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# Applications used in Small Modular Reactors

**Madira Paul***

*Key Discipline Laboratory of Nuclear Safety and Simulation Technology, Harbin Engineering University, Harbin, China*

***Corresponding Author:** Madira Paul, Key Discipline Laboratory of Nuclear Safety and Simulation Technology, Harbin Engineering University, Harbin, China; E-mail: madirapaul11@gmail.com

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## Description

Nuclear power has long been recognized as a reliable and low-carbon energy source, contributing significantly to global electricity generation. However, traditional large-scale nuclear reactors pose challenges in terms of construction, cost, and safety concerns. Enter small modular reactors, a promising advancement in nuclear technology that offers numerous benefits and potential applications. Small Modular Reactors (SMRs) are nuclear power plants with a smaller capacity, typically ranging from a few megawatts to 300 megawatts. Their design is focused on modularity, standardization, and scalability, enabling them to be manufactured in a factory setting and transported to the installation site. SMRs can be grouped into two main categories: Pressurized Water Reactors (PWRs) and High-Temperature Gas-Cooled Reactors (HTGRs).

### Applications

**Enhanced safety:** SMRs incorporate advanced passive safety systems, including natural circulation of coolant, which eliminates the need for active mechanical pumps. The smaller size also reduces the potential impact of accidents and facilitates containment in case of an incident.

**Flexibility and scalability:** The modular nature of SMRs allows for flexible deployment, particularly in remote or isolated areas, where large-scale grid connection may be challenging. Moreover, as electricity demand increases, additional modules can be added, enhancing scalability.

**Reduced construction time and cost:** Factory-based manufacturing and standardized designs enable SMRs to benefit from economies of scale, reduced construction timelines, and cost savings. They also require less land area for installation compared to traditional reactors.

**Enhanced nuclear fuel efficiency:** SMRs can utilize advanced fuels and fuel cycles, resulting in higher fuel utilization and reduced waste generation. Some designs also allow for the use of enriched or depleted uranium, plutonium, or even thorium.

### Pressurized Water Reactors (PWRs):

**NuScale power:** NuScale's SMR design features natural circulation of coolant, passive cooling mechanisms, and integral containment. It has received approval from the U.S. Nuclear Regulatory Commission (NRC) and has gained interest worldwide.

**Rolls-royce SMR:** Rolls-Royce's SMR concept utilizes a PWR design with a capacity of up to 440 megawatts. It focuses on providing a cost-effective and low-carbon solution for electricity and industrial heat applications.

**CAREM:** Argentina's CAREM reactor is a compact PWR with a capacity of 25 megawatts. It has been designed with a focus on safety, simplicity, and the ability to be quickly deployed in remote areas.

### High-Temperature Gas-Cooled Reactors (HTGRs):

**High-Temperature Gas Reactor-1 (HTR-1):** Developed by China, the HTR-1 is a 200 megawatt pebble-bed HTGR. It offers high thermal efficiency, inherent safety features, and the potential for diverse applications, such as hydrogen production and process heat.

**Very High-Temperature Reactor (VHTR):** The VHTR, under development in multiple countries, aims to achieve even higher temperatures for efficient electricity generation and process heat applications. It utilizes helium as a coolant and can potentially be used for hydrogen production, synthetic fuel generation, and desalination.

## Concepts

**Molten Salt Reactors (MSRs):** MSRs use a liquid fuel mixture of fluoride salts as both the fuel and the coolant. They offer inherent safety features, efficient fuel utilization, and the ability to transmute long-lived radioactive isotopes. Companies like Terrestrial Energy and ThorCon Power are actively developing MSR designs.

**Floating nuclear power plants:** SMRs are also being considered for maritime applications, particularly in remote coastal areas or as a means of supplying power to offshore platforms or desalination facilities. Rosatom's Akademik Lomonosov is an example of a floating nuclear power plant utilizing SMR technology.

**Regulatory framework:** Establishing appropriate regulations and licensing procedures for SMRs is essential to ensure safety while streamlining the approval process. Collaborative efforts between regulatory bodies and industry stakeholders are underway to address this challenge.

## Conclusion

Looking ahead, the future of small modular reactors appears promising. Their modular and scalable nature allows for flexible and efficient deployment in various settings. As the global energy landscape evolves, SMRs can play a significant role in meeting the increasing demand for clean, reliable, and sustainable electricity generation. Small modular reactors represent an exciting advancement in nuclear power technology. With enhanced safety features, flexibility, scalability, and potential applications in various industries, SMRs offer a promising solution for clean energy generation.

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