

SMRs: Mining's new nuclear option

SMR nuclear energy is becoming an attractive alternative for energy-intensive operations



Infrastructure > Power-remote-power Small modular reactors (SMRs) are getting closer to real-time deployment and use in Canada, due to several new developments in the space in the last two years.

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The Canadian government launched an SMR development action plan in December 2020, and four provinces - Alberta, New Brunswick, Ontario, and Saskatchewan - agreed to collaborate in developing SMRs.

In the US, Oregon-based NuScale Power is the first and only SMR vendor to receive US Nuclear Regulatory Commission design approval, Nuscale executive Diane Hughes said.

In December, Ontario Power Generation (OPG) announced that it would be building an SMR at its Darlington site with GE Hitachi Nuclear Energy. The project is slated to be completed as early as 2028, with the aim of creating a commercial, grid-scale SMR.

Meanwhile, Ontario-based Global First Power - which works with Ultra Safe Nuclear Corporation and OPG - is inching closer to build a micro-reactor at the Chalk River complex, operated by the Canadian Nuclear Laboratories.

The MMR developed by GFP received a license to prepare its site in May 2021, and aims to have its 15-MW Micro Modular Reactor (MMR) providing power in 2026.

These developments in Canada are mirroring an industry-wide acceleration in nuclear power technologies, Nuclear Innovation Alliance's Alex Gilbert told *Mining Magazine*.

"The first commercial microreactors have just started licensing now," he said. "The first ones will be online by 2025 or 2026, while mobile microreactors will be available by 2030."

The MMR developed by OPG is aimed at providing small amounts of power for smaller communities, but power availability can be multiplied by adding multiple units, Ken Darlington, UNSC's Vice President of Corporate Development, said.

"The Micro Modular Reactor produces 15MW of thermal energy, so it's almost a nuclear battery," he said. "It can generate electricity or use it to heat mines. It can also produce hydrogen. It creates the opportunity to be energy-independent."

While nuclear physics may not have changed, manufacturing and technology have innovated substantially, allowing for substantial developments in nuclear power, GFP Communications Director Eric McGoey said.

"These changes have allowed us to simplify reactor designs to give efficiencies in operations and maintenance, more prefabrication, and now we can run plants that don't require as many people to operate," he said. "These [MMRs] aren't as technologically complex as Candus [Canada Deuterium Uranium heavy-water reactors], and they don't sacrifice safety."

One innovative aspect of the MMR technology is that the reactor is only fuelled once, and can run for 20 years without refueling, Darlington said.

The MMR technology also does not need to be located near a water source, he added.

"This technology does not use water for cooling, so it doesn't need to be located near the water," he said. "It's a helium new-cooled reactor, and electrical generation is air-cooled."

The conglomerate has created a reactor with increased safety features, McGoey said.

"They are designed to use what we call passive safety features, so that if anything goes wrong, rather than required operators to spot that, it triggers a safety system which automatically shuts down the reactor," he said. "It just safely sits there, dormant, and operators can bring it back up and do troubleshooting, without any danger."

Mining

With every industry under pressure to decarbonise its operations and implement net-zero carbon emission policies, MMR and SMR nuclear energy is becoming an attractive alternative for energy-intensive operations, Darlington said.

"The multinational [mining] companies are looking at it - but they may have operations in Chile, in Africa, in countries that are not yet nuclear," Darlington said. "We're looking at very specific opportunistic regions in Canada and the US, where there's a well-established regulatory framework."

We do see growing interest from those countries," he said. "It's a big opportunity" for mining to decarbonise its operations, he said.

One mining company has already signed a deal with an SMR provider. SMR producer NuScale Power has already signed an agreement with Polish copper and silver miner KGHM, and plans to have their units deployed in 2030.

The agreement will see NuScale provide at least four SMRs, with the option of up to 12, to replace coal-based energy sources, she said.

Mines which were once powered by coal will have little difficulty in adapting SMRs for use, NuScale's Hughes said.

"Some coal plant generation infrastructure can be repurposed and reused, such as cooling water delivery systems, demineralised water, potable water, transmission lines, and the switchyard," Hughes said.

Nuclear-power mines will likely be an easier sell in Canada, NEI's Gilbert said.

There are few places in the US which do not have some sort of access to an energy source or grid, he said. "The Canadian market is more interested - because of the [lack of] energy infrastructure there, and the climate" which makes it difficult to add solar-powered energy, he said.

GFP's Darlington said that the mining industry generally seeks to adopt technologies that have been proven elsewhere.

Other industries may need to incorporate the energy approach first, NEI's Gilbert said.

"We're going to see [nuclear adoption] first in industrial applications," Gilbert said. "Once that happens, we'll see a broader uptake for potential in that for miners."

SMR expert Dazawray Landrie-Parker is already seeing a jump in interest for the technologies.

"There has been an increase in interest in these technologies, and we've seen a steady upward increase in requests on this topic", Landrie-Parker said, She also directs the nuclear sector at Saskatchewan-based consultancy Creative Fire.

Mining companies will increasingly be looking for energy alternatives as more and more jurisdictions adopt carbon prices, McGoey said. Currently, most northern mining operations rely on diesel.

"Not only is diesel exposed to carbon costs, but you can't buy diesel futures and control your costs in a predictable way," he said.

Carbon prices will also ultimately determine whether projects will be economic, Darlington said.

"Many projects have a marginal IRR [Investor Rate of Return], and with carbon tax going from 30 to 100 dollars, that will kill IRR," he said. "This is why MMRs will be a gamechanger, when it comes to carbon management - one 5MW unit eliminates 200 million litres of diesel and 600,000 tonnes of CO2."

Nuclear power and renewables

Adopting nuclear strategies to power off-grid projects does not mean there is no place for renewables.

"The really important thing to consider is that we're not trying to beat renewables, because in many ways SMR/MMR technology complements renewables," GFP's McGoey said.

The main challenge with renewable power is its intermittency, he said.

"To get around that reality, what you generally have to do is to overbuild, generally by a factor of 7 to 10," he said.

If a 10 MW-load mine opted to use only renewable energy sources instead of two 5MW UNSC reactors, they would need to build "somewhere between 70MW and 100MW of solar and wind , plus storage," McGoey said. "The physical footprint is quite large - overbuilding is the only way to get around the efficiency issue."

A hybrid energy plan incorporating both renewables and nuclear power would work best with mines, Darlington said.

"You'll be hard pressed to find mining operations that have the same load demands 24/7," Darlington said. "So having a renewable-MMR hybrid would allow you to manage load and peaks at operations. Solar and wind power systems can be integrated into the exact same system."

The type of energy system will ultimately depend on what the climate is like, what works for the community, and whether renewable or other power options is feasible, Landrie-Parker said.

"In Arctic Canada, with its midnight sun, solar might not be a year-round option, but that doesn't mean it's entirely not an option," she said. "We also need to look at where battery storage technology is going - the more development happens with battery storage, the more we can utilise the different options to respond to energy demands."

Challenges

SMRs and MMRs are "still developing a lot of technical data needed for licensing," NEI's Gilbert said. "Things are pretty inefficient now, but will get more and more efficient over time." He predicts that by the end of the 2030s, conditions will be optimal for widespread adoption of nuclear technology in remote mines.

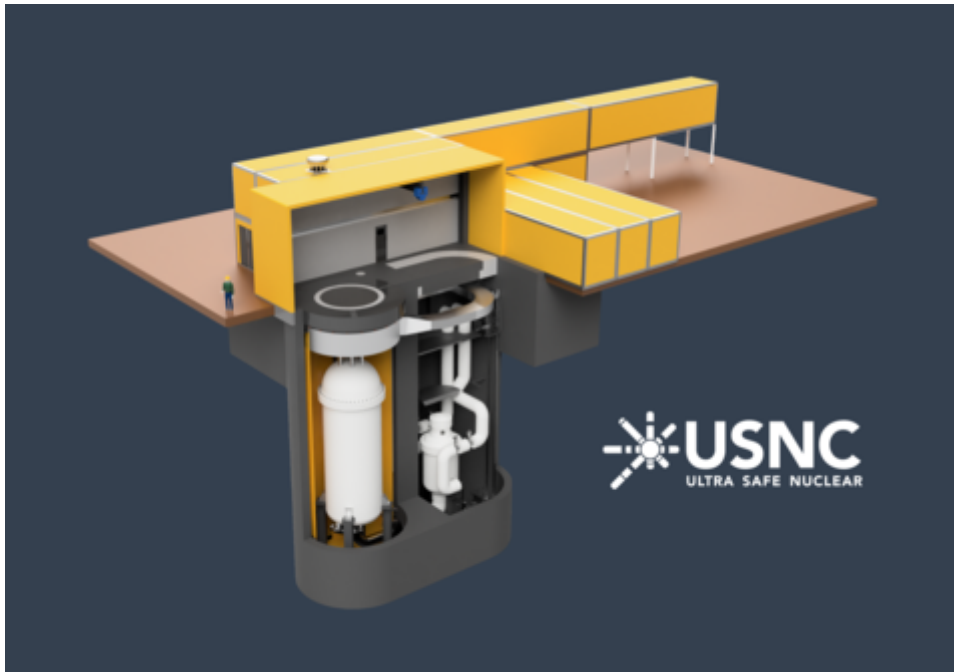
GFP is hoping for Canadian regulators to update their processes to enable SMRs to be approved more quickly.

"Now that we know the characteristics of the reactor, what are the pieces in the licensing processes that can be streamlined, so as not to force us to start from square one with every new SMR as if it's a new technology?" GFP's McGoey said.

"It's one of the things we're trying to do with this commercial demonstration, to look at licensing, go to the regulator, and talk to them."

Another challenge to increasing adoption of SMRs is energy illiteracy in many parts of Canada, Landrie-Parker said.

Energy literacy "is all over the map, from community to community and within communities. Especially outside of Ontario, as western Canada didn't have large nuclear facilities."



SMR
vendors
and

MMR lily pad

producers will need to connect with the public, explain what SMRs are, how waste is managed, and where it fits in with green clean technologies, she said.

"I think there's a lot of misconceptions that people have" about energy, she said. "I've recently looked at focus groups and surveys across Canada, and so many people see solar energy as Number 1," she said. "That's wonderful that solar is seen as a great option, but there needs to be an understanding that the energy system needs to be a mix."

The nuclear industry will need to look to the mining sector to learn how to bring communities onboard with projects, McGoey said.

"One way the mining industry is ahead of the nuclear industry in Canada is in developing mature and productive relationships with indigenous communities. We've seen a lot of that [mining companies reaching out to indigenous communities] in the last decade, where companies have IBAs [Impact and Benefit Agreements] and partnerships with indigenous communities to help with social license and buy-in.

"We haven't built nuclear plants in four decades, so we don't have the same understanding of aboriginal treaty rights and communities. We need to catch up with the 21st century," McGoey said.

There can be many community benefits from the use of an SMR or MMR in mining operations, Landrie-Parker said. Canadian mining operations are already required to have meaningful collaboration and community-focused programs with First Nations populations located near mine sites.

"The opportunity to have the SMR/MMR recycle heat output from [the mine] to heat a greenhouse would lead to more food security and food sovereignty" particularly for far northern Canadian communities, she said.

"I would love to see these [possibilities] being explored in a meaningful participatory way."



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