

Transport of nuclear and radioactive materials for microreactor deployment in Canada

In Canada and around the world, there has been increasing interest in the possible use of small modular reactors (SMRs) as a low-carbon footprint energy solution to achieve climate change targets. Three potential applications for SMRs in Canada are: on-grid; heavy industry; and remote communities, each characterized by different energy demands [1]. A subset of SMRs (microreactors) with power outputs of up to 20 MWe are expected to be suitable to offset diesel use in remote communities and mining sites.

Canada is home to over 275 remote communities which are not currently connected to the North American electrical grid nor to the piped natural gas network [2]. These communities are dispersed over a vast geographical area, many lacking year-round road access or only connected by air. In these remote communities, there will be unique challenges for deployment of microreactors which may be transported fueled or have the fuel shipped separately to the remote sites. Additionally, they will require transportation of the spent fuel to a disposal site. It will be essential to maintain the safe and secure transportation of nuclear and radioactive material to/from the microreactor deployment site.

While on-grid applications of SMRs are well-supported in Canada, off-grid SMRs and microreactors do not yet have the financial support of strong proponents or a well-defined deployment path. In order to expedite microreactor deployment, a framework for microreactor deployment has been established in Canada to align stakeholders on important actions and strategies within priority areas. This framework will meet Milestone 1 of IAEA Milestones for infrastructure development to support a nuclear power programme [3]. Transportation of radioactive materials is governed by national laws and the IAEA regulation [4] and is an important consideration in developing this microreactor framework.

Transportation of the fuel to the location of a Deep Geological Repository will be necessary. Moreover, northern SMRs may not have the same capacity for spent fuel storage as existing power reactor sites, and may require transport of spent high assay enriched uranium (HALEU) or novel chemical forms to an interim storage location. The different input fuel compositions result in different amounts of radioactive nuclides present in spent fuel. Previous work has noted that assessment of radioactive activation products in the complex geometry of a microreactor configuration as well as design of new shipping packages are issues that a licensee or vendor would have to consider.

Another aspect that should be considered is the method of transport. Remote siting may involve transporting nuclear substances on roads with lower weight limits than higher trafficked locations, or seasonal differences in transport route availability. Additionally, understanding the categorisation of transport routes may be less obvious, such as winter roads across a frozen lake.

Canadian Nuclear Laboratories, and Canada more broadly, is undertaking several projects that begin to address some of these issues. These include technical assessment capability enhancements in the areas of nuclear criticality safety and shielding. As well, a systemic review is planned of potential vulnerabilities during transport and pathways that result in radiological releases. This will result in a roadmap to address gaps in national standards and regulation that can guide future policy and research needs. A status update on this work will be discussed at the meeting.

[1] Canadian Small Modular Reactor Roadmap Steering Committee, "A Call to Action: A Canadian Roadmap for Small Modular Reactors," 2018. <https://smrroadmap.ca/>.

[2] Remote Communities Energy Database, Natural Resources Canada. <https://atlas.gc.ca/rced-bdece/en/index.html>.

[3] Technology Roadmap for Small Modular Reactor Deployment, IAEA Nuclear Energy Series No. NR-T-1.18, IAEA, Vienna (2021).

[4] Regulations for the Safe Transport of Radioactive Material, SSR 6 (Rev. 1), 2018 Ed., IAEA, Vienna, Austria.

Country or International Organization

Instructions

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Track Classification: Track 4 Computer Security and Emerging Technologies