SMALL MODULAR NUCLEAR REACTORS

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WHAT ARE SMALL MODULAR REACTORS (SMRS OR SMNRS)?

A limited number of very small nuclear reactors designed for specialised uses have been around for many years. These include power supplies for nuclear submarines, 'Slowpoke' reactors for heating buildings and various research reactors in universities.

What is being talked about now are power reactors up to 300 MW in size that could supply electricity to communities or industrial sites. Many of us like to refer to them as "SMNRs" rather than "SMRs" to acknowledge that they are indeed *nuclear* reactors, devices that present many of the same problems as their larger cousins as well as some new ones. While over 150 potential SMR designs have been suggested world-wide, none has yet been developed to the point of commercialisation. But the idea is that, given a large enough market, SMRs could be mass-produced in factories rather than having to be built on-site, thus reducing the unit price.

WHAT ARE THE SUPPOSED ADVANTAGES OF SMRS?

SMRs are promoted as a way of providing electrical power to small and isolated communities, mine sites etc. that are currently off the grid and using diesel generators. This is described as a way of responding to the climate change crisis and the need to drastically cut fossil fuel use. The current commercial power reactors are too large (at around 1000MW) to fit into many distributed power grids.

Importantly, SMRs are also seen as a way of salvaging Canada's fading nuclear industry and developing new markets overseas.

WHY HAVEN'T THEY BEEN DEVELOPED?

No company has been willing to invest the large sums necessary to commercialise SMRs. Many countries (e.g. Jordan, Ghana, Indonesia) claim to be interested, but not to the point of investing. There is a lost economy of scale in moving from very large to small generation systems. The hope of counteracting that loss by mass producing SMRs in factories would require production of thousands of a single type of SMR to realise. The hope of lowering costs as knowledge about how to achieve efficiencies is gained is challenged by the experience in the existing reactor market, where costs have increased rather than decreased with construction and operational experience.

SMRs would have most of the same environmental disadvantages as large reactors. They would generate the same kind of wastes, but in many scattered locations rather than in a few centralized sites. In fact, because these small reactors require either enriched uranium or plutonium as fuel, the wastes would be more radioactive per kilogram than the wastes from CANDU reactors that use natural uranium. Using plutonium would require very dangerous re-processing of CANDU fuel waste to extract the plutonium, and we would still have to deal with all the highly reactive fission products from both the CANDU fuel and the plutonium. So "burning up used CANDU fuel" is not going to solve the nuclear waste problem.

WHAT'S HAPPENING IN CANADA?

In 2018 Natural Resources Canada released a report called 'Canadian Small Modular Reactors Roadmap'. This was the product of a 10-month consultation with the nuclear industry, power utilities (including SaskPower), government regulators and some Indigenous groups. It describes a (make-

believe?) vision of a huge economic opportunity for Canada that must be grasped quickly. It suggests:

"First-movers in this area of high-tech innovation will lock in significant benefits. For Canada, this could mean anchoring jobs, Intellectual Property, and supply chains here; positioning Canada as a policy leader and international standard-setter for strategic influence; and delivering on our climate change and clean energy commitments" …

"Early-mover advantage will be critical to capturing global market share… For the international market, the estimated total global export potential of SMRs is approximately CDN$150 billion per year for 2030 to 2040."

However, it is noted that the public and Indigenous groups have concerns, and there is a need for "engagement and knowledge-sharing".

The Roadmap provided a list of priority recommendations. These included:

- That governments, utilities and industry should support demonstration projects (Chalk River is suggested as a proposed site);
- That financial risks should be shared between governments, industry and utilities;
- That legislation and regulations should be modernised "to ensure an economically viable and timely pathway" (briefing notes from the Canadian Nuclear Safety Commission warn that lengthy regulatory delays could kill a promising industry and suggest that small reactors be exempted from lengthy Impact Assessments under the new Impact Assessment Act)

The governments of Saskatchewan, New Brunswick and Ontario are enthusiastic about pursuing this plan, although quite what this could involve is unclear.

On the urging of the nuclear industry and the Canadian Nuclear Safety Commission (CNSC), Canada's new Impact Assessment Act regulations state that nuclear power reactors with thermal power less than 200MW are exempt from full environmental assessment. Thermal power is a measure of the heat produced by the reactor. Approximately one third of this heat is converted to electricity; the rest is waste heat. So SMRs below about 70 MW electric (MWe) are exempt. Off-grid locations with small power needs generally need about 2-30 MWe, so these would all be exempt. This is an issue that concerns us because each potential site for a reactor has unique features that need to be considered.

Meanwhile the CNSC is carrying out "pre-licensing vendor design reviews". This is an optional process that provides proponents with an opportunity to become aware of unforeseen barriers to success in achieving licensing approval. Ten or so of these reviews are currently in progress; about half are for designs over70MWe.

Also, at this time, an environmental assessment has been started for a requested licence to prepare a site at Chalk River, Ontario, for a small demonstration reactor, one of the over one hundred potential designs being promoted by different companies. The assessment is at an early stage.

So, there is a certain momentum developing here. However, the reality is that the process of design, testing, problem-solving, licensing and commercialisation would take many years and would result in a product that could only be realised with huge government funding. Thankfully, we have better and more timely alternatives for addressing the climate crisis and meeting our electricity needs.