HOUSE OF COMMONS
CHAMBRE DES COMMUNES
CANADA

Standing Committee on Natural Resources

RNNR • NUMBER 036 • 1st SESSION • 42nd PARLIAMENT

EVIDENCE

Tuesday, November 29, 2016

Chair

Mr. James Maloney

Standing Committee on Natural Resources

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● (0850)

[*English*]

The Chair (Mr. James Maloney (Etobicoke—Lakeshore, Lib.)): Good morning, everybody. Thank you for being here on this beautiful November day.

We have three witnesses in the first hour, and we'll get right into it. We have with us Mr. Michael Delage from General Fusion; Simon Irish from Terrestrial Energy Inc.; and Dale Austin from Cameco, who is a familiar face around here.

Thank you, gentlemen, for joining us today.

Mr. Austin, you know the procedure.

For the benefit of the other two, I'll explain that I'll give each of you up to 10 minutes to make a presentation, and then we'll open the floor to questions from the committee members. We have an hour.

Mr. Austin, why don't we start with you, since you're a veteran of these things?

Mr. Dale Austin (Manager, Government Relations, Cameco Corporation): Thank you, Mr. Chair.

It is my pleasure to be here today, to appear before the committee on behalf of Cameco once again, as your study examines the important role of the Canadian nuclear sector and the role it plays in our economy through trade, manufacturing and processing, and high-quality employment; addressing climate change and the transition to cleaner energy; and the advancement of nuclear science and technology, innovation, and research and development.

Cameco firmly believes that a strong natural resource sector that includes a strong and growing nuclear sector will continue to provide a stable foundation for ongoing growth and prosperity for all Canadians. As one of the country's leading sustainable resource developers, Canada's largest industrial employer of aboriginal people, and a major contributor to low-carbon technologies that address climate change, Cameco is proud to be a leader in Canada's nuclear sector.

Based in Saskatoon, Cameco is a significant player in the global uranium market and accounts for just under 20% of total global uranium production. Our portfolio in northern Saskatchewan includes the top two uranium-producing mines in the world, at McArthur River and Cigar Lake. We also maintain production sites in the United States and Kazakhstan, and development opportunities in Australia.

However, Cameco is much more than a mining company. We operate all along the nuclear value chain. Cameco owns uranium refining, conversion, and fuel fabrication facilities in Blind River, Port Hope, and Cobourg, Ontario. We're the sole provider of uranium conversion services for Canadian CANDU reactors, and our manufacturing facilities provide nuclear components for power reactors around the world.

I've been following the testimony of a number of other witnesses before the committee who have done an excellent job highlighting the important and significant contribution that the nuclear sector makes to the Canadian economy and our energy system—60,000 skilled jobs; 16% of Canada's total electricity mix, 60% here in Ontario; a $5-billion industry; and innovation and research and development. Today, then, I would like to focus most of my remarks on the impact that the nuclear sector has in northern Saskatchewan and our approach to community partnerships.

During previous testimony, I believe it was Mr. Harvey—who I see is not here today—who implored our sector to do a better job of telling our story. Mr. Strahl asked a number of questions about public confidence in our nuclear sector. This morning I would like to tell the story of Cameco's approach to indigenous and community relations in northern Saskatchewan and around the world, and the impact that approach has had on public confidence in Cameco's operations.

Indigenous engagement and employment has been a priority for Cameco since our inception in 1988. Our success as a company is directly linked to the long-term, positive partnerships that we have built with first nations, Métis, and other aboriginal communities where we operate. Nearly one third of Cameco's total Canadian workforce is comprised of individuals of first nations or Métis heritage. However, employment opportunities are only one element of Cameco's relationship with our partner communities. This year alone, Cameco, with our partner Areva, has signed two significant partnership agreements in northern Saskatchewan.

In June the “lands of north”—in Dene, “Ya’Thi Néné”—partnership collaboration agreement was signed with three first nation and four northern community partners, based on Cameco's five-pillar approach to community partnerships.

The first pillar is workforce development, with hiring preferences for people from local communities and career awareness so that people who are in elementary and secondary school have the opportunity to move on to post-secondary education, with the understanding that there may be a career available to them in the mining or nuclear sectors.

Second is business development, with a preference for community-owned businesses. It's a significant part of our supply chain, our work with community and aboriginal-owned businesses in northern Saskatchewan.

Third is community engagement, with new structures for engagement and consultation.

Fourth is environment stewardship, with ongoing community-based environmental monitoring of our operations.

The final pillar is community investment, with production-based payments paid to a community trust that the community can use in ways that it sees fit.

This comprehensive and unique agreement builds on an enduring partnership for the development of uranium resources in the Athabasca basin of northern Saskatchewan.

In addition to the lands of the north partnership, Cameco and Areva also announced the Six Rivers Fund, a unique legacy trust fund managed by an independent board of directors focused on youth education, sports, recreation, and health and wellness. The Six Rivers Fund will be supported from the profits of uranium recovery projects at our Key Lake operations.

These projects will be supported using the interest earned on the trust fund investments. In the decades ahead, we hope the Six Rivers Fund will reach a total of roughly $50 million. In its first year of operation, $100,000 was available for community projects in northern Saskatchewan.

We believe we have some of the most advanced and innovative collaborative agreements in the country, and possibly in the world, with our indigenous partner communities. We have moved beyond the approaches of the philanthropic “we should do this” and the risk mitigation “we have to do this” to the value-added “we want to do this”, because it makes our company better.

I have a short story to illustrate this point. Cameco once purchased an exploration property in Australia from a competitor that had spent many years unsuccessfully negotiating with local indigenous communities. Cameco, employing the same approach we use here in Canada, entered into discussions with local leaders and invited them to Saskatchewan to see first-hand how we operate. When we arrived in northern Saskatchewan, we arranged for this Australian delegation to live in our partner communities for a couple of days to ask their own questions and discover on their own how we operate and the relationships we've built with our local partner communities. Shortly after the visit, we were able to enter into a partnership agreement with those aboriginal communities in Australia.

One of the ways our approach to indigenous partnerships benefits our company, besides excellent employees and community businesses that serve our operations, is how we are viewed by our partner communities. Public confidence in Cameco's operations in northern Saskatchewan is very high. This confidence extends to other locations where we operate.

Our latest polling numbers, completed earlier this year, peg our province-wide support in Saskatchewan at roughly 81%. That 81% number also translates into northern Saskatchewan when it is taken as a unique polling sector. In Port Hope, Ontario, roughly the same amount, 89% of residents in the community, support the continuation of Cameco's operations.

While these results are encouraging, they are not surprising. Unlike other forms of energy and electricity generation, polling typically shows that support for the nuclear industry is often strongest where nuclear operations exist; and that the more individuals know and understand about the nuclear sector, the more supportive they tend to be. This, combined with Cameco's ongoing efforts to improve community partnerships, puts us in good stead everywhere we operate.

Canada's uranium mining industry, and the nuclear industry as a whole, is positioned to be a world leader for decades to come in both domestic and international markets. Current political, policy, economic, and environmental drivers are pointing at nuclear energy as a key element of a global shift to low-carbon energy and to a low-carbon economy.

Canada is one of the few countries in the world that can boast of a competitive advantage all along the nuclear value chain. We have the highest-quality uranium deposits and the ability to mine, mill, and refine uranium into fuel for nuclear power plants. Our CANDU reactor technology is deployed around the world. We manufacture reactor components. Our nuclear expertise as it relates to science, operations, technology, and regulation is in demand and recognized as world-class. We have a highly skilled, innovative workforce, including indigenous professionals, capable of making it all happen. With these tremendous strengths, Canada's nuclear sector is poised to take advantage of the opportunities for growth in the international nuclear marketplace.

Here is what we know about nuclear technologies and nuclear energy. Nuclear technology is proven and the long-term economic benefits of nuclear energy are clear. Comparing nuclear to other energy sources, I believe we can conclude that nuclear energy produces very low greenhouse gas emissions from a very small footprint. Our waste is managed in an effective manner, with new technologies emerging all the time to recycle and reuse that waste. A strong nuclear sector catalyses technological and other advances in medicine, material science, advanced manufacturing, and food safety.

Getting back to the point about telling our story, we as a sector do need to tell our story better, but we also need the support of Canadian governments—federal, provincial, and municipal—to help us tell our story. Rarely is the word “nuclear” mentioned by governments when they speak of clean energy or a low-carbon energy future, despite the significant role that nuclear energy could play in that type of future and the role it is already playing today to reduce greenhouse gas emissions around the world. Canadian policy-makers and political representatives should be proud of these contributions by our country and of Canada's leadership in such an important sector.

Canada holds a competitive advantage in the nuclear energy industry. We need to nurture that advantage and capitalize on the opportunities it presents. Invest in the sector. Support the work that is already under way, small modular reactor development as an example, and the basic research required to maintain that competitive advantage long into the future.

● (0855)

Make sure there are places for nuclear engineers and scientists to live and work in Canada by supporting the entire nuclear value chain. Help Canadian companies gain access to international markets for their products and employ more Canadians as a result of their success.

Thank you to the committee for taking the time to study a significant contributor to Canada's economy, the natural resources sector. As a global champion in both the uranium mining and nuclear sectors, Cameco sees tremendous potential in these markets over the next few decades.

I look forward to your questions. Thank you.

The Chair: Thank you, Mr. Austin.

Go ahead, Mr. Delage.

Mr. Michael Delage (Vice-President of Technology and Corporate Strategy, General Fusion): Thank you very much. It's an honour to be here today.

[*Translation*]

I would like to thank the members of the committee for the opportunity to discuss fusion energy.

[*English*]

I've provided a set of slides, which I am going to speak to. I wanted to start by just reminding people what fusion is.

The first slide talks about the fusion technology. Fusion is the energy source that the universe really runs on. It's the energy source of the stars and the sun. It's a process where, at very high temperatures and pressures, atoms are forced together and fused into other atoms. And on earth, what we would be doing to create energy from fusion is to fuse atoms of hydrogen. Now, that takes a temperature of about 150 million degrees. These are extreme conditions, and so this is a very difficult technology. The benefit is that a tremendous amount of energy can be produced. From those atoms of hydrogen, one kilogram of fusion fuel produces the same amount of energy as roughly 10,000 tonnes of coal. You could imagine building a power plant and putting the fuel source in a small room onsite and allowing it to run for 30 years.

Not only that, but it's a zero C02 source of energy. The reactors would run on demand, and the fuel source is abundant. We can extract the fuel source from sea-water, and there's enough on earth to run for hundreds of millions of years. This is an energy source that really will last for all of humanity.

Fusion R and D has been going on around the world for decades now, a lot of that led by national governments. More recently there's been a tremendous amount of progress, and I wanted to highlight some of that on the next slide. Not only is a multinational project called Iter under construction in the south of France, but we've also seen major facilities either under construction or commissioned or hitting important results in Japan; in Germany with the Wendelstein stellarator that was recently commissioned; in the United States at the national labs in Sandia and Lawrence Livermore National Laboratory. There are big investments being made around the world in this sector. I haven't even talked about the Chinese, who actually have fusion as a core element of their energy road map.

More importantly, what's new in fusion is the advent of private sector companies like my own, which is General Fusion. *Science* magazine, a science journal, a couple of years ago called us “Fusion's restless pioneers”, in that this is a group of entrepreneurs that have come together to look for more practical paths to fusion, not only more practical but more economically viable, and most importantly, that will achieve fusion energy commercially sooner.

In the United States, in Europe, and in the U.K., we've seen these companies attract tens of, even hundreds of, millions of dollars in private capital. Here in Canada, General Fusion is actually the second largest of these companies in the world. I'm proud about what we've done.

Here's a little bit about General Fusion. We're 65 people based in Burnaby, British Columbia. We've secured over $100 million in private capital since 2009. Investors in General Fusion include venture capital firms in Canada, in the United States, and in Europe and a sovereign wealth fund in Malaysia. Also highlighted are technology leaders such as Jeff Bezos, the founder and CEO of Amazon and a member of the Breakthrough Energy Coalition; and Cenovus Energy, Canada's oil and gas company, which has invested in General Fusion because of the opportunities that fusion energy could provide not only in terms of an energy source for the world but also as a heat source in the long run in Canada's oil and gas industry.

We're also proud to be supported by Sustainable Development Technology Canada. I would highlight that we are 65 employees, more than 50 of whom are in R and D. General Fusion is one of Canada's largest, if not the largest, R and D investor from the private sector in the nuclear industry in Canada.

Questions have been asked in previous sessions about what we have been doing to build awareness about what this technology is, and I wanted to highlight some of the recognition that General Fusion has received.

In the last few years, General Fusion has been highlighted everywhere from the cover of *Time* magazine, to this most recent month's *Scientific American*, to a TED talk that has received over a million views to date, to BBC World Service, to the *Vancouver Sun*, to *The New York Times*, and so on. And in the last two years, General Fusion has been named to the Global Cleantech 100. This is the first time that any nuclear company was named to the Global Cleantech 100, and we are one of the few Canadian companies on that list.

I also wanted to talk to you today about a document that we in the fusion research community in Canada have put together. This "Fusion 2030" document has been submitted to the committee. I understand it's being translated. It's a joint initiative of the fusion research community across Canada.

● (0900)

Not only General Fusion but also research groups in Alberta and Saskatchewan have been important leaders, and we've had contributions from people in Ontario and Quebec as well.

It's an initiative that proposes how we can position Canada to support the development and deployment of a demonstration fusion power plant by 2030. It proposes a staged program, the first part of which is an investment in renewing Canada's research capacity.

Unfortunately, Canada is the only industrialized country without a national fusion program, and we haven't had one for about 20 years. In that period of time, what we've seen is a decay of the research infrastructure in fusion R and D in Canada. Programs such as the plasma physics program at the University of British Columbia, from which our founder got his Ph.D., no longer exists. That means we're not training the graduates that a company like General Fusion needs. It means the research partners within Canada that a company like General Fusion needs don't exist, so we turn to recruit internationally and to partner internationally. That's a missed opportunity for Canada. Not only that; when there are successes in this technology around the world, we don't have the domestic researchers who can collaborate with those people externally and bring and take advantage of that technology.

The reason everybody else is investing around the world is not only because this is a game-changing energy source that could make a massive difference when it comes to global climate change and energy poverty, but it's also because fusion R and D impacts many fields. The superconducting technology that was developed for fusion research is what is in your MRI machines. Plasma physics has a tremendous impact on the semiconductor industry. Fusion has been one of the leaders in the development of scientific computing, a field that is touching everything now, from computational biology, to material science, to physics, to chemistry. Advances in fusion are pushing lasers, photonics, nanotechnology sensors, and robotics.

The reason other countries make big investments in fusion is also because it's a cornerstone of their R and D and innovation strategy. Again, this is something that we feel strongly needs to be a part of Canada's strategy.

I'd be happy to answer questions from you about what we've put together as a community, and I look forward to the discussion.

Thank you.

● (0905)

The Chair: Thank you very much.

Go ahead, Mr. Irish.

Mr. Simon Irish (Chief Executive, Director, Terrestrial Energy Inc.): Thank you very much.

Good morning, Mr. Chairman and honourable members of the committee. Thank you for providing this opportunity for Terrestrial Energy to contribute to your important examination of the future of Canada's nuclear sector, with a view to considering its innovation, sustainable solutions, and economic opportunities.

I'm here today to make the case that Canada urgently needs to renew its commitment to nuclear innovation. To be clear, this is not simply about renewing our commitment to the conventional reactor systems of the last 50 years, although that is important too. I'm saying that the tapestry of nuclear technology is far richer, and that we can do so much better.

The case I make is to renew Canada's commitment to nuclear innovation and specifically its commitment to advanced reactors being developed here in Canada by the private sector today. Providing industry with a clean, sustainable, and cost-competitive energy substitute to fossil fuel combustion in the time frame that we have set ourselves, by 2050, is the great challenge and opportunity of the age. Advanced reactors are uniquely capable of meeting this great challenge.

While there are sound economic reasons to re-license and refurbish existing nuclear plants to extend their productive lives, the conventional reactor technologies these plants employ are not the future of nuclear energy. After 50 years of development, conventional reactors are still too expensive, whether used in a small modular reactor or new, large nuclear plower plants. Different technology choices are needed.

The future of nuclear, and in fact the future of industrial energy provision, belongs to advanced reactors, the products of true nuclear innovation. These reactors will be smaller, far less expensive, quicker and simpler to build, and have many more industrial uses. Advanced reactors promise to provide the pathways to increase industrial competitiveness and support economic growth around advanced technologies. They promise to make our 2050 climate goals feasible by filling the enormous gap that current renewable solutions cannot fill. Renewables such as wind and solar show little ability to develop the product needed to drive deep decarbonization —clean, cost-competitive, reliable, sustainable, scalable: heat.

Advanced reactors can deliver this heat because they embrace true innovation in an industry that has seen little fundamental change in 50 years. They can do this because they employ fundamentally different technology choices. As market, industrial, and national needs change, we should look with fresh eyes on old problems, specifically on the merits of different nuclear technologies and the benefits that private sector-led nuclear innovation can bring today.

This is what Terrestrial Energy has done, the company of which I am chief executive. Others have done this as well. Terrestrial Energy is a developer of an advanced reactor called the "integral molten salt reactor", or IMSR. We are among the first advanced reactor vendors to be formally engaged in the regulatory process, in our case with the Canadian Nuclear Safety Commission.

The IMSR employs molten salt technology. It uses a liquid fuel, a molten salt instead of a traditional solid fuel. This is a fundamentally different approach and typifies the true innovation of advanced reactors.

With the IMSR, we as a company are on track with our plans to license, construct, and commission the first commercial advanced nuclear power plant in the world. It will be here in Canada and it will be operating in the next decade.

I expect it will just take four years to build our next IMSR power plants. They will be cost-competitive with coal or natural gas plants, yet unlike coal or natural gas plants, ours will produce no greenhouse gases. The IMSR promises to give industry a better product, industrial heat that is not tethered to grid or pipeline. It is not simply about electricity. IMSR power plants can be used, for example, to fuel clean natural resource extraction, clean petrochemical and chemical production, desalination, or to back up wind and solar power in place of natural gas—all this in Canadian and international markets. These markets are currently served by fossil fuels and are valued in trillions of dollars per year today.

● (0910)

This is not pie in the sky. It is the proven product of national laboratory development programs undertaken principally in the United States during the sixties, seventies, and eighties. We as a company have successfully made the IMSR innovation case to many in the nuclear industry in Canada, and abroad as well, where the IMSR is receiving significant international attention. It has been made to Sustainable Technology Development Canada, and it is being made today to the U.S. Department of Energy. I have been invited to meetings at the White House on two occasions in the past year to provide briefings on the capability of IMSR technology. Our U.S. affiliate is right now moving forward with its application to the U.S. Department of Energy for a $1.2-billion to $1.5-billion loan guarantee to support the construction of the first United States IMSR power plant.

IMSR development is receiving interest from many large industrial companies. It is supported by peer engineers and executives in the international nuclear community. They too recognize that the future of the nuclear industry lies with true innovation driven by the needs of this age, and therefore with advanced reactors. I believe the IMSR promises to be truly transformative.

Internationally, the nuclear energy option is today firmly in public political discourse, particularly as it relates to industrial competitiveness and achieving the towering ambitions of COP 21 climate targets. In Canada, by contrast, we appear embarrassed to mention nuclear technology despite our great tradition. We are in danger of being out of sync with change at a pivotal time and watching a great opportunity pass by.

Canada has the opportunity today, but perhaps not tomorrow, to establish itself as a leading nation in the race to commercialize advanced reactors. Foreign companies today are coming to Canadian shores to develop their advanced reactors because they recognize Canada's historic capabilities and, importantly, the openness of our regulator, the CNSC, to new technologies. Canada must make them welcome and give them a home. If it does, it stands to recapture its leadership position in a technology critical to a clean, competitive, industrial future for all of us. It stands to reap enormous economic benefits from helping the world meet its future energy needs and to continue Canada's position as a G7 net energy exporter.

I make the case for Canada to commit urgently to the nuclear innovation led by the private sector today, and to ask respectfully that the members of this committee embrace this opportunity and kick-start a new conversation about nuclear energy, nuclear innovation, and advanced reactors in our country, a conversation based on optimism, opportunity, and the promise of a much better world. This is an opportunity that cannot be missed.

I would be very pleased now, Mr. Chairman, to respond to any questions from your colleagues.

Thank you.

● (0915)

The Chair: Thank you very much, Mr. Irish.

Mr. Lemieux, I think you're first up.

[*Translation*]

Mr. Denis Lemieux (Chicoutimi—Le Fjord, Lib.): Thank you, Mr. Chair.

Thank you to all three witnesses for their fine presentations.

My first question is for Mr. Delage.

Your plan to develop energy through nuclear fusion is an unexpected but ideal method of producing energy, in other words, in limitless quantities without any CO2 emissions or toxic waste. I realize, however, that tremendous technical challenges remain. Given my basic technical experience and my background as an engineer, creating a mechanism that can operate at 150 million degrees Celsius strikes me as an insurmountable challenge. Therefore, there is something I need to understand. What is your development strategy for the years ahead? What kind of funding do you have access to in order to reach your objectives?

Mr. Michael Delage: Thank you very much for the question.

I'm going to answer in English.

[*English*]

You're right, 150 million degrees is a tremendous challenge, and no material can maintain or withstand those temperatures. What fusion systems have done for a long time is take advantage of magnetic fields. At those temperatures, every material becomes a plasma, as an ionized gas that can be manipulated with magnetic fields, and so magnetic fields can be used to hold that hot gas, that plasma, away from solid walls, or in our case liquid walls, and in that way contain this super-heated gas without it damaging the materials and the structure around it.

People have done this for a long time. In fact, fusion, I think, doesn't get enough credit for the progress it has made. If you were to look back a few decades, you would see the advancements in fusion, comparing the 1970s to today, have come along by about a factor of 10,000 in terms of energy produced. We're within a factor of two now of producing net positive energy for the grid, so this is why you're seeing this advance of private sector companies into the field.

On your question about the funding required, it really depends on the technology that you're talking about. All of the private companies, including General Fusion, are proposing ways that are much less expensive, that lend themselves toward something that can be a more practical power plant.

The $100 million we have secured to date has meant major advances in our technology, and we're looking at moving ahead toward the creation of a larger full-scale fusion system that again will be in the range of a $100-million sort of investment. We expect that we will secure most of that funding from the private sector.

Elsewhere in Canada, on the research and development proposal that we're looking to renew our capacity, we're starting small. We want to see something grow to the level of perhaps $20 million a year, to put the faculty positions back in place in Canadian universities so that we can graduate the talent we need to participate in this sector.

Those are the sorts of investments we're talking about.

[*Translation*]

Mr. Denis Lemieux: What type of financial support are you currently getting from the federal and provincial governments?

[*English*]

Mr. Michael Delage: Today the majority of our public funding comes from federal programs. We've had some early-stage assistance at the provincial level, but since then it's been federal. The biggest contribution there is through Sustainable Development Technology Canada. General Fusion is one of the larger recipients of funding support from SDTC.

We've also benefited, to a smaller degree, from programs such as the NRC IRAP. We've used NSERC programs to help fund collaborative research at Canadian universities.

Those are the leading programs we've taken advantage of.

[*Translation*]

Mr. Denis Lemieux: Could our government do more to speed up the pace of your research and development projects?

Mr. Michael Delage: Certainly.

[*English*]

Yes, absolutely, the government could do more. There are a variety of things that we've talked about with representatives. Investing in research and development at the university sector is one of the key things we've proposed. There are opportunities for direct investment in General Fusion to help us as we move forward with the construction of larger facilities. There are also opportunities for in-kind or collaborative work. We are going to need siting; we are going to need access to technologies that exist in Canada's national laboratories, such as at Chalk River; and the support for working with those national labs. It would be great to see programs like we have with NSERC, where there is collaborative research and development support for working with the national lab programs, because a lot of the cost of working with the national labs right now is fully loaded cost.

That's often prohibitive for smaller companies to be able to pay for that sort of research. I don't know if other colleagues here have had that same experience.

● (0920)

[*Translation*]

Mr. Denis Lemieux: Thank you, Mr. Delage. I took note of what you told us.

I have a question for Mr. Austin.

I'm pleased to see that you are helping to train first nations youth. Right now, do you have any first nations students working on their master's degrees or Ph.D.'s in your field with a view to becoming scientists?

[*English*]

Mr. Dale Austin: Thank you for the question.

Yes, we do. We have young people from our communities training in post-secondary education across the country. One of the challenges we face is that currently those people need to leave their home communities in order to study post-secondary education. For the most part, they do make their way back to their home communities and work for Cameco in very technical positions.

One of the areas where we're looking for further support is increased broadband access in northern communities so that there is access to university-level courses, post-secondary courses, through online learning. We expect, and certainly it's our belief, that if students were able to take some university-level courses in their communities, we would have even more success than we already have.

[*Translation*]

Mr. Denis Lemieux: My next question is for you, as well, Mr. Austin.

You said something that really caught my attention. You talked about recycling nuclear waste. Could you tell us a bit more about your nuclear waste recycling strategy?

[*English*]

Mr. Dale Austin: I can try, although it's a little beyond my expertise. As you know, when we capture nuclear fuel in CANDU reactors, uranium in this case, we use a limited amount of the energy in that uranium. Somewhere in the neighbourhood of 10% to 15% of the energy is all we use.

There is currently work under way at SNC-Lavalin and other companies on advanced reactor design that can take the currently spent reactor fuel and run it again through new types of reactors so that the spent reactor fuel existing today can be recaptured, recycled, and reused through new reactor types. That technology is in development now. We expect to see it working in the next few years. Beyond the uranium capacity we already have and new uranium developments in Canada, there is a significant amount of spent reactor fuel around the world that could be recycled.

The Chair: Thank you.

Mrs. Gallant, go ahead.

Mrs. Cheryl Gallant (Renfrew—Nipissing—Pembroke, CPC): Thank you.

While we are on that thread, we discussed at the last meeting the potential for recycling the used fuel rods, because only 1% is used in a CANDU reactor. Comparing that to the total cost of the second deep geological repository, do you think that, with the billions of dollars that are already set aside for the repository, it would be worthwhile to take some of that allocated money and put it toward the research and development to recycle used fuel rods?

Mr. Dale Austin: That's an interesting question. I won't comment on the redistribution of funding from one program to another, but I think you've heard across the panel today of the desire and the need for further investment in nuclear innovation across the board. Where that money comes from I will leave in your capable hands to decide, but it's apparent that if there isn't further investment in nuclear innovation, R and D, and technology development, the competitive advantage that Canada currently has all across the nuclear value chain is not going to be there in the years to come.

As Mr. Irish and Mr. Delage have said, certainly, as we look out, nuclear energy and nuclear power—different forms, new systems, new technologies—have a significant role to play in the energy future of the planet if we are looking to move to a low-carbon economy and low-carbon energy systems.

● (0925)

Mrs. Cheryl Gallant: Do you have any idea of the estimated funding that would be required to get this research and development into the prototype stage?

Mr. Dale Austin: I'm going to let my colleagues handle that, because they are more engaged in the R and D side of nuclear technology.

Mr. Simon Irish: I'll comment on the question on the capital requirement to develop these technologies.

On the advanced reactor technology, I think you have to appreciate that this exists in the new paradigm. The old paradigm of nuclear development was a state-led, enormous project. That is not the paradigm that we see today, which is private-sector-led. We expect that we will continue to receive significant private sector support. Our approach is that we are going to take that support, that clear private sector leadership, to the Canadian government and say, “There is leadership here. The private sector would like to commercialize these systems in Canada, and what we'd like at this point is assistance in getting over the development of the first plant.”

But the first plant in this whole project is not a $10-billion, $12-billion, or $15-billion project. This is a $1-billion to $2-billion project, because the technologies that we are looking at are on a rich tapestry. On that rich tapestry are the technologies that have accumulated over 50 years—a tremendous amount of national-lab-level investment already. All we are doing as a private sector company is looking at those technologies through the lens of today's market needs and national needs and asking if we should be developing these technologies now.

We believe that with our reactor, the IMSR, we should absolutely be commercializing this reactor, taking the last step, the engineering step, to bring this reactor to market. This is a $1-billion to $2-billion project for the first reactor—actually, I should probably say $2 billion from a Canadian-dollar perspective—and it's not a moon mission. It is not part of the old paradigm of state-led projects in the nuclear space.

Mrs. Cheryl Gallant: The NWMO was instituted in 2002, so we've had 14 years of research and development lending towards recycling this fuel. The deep geological repository combined—I think there are two of them, the low and medium waste and the high—is estimated to be $22 billion. A mere $1 billion or $2 billion to avoid having to watch over the spent fuel for hundreds of years seems to be cost-effective.

Mr. Simon Irish: Sorry, I think we may be talking at cross-purposes. I was talking about the $2 billion to develop the advanced reactors, but it's those advanced reactors that have the capability of consuming the additional energy and the spent nuclear fuel. Those advanced reactors offer a paradigm, an opportunity for the civilian nuclear industry in the future to be leaving a waste footprint that's 5%, even 1%, of the waste footprint it leaves today. That's the opportunity.

Mrs. Cheryl Gallant: What is the cost of a prototype model for your small modular reactor?

Mr. Simon Irish: It is $2 billion Canadian.

Mrs. Cheryl Gallant: But we're not talking about the same thing; advanced.

Mr. Simon Irish: It is an advanced reactor, absolutely.

Mrs. Cheryl Gallant: But it doesn't use the spent fuel. It's for the molten salt—

Mr. Simon Irish: We believe that is a pathway for this technology. One unique feature about liquid fuel reactors is they have the capability of consuming many different types of nuclear fuel. Some in the private sector today are leading with that characteristic to design a reactor to consume spent nuclear fuel. We have taken a commercial decision not to do that, because we think the most important thing is to bring an industrial reactor to the centre of industry quickly with existing fuel sources, which is low enriched uranium rather than spent nuclear fuel.

Mrs. Cheryl Gallant: Okay.

Mr. Delage, I was here back in the early 2000s when the previous government decided against supporting the bid for Iter to be in Canada. What is the progress? How long before it's estimated that we'll actually achieve nuclear fusion? I remember in university we were far from the fifty-fifty point. Where are we now?

● (0930)

Mr. Michael Delage: The generation of net gain power plants being built, Iter is one of them, the technology.... I would say, in hindsight, it may have been a good decision by Canada not to host, because the costs on Iter have grown and the schedules have slipped. To a certain extent, that does provide some freedom to Canada. What you're seeing with the research community in Canada is a looking past that age of technology, which dates to the 1980s and 1990s, to applying what's come out of other fields, like high-temperature superconductors, and looking at more practical paths to go faster.

The reason why our proposal is called “Fusion 2030” is because we think that in that time frame, we are going to see some of these more advanced concepts get to the stage where people are going to want to build a demonstration power plant, and we want to be part of that. Those are the time frames we're operating under.

If it's General Fusion, to be honest, I think we want to move faster than that. However, as an entire community, there are good initiatives around the world. The groups in Canada at the University of Alberta, are tied into some of them in the United States. At the University of Saskatchewan, they're tied to some of the work going on at MIT and in the U.K. There's an opportunity to build on that and be part of it.

The Chair: Thank you very much. We're beyond our time there.

Mr. Cannings, go ahead.

Mr. Richard Cannings (South Okanagan—West Kootenay, NDP): Thank you.

Thank you all for being here today.

I'll start with you, Mr. Irish. You mentioned that your technology would be significantly cheaper, I believe. That sounds like you are well along the road to building a reactor. You talked about your progress with CNSC, and you talked about having a reactor within 10 years, I believe.

Can you expand on that? Where are you in terms of siting and other issues you might have to deal with?

Mr. Simon Irish: I'm very happy to expand on that.

First, in terms of feasibility, we can point to a prototype reactor that has been built and operated at national lab level before. We're taking the engineering step. We're in the middle of basic preliminary engineering, and we are in the second half of phase one of our vendor design review , the first step of the regulation process with the CNSC.

Our project timeline is for a reactor in the 2020s. I would probably qualify that to say the second half of the 2020s. It's our view that, given this technology and the extent to which it has been developed over the last 50 years at national lab level, this is an engineering project. This is not R and D. This is not blue-sky nuclear research. You can actually bring one of these reactors to markets.

Mr. Richard Cannings: I'll move to you, Mr. Delage, with the same kind of question. You talked about how one of your main asks of the government is to reinvest in some of the research projects with universities and producing the graduate students you need. To me that sounds like we're still a little ways away. You talked about 2030.

Can you just provide a little more detail of where you think we'll be by 2030? I assume we're going to have a fusion reactor for the grid, or is that just a demonstration-type small reactor?

Mr. Michael Delage: I think by 2030, in Canada or elsewhere, there will be under construction a fusion power plant that will put electricity on the grid. It will be first of a kind, but I believe we will get there. What we want to do is make sure we're ready for that.

We're talking about the technologies now. There's a tremendous amount of innovation going on in the field of fusion, partially because some of the larger government-funded programs have slipped in timescale, so you're seeing creative people who are impatient, who are turning to new technologies and new ideas that are driving. We're seeing the private sector play a role. The private sector is a powerful tool for moving some of these things along quickly, and that's the case with us.

The reason we are asking for support at the R and D level is that these things are never static, even when you get to first of a kind. What you need to be successful in a field like this is an ecosystem. That ecosystem in Canada sees one private sector leader at General Fusion, and we're a world-class facility up there with any national lab facility, but we're on our own. You need a full ecosystem of partners at the university level to produce the students to do the fundamental R and D as well, who will be ongoing support, and you need private sector partners on the commercialization side.

We do have the benefit in Canada of having a mature nuclear industry that we can take advantage of when that time comes, and work with and leverage when that goes on. The missing piece for us right now really is that earlier stage.

● (0935)

Mr. Richard Cannings: When I was a kid growing up, many years ago, if there was anything more scary than nuclear fission, it was nuclear fusion, when you talked about atom bombs versus hydrogen bombs. I haven't heard anything in your presentation about the safety of this. Mr. Lemieux talked about how practical this is, but people who don't think of having a fusion reactor in their neighbourhood might be concerned.

Mr. Michael Delage: Yes, but in fact it's the opposite. One of the big advantages of fusion is that you operate on very small amounts of fuel at any given time. Maybe a second's worth would be in a power plant at any given time. Even if things go perfectly right and you manage to get the reaction going, which is hard, then it consumes the available fuel very quickly, so there's no chance of a runaway reaction.

At the same time, because those conditions are very difficult to achieve, if anything breaks in the machine and you don't achieve those conditions at all, then the reaction just doesn't happen. It's unlike fission, which is a spontaneous reaction. In fusion you have to work very hard to achieve those conditions. From that point of view, it's fundamentally fail-safe.

It also has the benefit of not using uranium or plutonium fuels, meaning you do not have the highly radioactive long-lived waste produced as a stream from the fusion reaction. It doesn't mean that there's no radioactivity at end of life; you'll have components like in a nuclear medicine clinic, or like in a fission reactor, that are activated. They need to be treated and carefully handled, but those are decadal time spans and not millennial-long. Its safety profile is actually one of the very attractive features of fusion.

Mr. Richard Cannings: Mr. Austin, I wonder if you could expand on your statements about the need for investment in education and what the federal government could or should be doing in promoting education in indigenous communities, right from elementary schools on up. We've seen the need for funding for elementary schools, and we've seen caps on funding for post-secondary education. I just wondered if that's what you would like to see from the government.

Mr. Dale Austin: Certainly that is one of the areas where we would like to see support from the government. These areas are in many respects not unique to the nuclear sector. Certainly for Cameco, investment in education, from primary education through to post-secondary, in northern communities would be a significant help to us. A significant part of our workforce comes from people who live in our communities. In terms of the ability of those people to study and learn at home, to live at home and find jobs, we really take advantage of those opportunities for our business. It makes us a better business.

Along with that, frankly, is the infrastructure needed to support those opportunities in northern Canada. When we talk about northern Canada, we talk not only of the area north of 60 but also of that band of development just below the 60th parallel, certainly where our operations exist. Basic infrastructure like roads, airstrips, and broadband, as I mentioned, would all be beneficial in those areas in terms of federal government support and provincial government support. That allows us to operate more efficiently. I think studies show that in terms of the cost of operating a mine site in northern Canada, where we operate, it's about two to two and a half times more expensive just given the lack of infrastructure.

So if we were to ask for government investment, it would be in infrastructure and education.

● (0940)

The Chair: Thank you, Mr. Cannings.

Mr. Serré, you have probably about four minutes.

Mr. Marc Serré (Nickel Belt, Lib.): Thank you, Mr. Chair.

Thank you to the witnesses.

I want to expand a bit on the issue of nuclear innovation and R and D. We heard from some other witnesses on recycling. We looked at water reactors, at the investments there, and also at the small modular reactor. I wanted to get your opinion. Obviously, as you indicated in your presentations, in parts of the world we're seen as a leader in many areas. Moving forward, we could try to spend the R and D dollars overall, but do you have any preference or suggestions for us with regard to targeting and being a world leader in one specific area? And would that be the small modular reactors?

Mr. Simon Irish: Certainly: now, a small modular reactor is only a commercial formulation. It says nothing about the technology that goes into it. That's just an expression. That's a commercial choice by vendors to make it small rather than a large grid-based one.

I would caution the desire to pick a lane, at this point. I think it's a much better policy to water many flowers than to try to pick a lane early. That's part of the old paradigm where the state got involved very early on and made a decision that in hindsight probably wasn't the best decision. Water many flowers and have a broad set of policies to support nuclear innovation. I think that is a much better approach.

Second, I think a key thing for nuclear innovation, efficient nuclear innovation, is to have a source of neutrons. If you want to compete internationally and have a vibrant domestic nuclear community, innovating for competitive products, you need a source of neutrons. The NRU has been that source of neutrons. If Canada wants to continue to be competitive in this field, it needs to continue to provide its domestic nuclear industry with a source of neutrons for research.

Mr. Marc Serré: Are there any other comments on the R and D?

Mr. Michael Delage: I would echo his comments about watering many flowers. I think at this stage, and this reflects what we've called for too, we're not at the point yet, but we do see, in the case of fusion, as we move forward through the period of the next 10 years or so, the opportunity to down-select and drive forward with a demonstration technology. The time frame where larger investments in a specific technology will come, but that's a few years ahead of us yet.

Mr. Marc Serré: Thank you.

Mr. Austin, I appreciated your comments about broadband investments, roads, and about the power grid in northern communities. That's certainly been heard also from other witnesses and other sectors in the mining industry and others.

In terms of your relationships, as a company that deals with first nations, can you expand a bit on some of the best practices? We've had some conflicting...that first nations are not on board with nuclear, but we have some good success stories. Can you help expand on what the industry should be doing more to engage the first nations?

Mr. Dale Austin: Certainly. The first thing I would say is that we've been at this a long time. The relationship we have with our partner communities was not developed overnight. We had some missteps early on. We recognized those missteps. What we have now is a relationship that, frankly, is built on trust. Our partner communities trust us to act in a way that is going to maintain safe operations, and to respect them in a way that we are a clear and understandable partner that acts in a manner such that they know we will do what we say we will do.

The point is that this takes some time. There are best practices in terms of discussion and consultation and partnership, and I think those are key. We now call these partnership agreements, or community partnership agreements, because we believe we are in a true partnership with our communities.

We recognize that we cannot exist as a company in northern Saskatchewan without the support of our partner communities. They're a significant part of the workforce that works in our mines. They are suppliers. Community-based businesses have been the major suppliers to our mine sites, in the order of $3 billion over the last 10 years, through contracts and relationships we have with community businesses, in most cases run by northerners or indigenous Canadians.

My advice is to go slowly, take your time, and try to understand the position that your community partners are coming from. Work with them so that they can understand what you're trying to accomplish together.

● (0945)

The Chair: Thank you very much.

Unfortunately, that's all the time we have for this portion. Gentlemen, thank you very much, all of you, for being here today and taking time out of your schedules. It's a great help to us in what we're trying to accomplish here.

We'll suspend for two minutes, and then we'll carry on with the next segment.

● (0945)

(Pause)

● (0950)

The Chair: We're ready to get under way here.

We have two more witnesses joining us this morning. From Bubble Technology Industries we have Lianne Ing, and from CANDU Owners Group we have Fred Dermarkar.

Thank you both very much for being here. I don't know if you were here earlier, but I'll open the floor to each of you for up to 10 minutes, and then turn it over to committee members to ask questions. You're free to deliver your remarks or answer questions in either official language.

Mr. Dermarker, you look like you're ready to go, so why don't we start with you?

Mr. Fred Dermarkar (President and Chief Executive Officer, CANDU Owners Group Inc.): Thank you very much.

It's truly an honour to be here this morning. I would like to thank you for the opportunity to speak with you about the Canadian nuclear industry, specifically the CANDU Owners Group, also known as COG.

Today I will explain who we are and tell you about our work, which is done in collaboration with our members, the operators of CANDU nuclear plants worldwide, including Canadian operators such as Bruce Power, New Brunswick Power, and Ontario Power Generation. I will give you some context on the value of this work, not only for our members in the industry but for Canadians as a whole.

COG is a not-for-profit organization entirely funded by its members, the operators of CANDU reactors worldwide. Our sole focus at COG is to continuously improve performance through collaborative knowledge sharing, research, and development activities. Simply put, our vision is to achieve CANDU excellence through collaboration. The goal is to sustain safe, clean, reliable, and affordable electricity for the millions of citizens worldwide who rely on our technology, including more than 14 million Canadians in Ontario and New Brunswick, who get much of their power from CANDU stations.

COG's activities result in an investment of more than $65 million in R and D annually. According to the European Commission Joint Research Centre's annual global ranking, this amount is equal to the R and D investment of a top-15 Canadian private company. It is a direct contribution to the economy, and to spin-off research and development activity in Canada in the public, private, and education sectors.

In regard to the education sector, working with the University Network of Excellence in Nuclear Engineering, or UNENE, COG invests about three-quarters of a million dollars annually on collaborative research projects with Canadian universities. Perhaps the most exciting part of this investment is the outcome of the research: a safe, clean, dependable, and affordable baseload electricity source, free of greenhouse gas emissions. This improves our quality of life and provides a low-carbon electricity source to address the threat of climate change.

With our members, COG has made great strides in the improvement of safety and performance in CANDU plants worldwide. In addition to pooling their financial resources, our members share the time and knowledge of their top engineers, scientists, operators, and maintainers. They work in teams alongside experts from COG and from companies like AMEC, Canadian Nuclear Laboratories, Kinectrics, SNC-Lavalin, and S.N. Stern Laboratories, to name just a few, all part of today's knowledge economy. They achieve together more than any single company could achieve on its own. That is the power of collaboration, and that is the strength of COG.

Here are a few examples of the results our members have accomplished together, and the research and knowledge-sharing programs COG facilitates.

A good place to start is with our post-Fukushima response, whose aim was to ensure our CANDU stations, and our people, are positioned to respond to highly improbable events well beyond those we envisioned when we designed and built the plants. Aligned with the requirements outlined by the Canadian Nuclear Safety Commission, ours was one of the most comprehensive and consistent responses worldwide.

On a personal note, I was directly involved in these initiatives. To see our nuclear plants successfully implement a strong response to Fukushima, and to help lead the world in that response, was a highlight of my career.

As well, through COG's R and D and joint project programs, our members have also extended the life of critical plant components, resulting in longer and safer plant operating life. This has saved billions of dollars, improved operating safety, and also reduced environmental impact by deferring the need for new generation. It has also enabled OPG and Bruce Power to adjust their project schedules to minimize the number of units that are shut down and are undergoing refurbishment and major component replacement at the same time.

● (0955)

Our research and development has also improved safety margins on operating equipment, which not only improves safety in a very fundamental way but also helps to improve revenue generation, thereby reducing the cost on a per-megawatt basis. It also has improved practices and programs to further reduce the environmental impact of our operations. This includes mitigation for impingement and entrainment of fish in the Great Lakes and improvements to spawning grounds.

Working together, our members have strengthened human performance and operator knowledge in safety and reliability. They have collaborated to develop new processes and techniques for better outcomes on everyday activities as well as unplanned events. The result is some of the best plant performances year over year in the history of our nuclear stations, even as they have moved into the later phases of life. For example, Bruce Power's 40-year-old refurbished units 2 and 4 reactors sustained 99.5% and 88.4% capability factors last year. Pickering unit 4, which began operation in 1971, achieved a 97.3% capability factor last year. These are excellent results that compare well with much younger units and reflect our ability to get more out of plant assets as our understanding of operations and maintenance has evolved.

Darlington, as the fleet's newest plant, has benefited most from that knowledge and research, because everything we learned from the earlier plants was applied to Darlington even sooner in its life cycle, which sets it up for strong performance post-refurbishment.

Through hundreds of shared initiatives, COG has provided the technical and experimental basis from which our members implement programs and plant changes. The billions of dollars in savings is an excellent return on their investment in both financial and human terms.

I'm now going to step back and provide a bit more context on the foundation of our organization. COG was formed 32 years ago, in 1984, by the Canadian nuclear operators, all of whom operated plants with made-in-Canada CANDU technology. Two years later, the first of COG's international members, also CANDU operators, joined and were followed by others. Today our international members include CANDU and pressurized heavy water reactor operators in Argentina, Romania, Korea, China, Pakistan, and India. In fact, every utility worldwide operating one of these reactors is a member of COG, and these reactors account for more than 10% of all power reactors worldwide. We should take pride in seeing this unique, made-in-Canada technology used extensively and successfully throughout the world.

COG's international aspect allows for further cost sharing, which means our Canadian plants benefit from research jointly funded by the international community. The international members bring diverse perspectives from operating their plants within different cultures and from vantage points that may differ from our Canadian perspective. This strengthens us and lifts our eyes to challenges and opportunities for innovation that we may not otherwise have considered.

This also provides COG the opportunity to share the strengths of our Canadian experience in areas of the world still developing nuclear capacity, including in the areas of nuclear safety and safety culture. The world is small, and a nuclear event anywhere has a ripple effect everywhere. By helping to strengthen our international partners in their operations, we also strengthen nuclear's reputation here at home.

We are also building bench strength through supplier participants. In collaboration with the Organization of Canadian Nuclear Industries, we have connected operators and suppliers in a dialogue to improve safety and reliability right through the supply chain. This includes in the plant, where suppliers are working more closely with operators than ever before. In particular, we have focused efforts on preparing suppliers for the refurbishment at OPG's Darlington station and for the major component replacement projects at Bruce Power.

● (1000)

COG is an entry point for its members to interact with many organizations worldwide. Our collaboration agreements with industry organizations here in Canada and globally have led to award-winning partnerships as well as stronger policy at both the national and global level.

When we talk about the future of nuclear, we can and should look to new technologies. We can also continue to rely on the ones serving us well today. The Darlington, Bruce, and Point Lepreau plants can provide safe, clean, affordable, and predictable power for generations of Canadians to come.

In closing, COG's mission is to improve performance through collaboration. The goal, always, is continuous improvement through both the human and technical performance of our operating stations. COG's role is to help our members better operate their nuclear plants, achieve stronger human performance, and ultimately build a foundation for public trust.

Thank you for your interest in the future of nuclear and for giving me the opportunity to share with you COG's role in shaping its future.

The Chair: Thank you very much, sir.

Ms. Ing.

Ms. Lianne Ing (Vice-President, Bubble Technology Industries Inc.): Good morning, Mr. Chair and members of the committee.

[*Translation*]

Thank you for inviting me to discuss the future of the nuclear sector.

[*English*]

In the course of your study, you have already heard from many of our colleagues in the nuclear sector. You've heard about how nuclear power provides 15% of Canada's electricity, using a safe, reliable, and low-carbon technology. You've heard that the nuclear sector provides 60,000 high-quality jobs in Canada, and you've heard how Canada's nuclear knowledge is a strategic capability providing Canadians and our partner nations with long-term energy security, and giving us a seat at the international table for important topics like nuclear non-proliferation.

Since you've already heard about these benefits, I would like to spend my time with the committee today discussing Canada's nuclear sector in a broader sense, specifically focusing on the innovation and nuclear expertise that resides in Canada outside of the traditional nuclear power industry. My hope is that this slightly different perspective will underscore how investments in the nuclear sector can have positive effects on Canada's innovation capacity in many adjacent sectors, including defence, counter-terrorism, space research, and medicine.

Our company, Bubble Technology Industries, is a direct example of how government investment in nuclear research can yield long-term economic benefits to Canada. In 1988 our company was formed as the very first commercial spinoff from the Atomic Energy of Canada Limited, or AECL. We were created to commercialize a new type of radiation detector, called the Bubble Detector, which was invented by my father, Dr. Harry Ing, while he was working as a research scientist at AECL.

Radiation detectors are, of course, important in the traditional nuclear power sector, but they are also important in many other sectors where radiation can be found. In defence and security applications, we need to detect, track, and, when needed, intercept nuclear materials that could pose a potential security threat. In addition, we can use radiation to help find other types of security threats such as explosives, concealed weapons, and contraband.

There are also many other applications where radiation is used, such as medical diagnostics and life-saving nuclear medicine procedures; industrial sterilization and packaging processes; density gauges used in the construction industry; inspection techniques used to check the quality of welds in the aerospace industry; disease control for crops in the agriculture industry; and well-logging techniques in the oil industry. As a result, when we talk about the broader nuclear sector, we are in fact talking about nuclear technologies that intersect with many other industries that are vital to Canada's economy.

As part of that broader nuclear sector, our company started with just seven employees and a single radiation detection product. The spinoff process was new to AECL and new to my father. There were many sleepless nights in those early days, trying to figure out how to keep a small spinoff company afloat.

Fortunately, we survived it. In the intervening 27 years that we've been in business, we've grown to about 50 employees, we now have more than two dozen products that are successfully exported to 25 countries, we've been awarded more than 20 patents, and we've conducted over 200 innovative contract research programs for customers around the world.

Our cutting-edge technology has been used in counter-terrorism applications to protect people and infrastructure at some of the world's largest events, including multiple U.S. presidential inaugurations, multiple Super Bowls, World Series events, the Olympics, and major international political summits.

Our technology has also flown on over two dozen space missions to support research aimed at protecting astronauts from radiation hazards, and understanding the radiation environment in space a little bit better. Astronaut Chris Hadfield conducted experiments on board the international space station using our radiation detection technology, and he personally spoke about how radiation in space is a serious concern for astronauts, particularly as we look ahead to longer-manned missions to Mars.

Our company's accomplishments have been made possible by a creative, dedicated, and highly skilled staff. Within our company we have the ability to generate innovative ideas and then carry those ideas through all stages of research, development, production, and worldwide deployment.

When we started back in 1988, as a tiny spinoff company from a government lab, I don't think anyone could have predicted the evolution of our company. When you start a company, the odds are not good. Innovation, Science and Economic Development Canada tracks small business statistics: 50% of small businesses in Canada fail after five years; less than 12% of small businesses in Canada export their goods or services, and when they do, they typically export to a single country, usually the United States. Yet even with those somewhat discouraging statistics, small and medium enterprises, or SMEs, continue to be the backbone of the Canadian private sector. SMEs employ over 90% of the private sector workforce in Canada, and they created more than 95% of the net new jobs in Canada between 2005 and 2015. Those two figures alone make it imperative for Canada to nurture and invest in its small businesses, as they truly are the engine of the Canadian economy.

● (1005)

When you invest in nuclear research and innovation in Canada, and when you support small businesses in Canada through programs like the SR and ED tax incentives, NRC's industrial research assistance program, and PSPC's build in canada innovation program, you open the door for a group of small businesses that can beat the odds. You create companies like Bubble Tech, and others in our sector, that can beat the 50% failure rate for start-ups, that can scale from seven employees to 50 employees in a sustainable way and provide high-quality, knowledge-based jobs, and that can export to 25 countries instead of one country or no countries.

Beating the odds is possible, because with the right focus and sustained government investment, Canada is well positioned to be a world leader in the nuclear sector, not only in the traditional nuclear power segment but also in the broader nuclear sector, which intersects with defence, security, medicine, construction, aerospace, agriculture, and the oil industry.

The government can help small businesses like ours beat the odds by supporting the full spectrum of nuclear research, innovation, and commercialization activities in Canada. We need to educate and train highly skilled personnel in the nuclear sector. We need to encourage Canadian research by implementing a small business innovation research program in Canada, similar to programs used in more than a dozen countries, including the United States. We need to encourage the Canadian government to lead by example, by buying innovative Canadian technologies, and by considering Canadian content in its purchases. And we need to further incentivize large companies doing business in Canada to partner with small Canadian companies.

More than anything, we need to recognize that small Canadian companies can be world class. When they are, they warrant our support, because they represent our country's best chance at job creation and economic growth. Thank you.

[*Translation*]

Thank you for your time.

● (1010)

[*English*]

The Chair: Thank you both.

Just so that we don't run out of time, I propose that we do five-minute rounds in the first round.

Is everybody in agreement with that? Okay. Great.

First up, I believe we have Mr. Tan.

Mr. Geng Tan (Don Valley North, Lib.): Thank you.

My question goes to COG. We have CANDU reactors running in the world, in Canada, China, Korea, and several other countries, thanks to the hard work done by the operators and also through COG. Our CANDU reactors remain the best performers among the nuclear fleet worldwide.

Inevitably, some day these CANDU reactors will age and eventually be decommissioned. I assume it is quite unlikely that we are going to see a new reactor, a new build, in Canada in the next years, or even the next decade. So while we have to decommission our CANDU reactors, we cannot decommission our talent and manpower, and the brain power, for example, at Chalk River, or other people working in the field.

I guess for the Canadian nuclear industry to survive and even to grow, we need to create a market globally. Right now, our technology, like our CANDU 6, is a generation II technology. We used to have ACR-1000, which is a generation III. You know that; you know that probably better than me, but nobody has even talked about that, so that's been on the shelf.

If we go to the global market, what technology can we provide, and what should the government do to have a long-term strategy to support the growth of our nuclear industry in Canada?

Mr. Fred Dermarkar: Thank you very much for the question.

First, I would like to clarify that the CANDU Owners Group does not engage in marketing activities. The responsibility, actually, or the lead for marketing CANDU technology is with SNC-Lavalin. SNC-Lavalin has the rights to do that. They are in the best position to talk about exactly what they are doing, but I would be happy to share with you some of the information that has been publicly made available.

They're in active discussions right now with China for developing the advanced fuel CANDU reactor. China's vision for nuclear technology is that it would like to recycle the fuel from its light-water reactors, the pressurized water reactors that it's operating in its country. The CANDU reactor provides a viable technology for taking spent fuel from the light-water reactors and re-burning it in a CANDU-type reactor. Their vision, as I understand it, is for every four light-water reactors to build one advanced fuel CANDU reactor to accept the fuel. That provides certainly an exciting opportunity, because it provides a market for about 25 advanced fuel CANDU reactors just in China. Again, SNC-Lavalin is in a much better position to speak on this. I'm reflecting information that I read about in the public domain.

In regard to the second part of your question, on what is government's role in sustaining it, government has a key role in sustaining the infrastructure that enables nuclear to exist, to continue to improve with time. I just came back, for example, from a trip to India last week. I met with the leaders of the Department of Atomic Energy, the Atomic Energy Regulatory Board, the Nuclear Power Corporation of India Limited, and the Bhabha Atomic Research Centre. There they have sustained a vision around nuclear development that transcends changes in government, that is long-range, and has many aspects to it. Underlying it is a very strong research base.

We need to have a strong R and D platform. The importance of having a research reactor just was mentioned at the previous session. Today, COG is doing work in the NRU reactor. We are making the most of the time that we have available to us before that reactor shuts down.

What will we do when that reactor shuts down? We will still need to do some research. We will likely need to do some research in the coming years. What we are doing right now at COG is looking for alternative places to do that research if we cannot do it here in Canada. What that means is wherever we do that research, that facility will build the knowledge and capability and Canada will not, which means that in terms of sustainability we are driving towards a dead end if we don't build the fundamental R and D capabilities.

At COG we will find alternatives to support our members. We will have to look outside the country if we cannot find it in this country. But it will be a loss for Canada to go to other countries to do this fundamental research that we need to sustain the technology.

● (1015)

The Chair: Thanks.

We're going to stick to the five minutes.

Mr. Barlow.

Mr. John Barlow (Foothills, CPC): Mr. Chair, I'm going to share my time with my colleague Ms. Gallant, just to ensure that we both have a chance.

For CANDU, over the past few weeks since we started this study, we've heard about some pretty interesting advances or potential advances in technology, whether it's nuclear fusion, fast neutron reactors, SMRs, and today we heard a little bit more about the molten salt reactor. I'm happy to hear that you are also at CANDU working on advanced fuel reactors as well, as I think it's important that CANDU remains on the leading edge on the technology side.

I'm just wondering if you can answer the fact that the opportunity to build another reactor in Canada is difficult, but what is CANDU doing to try to change public perception in terms of a couple of things—the safety of the CANDU reactor as you move forward in technology, and advancements in terms of reducing the cost of building a CANDU reactor?

I know for us, in Alberta, we don't have any nuclear power. There's been lots of discussion on reactors in northern Alberta to help power the oil sands. So perhaps you can talk about changing public perception on the safety and also the cost of a CANDU reactor, and maybe some advancements that are helping to address those two things.

Mr. Fred Dermarkar: In regard to your first question, with respect to safety, COG is not, to clarify, an advocacy organization. We don't do marketing campaigns or anything along those lines. We are very much a technical organization. What we do is work with our members to identify where there are opportunities to improve safety margins, to improve environmental performance, and so on.

I want to note that the performance of the fleet today is already very high, but we want to get ahead of problems. In the world of nuclear safety, we have an expression in our industry that nuclear safety is like riding a bicycle: if you're not moving forward, you're falling off. You need to continuously move forward.

What we do at COG is look ahead. We identify where the aging mechanisms are likely to be, what the safety margins associated with those aging mechanisms are, and how we can get ahead of the problem as the fleet of reactors ages with time.

We have been very successful so far, because performance, 40-some-odd years later, continues to be very high. Our members in turn—OPG, Bruce Power, and New Brunswick—can then use this information as a mechanism for public discourse. It is they who would be engaging with the public in shaping public opinion, not so much the CANDU Owners Group.

With regard to the question around what we are doing to improve constructability, we're not involved in that. That is very much a design engineering issue with companies such as SNC-Lavalin that are marketing the new reactors, and we don't become involved in that. We become involved as soon as they're into the commissioning and operation phase. At that point, we are involved and help to provide support through collaboration.

● (1020)

Mr. John Barlow: I'll pass this over to my colleague Cheryl.

Mrs. Cheryl Gallant: Thank you.

Welcome back to you both.

Lianne, the last time you were here you talked about the “valley of death” for the development of technologies. That phrase stuck with the committee for months, even beyond the current study we were on. Would you please tell this committee, first of all, what the valley of death is and then describe what we still need to do as a government to bridge that gap?

Ms. Lianne Ing: Thanks for the question, Cheryl.

When we speak about the technology valley of death, we're talking about the gap that exists between funding that supports research and then somehow bridging that to actually exploiting commercial value out of the technology: bringing it to market, selling it within Canada, and as well exporting it. For many years in Canada, there was simply no funding mechanism that would help a company make that leap from research to commercialization.

In the last few years, the government has introduced PSPC's build in canada innovation program, which is specifically geared toward taking high-maturity technologies and providing funding so that federal agencies can try that Canadian technology at very little risk. The funding comes from PSPC. There's a match between a company with the new technology and a federal department, and the federal department acquires the technology through PSPC funding and then is able to test that technology. We've been able to use that program with such groups as the RCMP and the Canadian Department of National Defence to get them to try some of the new radiation detection technologies that we've developed at Bubble Tech.

That is a single program, which is certainly a move in the right direction. It takes you to that first sale, but doesn't really follow through or provide long-term support for subsequent sales.

I think in Canada one of the difficulties has always been—particularly in our sector, defence and security—that we're obviously very heavily involved with many other NATO allies, and sometimes it's easy to just tag along with what other people are buying without taking a good, hard look at home-grown technologies that may be best in class and need that opportunity to get utilized by a customer in the market.

One thing we would love to see is just more opportunities where the Canadian government is really taking a good, hard look at Canadian technologies, and, where the merit is there, where the technology is solid, to really be a leader by adopting the technology and being able to demonstrate that Canadian technology in real-field applications.

For us, when we go to export overseas, one of the first questions we receive from any other foreign government is who else is using this? Is your own government using this? For many years we would have to say, well, the Americans are using it, or various groups in Europe are using it, but it's a difficult position to be in. You'd like to be able to say that your own government has selected your equipment and can provide references. I think that's one of the key things the government can do in the future.

The Chair: Thank you.

Go ahead, Mr. Cannings.

Mr. Richard Cannings: Thank you for coming here today.

I'll start with you, Ms. Ing, and follow up on that line. You mentioned PSPC and other government programs that are helping SMEs bridge that "valley of death". One of them, I believe you mentioned, was SR and ED. I've heard from other SMEs that negotiating the bureaucracies, application processes, and reporting processes on SR and ED is really beyond the capacity of some small companies. Have you been there, and how might you advise the government to improve on that?

Ms. Lianne Ing: We've used the SR and ED program for many, many years. As a small company, we're somewhat unusual because we started our company doing a lot of work in defence and space research. We developed expertise in navigating government forms and applications fairly early in the company's existence, but we can certainly appreciate from many small businesses that those processes might be considered quite daunting.

From our perspective, the thing that we appreciate about the SR and ED tax incentive program is that it does not try to pick a winner in terms of a research area. It allows small companies to decide for themselves, on their own business cases, what sort of research makes sense. From our standpoint, we think that's a very important feature of that program. It is very difficult to predict what is going to be the next disruptive technology. It is disruptive because people aren't expecting it to happen. When government tries to pick winners by focusing funding into very specific technology selections, there's a possibility that you end up undermining a small company that might be on the verge of some remarkable breakthrough. We think the SR and ED tax incentive program is very good in that it allows us to decide what sort of research we think our company should pursue.

One of the things that's been rolled back over the last couple of years in SR and ED is coverage over things like capital expenditures. There are, as far as we can tell, almost no grant programs from the Canadian government that support capital expenditures associated with research. We think that's an oversight. A lot of research is very capital-equipment-intensive. It requires investment by small businesses in sometimes expensive new technologies, and having no support for capital expenditures does make it difficult for companies to compete in the high-tech sector.

● (1025)

Mr. Richard Cannings: Moving to Mr. Dermarkar, you mentioned that COG did some post-Fukushima work. I'm just wondering if you could expand on that and what you think of Canada's position in terms of modelling a Fukushima-like event at one of the CANDU reactors—how that response might look, and how we're prepared for that.

Mr. Fred Dermarkar: Thank you for the question.

Immediately after the event happened on March 11, 2011, through the CANDU Owners Group we formed a group called the CANDU industry integration team. This was a group of leaders from all the utilities, both domestic and international. We started to identify and build a strategy toward responding to the event, based on the best information we had at the time. As more information came out, we fine-tuned our strategy. Through the CANDU industry integration team we also had a mechanism for having a dialogue with the regulator. We kept the regulator informed of the direction in which we were heading, and the regulator in turn kept us informed of where their expectations were also heading. So we maintained a dialogue but still independence between regulator and operator.

Because we were working together as a group, we were able to have different utility members of that group participate in different international forums, so we were able to cast a large net that captured what the international community was doing and bring it back into the COG community. Then we tuned it to our particular technology.

The CANDU reactor has some inherent features that are excellent for the kind of event that happened at Fukushima. The most notable of these is that, unlike any other power reactor, the CANDU reactor essentially sits in a pool of cold, low-pressure heavy water that's about 250 tonnes, and then is surrounded by another pool of cold light water that's about 500 tonnes. So if there were a loss of power, you have immediately 750 tonnes of cold water right there that helps to mitigate the progression of the accident. We leveraged that and identified what additional mitigation strategies we could put into place to significantly or indefinitely prolong the cooling to the reactor should the primary and backup systems fail, as they did at Fukushima.

We built a whole new line of defence in depth based on portable equipment that could be brought in, easily and quickly connected, to feed those water systems that were already there that were keeping the reactor cool, and because of the design of the CANDU reactor, we had quite a bit more time available to bring in that portable equipment. We leveraged that, so we built that into the strategy. I believe we have a very solid base now for being able to say that if there is any kind of unexpected event, we have multiple different ways, not only within the plant but by bringing in portable equipment from outside the plant, to terminate the event earlier, before it progresses into a severe accident.

● (1030)

The Chair: Thanks.

Mr. Fragiskatos.

Mr. Peter Fragiskatos (London North Centre, Lib.): Thank you very much, Chair.

Ms. Ing, my question is for you. I'm very interested in the potential of nuclear energy, but I'm also interested in the dangers it poses and the great work that firms such as yours are doing to guard against those dangers.

Just a few months ago, the Prime Minister pledged $42 million to global efforts to secure nuclear materials from terrorists. Al Qaeda and Daesh and other groups have been quite open about their interest in securing access to nuclear materials for all sorts of purposes, ones that we should be very concerned about. Government, however, can't do everything on its own.

With that in mind, I was reading about your FlexSpec backpack, this portable radiation detection system. First of all, how does it work? More importantly, for the purposes of the Canadian population, how is it used by law enforcement agencies to counter potential nuclear terrorism threats?

Ms. Lianne Ing: Thank you for your question.

Our company designs and builds various radiation detection products. The FlexSpec backpack is one of them. It is a portable device that fits into an innocuous-looking backpack and runs off a smartphone. Law enforcement users will typically wear this—

Mr. Peter Fragiskatos: Sorry, did you say it runs off of a smartphone?

Ms. Lianne Ing: Well, it connects to a smartphone to provide the user interface. There's a small single-board computer that runs inside the device and does all the heavy lifting for computation.

Law enforcement personnel will wear this system. They will often be doing this in a plainclothes scenario. When there's a large event with a crowd of people, for instance, they can easily walk through and amongst the crowd, and the system is constantly looking for any indications of elevated radiation levels. Importantly, it also is able to discriminate between different types of radiation. You can have many innocent or legitimate sources of radiation, like people who have had a nuclear medical procedure. It can differentiate between that type of radiation and the type of radiation that might be associated with a weapon.

It's one example of many different types of products that are used by law enforcement that use mobile systems, airborne systems, and systems that are mounted on maritime vessels. The goal is simply to try to increase the probability of detection of illicit materials, preferably before they can be assembled into any kind of a threat, and be able to then intercept those materials before anyone can deploy them.

In the United States, for example, after 9/11 there was a recognition that threats such as nuclear threats, as well as chemical and biological attacks, were things that law enforcement needed to be concerned about. In the intervening years, there has been a heavy investment to equip regular law enforcement agencies with this type of equipment so that they can assist with carrying out that type of detection mission.

Mr. Peter Fragiskatos: I'm interested in the number of law enforcement agencies that are using this. Is it just Canada and the U. S. that have turned to this? Could you speak on that?

Ms. Lianne Ing: Sure. Without going into specific customers, there are law enforcement agencies across North America, in Europe, and in Asia that use this sort of equipment. It's becoming increasingly prevalent.

The United States tends to be an early adopter of this type of technology. They have very strong budgets that go into Homeland Security programs. The federal government in the United States will provide grants from the federal level that will flow down to state and local law enforcement groups, specifically to equip those groups with this type of specialty equipment.

We've seen an increase in this type of equipment purchase overseas in places like China, India, Japan, and South Korea.

Mr. Peter Fragiskatos: Chair, I have probably a minute or two left. I'd give that to any of my colleagues who want to use it.

The Chair: Mr. Tan?

Mr. Geng Tan: I'm done. Thank you.

The Chair: Mr. Serré, for about a minute.

Mr. Marc Serré: Thank you, Mr. Chair.

I just want to get your opinion on the emerging.... China has been spending quite a few dollars on nuclear. Can you elaborate a bit about that, and what effect that could have on us?

Mr. Fred Dermarkar: In terms of nuclear energy technology, China is a very large player in all sectors, and clearly in the nuclear sector it is emerging to be likely one of the biggest players in the world.

I'll offer a personal view on it, so this is not a view that reflects the membership of COG. I believe the opportunity we have with China is to participate in their program rather than compete head-on with their program. I think Canada has a lot to offer in that regard throughout the supply chain as well as with the specific technology.

I can tell you that in the CANDU Owners Group, we've been very successful with China in regard to our knowledge, our leadership, and our management program. At COG we run this program that's three weeks in duration, and for one of the weeks it involves travelling to a nuclear site and observing what was learned in the classroom, regarding leadership and safety culture practices.

CNNO in China liked our program so much that they put 140 of their managers through that program over the last three years. That's a huge cost to them, because we charge about $10,000 or $11,000, and then there are all the travel and expenses that go with that, so it's about $20,000 a person. That's an area where they very much liked what we had to offer, and it's on the human side of the business. In the case of China, as they're growing very rapidly, their ability to sustain the knowledge base and the leadership capability is going to be one of their challenges. We could, through our knowledge and experience, help to bridge that gap. That's just one example where we could use or leverage the opportunity that China presents.

● (1035)

The Chair: Ms. Gallant.

Mrs. Cheryl Gallant: Thank you, Mr. Chair, and through you to, first, Mr. Dermarkar.

The issue of Fukushima was raised. I'm just wondering whether or not you could also share with the committee what Tyne technologies has done with the passive autocatalytic recombiner?

Mr. Fred Dermarkar: I'm sorry, I know technologically what the passive autocatalytic recombiners are, but I'm not really sure what Tyne technologies has done with them.

Mrs. Cheryl Gallant: That was another spinoff from AECL, and perhaps Ms. Ing can elaborate on that.

First, Ms. Ing, with the national shipbuilding strategy, we're putting billions of dollars into that, and you mentioned there are different applications for nuclear technology. We all know about medicine, energy, and non-proliferation. You also mentioned welds, and there's certainly an awful lot of welding going on in shipbuilding. Are you aware of any opportunities for the nuclear industry in terms of this huge investment into our navy?

Ms. Lianne Ing: There are a number of companies that specialize in neutron radiography techniques, which is what's used in the aerospace industry to inspect things like metallic castings and welds. I'm not sure whether they've been applied to the shipbuilding industry previously. Certainly those techniques provide a very high level of inspection and imagery that will identify any particular defects. Clearly, in the aerospace industry, those types of defects can be fatal immediately, so there's a very high-quality standard that's imposed upon the aerospace industry.

A number of groups that have grown up in Canada specialize in neutron radiography, and they might be able to provide some insight into whether their techniques can be applied to shipbuilding techniques.

Mrs. Cheryl Gallant: In terms of tracing nuclear material, not just detecting it, are you familiar with any technology that has been developed on that front?

Ms. Lianne Ing: In terms of tracking the movement of material, yes, there's a number of techniques. There are active tracking techniques, where people will attach radiation detection devices typically connected to secure wireless networks that will allow you to trace a shipment of material and ensure that the full quantity of material moves from point A to point B without anything going missing.

There are also different techniques involved in what's called nuclear forensics. Even after nuclear material has been removed, for example, it can leave behind non-radioactive indicators that this material was previously present. In other words, the ionizing radiation can change some of the material properties in the environment, even after the material has left the area. There are some techniques being developed now that can detect those small changes and thereby trace the path of nuclear material.

● (1040)

Mrs. Cheryl Gallant: When I asked about Tyne engineering and the passive autocatalytic recombiner, you were nodding your head. As it applies to a circumstance like Fukushima, would you explain to the committee what it's about?

Ms. Lianne Ing: I'm probably not in a great position to explain in detail what Tyne has been doing in that area. They are another spinoff company that came out of AECL. They've been able to carve out a niche capability where they're providing those sorts of technologies to the industry. I wouldn't attempt to explain in detail how it works.

Fred, would you like to...?

Mr. Fred Dermarkar: Sure.

Again, I can talk about the technology but not so much about the company itself. The technology was developed at Chalk River, Canadian Nuclear Labs, originally. In a nuclear plant, when you have a severe accident and metal temperatures get above a certain level, you can have a reaction between zirconium and water that results in the dissociation of hydrogen from oxygen. You end up building hydrogen in the containment atmosphere. That's exactly what happened at Fukushima. The explosions that you saw were hydrogen explosions. They were not nuclear explosions. They were hydrogen explosions that were from the dissociation of water in the reactor.

What a passive autocatalytic recombiner does is it allows the hydrogen and oxygen to recombine at a lower threshold. There's a catalyst that allows the hydrogen and oxygen to recombine so that they're doing so at a concentration that is well below the flammability concentration for hydrogen. It takes the hydrogen out of the air before the hydrogen gets to the point where it becomes explosive. We are implementing those around the world, actually.

The Chair: Thank you.

That takes us to the end of our time. Thank you very much, both of you, for joining us this morning. We appreciate it, and it's very helpful to us.

The meeting is adjourned.