right? And we can have, like, emergency planning areas that are very small. You know, NIST is at its fence line. But a lot of these universities have emergency planning areas that are within the building itself.

So, you know, someone can be at the site boundary, right, which could be the building during an event and be well below the concern for safety.

COMMISSIONER CROWELL: Okay. Do you want to add to that?

MR. MORRIS: Yeah, thanks, Josh. I would just add that it's not that there weren't -- I know you didn't say this. It's not that there weren't any changes to our oversight program. There were. The key ones stemming from NIST were focused on looking at risk significant activities that occur, like, refueling for example and actually having eyes on during those where as in historically we didn't necessarily do that.

So these are some of the fine-tunings that we're doing, just to our oversight program. So there were lessons learned, I guess, is the point. And there are changes that have been incorporated.

COMMISSIONER CROWELL: And if you don't remember, the public asked, was NIST the result of technology deficiency, operator error or lacks oversight? What would the answer be?

MR. BORROMEO: The latter two mostly, I would say, right? So that's why we wrote the confirmatory order to have NIST take a look at things like their problem identification and resolution processes, their leadership accountability.

So they are, you know, working on improving those. We are remaining close oversight of those improvements as well as ensuring that they're operating safely whenever they're, you know -- as they're trying to recover from the event.

COMMISSIONER CROWELL: And I would just, as a general matter, the -- well, you know, some of these advanced reactors and certainly at the research testing size and scale can have a relatively small site boundary because of the relative risk, you know, that's well justified, you know, from a technical and risk perspective, but from a psychological perspective for the public, it's hard to get your head around that you can be in another room next to a reactor and not have an undue amount of risk.

And so it's important to be able to characterize these things and put it in context for people who don't, you know, fully appreciate all of the advanced science and engineering things that even your staffs do.

Moving on here, Rebecca, it was very helpful to hear the history of our security framework. And I'm wondering if in retrospect there is any regret post-911 for not doing a review of Cat 2 facilities as well as Cat 1 and 3. And you would think that if you did it for the one lower and the one higher that you could capture the one in the middle.

So tell me if that was an oversight in retrospect given what we are dealing with now with Cat 2 facilities coming onboard?

MS. OBER: Yes, I mean, I think in retrospect where we are now, if we had addressed it then, it would definitely simplify things at this time.

However, I will point out we are, you know, 20 years past that. The technologies have changed. The threat environment has changed. And so completing this review now is probably the most accurate representation of the necessary supplemental security requirements that those sorts of facilities should use in terms of the threat in technology.

Scott was there at the time --

MR. MORRIS: Ouch.

(Simultaneous speaking.)

MR. MORRIS: So absolutely, you know, I don't want to say Monday morning quarterback -- I don't want to -- I just did.

At the time, I can just tell you that we were resource constrained, and there were a lot of things coming at us as an agency, particularly in the security realm.

And so we had to make choices about where we are going to spend our resources and where we weren't, and that was one of them.

(Simultaneous speaking.)

MR. TAYLOR: A big benefit today to taking this on is that you actually have facilities that are going to possess the Cat 2. So you now understand the business models and the needs of those facilities.

So building a program today with that understanding, you build a better box for it than you do when you try to take it on generically and guess at what the needs are going to be. So the pros and cons to both approaches is something, and I find that the industry shares a lot of information that helps us build these better.

COMMISSIONER CROWELL: And I don't disagree with you at all, Robert, but I think even a generic look given that you're capturing Cat 1 and 3. In any event, here we are.

Rebecca, one more question for you. I know that's important to have as much, you know, consistency and predictability for licensees and applicants of what their security requirements are going to be. That being said, there is a lot of variety of technologies and new technologies in the world of RTRs so I could also argue that an ad hoc approach is appropriate in some instances because of the uniqueness of the facility. So tell me how you balance those competing kind of priorities.

MS. OBER: Yes. So I guess in terms of specifically the Cat 2 SNM security requirements, as we stated, those are the ones that we have yet to really address in terms of additional security measures.

The first facility that came in was SHINE obviously. And so based on that, we did look at the threat level, the risk to that technology and developed a methodology and supplemental security measures that we reviewed and approved by the Commission that we, as staff, are planning to use as a basis in looking forward to future technologies.

We recognize that when these new technologies come in, there will be some sort of a case-by-case analysis, but the idea is to have a general process and methodology that we can start with as well as a list of supplemental security measures that are appropriate for that type of material.

And then we can reevaluate each licensee at that time, but we are starting with the framework, we're starting with the methodology that will ideally make that review more efficient.

COMMISSIONER CROWELL: And then that will evolve or be memorialized over time as we gain experience and there's --

MS. OBER: Yes. Yup, lessons learned are always, you know, implemented.

COMMISSIONER CROWELL: Okay. Thank you. I appreciate it. Thank you, Mr. Chair.

CHAIR HANSON: Thanks, Commissioner Crowell. Thanks, everybody, for the presentations this morning. You know, I wanted to start off echoing something Commissioner Caputo said, I thought on a first read through, I thought the microreactor paper was very good, and it had a lot of really novel and interesting concepts.

And it admits in that paper, it's a first step towards thinking in novel ways about our existing regulations in order to support kind of multiple deployments of standardized designs.

And I think the issues that Commissioner Caputo raised as well about backfit and 103 versus 104 and so forth are also really worth diving into and exploring. And I look forward to, you know, all four of us working together and with the staff to turn the microreactor paper and also the NPUF final rule as well.

With that, I want to dive in a little bit, Rob, I think on this 104c issue and the notion of minimal regulation. I mean, Dr. Towell was very diplomatic, and I appreciate that. But there is also -- I guess I think I need you to paint picture or have some context for me around the audit process with Abilene Christian in particular but also within, you know, any reactor.

And the number that really sticks with me is the kind of 300 audit questions. And what those were about, how necessary, you know, why did the staff think that those particular areas were necessary or that particular volume was necessary at this stage in the process.

You know, I still echo my remarks, I think, about the Kairos review, Rob, and I think the outstanding job the staff did in terms of structuring that, but also really focusing on that, right? Both from a 52 to 50 perspective but also a CP versus OL perspective. So can you kind of put some context around that for me, please?

MR. TAYLOR: Yeah, certainly. The audit process is a phenomenal tool to allow the staff to have a full understanding of the design and the technology.

So you will see a number like 300 questions. A lot of that is confirmatory. Do we understand what your application says and making sure that we fully understand the safety profile and the basis for the facility. And what that leads to is very few requests for additional information because we don't have to go seeking that information in a request for additional information.

So we usually deal with those questions in a dialogue format. And we'll put the question out so that they're ready to address it. And a lot of them go away very, very quickly in a dialogue during the audit.

So we'll ask questions making sure we have the full picture of the safety case and the safety basis decision that we need to make. And then only the subset where we say, hey, we need something on the docket that isn't in your application. Do we proceed to the RAI process? So then we're very rigorous in what things are and how much we ask for and what's necessary.

With regards to the ACU application, I think overall it's going well in that respect. Specific to the areas where we might have a little bit of disagreement, they are around design changes that ACU is making to specific materials in the safety-related case of the facility, so safety-related components in the facility.

And those were environments where there is data that demonstrates there is potential for degradation. And we want to make sure that we have enough information at the CP stage to understand whether there is a true long-term degradation concern in that environment because if we approve the material now, we want to be reliable and not come back at the operating licensing stage and say, hey, the data says you don't have enough of a basis to support the safety related case of that component.

So we're trying to get to that right threshold. I can understand why different perspectives may exist on how much is needed. But as a safety-related component in the facility that there is data and there is information that says, hey, this environment that it's going to be in might pose degradation risks. We want to make sure we have enough information to say that's manageable over the lifetime of the facility.

CHAIR HANSON: Yeah, look, that's super helpful. I mean, I want to recognize from where I sit, you know, the really limited ability that I'm going to have about specific technical related questions that are kind of under review. But you can also understand that, like, 300 sounds like a big number.

MR. TAYLOR: Mm-hmm.

CHAIR HANSON: You know? And I think it's important, too, from my perspective, and I hope my colleagues will agree that, you know, having these really focused and efficient reviews under 104c and the minimal regulations is really important.

And I think it's really important for really kind of the future of risk informing subsequent reviews as well, right? Because what happens then? We issue a CP. They go put a shovel in the ground, hopefully get an OL. And that's how we're going to learn, and that's how we're going to get data that's going to actually benefit everybody.

And so asking the right kinds of questions up front is really important in order to ensure public health and safety, but also allowing that progressive path forward to really get to in a way that the payoff, which is the operating data that we're going to see and the real data that we're going to see from some of these degradation mechanisms that we kind of want to probe up front. Yeah, okay. Good. Thank you.

Josh, can you give me a sense of where we kind of stand with license renewals for research reactors? I've heard various things over the things about kind of where we are, how many, how long they're taking, you know, the capabilities of our licensees, et cetera?

MR. BORROMEO: Sure. Yeah, so staff has been working really hard over the past few years to really work down all the renewals. And right now we have two in-house right now. So those two we are progressing along very well with only a handful of sections remaining on those. So we're making good work on those.

With the university licensees, and I think it was mentioned in the last panel, they only have a handful of staff, right? So when we do ask a question sometimes it -- you know, getting the right resources in place can take a little bit longer which is why sometimes, you know, the reviews get a little lengthy.

But we're being told by our licensees what would really help that out would be the NPUF rule, right, and the non-expiring licenses which would really provide a benefit for them resource-wise as well as the NRC staff.

CHAIR HANSON: I really like this concept in the final NPUF rule of not having an expiration on some of these, particularly, right, if you go out and see these reactors. They've been in place since the late 60s, early 70s. They've operated safely at low powers for a really long time. They're going to continue to do that under the right conditions, et cetera.

I guess I do want to -- the other aspect of that final NPUF rule thought is the periodic submission of final safety evaluation reports, basically updating that on occasion.

Can you just remind us the frequency there and that we haven't -- you know, kind of what's the trigger resubmitting and FSAR for licensees?

MR. TAYLOR: Right. So in the NPUF rule, initially we are going to issue orders to have our licensees kind of stagger the submittal of their first FSAR. But then after that, it's going to be on a five year basis, right, and they are going to be required to submit it on that periodicity.

Within that, they will have to include any changes that they made under 5059 and will be able to remain, you know, aware of anything significant, right? And during that time, we'll provide oversight, right, for those changes, too.

CHAIR HANSON: I see. So it's kind of a -- that's very helpful. I mean, if nobody had made changes for example under 5059 because they didn't have a need to, they could ostensibly resubmit the FSAR that they had previously submitted and said, look. Everything is still good. We've learned a few things. You know, here are kind of the updated sections, et cetera. It is really a management -- it's a regulator oversight by the differences the?

Do I have that right?

MR. TAYLOR: Yup, yup, yup. Absolutely.

CHAIR HANSON: Okay. All right. Very good. Thank you. Let's see.

I think I'm just going to wrap it up there. Thank you all very much. I am going to hand it over to Commissioner Wright, which is never a bad idea.

COMMISSIONER WRIGHT: Happy I'm last. So good morning and thank you for your presentations and the work that went behind it to get ready. So thank you and everybody on your team who supported you.

So as I told the first panel, you know, the RT world to me it's kind of unique. It's interesting. And that's absolutely necessary. It's needed as we advance the safe deployment and safe use of nuclear technologies, right? Regardless of their use, commercial, research, medical, whatever. So I really appreciate all that you and your staff are doing in this area. And it is helpful. You know, we have a mission and we're trying to get really focused on this.

Before I actually get to the questions, I wanted to ask something here a little bit different just because I'm curious. Has anyone here on the panel today, do you have any personal experience through RTRs at school? Did any of you do that maybe as part of your college stuff?

MS. BEASTEN: I did. I was a senior reactor operator at the University of Maryland, actually.

COMMISSIONER WRIGHT: So is there any part of that experience you would like to share maybe? How do you bring that insight and experience to your job here?

MS. BEASTEN: So to make a really long story short, the fact that the University of Maryland had a training reactor was the reason I decided to go there for graduate school. It would have been an invaluable opportunity to learn how to operate it and use it for my PhD thesis research. You know not a lot of people get that opportunity.

And I knew I wanted to do something in the nuclear field, and that was the best thing I could have thought of to get me a leg up to explore all of the options available that existed in the industry. I wound up here with the NRC, which has been a great way to translate what I learned from operating the reactor to what I do day to day.

COMMISSIONER WRIGHT: Was there like an RTR college team group here at the NRC?

MS. BEASTEN: No, but I did want to start a fantasy football league.

COMMISSIONER WRIGHT: Okay. Very good. I want to thank you for that. And I'm going to stay with you for a second. Because during some of my trips to RTRs over the last couple years, license certificates were a big deal. And it became a big concern of mine, and I stayed on top of it because some of them graduated and never got their certificates. And that's an important accomplishment, right?

So I just want to recognize the staff and thank them and thank you for prioritizing that and to clearing that backlog and try to keep it clear. And if I could ask, how did you go about clearing it? What did you have to do and, you know, are those actions still in place, you know?

MS. BEASTEN: So processing the certificates requires a certain amount of onsite presence, which is why struggled with it during the COVID-19 health emergency. We didn't have a lot of staff here to facilitate the issuance of the certificates.

So we also previously issued them in batches. And now we issue them as soon as the operator license is issued. So, you know, we've taken steps to just stay on top of it.

COMMISSIONER WRIGHT: All right. Well, thank you. Because it's helpful when people notice it.

Holly, how are you this morning? So the first panel touched on sharing, you know, operating experience across members. So how does the staff ensure that it's consistently receiving and incorporating the latest and greatest operating experience? And how does the NRC share that information it receives from one facility on operating experience across the RTR industry?

MS. CRUZ: Thank you, Commissioner. The event tracking has improved efforts with the OPI group to increase awareness of RTR events. We've also enhanced cross-communication among staff and the community of TRTR. That has improved the effectiveness of event response and provides an opportunity for the staff and the TRTR community to incorporate lessons learned and to training and procedures.

RTR staff and management conduct routine meetings with TRTR community to discuss regulatory and operational issues. I think Amber mentioned that this morning as well. And the staff has increased communications with state and federal agencies to host state representatives and the DOE RTR fields program management on inspections at our DR facilities.

And Amy had mentioned the operating experience database the NRC has taken steps to increase sharing of information with NRC's licensees by providing access to the IAEA database. And the IRSRR allows the NRC international organizations to share operating experience in a single database and that enhances communications domestically and internationally and provides opportunities to identify commonalities among events report globally.

And then finally the staff utilizes various forms to share information on RTR events through participation in various forms such as ANS conferences and through the RIC.

COMMISSIONER WRIGHT: Right, right. Thank you. Scott?

MR. MORRIS: I just wanted to briefly add. It didn't come up in this morning's panel, I don't think, and it didn't come up in ours. But there's an analog to the TRTR. It's called IGOR. And I'm not going to remember what that acronym means, but it's an international group of research reactors. Let's just say that's what it is. I think that's what it is.

But they also meet annually with the national TRTR here. So that's yet another opportunity to expand that.

COMMISSIONER WRIGHT: Good, great. Thank you. So my colleagues were asking some questions earlier, and I think the Chair started when he came to you about, you know, the 104c stuff and minimum amount of regulation and all that. So I'm not going to go there.

But in the first panel we heard a mention that we've had some turnover. And we've had turnover everywhere, right? And I think they specifically said they lost three people on a core team if I heard that right?

MR. TAYLOR: The team lead changed over three times.

COMMISSIONER WRIGHT: They did?

MR. TAYLOR: Mm-hmm.

COMMISSIONER WRIGHT: So it does raise a little bit of a concern because the core team, we're supposed to -- the whole intent of that purpose is to keep that consistency, that familiarity, and the same people, same thing, move it start to finish, right?

So when we lost those people and they turned over, was it because of retirements, or did people go to different agencies or did they go somewhere else within the NRC? I mean --

MR. TAYLOR: So we lost one externally to a vendor for an advanced reactor. We lost one to a great promotion opportunity inside the agency. And then we lost a third to a commission office so.

COMMISSIONER WRIGHT: I was afraid you were going to say that. Yeah, yeah. I resemble that remark. Yeah. But it does, it speaks to just the number of people we have, right, and the resources?

MR. TAYLOR: And they are all nuclear engineers, which is a very critical skill set and a challenge for us. And it continues to be a challenge for us.

The beauty of the core team, though, is they're a team. So just because I lose a piece of the puzzle, the rest of the puzzle is still there. So I need to get a new piece and put it in there. And there's a knowledge management and come up to speed. But it's not like that work just disappeared, right? That work is still with all the rest of the core team because they're doing the review together.

COMMISSIONER WRIGHT: Right.

MR. TAYLOR: So it actually helps us in some respects when we do have turnover. The core team adds a value in that function.

COMMISSIONER WRIGHT: Right. And if I could follow up on that, so when you're building your core team, you know, I know that we've hired, what, roughly 600 people in the last couple years.

And it takes a while to get them acclimated and ingrained into the NRC way of doing -- sometimes three years or so, right? But they still don't have the experience. They're just building that knowledge base.

So where are you pulling your core teams from? I mean, is that pool of talent like really small now and how long will it take to grow that pool?

MR. TAYLOR: So the core teams are principally in our advanced reactor DANU Division. They are staffed within that division already. So they're inculcated with the thinking, the approach that we want to take from the beginning. So they're constantly getting trained and brought up to speed even before they're put on a core team relative to that.

So we have a constant training and development program as part of those activities. And then when we build the core team, we try to make sure that core team has a lot of diversity with regards to experience and capabilities and backgrounds and things like that so we that we come at a project from all aspects and that we challenge ourselves sufficiently.

So, yes, it's a challenge. We put the best mitigating measures we think we can in place.

COMMISSIONER WRIGHT: So one of the things -- the reason I'm bringing it up and wanted to kind of address it. Burnout has been something that I've heard that you've had people who have been really intensely engaged in maybe rulemakings and other things that they are tasked with, right?

And then on top of that, they're doing this. And so you take a burned out person here, and they're already burned out when they're going to work for something else. Is that really being addressed now where we're relieving that?

MR. TAYLOR: So we're doing our best. Staffing continued to be a challenge. We're understaffed relative to the budget as we try to hire the critical skill set. So we've done a great job of hiring. I think we need more work on some critical skill sets as we work on it.

And those are the ones that are very difficult to compete with externally. So, yes, there are staff who are highly capable, very talented and can work on multiple projects. And we try to manage the burnout and we try to keep, you know, that positive work-life balance going and stuff like that.

So we focus on it, and we do the best that we can. And if it ever comes to a person versus schedule, we're going to make the decision to protect the person. We care about our people enough. We need them in the long-term. We can't ruin them in the short-term just for one success.

We'll adjust. We'll figure it out and balance.

COMMISSIONER WRIGHT: Well, I appreciate it. And I know it's difficult. And we're aware, you know, at the Commission level. And, again, I know I'm not speaking for all of them because I can't, but I know they probably share the same feeling. And that is whatever we have to address that we need to do to help there, please keep us informed on that because sometimes I feel like we get to it late, you know? And I don't think it's on purpose, but we want to help in any way we can.

MR. TAYLOR: I think one of the most important things is to collect the data on why staff leave and understand that data and then figure out how to act on the data.

MR. MORRIS: This is a segue of what I was going to offer is that it's not just about hiring and training. It's about retention. And you now, because we've had the conversation about retention related activities. We're doing another critical skills for other critical skill sets. But this is one of them.

COMMISSIONER WRIGHT: Okay. Thank you so much.

CHAIR HANSON: Thank you. Thank you all for your presentations. Thanks for our first panelists. Many of them are still here in the room. Thanks to my colleagues. I think we had a good discussion this morning. We covered a lot of really meaty topics. I think this is a really intriguing area and there is a lot of growth and innovation that is happening here. I think we're really seeing the benefits of a lot of the students who are engaged in this.

I mean, one of the great things about the University of Maryland program is not only can you use that little reactor to do your PhD work, but if I remember correctly, Amber told me once that even at, you know, a reprobate humanities major like me can go and get a reactor license, an operator license at the University of Maryland, which is pretty great as well in terms of bringing students into this field.

So I really appreciate the discussion and with that, we are adjourned.

(Whereupon, the above-entitled matter went off the record.)