

NUCLEAR ENERGY IN NEW JERSEY



What is an advanced reactor?

Advanced Reactors are a new class of nuclear energy that improves upon technology that has been operating since the 1950s. They build on decades of operating experience while incorporating advances in safety, materials, fuels, and plant design.

The Nuclear Regulatory Commission (NRC) generally uses the term “advanced reactor” to include advanced light-water reactors and non-light-water reactors. These designs may incorporate features such as passive safety systems, alternative fuels or coolants, improved operational flexibility, and new approaches to construction and deployment. Small modular reactors (SMRs) are defined primarily by their smaller power output and modular design approach, rather than by a single reactor technology. Some SMRs use light-water reactor technology, while others are non-light-water designs that use alternative coolants, fuels, and materials. SMRs are generally designed to be more compact and scalable and may be deployed as individual units or in multi-unit configurations. Advanced reactors can range from small modular designs to large-scale reactors. Together, they represent a diverse set of technologies intended to improve safety, performance, flexibility, and deployment options compared with earlier reactor designs.

When will the next generation of nuclear reactors be ready?

The first advanced nuclear plants in North America are expected to begin operations by 2030, and some may even be deployed sooner. In 2023, the NRC approved the first SMR design. This means utility companies can now apply for a combined license to build and operate this small modular reactor.

Are Advanced Reactors safe?

Advanced Reactors incorporate a multitude of safety features, building upon experience from the robust safety operations of the current fleet of nuclear plants. Each nuclear plant is protected by multiple backup safety systems. Some will be capable of operating without backup electricity.

Advanced Reactors can operate with significantly enhanced safety compared to traditional light-water nuclear reactors. Advanced Reactors often run at lower, safer pressures because of the special coolants they use. In many cases, they can also take advantage of passive safety measures rather than relying on active safety features that require a backup power supply or human intervention to work. These passive safety measures allow reactors to withstand a broader set of accident conditions without causing damage.

How will Advanced Reactors incorporate even more safety features?

They can achieve this in two main ways. The first method involves using advanced fuel types that leverage 60 years of operating experience from existing reactors. The second method focuses on implementing safety features that do not depend on active systems like pumps or valves. Instead, these features rely on gravity and natural convection to ensure the safety of the reactors, workers, and the public.

Do Advanced Reactors produce used fuel?

Advanced Reactors may produce smaller amounts of used fuel, in forms that will make disposal easier than current LWR spent fuel. Some designs will even allow for the recovery and reuse of spent fuel. Advanced Reactors may produce used fuel with different materials and configurations than conventional nuclear plants, but they still can be safely stored using the same proven technologies. This includes fortified storage systems designed to withstand extreme events such as earthquakes, fires, and hurricanes, as has been done for decades at existing nuclear power plants. Advanced nuclear plants will allocate funding for the management of used fuel, and the government guarantees that this funding will be adequate to cover the cost of managing it. Regardless of the approach taken to manage spent nuclear fuel in the U.S., there is existing technology and expertise to maintain safe handling of this material for the long-term.

What types of fuel are used in an Advanced Reactor?

Advanced reactors can use several different types of nuclear fuel depending on the reactor design, including uranium oxide fuel, TRISO (TRi-structural ISOTropic) particle fuel, metallic fuel, and fuel dissolved in molten salts. Many advanced reactor designs are expected to use HALEU (high-assay low-enriched uranium, enriched between 5% and 20% in U-235), which can be fabricated into different fuel forms and can enable smaller reactor designs, longer operating cycles, and improved fuel utilization compared with conventional lower-enriched fuel.

How is waste management regulated for Advanced Reactors?

New Advanced Reactor designs will introduce new waste streams that may differ significantly from those generated by conventional reactors, depending on the specific reactor design. The characteristics of Advanced Reactor waste will vary greatly. The physical, chemical, and radiological properties of these wastes will depend on the specific reactor technology and company-specific design. Storage of Spent Nuclear Fuel from Advanced Reactors could be regulated by the NRC or regulated and operated by the DOE.

Some advanced reactor designs are exploring the potential to utilize used nuclear fuel or recycled fuel, similar to practices in countries like France, to produce a significantly smaller amount of used fuel. Regardless of the approach we choose for managing spent nuclear fuel in the U.S., we have the technology and expertise to ensure the long-term safe management of this material.

Are Advanced Reactor nuclear plants expensive?

When considering which type of technology to build for new electricity generation, costs for each option are compared against each other, and the lowest cost is chosen. As with other novel technologies, the first advanced nuclear plants will initially have a higher cost than alternatives. However, a wide range of recent studies have shown that a diverse portfolio of generating technologies, which includes nuclear energy, results in the lowest costs of energy.

Aside from electricity, nuclear energy also provides a lot of additional value to our electricity system as it is carbon-free, runs 24/7, and improves life in the communities where it is located. Having nuclear energy in the U.S. helps us remain the innovative, inventive society that has made us a world leader, and having a reliable source of energy also contributes to our national security. The USDOE supports initiatives to standardize designs to help further reduce costs.

Is it safe to live near an Advanced Reactor plant?

When people think of safety in relation to nuclear plants, questions most often arise around radiation, so it is helpful to understand the process that produces radiation. Advanced Reactors are powered by uranium fuel that undergoes a reaction, called fission, which produces heat. The heat is used to turn water into steam, which turns a turbine. Radiation also results from the reaction. Advanced Reactors are designed to seal off radiation from the outside world using barriers that radiation cannot travel through. Each nuclear plant is protected by multiple backup safety systems.

Advanced reactor designers have learned from incidents at Three Mile Island, Chernobyl, and Fukushima, incorporating innovations to further enhance nuclear safety. Advanced Reactors incorporate a multitude of factors, from their location below ground to the use of natural physics that reduce the reliance on pumps and valves. In fact, most Advanced Reactor designs are able to maintain a safe configuration without the need for operator actions, power, or water, which have been factors in previous incidents. Of course, plants will always have operators trained to respond in case of an emergency.

How long have the current power plants in New Jersey been safely operating?

Salem 1, Salem 2, and Hope Creek have been safely operating since 1977, 1981, and 1986, respectively. The Nuclear Regulatory Commission (NRC) has a comprehensive program of inspections for commercial nuclear power plants. The NRC conducts routine inspections, which are an important element of NRC's oversight program to ensure that licensees meet NRC's regulatory requirements. Through this oversight program, the NRC inspectors verify that the organizational structure, operator qualifications, design, maintenance, fuel handling, and environmental and radiation protection programs are adequate and comply with NRC safety requirements. The NJDEP's Bureau of Nuclear Engineering has nuclear engineers that accompany the NRC inspectors in the oversight program inspections for more than 30 years. When licensees meet the program requirements, we know that they are conducting safe operations that protect the public and the environment from any undue nuclear risk. The Salem 1, Salem 2, and Hope Creek plants have operated safely in accordance with these NRC requirements.

How is Spent Nuclear Fuel stored at the power plants in New Jersey?

Spent nuclear fuel can be stored either in a water-filled spent fuel pool or dry cask storage system. Spent nuclear fuel is safely stored in specially designed pools at Salem 1, Salem 2, and Hope Creek. If the spent fuel pool storage is approaching capacity, then the licensees use dry storage systems to store the fuel. The three operating power plants in New Jersey use dry cask storage systems to store the spent nuclear fuel in an Independent Spent Fuel Storage Installation (ISFSI) pad at the site, thereby allowing space for newer spent fuel to be stored in the spent fuel pools. The NRC regulates spent fuel through a combination of regulatory requirements, licensing, safety and security oversight, inspections, and assessment of performance.

ADVANCED REACTOR FEATURES & SIZES

Safety

Requires no or minimal operator intervention to remain safe in the event of an accident

Waste Reduction

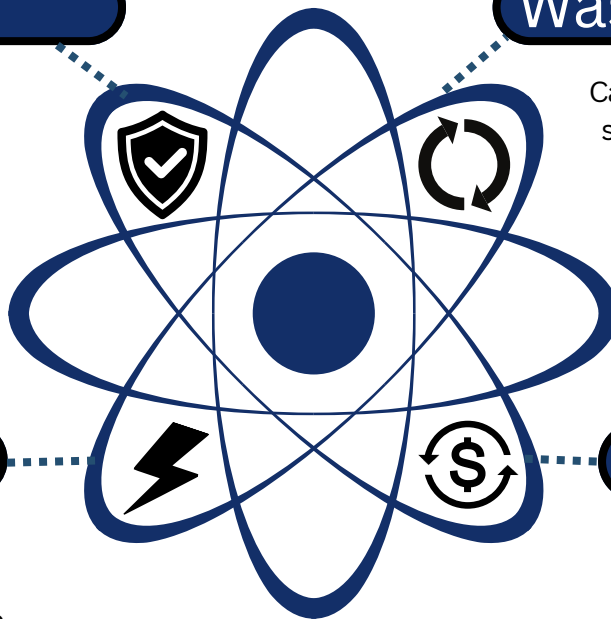
Can greatly reduce the amount of spent fuel requiring disposal and some technologies can re-use spent fuel

Versatility

Can provide heat energy for industrial processes, water desalination, and load-following to support intermittent power sources

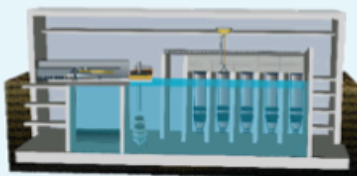
Financeability

Can employ factory manufacturing and be made with less capital cost



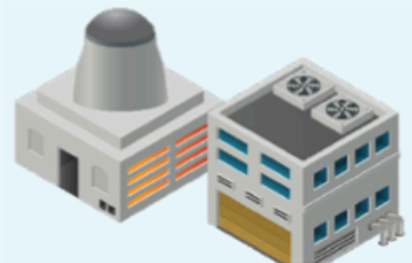
Microreactors Range: 1 MW to 20 MW

Can fit on a flatbed truck, and are mobile and deployable.



Small Modular Reactors Range: 20 MW to 300 MW

Can be scaled up or down by adding more units.



Full-Size Reactors Range: 300 MW to 1,000+ MW

Can provide reliable, emissions-free baseload power.

***MW refers to one million watts of energy.**

****Graphics and text are from The Department of Energy's Nuclear Office. www.nj.gov/nuclear**