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To
Standing Committee on Environment and Sustainable Development
House of Commons
Ottawa
1 March 2022

Re: Study on Nuclear Waste Governance in Canada

Thank you for providing me with this opportunity to speak with you. My name is M.V. Ramana and I teach at the School of Public Policy and Global Affairs, University of British Columbia. I carry out research on various technical and policy challenges associated with nuclear energy and small modular nuclear reactors (SMRs). I will focus my remarks on the implications of the potential deployment of SMRs for the governance of nuclear waste in Canada.

1. My research shows that SMRs cannot solve the problems confronting nuclear energy, specifically, its inability to compete economically with alternative sources of electricity. If they are actually constructed, SMRs could accentuate this problem.

2. The term small modular reactor actually encompasses a wide variety of reactor designs and these produce different kinds of nuclear waste. The SMRs being considered for possible deployment in Canada in the foreseeable future all have one common feature: they are all very different from the traditional CANDU reactor design. The designs I am referring to are the ARC-100, which is a sodium-cooled fast neutron reactor; the Micro-Modular Reactor (MMR), which is a high-temperature gas-cooled reactor; the BWRX-300, which is a light water reactor; and Moltex, which is a molten salt reactor coupled with a reprocessing plant. Each of these will produce radioactive wastes that vary in characteristics such as chemical composition, physical form, and uranium enrichment. These differences mean that the methods developed for dealing with CANDU reactors will not work as such for these wastes. For example, a geological repository will have to account for the higher uranium enrichment levels because of concerns about criticality.

3. Some SMR designs envision the reprocessing of spent fuel. Advocates of reprocessing claim that it solves the waste problem. But, except for most of the plutonium and uranium, the radioactivity present in the spent fuel is redistributed among different waste streams which enter the environment, sooner or later. Most models of repository behaviour suggest that the radioactive doses to the public in

the long term is dominated by long-lived fission and activation products. Therefore, reprocessing makes little difference to long-term management of nuclear wastes, while making nuclear weapons proliferation easier.

4. The challenge with some of the wastes generated by SMRs is their chemical nature. Wastes from molten salt reactors could be in chemical forms "not known to occur in nature" and thus unsuitable for geological disposal. For fast reactors like ARC-100, the problem is that metallic sodium is very reactive.

5. The historical experience with the wastes generated by earlier reactors of similar design reinforces these concerns. For example, the fluoride salt wastes generated by the Molten Salt Reactor Experiment that operated in the United States have been very difficult to manage, and the Oakridge National Laboratory has been spending about $10 million every year for decades, all for a small 8 MW reactor that operated for under four years.

6. To summarize, borrowing from George Orwell's Animal Farm, I would say that "All radioactive wastes are problematic, but some radioactive wastes are more problematic than others".

To
Standing Committee on Environment and Sustainable Development
House of Commons
Ottawa

4 March 2022

Re: Study on Nuclear Waste Governance in Canada

Dear Committee Members,

Thank you for the opportunity to speak with you on March 1. Please allow me to follow up on two of the topics that were raised during the question & answer session that I could only address very briefly in my answers.

1. One question that came up concerned the potential conflict of interest resulting from the current governance structure where the Canadian Nuclear Safety Commission reports to the Minister of Natural Resources. Article 8 of the international Convention on Nuclear Safety, which Canada has signed and ratified, calls upon signatories to "take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilization of nuclear energy". I do not think the current reporting structure constitutes an effective separation. Unfortunately, the situation for any regulatory agency is like that of

Pompeia, Julius Caesar's wife, of whom, Caesar is supposed to have said, "Caesar's wife must be above suspicion".

2. The current structure naturally induces suspicion. The problem is that Natural Resources Canada has the responsibility to develop and promote nuclear energy. Because the CNSC is responsible for the protection of "health, safety, security and the environment", its ideal role can, on occasion, be at odds with the promotion of nuclear energy. Conversely, when regulating a technology that is being promoted by the Ministry, the regulator might be motivated to adopt practices that prioritize the potential for rapid deployment rather than ensuring a higher degree of safety and precaution.

3. Looking at some of the presentations of the CNSC on Small Modular Reactors, a set of technologies I have been studying very closely for over a decade, I cannot but observe the appearance of willingness to provide an easy path to licensing. At the 27th Annual Regulatory Information Conference in 2015, for example, a CNSC presentation entitled "Regulation of Small Modular Reactors (SMRs) in Canada: Progress and Challenges" promises that CNSC is "committed to setting the right level of requirements and guidance to enable flexibility without compromising safety". While CNSC claims to be committed to not compromise safety, the emphasis clearly is on the ease with which a reactor vendor can get the requisite license for construction of an SMR.

4. The second topic that was raised was that of the proliferation risks associated with pyroprocessing. That technology was developed by the US Argonne National Laboratory and has been examined carefully by technical experts. The general conclusion is that pyroprocessing does increase the risk of proliferation, and that risk is roughly comparable to the risk associated with the traditional reprocessing technology called PUREX, which has been used by many countries to produce plutonium for nuclear weapons.[1]

5. The proliferation risk stems from the fact that pyroprocessing separates out the radioactive fission products in spent fuel. These fission products provide a severe radiation barrier to handling spent fuel. Without this barrier, the plutonium can be extracted in pure form in a relatively cheap and small laboratory hot cell. To understand more about this issue, I refer you to two open letters written by US nonproliferation experts and former government officials and advisors with related responsibilities.[2]

[1] R. Bari et al., "Proliferation Risk Reduction Study of Alternative Spent Fuel Processing" (Brookhaven: Brookhaven National Laboratory, July 2009), https://www.bnl.gov/isd/documents/70289.pdf.
[2] https://thetyee.ca/Documents/2021/05/26/OpenLetterNuclearFuelJustinTrudeau.pdf; https://npolicy.org/wp-content/uploads/2021/08/Second-Trudeau-Letter.pdf