Coalition for Responsible Energy Development in New Brunswick

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Presentation to the Legislative Assembly of New Brunswick
Standing Committee on Climate Change and Environmental Stewardship
Small Modular Reactors (SMR)

February 14, 2023

Good morning and thank you for the invitation.

My name is Susan O'Donnell and I represent the Coalition for Responsible Energy Development in New Brunswick. Our Coalition has 10 members in the core organizing group:

- Council of Canadians Fredericton Chapter
- Council of Canadians Saint John Chapter
- Leap4ward Saint John
- Concerned Citizens of Saint John
- Sustainable Energy Group Carleton County
- Extinction Rebellion New Brunswick
- New Brunswick Anti-Shale Gas Alliance
- RAVEN project at the University of New Brunswick
- Plutonium Project at St. Thomas University
- Sierra Club Canada Foundation Atlantic Chapter

On our website are the names of the 15 other organizations and businesses, and more than 120 people across New Brunswick who support our work.

Our mission is to advocate for responsible energy development in New Brunswick to address the climate crisis using these four guidelines:

1. Reduce energy demand by eliminating energy waste and maximizing energy efficiency.

2. Eliminate the development of fossil fuel energy and phase out nuclear energy.

3. Increase the percentage of electricity generated by renewable energy with storage in New Brunswick.

4. Support solidarity actions with communities experiencing the harmful impacts of our energy choices in New Brunswick, across Canada and globally.

- In our Coalition, I represent the RAVEN project at the University of New Brunswick where I'm an adjunct professor and social science researcher with expertise in technology adoption.

- Our Coalition has taken an active interest in the New Brunswick SMR projects. In July 2022, we applied to the federal Minister of Environment and Climate Change to designate the ARC and Moltex projects for a federal impact assessment.

- Our application is 75 pages, outlining the concerns we have about these SMR projects. We encourage you to access the application on our website to understand all our concerns.

- Three Indigenous organizations in New Brunswick and 15 environmental or health organizations wrote letters supporting our application. The Minister also received more than 300 letters from the public, the vast majority in support. Our application has been downloaded more than 800 times from our website.

- In December, the Minister denied our request. However, we achieved our main objective: to bring wider public attention to the risks of these SMR projects.

- That's why I'm here today, to bring public attention to the risks of developing SMRs in New Brunswick and discuss them with you.

- The New Brunswick government gave these two start-ups - ARC and Moltex - 30 million dollars, and the federal government gave Moltex 50.5 million dollars.

- We've looked for, and have been unable to find, evidence that these SMR project proposals underwent a successful independent scientific assessment before they were funded.

- Our Coalition has only one recommendation for this committee: that you base your decision about supporting SMRs, or not, on the best scientific analysis conducted by independent experts with no conflict of interest, and not funded by the nuclear industry.

- In my presentation, I will share some findings from the best available independent scientific analysis of SMRs.

What are "advanced" reactors?

- The ARC and Moltex designs are called "advanced" but that only means they are very different from all other nuclear power reactors in commercial operation.

- Most of the large nuclear power reactors operating across the world are "light water reactors." In the U.S. for example, they are all light water reactors, cooled with ordinary water and using uranium fuel enriched at a low level.

- In Canada, all nuclear power reactors are CANDUs, cooled with heavy water (water containing extra neutrons to make it heavier) and fueled with natural uranium.

- NB Power chose two advanced reactor designs not cooled by water: the ARC-100 design is cooled by liquid sodium metal, and the Moltex design is cooled by molten salt.

- Neither of these two reactor designs have ever operated successfully in a commercial setting. ARC and Moltex are assuming there will be a market for a sodium cooled SMR and a molten salt SMR. That's a big assumption, that customers exist for these kinds of SMRs.

- The two designs will require different kinds of fuel: The ARC design is for an enriched uranium fuel called HALEU, and the Moltex design calls for a plutonium-based fuel.

- Enriched fuel means there's more of the kind of uranium in it that can make nuclear explosions. HALEU fuel is more enriched but considered safe for commercial power reactors.

- Global nuclear fuel supply chains have been developed for light water reactors. In Canada, the nuclear fuel supply is geared toward CANDUs. No fuel supply chain exists for advanced reactors.

- ARC says its SMR design is based on the second Experimental Breeder Reactor, the EBR-II, a sodium-cooled reactor that operated in a laboratory for 30 years.

- It's a big leap, a giant technical leap, from a laboratory reactor to a reactor that generates power successfully in a commercial setting. Many technologies work in a laboratory but fail in a commercial environment, in part because the supply chains do not exist to support them.

- You may be thinking "great, that's exactly what we want to do, build a global business network to support these advanced reactors." But as I will explain, expert analysis found that the fact that it doesn't yet exist creates a significant challenge to their commercial success.

The best available science on advanced reactors

- Both ARC and Moltex have operations in the U.S. Similar to the presentations they are making to this committee, ARC and Moltex each presented to a committee of 16 senior nuclear experts for the National Academies of Sciences, Engineering and Medicine in Washington.

- The National Academies' report on advanced reactor fuel and waste was published a few months ago, in November. The 330-page report includes analysis of molten salt and sodium cooled reactors and comments on the ARC-100 and the Moltex SMR designs.[1]

- The report was a consensus of the 16 nuclear experts and was peer-reviewed by a different set of 13 nuclear experts coordinated by a retired senior scientist and a university president emeritus. You could not get a better gold standard of scientific review.

Timelines for developing SMRs

- One of our Coalition's primary concerns is that SMRs will take far too long to develop to be included in a climate action plan that must deliver results within the next decade.

- The experts say the types of reactors not cooled by water will take much longer than a decade to commercialize. [quote from their report] "Most of the advanced reactors, especially the non–light water reactors, will confront significant challenges in meeting commercial deployment by 2050." (p. 22)

- One reason for the lengthy time is the need for comprehensive prototyping. I mentioned the giant leap between a laboratory and a commercial setting. According to the experts, there will be significant delays demonstrating the basic strength and performance of materials when subjected to new coolants, temperatures, and pressures because of a lack of adequate capabilities to develop, test, and qualify advanced fuels and materials.

- The experts say that for advanced reactors to be commercially successful, a significant challenge will be developing a new fuel supply chain. The global fuel supply geared for light-water reactors took many decades to develop. It cannot be replicated quickly and will only be developed if SMRs are cost competitive and have a future.

[1] National Academies of Sciences, Engineering, and Medicine 2022. Merits and Viability of Different Nuclear Fuel Cycles and Technology Options and the Waste Aspects of Advanced Nuclear Reactors. Washington, DC: The National Academies Press. https://doi.org/10.17226/26500.

- Right at the start, it will be a challenge to source the HALEU fuel required for the ARC SMR design. The only supply of this fuel is in Russia, and sanctions will likely make that Russian fuel unavailable in future.

- The U.S. has no capacity to manufacture HALEU fuel, although it is planning to ramp up to manufacture HALEU to supply the SMRs being developed in the U.S. It is unknown if HALEU will be available to reactor projects in Canada in the coming decades.

- The Moltex SMR design proposes to make its own fuel from used CANDU fuel, using a reprocessing technology called pyroprocessing, which I'll come back to in a few minutes. For timelines, the expert report notes a significant drawback: it is a batch process, which makes scaleup difficult.

- One expert committee member previously assessed the only industrial-scale experience in the world with the pyroprocessing method proposed by Moltex. The original timeline for that pyroprocessing project had to be extended and it will take many decades, 30 times longer, than originally planned.[2]

Costs of SMRs

- Our Coalition is concerned about the costs of building SMRs and the impact on electricity rates.

- The expert report states that the costs of advanced reactors and their associated new fuel cycles – just at the pilot reactor scale – would be at least several billion dollars for non–light water advanced reactors (like ARC and Moltex).

- These costs would rise to hundreds of billions of dollars for full deployment of an alternative fuel cycle that would replace the arrangements that exist globally for light water reactors.

- I'll stress that the 16 experts on the study panel are nuclear industry consultants, senior scientists and professors with long careers working with and analyzing nuclear reactors and fuel cycles in laboratory and commercial environments.

- In their consensus report, these experts state that [quote] "Implementing just a few of the most promising reactor concepts and their associated fuel cycles at a large commercial scale would require substantial government and industry investments well beyond 2050." (p. 1)

[2] Lyman, E. (2017). External Assessment of the U.S. Sodium-Bonded Spent Fuel Treatment Program. Presentation at the International Atomic Energy Agency (IAEA) International Conference on Fast Reactors and Related Fuel Cycles: Next Generation Nuclear Systems for Sustainable Development, 26–29 June. Yekaterinburg, Russian Federation.

SMRs and radioactive waste

- Our Coalition believes the nuclear industry has no social licence to produce more toxic radioactive wastes that must be kept isolated from all forms of life for millennia.

- No permanent facility to store high-level radioactive waste exists in Canada, it's all in temporary storage. Local residents and Indigenous nations oppose plans to site a deep geological repository in Ontario and to transport waste from other provinces into Ontario.

- The metallic sodium coolant in the ARC-100 design reacts violently with water or air, posing a serious fire hazard. Accidents have occurred at the site of previous attempts to commercialize sodium-cooled reactors in the U.S., France, Japan, and Scotland.

- The expert report states that liquid sodium metal reactors like the ARC-100 design would produce large volumes of spent fuel waste bonded with sodium and decommissioning waste that would require treatment by methods not yet technically mature at the industrial scale.

- Molten salt reactors like the Moltex SMR design would produce multiple waste streams, not only from the reactor but also from the WATSS process that has to operate in order to produce the initial load of fuel for the reactor. Because of the chemical and physical properties of salts used in Moltex, these wastes would require processing before disposal.

- These treatment methods are in early stages of exploration - the experts do not know yet how these new kinds of radioactive wastes can be handled and managed.

SMRs and high-level waste reprocessing (recycling)

- Moltex claims that its technology can use up nuclear waste. The expert committee analyzed the type of reprocessing – pyroprocessing – proposed by Moltex as well as other methods, because Moltex is not the only company claiming it can reduce and recycle nuclear waste.

- The experts found these claims had little merit because the long-lived harmful products cannot be neatly removed from the used fuel. They concluded that [quote] "the introduction and use of advanced reactors and small modular reactors in and of themselves will do little, if anything, to eliminate the need to manage and dispose of nuclear waste." (p. 165)

- Moltex itself acknowledges that less than one percent of the CANDU spent fuel could potentially be re-used as fuel in its SMR, leaving more than 99 percent in the form of many new radioactive waste streams to deal with.

SMRs and nuclear weapons proliferation

- Our Coalition also believes there is no social licence in Canada to support technologies intended for export that may increase the risk of developing nuclear weapons in other countries.

- Experts agree that reprocessing nuclear waste to extract the plutonium introduces the risk of nuclear weapons proliferation. Canada imposed an informal ban on reprocessing in the 1970s. The government is considering allowing reprocessing as part of the new radioactive waste management policy expected in 2023, but civil society groups are campaigning for a permanent ban.

- The expert report notes that Moltex continues to claim that the main output of its pyroprocessing would be useless in weapons.

- In contrast however, the experts say: [quote] "While these technologies may provide some benefit in delaying direct use of the materials, there was consensus among the committee members that none provided significant proliferation resistance at this time." (p. 221)

- In addition, the expert report states that the HALEU fuel that ARC-100 design requires is enriched to a higher level than the fuel used by light-water reactors, and so expanding the global use of HALEU fuel would potentially worsen weapons proliferation and security risks.

Conclusion

- The experts say that advanced non-light-water reactors will have difficulty reaching commercialization by 2050. This contrasts with ARC's claim that its reactor will be ready by 2030, and the Moltex target of mid-2030s. How can this disparity be explained?

- Moltex claims that its technology can reduce the radioactive waste problem at Point Lepreau. How can they defend this claim when the expert report states the opposite?

- Moltex also claims that its technology will not increase the risk of nuclear weapons proliferation, but again, the expert report states the opposite. How can this be explained?

- The expert report raises questions about the large volumes of radioactive sodium wastes that the ARC-100 design would create and the wastes the Moltex design would create for which no industrial-level management methods exist. Who will answer these questions?

- The expert report states that the cost of building pilot reactors for non-light-water designs will be at least several billion dollars. Further, it will cost hundreds of billions of dollars to develop an entire nuclear fuel supply infrastructure to service non-light water reactors. Supporting these efforts will continue to require significant public funds well beyond 2050.

- At the same time, NB Power, the New Brunswick government, ARC and Moltex have not revealed the cost of their SMR plans. Why have they remained silent?

- Thank you for your attention. I look forward to discussing these issues with you and will do my best to answer your questions.