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TECHNICAL SESSION - TH23

GLOBAL APPROACHES TO SMALL MODULAR REACTOR AND ADVANCED REACTOR LICENSING

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THURSDAY,

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The Technical Session met via Video-Teleconference, at 8:30 a.m. EST, Dan Dorman, Executive Director for Operations, presiding.

PRESENT:

DAN DORMAN, Executive Director for Operations, OEDO/NRC

RAMZI JAMMAL, Executive Vice-President and Chief Regulatory Operations Officer, Regulatory Operations Branch, Canadian Nuclear Safety Commission

MARK FOY, Chief Executive and Chief Nuclear Inspector, Office for Nuclear Regulation,

United Kingdom

ANNA BRADFORD, Director, Division of Nuclear Installation Safety, International Atomic Energy Agency, Department of Nuclear Safety and Security

SAMA BILBAO Y LEON, Director General, World Nuclear Association

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

8:30 a.m.

CHAIR DORMAN: Good morning, good afternoon, good evening, everyone. I am Dan Dorman, Executive Director for Operations at the U.S. Nuclear Regulatory Commission, and I have the distinct honor to serve as the chair for this technical session on global approaches to small modular reactor and advanced reactor licensing. I'm pleased to be accompanied by four of my distinguished international colleagues who will each bring their unique perspective to offer on this topic.

As we know, many people believe that small modular reactors and advanced reactors, which I will collectively refer to as SMRs, are seen as the next big thing in the nuclear energy industry. As such, vendors in many countries are developing new technologies and submitting them to regulatory bodies for their review.

In an effort to become a more modern risk-informed regulator the NRC is identifying ways to review these new designs more effectively and efficiently while continuing to prioritize nuclear safety and security. In an effort to be more

transparent we are engaging more frequently with applicants, gaining additional insights into their regulatory approaches.

We have been more transformative through our international regulatory cooperation including increasing our collaboration with the Canadian Nuclear Safety Commission on SMRs. Through this expanded cooperation the NRC and the CNSC have issued three joint reports and plan to issue additional reports that are generally applicable to advanced reactor developers and designers.

The NRC and the CNSC also plan to issue targeted reports addressing specific technical aspects for individual vendors or potential applicants. This bilateral work has been mutually beneficial, enabling both of our agencies to identify efficiencies in our respective processes by sharing resources and technical expertise and identifying important lessons learned. I want to acknowledge that there are many opportunities for enhancing collaboration in this area without compromising a national regulator's sovereign and independent decision making authority.

Increased cooperation with our

international partners provides unique perspectives in regulatory approaches with positive impacts on nuclear safety. We can become more efficient as we continue to share resources and expertise.

Without further ado, I'd like to welcome our four highly-esteemed panelists.

Mr. Ramzi Jammal is the Executive Vice President and Chief Regulatory Operations Officer at the Canadian Nuclear Safety Commission. Mr. Jammal has over 35 years of experience in the nuclear industry, combining management skills with scientific experience. Additionally he represents the CNSC in various international activities which include co-chairing the IAEA Fukushima Report, leading Canadian delegations to the Convention on Nuclear Safety and the Joint Convention on the Safety of Spent Nuclear Fuel Management and on Safety of Radioactive Waste Management. Mr. Jammal also sits on the IAEA Commission on Safety Standards.

Mr. Mark Foy is the Chief Executive and Chief Nuclear Inspector at the United Kingdom's Office for Nuclear Regulation. In this role he has successfully led ONR's regulation across various sectors of the nuclear industry, securing

improvements in safety performance of operational facilities, and leading the design assessment and licensing of new reactor technologies seeking deployment in the U.K. Mr. Foy's 35 years of experience in the United Kingdom's civil and defense nuclear industry combined with extensive international experience including various senior roles within the international regulatory community enable him to provide authoritative leadership and advice on nuclear safety and its regulation.

Unfortunately Deputy Director General Lydie Evrard of IAEA is unable to participate in our session today, however we're very pleased to have Ms. Anna Bradford from the IAEA here to step in and provide IAEA's perspective. Ms. Bradford is Director of the Division of Nuclear Installation Safety in the IAEA's Department of Nuclear Safety and Security and has been in this position since September 2021. Prior to joining the IAEA she had a distinguished career at the U.S. NRC for over 20 years, most recently as Director of the Division of New and Renewed Licenses in the Office of Nuclear Reactor Regulation. Additionally Ms. Bradford was Chair of the IAEA SMR Regulators' Forum for three years.

Ms. Sama Bilbao y Leon is the Director General of the World Nuclear Association. She has more than 20 years of experience in nuclear engineering and energy policy. Ms. Bilbao y Leon has worked in the nuclear industry in academia and in international organizations including as head of the Division of Nuclear Technology Development and Economics at the OECD Nuclear Energy Agency, Head of the Technical Secretariat for the Generation IV International Forum, and Head of Water-Cooled Reactors Technology Development Unit at the IAEA.

I thank each of you for being here to support this session, especially considering the events going on in the world and your leadership roles and the time differences between where you are and the United States.

Before I begin my presentation I will note that there will be a question and answer session following all of the panelists' presentations, and we have two polls for this session. So please feel free to enter your questions in the chat box provided on the screen and be ready to answer the polls when we get to that point. And we will get to as many questions as possible at the end of the session.

So I will now begin with my brief presentation about the NRC's global approaches to SMR and advanced reactor licensing.

There is significant interest and momentum toward deploying new advanced reactor technologies to meet future national energy needs. Regulatory preparedness is critical to support that deployment.

In January of 2019 the United States Congress enacted the Nuclear Energy Innovation and Modernization Act, or NEIMA, and directed the NRC to establish a new regulatory framework for commercial advanced nuclear reactors. The NRC has been preparing for the regulation of advanced reactors for many years. We are enhancing our analytical tools and capabilities, endorsing new standards for advanced reactors, resolving key policy and technical issues, and progressing and completing a variety of rulemaking activities. We have several ongoing rulemakings aimed at aligning our licensing processes, implementing lessons learned from recent new reactor licensing, and developing our regulatory requirements for new advanced reactor technologies.

The NRC is working to transform the

regulatory framework for advanced reactors into a modern risk-informed and technology-inclusive approach, the centerpiece of which is the Part 53 rulemaking. While staff efforts continue to modernize the regulatory framework, we are also actively conducting licensing reviews, supporting preapplication activities, and hosting public meetings with interested stakeholders.

Next slide, please? NRC's regulations allow different regulatory pathways which licensees may choose based on their commercial interests and business strategy. The first process is the Part 50 licensing process which prescribes a two-step process involving issuance of a construction permit followed by an operating license. After the NRC reviews the construction permit application and is satisfied that all requirements have been met with respect to the safety of the preliminary plant design and the suitability of the prospective site, the Agency issues a construction permit that allows an applicant or utility to begin building the plant.

The final design information and plans for operation are developed during the construction phase. Because of the potential risks that could

arise after construction has started, this process is more unpredictable, less efficient, and has no protection from backfitting or having the operator license denied by the NRC if the applicant does not meet applicable requirements. The current fleet of reactors operating in the U.S. were all licensed under the Part 50 process.

The second process is the Part 52 licensing process which is a single-step licensing process. NRC established new alternatives which describe a complete -- a combined license process, and early site permit process, and a standard plant design certification process. An application for a combined license may incorporate by reference a standard design certification and early site permit, both, or neither. This approach allows for early resolution of safety and environmental issues before construction begins. The issues resolved by the design certification rulemaking process and during the early site permit hearing process are not reconsidered during the combined license application review, therefore this process is more predictable since it resolves the safety and environmental issues before authorization -- before authorizing

construction. The NRC staff would then only need to review site-specific design characteristics in the combined license application.

The Part 52 process also allows for meaningful public participation throughout the review process. Because the Part 52 process encourages standardization of nuclear reactor designs, it reduces financial risk for nuclear power plant licensees. As of today the NRC has issued 5 early site permits, certified 5 reactor designs, and issued 12 combined licenses at 7 different sites under the Part 52 process. Part 53 represents a new licensing approach which I'll speak about in more detail on the next slide.

If I could have the next slide, please? The NRC staff is committed to our vision of developing an innovative, predictable, and appropriately flexible framework to enable an efficient licensing process for advanced reactors. The enactment of NEIMA reinforced the need to develop this new regulatory framework. Part 53 will provide the same degree of protection of public health and safety as required for the current generation of light water reactors licensed under Part 50 and Part 52. It will

move away from the prescriptive nature of the current requirements and instead will use a technology-inclusive, risk-informed, and performance-based framework. In addition, Part 53 will help implement Commission policy on the use of PRA technology and the goal of increasing the use of PRA in all regulatory matters to the extent supported by the state of the art and in manner that complements the NRC's deterministic approach and defense-in-depth philosophy.

Part 53 leverages the transformative methodology for licensing novel and non-light water reactor technologies discussed in the Licensing Modernization Project. The NRC staff is engaging in very extensive stakeholder outreach during the rulemaking and has received diverse and significant input.

In October 2021 the NRC staff requested a nine-month extension to the current schedule for Part 53. The staff requested this extension based on consideration of stakeholder requests for an option that includes a more traditional deterministic licensing framework for advanced reactors. In addition, the NRC staff recognized that more time

would support further engagement with stakeholders, including the Advisory Committee on Reactor Safeguards, and further iteration on rule language before sending a proposed rule to the Commission.

On November 23rd, 2021 the Commission approved the staff's extension request. This extension will provide additional time for the staff to continue efforts to reach alignment with external stakeholders on the scope of the rulemaking and further develop the rule language. It will allow additional time for external stakeholders to participate constructively in the rulemaking process and ensure better coordination with other NRC advanced reactor activities. If approved by the Commission, Part 53 is now expected to be published as a final rule by August 2025.

Next slide, please? Part 53 builds on a strong foundation of Commission rules, policies, and decisions on performance-based and risk-informed regulations. The rule embodies a risk-informed framework that capitalizes on the progress in the state of the art and probabilistic risk assessment. Additionally, the rule modernizes the licensing basis change process into a risk-informed approach that

leverages the design margin to afford operators greater flexibility. Moreover, Part 53 features a consequence-oriented regulatory framework by leveraging alternative graded emergency preparedness and security requirements that reflect a facility's potential risk to public health and safety.

Principally Part 53 affords designers and operators enhanced flexibility by enabling reactor design with demonstrated safety attributes to leverage the safety margin and gaining operational flexibility. Additional flexibility will be offered in the Part 53 rulemaking by including alternative approaches to establishing the safety case of a design.

Overall Part 53 strives to strike an optimal balance between flexibility and predictability by providing clear and specific performance-based requirements to ensure an efficient and effective licensing process for advanced reactor designs.

Next slide, please? Whatever licensing pathway a potential application follows NRC places a great deal of importance on what we refer to as preapplication activities. Generally,

preapplication activities refer to the exchange of plans, information, and analyses prior to the formal submittal of an application, some examples of which are listed on this slide. The intent of preapplication engagement is to improve the timeliness and predictability of licensing reviews which is to the advantage of both NRC and the applicants and the public.

The categories of information that we encourage potential applicants to share include their proposed licensing schedule, the identification of novel or unusually complex policy issues, and plant design information. In part, this helps the NRC to align our resources and improve our readiness to perform the review. Potential applicants may provide information in regulatory engagement plans, topical reports, and white papers. Staff provide feedback in various forms depending on the type of information. This may be provided as written feedback such as safety evaluation reports for topical reports, as well as in public meetings.

Both NRC and industry have developed guidance to systematize and standardize preapplication engagements and continue to apply the

lessons we are learning from lead actors to further refine the process.

Next slide, please? With respect to small modular reactors the NRC is engaged in preapplication activities covering standard design approvals, combined license applications, and construction permits for small modular reactor designs. Specifically, the NRC is engaged in preapplication activities with NuScale Power to support a future standard design approval application for the NuScale Power Module NPM-20 reactor design. We're in activities with Carbon Free Power Project for a future combined license application referencing the NuScale NPM-20 small modular reactor design, we're in discussions with GE Hitachi on its BWRX-300 small modular reactor design, and with Tennessee Valley Authority for a construction permit and future operating license application for the Clinch River Site in Tennessee, and with SMR, a subsidiary of Holtec International, on its SMR-160 small modular reactor design.

The NRC completed its safety review of the NuScale standard plant design and is currently engaged in rulemaking activities to certify this

design.

Based on recent experiences with the licensing activities under Part 52 the NRC is engaging in rulemaking activities to align the requirement for license applications submitted under Part 50 and Part 52.

Next slide, please? Over the last year we have seen the landscape for advanced nuclear technology steadily evolving and we are adapting and changing with it. This interest is driven in part by strong congressional and Executive Branch support for deploying advanced nuclear technologies.

Perhaps the first observation on this very busy slide is the diversity of technologies including liquid metal, gas-cooled, and molten salt designs. We are seeing strong preapplication engagement from many vendors and we continue to encourage that. Our focus remains on early engagement to identify and address the technical and regulatory aspects of the novel designs, features, and methods inherent in these technologies.

We are seeing interest in a class of reactors that is called micro reactors. These are small reactors producing less than 50 megawatts

thermal. Some vendors envision deployment of micro reactors in remote areas and some are considering reactors that could be transported back and forth to a factory for refueling or between sites as the need may be, however the Atomic Energy Act requires a national environmental policy review of all sites, limiting the potential as-needed deployment.

Several universities and private entities are considering constructing and operating non-power reactors that use advanced reactor technology to perform research and development and the NRC staff is currently reviewing a construction permit application for the Hermes test reactor which will be used by Kairos to further develop their high-temperature salt-cooled power reactor design.

This slide also highlights the names and the diversity of designs that are awarded funds from the Department of Energy's Advanced Reactor Demonstration Program. This gives credence to the technology-inclusive framework that we are building in Part 53.

I'd note also the orange or red highlighted boxes. These are full-scale power reactors aiming to be built by 2027. This slide also

shows the introduction of tri-structural isotopic, or TRISO fuel in commercial reactor designs. The NRC staff is engaging with several vendors through topical reports and white papers on issues related to TRISO fuel such as fuel qualification, fuel performance, and source term.

Next slide, please? One very important element that must not go unnoticed and is central to this session is the importance of our international relations. We realize that focusing on our international collaborations is as important as our collaborations domestically. There is a lot of momentum and interest worldwide in small modular reactors and advanced reactors and keeping abreast of these activities will ensure that our advanced reactor vision is successful.

We want to continue international cooperation efforts, share lessons, and consider that safety decisions taken in one country can inform safety decisions in another country. Therefore, we participate in international organizations like the IAEA and the Nuclear Energy Agency and in these settings we are generally involved in establishing safety guidance documents.

As part of the Small Modular Reactor Regulators Forum we align with the international community on important topics such as fundamental safety functions and defense-in-depth. The position papers produced by this forum and exposure to other regulatory approaches allows us to leverage international experience for developing NRC regulations and guidance.

We are also actively collaborating in the Nuclear Energy Agency Working Group on the safety of advanced reactors development of guidance for fuel qualification. The NRC has taken advantage of expertise from the international community to inform our product. We expect the same benefits from ongoing collaborations on analytical codes and methods and a recently initiated project on material qualification and we envision that this type of harmonization with the international community will help vendors considering licensing in more than one country.

As a regulator we also cooperate bilaterally with key countries to gain insights and best practices. For example, we signed a memorandum of cooperation with Canada which is allowing us to

create joint technical exchanges and preapplication reviews. We have worked constructively with various advanced reactor vendors to identify projects and establish a framework that would support coordinated safety reviews of key design aspects for some advanced technologies.

Most recently we issued two joint reports. The first report documents the CNSC and U.S. NRC position about the X-Energy Xe-100 reactor pressure vessel construction code assessment.

And the second one documents the results of a broad overview of the NRC and CNSC regulatory frameworks and provides a specific comparison of the NRC's Licensing Modernization Project with the CNSC approach.

This concludes my prepared remarks. I'll now turn the floor over to Ramzi Jammal.

Ramzi?

MR. JAMMAL: Thank you, Dan.

Morning, good afternoon, colleagues. I'll start by letting you know that I am presenting -- talking to you today from the un-ceded territory of the Algonquin and Anishinabe peoples.

Next slide, please? A few years back

many of us were getting together looking at the future of nuclear, and in specific innovative technology in SMR. Back then was a futuristic discussions. Today we are in it.

So what we're looking for is where are we now; where we going to be next five years? Definitely domestic and global fleets will be the new paradigm of the industry and with respect to the preparedness associated with the ability of regulating SMR. So where do we go from here right now with respect to the fact that regulators must be ready and prepared in order to address regulatory innovations.

Next slide, please? From a CNSC perspective we continue to take a life cycle approach for SMRs and we are applying through a graduated approach a risk-informed decision making by apply what you call rolling progressive regulatory decisions. As a matter of fact, in 2019 the IRRS Mission give us a good practice with respect to the CNSC readiness in order to regulate SMRs. International cooperation and collaboration is key for such success. And we continue to invest in our regulatory improvements to ensure that effectiveness

and efficiency of the regulator will be maintained at all times.

Next slide, please? What I'll like to discuss with you what is an effective and efficient regulator from this Canadian perspective.

We start by enhancing our internal safety culture. The fact that we will be collaborating internationally, we will be conducting joint reviews with other regulators. The transformation and the culture with the CNSC from our technical experts will have to be -- will have to change. What does this mean?

The international collaboration, let it be national or international, is not an erosion of the knowledge and technical capability of our staff. It is confirmation that the science does exist and has no borders, but at same time there is no erosion to the regulatory decision making nationally and will not take away at all the sovereignty with respect to the decision making.

What we need to do is continue to strengthen international collaboration. Dan mentioned our collaboration with our colleague in U.S. NRC. These steps have demonstrated that the

national collaboration has benefit and this beneficial outcome helps us to provide technical information again for regulatory decision at the national level without compromise to safety. We are working with our colleagues from the U.K. and in specifically ONR in order to take on the lessons learned from the U.S. NRC and improve such collaboration.

So what does it mean from effective and an efficiency from regulatory perspective? Well, I'll start with we must work with industry. We cannot be isolated from industry or the governments. We have to work together in finding answers and providing assurance to the public that safety is paramount for all of us collectively, regulators and industry. We are obligated to disseminate scientific and technical information to the public and we need to engage with indigenous nations and communities, especially as we speak today with the invasion to the Ukraine and the threat of nuclear disasters that has become the focus currently in the public, in the media of the risk of the nuclear ignoring the fact the beneficial element of nuclear and the fight of climate change. Our work has to increase in order

to commit for transparency and build trust of the public especially in the current situation.

Next slide, please? What is our role with respect to advanced reactors? This slide is self-explanatory. I'm just going to pick on couple things. Actually bit more than couple things. Just address the fact that our staff capability and agility has been demonstrated. We did transform and reform the directorate for innovation to become what we call the DART, D-A-R-T, which is the Directorate of the Advanced Reactors and Technologies.

We will be objective-based and performance-based regulatory framework, as we always were. We will be applying the risk-informed decision making process to determine how safe is safe. And I would like to leave you with the fact that we will be applying the rolling regulatory decisions. We will continue to support such decisions by the regulatory research and international collaboration.

Next slide, please? The industry has changed. We are facing new industry, new paradigm, and specific for the deployment of the SMRs. There will be small micro reactors, as mentioned by Dan. There will be shorter construction timelines.

Communities will be accepting it or not accepting it. The outcome will be from what we hear from industry a fleet approach, both nationally and internationally.

As a regulator we are prepared for the new technologies. From our perspective we have demonstrated that our regulatory framework is flexible and transformed in order to face this new paradigm. We continue to look at enhancement from counterparts and colleagues so that we are not missing any points with respect to the deployment of SMR.

Next slide, please? We are applying the multi-faceted approach. On the international scene regulatory collaboration is a must. We cannot continue internationally to say we have one-of-a-kind even though it's a know technology or the only kind that we have. The regulatory philosophy and collaboration has to change in order to make sure that there is international governments and harmonization with the safe deployment of SMRs.

What does international harmonization mean, collaboration? Very much possible in the future that regulatory decisions from Canada or the

U.S. can be transported to other countries or emerging countries in order to ensure that consistency is being present and support is being provided.

Domestically in Canada we're working with our industry in order to harmonize and ensuring harmonization of the standards. We are supporting global harmonization and deployment by interacting with WNA, WANO and other organizations. The key point here is the technical part is easy, is controlled because it's still within the nuclear bubble. However, engagement with stakeholders is key. Let us be proponents. We need to build trust and transparency with the public so they can understand that the culture for safety is applicable at all levels in Canada from the governments to the regulators and to the industry.

Next slide, please? I will put emphasis on international collaboration. It is key for an effective and efficient regulation and it is one of the major steps in transforming the regulatory decision making through international collaboration and through the science. Many of you heard me before; I'm going to sound like a broken record. The

fact that the neutrons in the U.S. will be the same as neutrons in Canada or the same neutrons in the U.K.

We cooperate and shared information with many of our countries -- sorry, of our country -- like-minded countries and organizations in advanced reactor technologies and we start with the fact that our president -- he is the chair of the CSS, and the IAEA has a key strong role in order to make sure that the readiness of deployment of SMR will not be impeded by lack of clarity, lack of regulatory decisions. We continue to lead and participate in -- with the IAEA, with the OECD-NEA with respect to reactor designs, and we continue to work with the working group, both trilaterally, bilaterally and collectively internationally.

As mentioned by Dan, we have U.S. NRC memorandum of cooperation. This work has been a success and we will make sure to continue to be a success. And we did same thing with our colleagues from the U.K. in order to make sure that the collaboration will continue for the deployment of SMRs. From our experience of the international collaboration there are a lot of commonalities that

we can bank on and we can work towards.

In conclusion, successful deployment of SMR is not only on the shoulders of the regulator; industry has a role to play. Putting safety first, domestic and global harmonization and deployment is key success to combat the fight against changes in the climate changes. We should not forget the public trust because they are at the end -- sorry, I'm on the conclusion slide. Public trust is key for the communities and the public to accept our decision making process through transparent and open discussions with the public, answering all of their questions.

I am on the last slide. Sorry, colleagues. I'll be available to answer any questions.

Sorry, Dan. Got excited. Didn't say next slide.

CHAIR DORMAN: Thank you, Ramzi, for that comprehensive view from our neighbors to the north.

Now we'll turn across the ocean and get the perspective from the United Kingdom.

Mark, the floor is yours.

MR. FOY: Thank you very much, Dan.

Hello, everyone, from the U.K. I'll wait for my slides to come up.

Next slide, please? So society wants clean energy that is both safe and secure, but also is optimal cost to the national economies, and in the U.K. the government has identified nuclear energy as a key player in our low-carbon economy. That commitment was signaled back in 2019 in what in the U.K. we call the Nuclear Sector Deal, and that's been reaffirmed since in various publications that you can see here on this slide.

In the U.K. at the moment we've got the EPR under construction at Hinkley Point C. And Sizewell C, a further EPR is going through site licensing. We just completed our generic design assessment of the Chinese HPR 1000. Coming up we've got the Rolls Royce small modular reactor design that's due to commence generic design assessment at the start of next month. And we're also supporting the government in its design to develop an HTGR demonstrator.

But what I've sensed in even just the last few weeks is a keen appetite for more nuclear deployment, and that deployment is to be sooner

rather than later. To realize these opportunities there's got to be a constructive environment for new technologies to be readily deployed and developed.

Next slide, please? Regulators have got a critical role in helping industry to work in ways that are safe, sustainable, and which do offer best value, but also acting in the best interest of public safety. Regulation can be both an unnecessary barrier to growth for many businesses and a catalyst for investment in new sectors.

But regulation is ineffective. It can be expensive and difficult to implement, but a well-designed regulatory system provides certainty to reduce investment risk and good regulation can be a vital part of any infrastructure supporting growth, encouraging innovation, and creating consumer confidence and it enables the rapid and safe adoption of new technologies. As a regulator ONR knows it has an important role in creating and sustaining the conditions where these new build projects can flourish.

Next slide, please? In terms of our approach our enabling regulation philosophy means that we engage early and constructively with vendors

and associated stakeholders, preapplication work as has been termed by others. It creates that collaborative environment focused on a common purpose where new projects can thrive and deliver effectively against clear prioritized outcomes that all are agreed upon.

In practice it's meant working with industry in a stable and progressive regulatory environment and the aim is being to reduce that regulatory uncertainty and avoid undue burden based on a proportionate and, as Dan has said previously, a risk-informed approach.

Doing early engagement the range of SMR and ANR technologies listed here on this slide we've had to do various things, but really at the simplest form we've even just had to put the U.K. context to these vendors of these technologies, setting out regulatory expectations, being clear that inherent safety still needs to be justified, and that small does not necessarily mean a reduction in standards.

Regulatory processes are also often cited as a barrier to innovation, but ONR and other fellow national regulators are here to support industry's ambitions so long as the required standards of safety

and security are being achieved. As an independent regulator public safety will always come first, but to the extent that it's possible we will be agile and will be responsive to the needs of the industries that we are regulating.

Next slide, please? There are various challenges that we face. There's a need to work together better as regulators, as vendors of these technologies, and designers of the wide ranges of technologies that are being considered, to be more open and honest with each other, realistic in ambition, and seeing what the challenges are and how they can become -- overcome by working together.

There's also a whole variety of industry standards and regulatory requirements out there and effort will be needed to rationalize these, achieve convergence, and realize the benefits that they will bring.

And also sovereign regulatory systems pervade. We've got to be open-minded and adopt a strategic outlook, learning lessons say from aviation, radioactive materials transport, and non-proliferation framework where common approaches have been established but they don't erode sovereign

decision making.

Regulatory and legal frameworks have got to evolve and new technologies may need new approaches to regulation, new legislation, and new standards. In the U.K. we've actually revised our generic design assessment process to better align with the varying maturities of reactor designs that are coming forward, providing flexibility to the vendors.

Resources will also be a real challenge for both industry and regulators that will only be solved by working together, but it will also be aided by the international regulatory cooperation that's been indicated by Ramzi and by Dan.

Stakeholder public trust and confidence is also essential and we've all got a part to play in building that, developing engaging -- engagement strategies that help stakeholders understand nuclear, that it's safe, secure, and reliable energy for society. But we've got to use language that they can relate to, that they are comfortable with, and will understand. And that is all part of moving forward with the new build agenda.

Next slide, please? Looking at the

global context, there's been no surprise that we do work closely with fellow national regulators across the globe, multilateral and bilateral cooperation through agencies such as the IAEA and the NEA. And that's focused on global nuclear safety standards and good practice that we all look to actually comply with and achieve, Gen IV Forum, the Working Group on Safety Advanced Reactors, and others. But we also strive to work with our fellow national regulators in bilateral and trilateral arrangements such as U.S. NRC, Canada's CNSC, ASN in France, STUK in Finland, and others in technological developments to learn and share how they are being approached and understand how they can be regulated effectively. It enable benchmarking, identification of good practice, and where we could do better and collaborate more.

I know that many in the industry are keen to see harmonization of standards and there's an appetite from ONR and several like-minded national regulators to work towards establishing these harmonized approaches to licensing and assessment of new reactor technologies. We are keen to achieve the benefits that it will provide.

I'll also highlight the opportunity

that's going to be presented by the IAEA in looking at establishing the harmonization initiative to standardize regulatory and industry approaches. That is a much needed initiative.

Next slide, please? In terms of the future I think what we need to do is to see the industry working effectively together, where vendors are honest with each other, the wider industry and governments, and with regulators of what is credible, what is unrealistic in terms of maturity and deliverability. We've got to avoid making the mistakes of the past of over-promising and under-delivering. Greater cooperation has got to be evident and making better use of industry groups.

That future has also got to see greater international collaboration between national regulatory bodies. It's got to be commonplace established harmonized approaches to licensing assessment of those new technologies and the benefits it will provide such as common standards, reduced assessment times, and convergence of reactor design being deployed globally.

Embarking nations, they will be entering the nuclear age where they are appropriately

supported by those mature regulators and helping them to put in place robust legal and regulatory frameworks. All of that hopefully will come together to achieve the nirvana of fleet deployment to safe and secure common reactor designs on a global scale.

Next slide, please? In terms of getting it right, you should be seeing strong risk-informed regulatory frameworks with degrees of commonality across assessments and licensing, a global industry delivering evident high standards of safety and security performance, and ensuring the protection of society, and that technologies are being deployed efficiently, effectively, safety, and securely.

Next slide, please? In conclusion, from an ONR perspective we will remain agile and supportive and we will work with the industry in a targeted, proportionate, risk-informed way to ensure the safe and secure deployment of these reactor technologies. We'll also continue to pursue international harmonization of regulatory requirements and we look to optimize all of our processes including the making use of pre-existing assessments from other regulatory bodies where it is appropriate to do so, but again emphasize that we

don't exist to prevent the adoption of modern reactor technologies. We are here to facilitate it so long as it can be done safely and securely.

Modern reactor technologies should actually enhance nuclear safety and security, and all of us need to work together to ensure that it's achieved safely to the overall benefit of the societies that we serve. Thank you very much.

CHAIR DORMAN: Thank you, Mark.

So now we have perspectives from three nations and bilateral and trilateral engagements as well as seeing the importance of a broader international perspective and engagement. And so now we're turn to the International Atomic Energy Agency for a broader perspective on harmonizing standards and so forth.

So, Anna Bradford, the floor is yours. Thank you.

MS. BRADFORD: Thank you, Dan. Can you confirm you can hear me okay?

CHAIR DORMAN: Yes, we hear you fine.

MS. BRADFORD: Great. Thank you.

And let me send the apologies of DGD Evrard. I know she wanted to be here today to

participate in this discussion. This topic is very important to her and to our agency, so I'm glad to be here today to talk about it on the part of the agency.

So my presentation, if you could go to the next slide, please? It will be threefold. I'm going to start with an overview of the IAEA work on small modular reactors and non-water-cooled technologies. Then I'll focus on the challenges and then I will end with some views for the future.

Next slide, please? So there are in particular four major activities that the Department of Nuclear Safety and Security has currently undertaken related to the safety of these novel technologies that I'd like to discuss today.

There's the work conducted by the SMR Regulators' Forum, which has already been mentioned once or twice; the review of the applicability of safety standards to SMRs and non-water-cooled reactors; the development of several documents with a purpose to provide examples of practical application of safety standards and also gathering member states' experience, and fourth, the development of a repository of knowledge. And I'll come back more on all of these topics.

Our departmental activities are also part of the agency-wide platform on SMRs. This platform is coordinating high-level general work in the area of SMRs and it has been established with the aim at better coordinating the activities conducted within the agency because there is quite a lot going on at the moment.

So next slide, please? So the SMR Regulators' Forum started their activities in 2015. It has since completed two phases of work resulting in publications on the different topics that you can see here. These topics were selected by the participating regulators as being important to need some discussion and resolution. In their work the SMR Regulators' Forum aims to reach common positions and in some cases provide recommendations to the IAEA.

In the ongoing Phase 3 one of the key topics of interest of the SMR Regulators' Forum is how to enhance regulatory cooperation. This is perceived to be of maximum importance for SMRs. The forum is looking at different options such as mutual recognition of other regulator's assessments or perhaps increased collaboration.

Another important topic in Phase 3 is the integration of security safeguards and safety-by-design principles. If this is not addressed during the design stage, it may be very difficult and costly to address at later stages of the nuclear power plant.

The IAEA is working very closely with the SMR Regulators' Forum on these topics and plans to build on the work developed by the forum to guide future activities and publications particularly on the topic of regulatory cooperation.

Next slide, please? IAEA has completed and applicability review of the safety standards to SMRs and non-water-cooled reactors covering all the aspects of their lifetime. The review takes into account inputs by experts from 30 member states and several international organizations including some regulators and the SMR Regulators' Forum. The review has confirmed the overall applicability of the IAEA safety standards to SMRs and non-water-cooled reactors.

However, we've also identified some areas of non-applicability, some gaps, and some additional considerations that may deserve further work, mainly to help the implementation of the safety standards to

these technologies. To some extent this work can be done without amending the safety standards themselves. The findings of this review are presented in a draft safety report which is due to be published later this year.

On the next slide I'll provide you with an overview of the key challenges we've identified as part of this work and these (audio interference) alignment with the findings with the (audio interference) from the SMR Regulators' Forum.

So next slide, please? (Audio interference) some of the safety standards, mostly those related to design and safety analysis may not apply directly to non-water-cooled reactors (audio interference) clarify the intent of the safety standard in a technology-neutral manner.

Second, some areas of novelty of non-water-cooled reactors and SMRs may have safety implications not captured in the safety standards. Their future consideration may result in new or revised requirements or recommendations. For example, there may be new phenomena, failure modes, design features, or alternative operating models. There may also be differences in the deployment

model.

For example, the future owner or operator may not be known during the phase of manufacturing which may have implications for the future licensee responsibility for safety during operation.

Another example of importance is the case of the transport of a transportable nuclear power plant. There are currently no safety standards that cover this exact situation.

Third, there's a lack of regulatory and operating experience for some of these designs with challenges for the safety demonstration, particularly when considering first-of-a-kind technologies. Furthermore, even when safety standards are applicable, there's a lack of experience on how to apply them in practice. For example, when it comes to the concepts of severe accidents, assigning (audio interference) conditions, or the implementation of defense-in-depth interpretations of these terms can be different from those used for conventional water-cooled reactors.

And finally, there is increasing interest in cooperation among regulatory bodies in view of the potential global deployment of SMRs and everyone's

limited resources.

Next slide, please? So at the IAEA we've been working on defining a way forward to help our member states address these challenges. We're currently developing a plan in terms of publications and activities in 2022 and beyond consisting of three major work streams: First, we'll be working with the Commission on safety standards and the safety standards committees to plan for the consideration of how to enhance safety standards' applicability to SMRs and non-water-cooled reactors.

Second, we're planning to develop publications to capture learning from practical examples for specific technologies, mainly non-water-cooled reactors and transportable reactors, on how the existing requirements and recommendations may be fulfilled.

Third, we're planning to develop a repository of technology-specific knowledge comprising technical documents, webinars, and training materials. This information could support future safety standard requirements and recommendations to be developed by the IAEA.

Next slide, please? We're also seeking

to strengthen our work with regulators that are licensing or preparing for the licensing of SMRs and non-water-cooled reactors, particularly taking forward the work developed by the SMR Regulators' Forum. The IAEA can serve as a platform to enable regulators to work together on SMRs and try new ways of cooperation. We have several tools to facilitate this cooperation.

For example, regulators can work together in the IAEA Technical Review Services for Conceptual Designs. This can help regulators to develop common positions on areas of safety for SMRs that are not well-covered by IAEA safety standards.

Also, the development of an IAEA detailed publications on effective regulatory cooperation on design assessment following the recommendation of the SMR Regulators' Forum. This work could consider potential processes to enable regulators to carry out joint regulatory design assessment.

And lastly, I'd like to mention that the agency recently launched a new initiative called the Nuclear Harmonization and Standardization Initiative that provides wider perspectives to collaboration and harmonizing regulatory and industrial approaches in

support of the global deployment of safe and secure SMRs. This is in the very initial stages of formation, so I'm not going into more details about it here today, but we will be providing more information on this in the near future.

Dan, that's all I wanted to cover today, so thank you very much for your time.

CHAIR DORMAN: Thank you, Anna.

And now for an additional perspective, a broader perspective, we'll turn to Sama Bilbao y Leon, World Nuclear Association.

Sama, the floor is yours.

MS. BILBAO Y LEON: Thank you. Thank you very much, Dan. It is a true pleasure to be with all of you today.

So I see -- I don't see -- okay. Here are my slides. Perfect.

So let's go to the first slide because I wanted to maybe start by providing a little bit of context of why this is very important. Of course, I know that all of you are familiar with the very important role that is expected from nuclear energy as we try to address the huge challenge of climate change. So and then of course I'm looking at these

as a -- at a global level.

So obviously both International Energy Agency and the IPCC call for an increased role for nuclear energy. This is going to require not only to maintain and do -- to extend the life of the current fleet of nuclear reactors as long as is feasible and economically possible, but also of course the construction of new reactors.

This is going to be the (inaudible) of many according to the scenarios. We are going to need many gigawatts of new nuclear capacity which is going to be large and of course small modular reactors. So, and the key here we are going to need this urgently.

So if we go the next slide, I also want to highlight that -- if you please click three times to see the three additional images in the slides? Thank you.

So the point here is we envision of future in which nuclear energy will have an increased role, both for electricity production, but also using the zero carbon nuclear heat for industry, for hydrogen production, for district heating, et cetera, et cetera.

So to me there are three major challenges that we as a nuclear community need to address together in order to ensure that nuclear can actually play this huge role that we all think it needs to play in this clean and just world. So to me those are financing, which is an area which we are working very closely. There is perception. And finally of course regulation. So I'm going to focus today in the area of nuclear regulation.

So if we can go to the first -- next slide? Of course we know that our existing very robust national regulatory requirements were developed with little foresight regarding the possibility of the global nuclear industry that we have today. So while the fundamental requirements and standards have been developed and agreed (audio interference) --

So in this report that you would see here, we demonstrate that the nuclear industry is being held back, but the national approach is to licensing and regulation. And what should be an efficient series of nth-of-a-kind projects with significant learning curves have turn into a never-ending series of first-of-a-kind ones. And this is

something that we can see clearly by the four EPRs that are either in operation or under construction today, both in Finland, in France, in China, and the United Kingdom. So this is something that is adding uncertainty and risk to the deployment of new nuclear technologies.

So let's go to the next slide because of course the issue is even more significant as we are looking at the small modular reactors because the business case and the essence really of the small modular reactors to have nth-of-a-kind deployment, which is predicated in the same reactor being built in a factory mode and shipped to the different locations around the world.

So, and of course also this is going to require the emergency of a global market that needs to be as standardized and streamlined as possible, and just as importantly the consolidation of the global supply chain with standards set in a way that is as global as possible.

So, this of course means that a streamlined licensing process between countries will significant help to facilitate this deployment. And it is vital if we are going to take advantage of the

decarbonization opportunities that nuclear provides. So this means that we really need to reinvent or maybe adapt the way we are doing international licensing and regulation to these global world in which we are today. So what we are looking is in processes that could lead to the development of multinational cooperation to support the streamline an harmonized licensing and regulation of these innovative small modular reactor designs.

So let's go to the next slide. So you already heard a number of efforts that have been going on for quite a while. And so this is good. We've been working on this coordination and harmonization for a while. At the international level you have already heard the work that the International Atomic Energy Agency is doing, developing the SMR platform. That will bring together its activities such as the SMR Regulators' Forum and its review of the applicability of the safety standards for emerging reactor designs, among others. And of course, the Nuclear Energy Agency at the OECD have also been collaborating through the MDIP and the also the CMRA committees.

So at a regulator level you heard; I'm

not going to insist, the very important ongoing collaboration between different national regulators such as the CNSC, the U.S. NRC, and the U.K. ONR. So that is obviously very, very positive for our steps.

And we also have the work that is taking place for example in WENRA that they are constantly reviewing and updating the safety reference levels, which are obviously widely used by industry and regulators.

So within industry we have the CORDEL, which is a working group that we have within the World Nuclear Association, which I will discuss in a second. And then of course we have other efforts. For example, ENNIS, which is a group that is aiming to convert a set of European nuclear installation safety standards and they're harmonizing limitation. And then of course we know that organizations such as EPRI and the EUR have been working on the development of owner and operator requirements to help drive standardization.

So if we go to the next slide, I will tell you a little bit more about CORDEL. So CORDEL was created in 2007 and has been working together with industry -- I mean within industry and also with

regulators and with governments to really move forward for greater harmonization of regulatory authorities. So we have been working together. We have defined much more carefully or much more granularly the need for greater harmonization of regulatory approaches and we have also looked for practical examples in other industries or perhaps within the nuclear industry. So we looked at the regulatory approaches for the transport of nuclear materials and we also look at the regulatory approaches in the aerospace industry.

So taking those examples, we are looking to increase the licensing predictability through the use of a consistent approach to reduce cost as much as possible by reducing licensing efforts and minimizing the redesign by different countries. And of course reduce construction schedules through a consistent construction approach. And very importantly facilitate a consistent supply chain with the same goals and standards throughout the global nuclear supply chain. So all these will help reduce risk and increase investor confidence to a consistent deployment.

So as I said, we've been working on this

for a long time, since 2007, and I think we've done a significant effort and we are making significant progress.

And if we go to the next slide? I won't really go into the details because I am actually running out of time, but I just want to hint to a potential framework that the CORDEL Group at the World Nuclear Association is being develop in the last six months to a year.

So this is a potential international framework that may help streamline international licensing and regulation at a global level. So this is an approach that is currently under review and we are hoping to present this very soon to our working group members.

So in fact, if you go to the next slide, there will be -- in May there is going to be a workshop of the CORDEL Working Group in which ware going to discuss in more detail the proposed framework and how it may be sharpen or improve in order to actually make it feasible and make it applicable as we move forward.

So let me just go to the last slide where I have my conclusions where essentially -- and what

I'm saying is just like you have heard from the other previous speakers. There is an urgent need to move forward together because if we really want nuclear energy to take the role that it needs in this decarbonization and also helping newcomer countries and developing countries to reach the economic development that they need, we really need to accelerate our efforts towards the streamlining of these licensing and regulatory processes.

So in that sense while there is a lot of cooperation between a lot of the organizations that you've seen you've seen before, there really seems that some of these activities tend to be done in isolation from one another. So we really think that there is an urgent time to bring, number one, government leadership to actually put in place the legal frameworks, the policies, and to bring forward the capabilities that are going to allow regulators and governments and industries to truly work together.

And as you said, there is currently a lot of collaboration, but perhaps we really need to figure out how to make this collaboration much more effective so we actually continue to move forward at

the speed that is required.

So perhaps the three points that I will just highlight, which again nothing new; you have heard this from the previous speakers: Number on, we really need to capitalize maybe pragmatic approaches to align the licensing and regulation for existing water-cooled reactor technologies, large and small, because obviously those are the ones that are going to be deployed earlier. So we need to facilitate this deployment.

Then we really need to make use of all the lessons learned from pervious harmonization efforts in water-cooled reactors and other technologies to really develop the regulations for advanced technologies in a way that we are not going to find ourselves reinventing the wheel and having to do go back to align our licensing processes.

And finally, we need to support newcomer countries as they design their regulatory approaches and to help them optimize them so they can learn from how much we have learn in current nuclear countries.

So with this, I will stop and back to you, Dan.

CHAIR DORMAN: Thank you so much, Sama.

And thank you to all of our panelists for your presentations. I think we've generated interest in our audience.

Before we begin the question and answers, we do have the first polling question. If we could get that teed up for the audience. You can click on poll on the right side of your screen and answer this question of what do you think will be the biggest challenge to deploying SMRs and advanced reactors?

And while you're doing that, let me just bring up a general question that was touched on, the sovereignty of individual nations. But in looking at harmonization and collaboration, how do you balance that with the sovereignty of individual nations?

So let me open that up to the panel for your thoughts.

While folks are weighing that question, I think that we each have different legal frameworks. We have different administrative procedures that we need to go through and fulfill our obligations within our nations to engage our stakeholders in the process and inform our decision making in that regard. But as Ramzi indicated before, the neutrons are the same

in the U.S. and in Canada and the U.K. and elsewhere.

So I think there are -- in harmonization and collaboration I think we are best focused on the specific technical issues to find a common thought on risk-informed and performance-based standards and find harmony in those areas.

Turn it to Mark.

MR. FOY: Thanks, Dan.

We have discussed it before and recognize the challenges between regulatory regimes that exist, but I think there's an acceptance that we've got to approach it in an open-minded manner, not recognize that perhaps a system that sits in the U.S., Canada, France, U.K., or wherever is the best system. We've got to come at it literally open-minded, clean slate, what is the best way to approach international assessment licensing of a particular technology? And I think if we do it in that manner, you've got the best chance of success.

Where it has failed in the past is when people have come to the table to talk about working together and they say, well, we do it this way in our country and we've got to keep on doing it this way. We'll never get anywhere with that.

And then it also touches on a point that some has made that around we have to get government on board with this. Government has got to be supportive. Regulators can have the best intent the world, but if you don't have the backing of your government, again you're not going to go anywhere. So I'll just leave it there and (audio interference) commenters.

CHAIR DORMAN: Ramzi and then Sama?

MR. JAMMAL: Thank you, Dan. To add to what Mark has said, it's key to understand the fact that nuclear -- harmonization in the nuclear domain should look at the SSR-6, the consent to the findings of technical certification of a package. And I'm not diminishing at all the risk of an SMR versus a package.

So there are good practices internationally within the nuclear and such things can be -- the systematic approach can be applied for the SMR. And at the same time this is not new to the regulatory industry other than nuclear regulators. Aviation does it. Pharmaceutical does it. Look at the vaccine roll-out. So these are key principles that we can learn from. And as Mark mentioned, if

we're going to come to the table the U.S. is better than Canada, Canada is better than U.K., there is no point having that discussion. So the end point is sovereignty will continue to exist because the final decision making is going to be by the regulator and in Canada specific will be the commission.

In addition is there's need to a policy perspective from the governments in order to support the regulators to allow such things to take place from a positive perspective without interfering with the independent decision making.

CHAIR DORMAN: Okay. Thanks, Ramzi.

Sama?

MS. BILBAO Y LEON: Yes, thank you. I really was -- I think that both Mark and Ramzi have cleared up most of what I was going to say.

Maybe the last thing that I would say is that sometimes I wonder if the word harmonization is a little bit not the right word because sometimes it feels that we may actually pile up regulations as opposed to actually do what we want, which is more optimize. So this is why I tend to talk about streamlining.

This means that it doesn't mean that one

regulator needs to give up the way they do it or they need to lose their sovereignty and their independence, but we can find -- optimize approaches and we can have innovative approaches to actually streamline the processes and the way the different regulations are being looked at so that in the end everybody gets to do their job and they -- but do it in a way that we achieve the goal that we need to.

CHAIR DORMAN: Okay. Thank you.

MS. BRADFORD: Can I say one thing, Dan?

CHAIR DORMAN: Sure, Anna.

MS. BRADFORD: I would just say I mean Ramzi is right, a neutron in one country is the same as a neutron in another country, but I would say the way people feel about those neutrons and what they think needs to be done about those neutrons can of course be very different from country to country. And I think that the sovereignty is one of the big challenges about an international harmonization approach and it's one that's going to have to be addressed. I think the only solution is that the common approach has to be one that's acceptable and that each sovereign nation can accept. As Mark was saying, we have to come to it with an open mind, but

it is quite a challenge. I just wanted to add that. Thank you.

CHAIR DORMAN: Thanks, Anna.

I understand we're having some technical difficulties with the polling, and I know the team is working behind the scenes to get that back. So we'll go onto another question.

The questioner suggests that there are possibly conflicts between safety enhancements for SMRs and economic goals for the developers. And the question is how do you resolve those?

I think I'll take a first stab at that. And I see Ramzi's hand as well.

I think from a regulatory perspective we're not wedded to the economic goals of the design in the first point, but as the developer faces trade-offs in the development of the design, they'll need to meet the regulatory standards for safety. So they'll need to provide safety enhancements that are needed to meet the regulatory standards and see how they can work that out to achieve the goals of what they're trying to put in the marketplace.

Ramzi?

MR. JAMMAL: Yes, thanks, Dan. My

answer will be based on two levels or two segments of economic goals: In Canada we've been doing the vendor design review or pre-licensing reviews for several years right now, a little over five years. Our mandate is not economic mandate. The fact that we provide clarity with respect to license-ability of the design in Canada, that provides some economic benefit to the designer. And even though it's not our mandate, through the regulatory certainty, clarity -- and in Canada we can say that there is administrative protocol that we put in place that's really anticipate what challenges in the licensing process the applicant will face.

So economic outcome is not our mandate, but we will be able to provide regulatory certainty so that the first-of-a-kind -- and if applied for the nth-of-a-kind, that will be the industry's economic factor; that's not ours. But we provide regulatory certainty. And since Canada -- we were the first G7 to receive an application for a design that OPG has selected, which is the GE XWR, or X-Energy. Those are key principles of regulatory certainty that will support economic factors at both levels for the applicant, which is not our mandate, but at same time

for the operators overall.

CHAIR DORMAN: Okay. Thanks, Ramzi.

Others want to weigh in on this question? Mark?

MR. FOY: Yes, thanks, Dan. I think from for me I'm not quite sure where the question coming from because SMRs still have to satisfy the same standards that existing reactors do. So that would be built into the cost space. We are not driving additional higher standards of safety. There are claims around SMR technologies that they are safer by design, passively safe, fault tolerance and such like. Those are the claims of the vendors and they must be building those into the designs.

So to my mind I don't think it's regulation that's driving any economic impacts on SMRs. They still have to meet the prerequisite safety standards and those that are set by the agency. To my mind there are lots of benefits to SMRs in the economic world. Ramzi's already talked about the nth-of-a-kind. SMRs are intended to be deployed in large numbers. So you're going to see significant economies of scale over and above what you get for gigawatt scale reactors. And again a stable

regulatory environment I think gives confidence, de-risks these projects, and is more attractive shall we say to the investment market. So I'll leave it there.

CHAIR DORMAN: Okay. Thanks, Mark.

I see we have the results of the first polling question. And so I think that about half of the group has identified first-of-a-kind technology as the biggest challenge to deploying these technologies. I think also the financing seems to rise in people's concerns. And Sama highlighted that and did not go into depth on the financing piece in her presentation, but wonder if anyone has any thoughts on this -- results of this polling question?

(No audible response.)

CHAIR DORMAN: No? So if not, we'll -- the question of fabrication and construction codes and how those differ across geopolitical boundaries -- Sama talked a bit about the nth-of-a-kind. And so I think those are areas that create a burden for the designer to translate what worked for the first-of-a-kind in one country and then translate that into an acceptable approach in other countries. Any thoughts? And I think I was intrigued by Sama's

slide that she very briefly touched on that had regulatory-led on the right side, but it also had the industry-led on the other side. So there's a role of industry in working towards harmonization or streamlining. So interested in any thoughts on that element of the challenge. Sama?

MS. BILBAO Y LEON: Yes, so I mean I completely agree, there is obviously the regulatory side, which is clearly very important, but as both Ramzi and Mark mentioned, there is a very important role for industry here. So codes and standards is obviously very important and this is one of the areas in which we are working on.

And also the other thing is this continuous engagement between the industry and the regulators, to truly understand what we are talking about. Because this is what I mentioned earlier, that sometimes even though the regulation is clear and we are all based on the same IAEA standards. Sometimes the interpretations are different. So I think that this engagement with industry and regulators, to walk together these paths so we don't have surprises at the last minute is very, very important.

CHAIR DORMAN: Okay. Others on that?

MS. BRADFORD: Dan, if I could go back to the --

CHAIR DORMAN: Yes, sure.

MS. BRADFORD: -- poll results about the first-of-a-kind?

CHAIR DORMAN: Yes.

MS. BRADFORD: I would just agree that's a challenge. It's very hard to be first. You're blazing the trail, people that come after you benefit from the lessons that you've learned and maybe the changes that were created in the context around you.

We recognize at the agency that there's a gap there with first-of-a-kind, and so we're going to start probably putting together a document on what is needed for licensing of a first-of-a-kind reactor given that you might not have much operating experience, might not have models that apply, things like that. So that's definitely -- I just would agree with the results of that, that that does need some attention. Thanks.

CHAIR DORMAN: Yes, thanks, Anna. And it -- also imbedded in that question there was first-of-a-kind and also non-LWR. And for all of our

experience with LWR, non-LWR just introduces different issues. And so how we address those different issues. And for us in the U.S. the preapplication discussions are critical in identifying and obtaining early resolution on those. But it is a significant challenge.

Ramzi, I saw your hand go up?

MR. JAMMAL: Yes, thanks, Dan. Definitely the challenge for the first-of-a-kind is going to be existing, but we have to focus on the technology at this point, the generic element, the basis we spoke about. As Anna said, yes, it's how do you interpret the neutrons and how you do accept them is different than the technical element with respect to the neutrons. So the first-of-a-kind is a take-off element. There are some generic components that can be applied from a lessons learned perspective, but there are some uniqueness to that first-of-a-kind. And I can speak of a Canadian perspective. We're working collaboration with the U.S. NRC. And as a lead regulator the collaboration with the industry. even the applications potentially between TVA and OP -- and the Ontario Power Generation, those are key elements for us not to

duplicate the effort. But I can speak of the first-of-a-kind. We are relying and cooperating with the U.S. NRC on may of the topical areas that you already reviewed from the codes perspective and we are assessing to meet our requirement. So the first-of-a-kind is going to be unique to the technology with some generic element.

On the international front; Sama and Anna mentioned little bit, but we will require international governance. So if Canada is out first, it would be yes, it's out first. Yes, we are trailblazing. What's going to destroy the regulatory credibility is if some international document comes with an opinion. That will really take away the work that was done to date. And in the nuclear industry, because safety is paramount, we do it sometimes without recognizing what does enhancement mean? It's not what we did is unsafe. And that's why we say it's a rolling regulatory approval.

And one of the questions to me was how do you apply this conform? The data comes from everywhere. So in other words, from the vendor design review we do have enough information to be able to determine what is the acceptable risk and how

we apply risk-informed decision making.

CHAIR DORMAN: All right. Thanks, Ramzi.

Mark?

MR. FOY: Thanks, Dan. I would hope that attendees are recognizing that there is an appetite amongst regulators to work together, but not just with regulators, but also with the industry. So although first-of-a-kind actually does have some risk associated with it, I think you're going to see the benefit of people/organizations working together to allow that first-of-a-kind to be a success and to be deployed more efficiently and effectively.

But I think what has to happen is to have open honest discussions. So it's no good having unsubstantiated claims about what a particular reactor technology can do. You've got to have the evidence there. And what that does, it builds trust between all the various stakeholder organizations and increases the chance of successful deployment of the technology.

So first-of-a-kind, yes, does have risk, but I think you'll start to see benefits that haven't existed previously. Technologies 30, 40 years ago

that were developed in the U.S. predominantly deployed in the U.S. for quite a period of time. Likewise in the U.K., AGR technology. And they stayed within those sovereign states. What we are now talking about is cross-bound deployment across the globe. And I think people are attuned to working together and making a success of it. It will be a challenge, but I think we're starting that journey. It's a long way to go, but it will require focus and effort.

CHAIR DORMAN: Thanks. Thanks, Mark.

Let me take a moment now and turn to the audience and tee up our second polling question. In what areas could collaborative efforts among regulators provide the greatest potential benefit in terms of clarity, consistency, and efficiency for SMR and advanced reactor licensing? So acceptance of common standards in which of these areas?

And while you're considering that, Ramzi, you talked a little bit to the question of how risk-informed decision making -- I think as we look at different technologies, non-LWR technologies, we have obviously a great wealth of detailed data that supports our risk models for light water reactors,

but as we look at other technologies perhaps more uncertainties in the models. And how do we address uncertainties and how can we better cooperate together to share experience and lessons learned?

MR. JAMMAL: I'm sorry, Dan. Was the question to me? Sorry. Or just to --

CHAIR DORMAN: Well, it's to anybody, but I think in the context -- both in risk and deterministic analyses as we look at new technologies where perhaps we have less of an empirical database, how do we deal with that in our licensing evaluation?

MR. JAMMAL: (Audio interference) --

MS. BRADFORD: Dan, this is Anna. I think this is where --

CHAIR DORMAN: Anna? Yes.

MS. BRADFORD: Yes. I would just throw something out there. I think that this is where the graded approach comes in. As you gain more knowledge and information, you can perhaps adjust to fit that. But at the beginning when perhaps there's more risk and you don't have as much data to base it on, you have to appropriately grade your safety requirements or operating conditions or something like that. But that's what comes to my mind right away is the graded

approach regarding how much knowledge you have about that technology.

Ramzi, I'm sorry, did I cut you off?

MR. JAMMAL: Not at all Anna. Anna said it: there is graduated approach recognizing what is an acceptable risk? We have regulatory requirements with respect to deterministic values and we have requirements from an objective with respect to PRA. In Canada we call them PSA, or probabilistic safety assessment.

If you look at the regulatory framework, we always say continuous enhancement. And in Canada we have the PSR element, and the periodic safety review will provide us with areas of improvement. Again we have the regulatory framework in place. And from the fundamental principle, enhancement towards the future, it does not mean the current status is unsafe. What I'm trying to say is the licensing approval is unsafe. And the clarity and certainty as part of the design with the industry -- industry has a big role to play on the standardization and the modeling perspective.

Yes, there is a need for empirical formula, but we have to rely on modeling, and modeling

is so sophisticated today. That will give you a pretty good predictability on where we would like to be or we want to go and at the same time what is the risk with respect to the uncertainty? The communication of the uncertainty not being unsafe. The uncertainty, communication of uncertainty is to say we know what is -- what that is and how we going to go about improving it. And recognizing that uncertainty is part of the approval process because we accept risk. And the key point is what is the acceptable risk that the regulatory body is going to take? And it does not mean we're going to erode again the safety determination. This is a continuation. That will be my answer.

CHAIR DORMAN: Okay. Thanks, Ramzi.

If we could just bring up the results of the question and then I'll come back to you, Mark.

So looks like the general assurance standard seems to be the consensus view of the area for the greatest efficiency, and also PRA standards. So interesting perspective from our audience on this area. But room for improvement across the full suite of codes and standards.

Mark, back to you. You had some thoughts

on that last question.

MR. FOY: Yes, it's just really underpinning what some of the previous speakers have said. It's that incremental approach, but it's a mix of PSA, deterministic, and basic engineering as well actually. So there are three legs to it. And you were taught that incremental approach. But I think the basis for it all is the fault analysis. So you're looking at the fault analysis to keep that indication part where the riskier areas of a particular design are, and that would enable you then to focus your effort not just as regulator, but also as a vendor of that technology as well.

CHAIR DORMAN: Yes, great. Thanks, Mark.

So we're coming near the conclusion. Let me ask one more question that's really quite a broad question. I don't know that we'll have time to do it justice, but where does security fit in all of this? Obviously we're in an interesting world environment evolving kinetic and cyber threats, also evolving security technologies. But as we look at new and advanced reactors, how does security fit into the licensing approach?

Ramzi, I saw your hand go up.

MR. JAMMAL: Yes, thanks, Dan. I'll speak from our experience. We did -- as part of our readiness for SMR we did review all of regulatory requirements and regulatory framework and we recognize that some of our security regulations, existing security regulations are very prescriptive to the point that we'll be (inaudible) impediment, but will become a challenge for no added reason other than the experience we gained over time from regulatory oversight. Because the CNSC regulate the three Ss: safety, security, and safeguard.

We are on the process and towards the last step in the regulatory amendment to balance our safety requirements to be performance-based at same level as the safety element and accepting the objective that the proponent or the designer will meet our security objectives without compromise to the safety -- sorry, to the security culture itself and meeting our requirements. So we are amending our regulation and we are almost at the last step with respect to publishing the regulation.

CHAIR DORMAN: Great, Ramzi. Thank you.

Others? Mark?

MR. FOY: Yes, similar to Ramzi, we actually also regulate the three Ss, and we've moved from a prescriptive approach to regulational security to being more outcome-focused. So we don't regulate and say you have to have a fence so high, you have to have so many responders on site at any particular moment. What we're going to say is you've got to put sufficient measures in place to delay the threat by a certain period of time. And that then -- what that does, it instills ownership on behalf of the operator, the licensee. So instead of them relying on us to tell them what measures they have to put in place, they have to think about it themselves. They take ownership of it.

In terms of these new technologies, we complete a safety assessment and the security assessment in our work in relation to completing generic design assessment. So when we issue our design acceptance confirmation, it considers both security and safety matters in the (audio interference).

CHAIR DORMAN: Great. Thanks, Mark.

Ramzi, I saw your hand go up again.

MR. JAMMAL: Yes, just 30 seconds. I

would like to add the fact that security is integral to safety; safety is integral to security. Because the end consequences from safety or security is your logical impact. And if you take that into consideration, the commonality between the two are phenomenal and that's why you would see our amendments to performance-based from security perspective. And those -- that's such -- well, I won't call integration, but collaboration and harmonization is key. So that one is interconnected with the other.

CHAIR DORMAN: Yes, thanks, Ramzi. And I would just add that as we look at technology-inclusive framework and we look across the spectrum of designs that may come to us, the characteristics of an accident, whether it's induced by natural causes or by malicious intent, are very different in terms of the timing of the development of the hazard and that may affect the performance considerations for the security response in terms of delay, detection, delay, and response. And so having performance-based requirements that are tailored to the specifics of the technology I think are important.

Mark?

MR. FOY: Yes, thanks, Dan. Just quickly, 30 seconds again. In terms of our goal setting security regime and the assessments of these new technologies -- because all aspects of security -- because I saw there was a cyber -- evolving IT threat that -- physical IT and cyber personal protection information security, all the gamut of security that you would expect.

CHAIR DORMAN: Yes, great. Thank you.

So, Anna?

MS. BRADFORD: Yes, I would -- just very quickly I would say you asked how does security fit into this, and I would say in a simple approach it needs to be at the very beginning with SMRs. As SMRs are developing novel approaches to safety, there should also be novel approaches to security because we have a unique opportunity here to just have it integrated from the beginning. So thanks, Dan.

CHAIR DORMAN: Great. Thank you.

All right. Any last words?

(No audible response.)

CHAIR DORMAN: Thirty seconds here, thirty seconds there. We're a few minutes over. I

want to thank all of our distinguished panelists for taking time out of your very busy schedules in a very challenging time to spend this time with us. It's been a wonderful discussion.

I want to thank our audience for your participation.

I want to thank all of the team who supported making this happen and worked behind the scenes.

This concludes this technical session and the final technical sessions of this year's RIC will commence at 10:30 Eastern Time. Have a wonderful day. Thank you.

(Whereupon, the above-entitled matter went off the record at 10:03 a.m.)