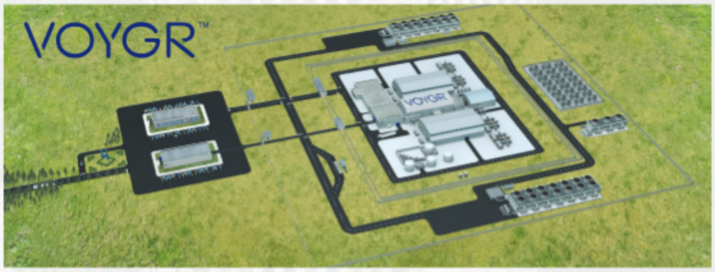
NUSCALE
Small Modular Reactor

NuScale is changing the power that changes the world by creating an energy source that is smarter, cleaner, safer, and cost competitive. The NuScale small modular reactor (SMR) offers a scalable power plant solution incorporating enhanced safety, improved affordability, and extended flexibility for diverse electrical and process heat applications.

Based on proven light-water reactor technology, the NuScale VOYGR™ plants use an innovative and simplified design that is substantiated by an extensive testing program.

Electric Output	77 MWe per module
Reactor Power	250 MWt per module
Design Life	60 years
Fuel Type	<4.95% enriched UO_2



Description: The NuScale Power Module™ (NPM) is a 250 megawatts thermal (MWt) integral pressurized water reactor (PWR) that employs gravity-driven natural circulation of the primary coolant for both normal operation and shutdown mode. The NPM, including containment, is fully factory-built and shipped to the plant site by truck, rail, or barge. NuScale's flagship VOYGR-12 power plant design can accommodate up to 12 NPMs, resulting in a total gross output of 924 megawatts electric (MWe). We also offer smaller power plant solutions, the four-module VOYGR-4 (308 MWe) and six-module VOYGR-6 (462 MWe), that are underpinned by the rigorous safety case of our flagship design.

Licensing: Design, testing, and analysis activities to support a design certification application (DCA) with the U.S. Nuclear Regulatory Commission (NRC) have been underway for several years. Following extensive pre-application activities conducted with the NRC since 2008, the DCA was submitted and review commenced by the NRC in March 2017. The NRC completed the final phase of the review with the issuance of the Final Safety Evaluation Report (FSER) in August 2020, making NuScale the first ever SMR to receive NRC approval.

Deployment: By the end of this decade, a NuScale VOYGR power plant will become part of the Carbon Free Power Project (CFPP), an initiative spearheaded by the Utah Associated Municipal Power Systems (UAMPS). UAMPS is a consortium of 48 public power utilities with service areas in eight western states. UAMPS is currently active on the CFPP site performing site characterization activities. In January 2021, UAMPS and NuScale executed agreements to help manage and de-risk the development of the CFPP. Pursuant to the initial orders from UAMPS, Fluor Corporation and NuScale (as a subcontractor to Fluor) are to develop higher maturity cost estimates and initial project planning work for the licensing, manufacturing, and construction of the CFPP. These agreements are an important step in a deployment plan that is expected to result in the order of NPMs by UAMPS in 2022. Interest in NuScale's technology from other power companies continues to build in U.S. states that have or intend to pass legislation for reducing electricity emissions and/or establishing clean energy goals. Internationally, significant interest in NuScale VOYGR plants has been expressed in the United Kingdom, Europe, the Middle East, Africa, and Asia.

Safety: NuScale's Triple Crown for Nuclear Plant Safety™ has achieved a paradigm shift in the level of safety of a nuclear power plant. NuScale's SMR technology is a revolutionary solution to one of the biggest technical challenges for the current fleet of nuclear energy facilities. Its innovative and comprehensive safety features provide stable, long-term nuclear core cooling under all conditions, including severe accidents.

These safety features include:

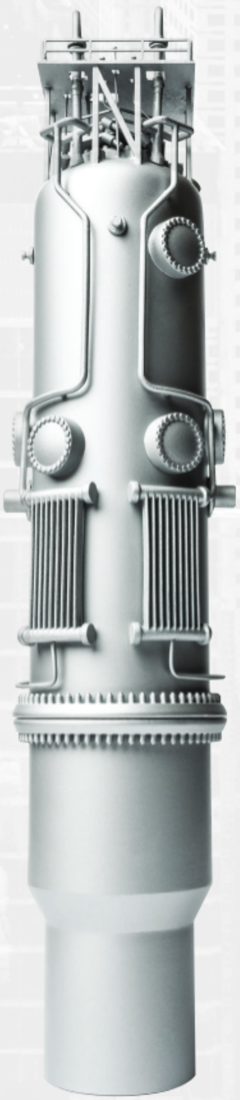
- In a station blackout condition, the NPM safely shuts down and self-cools indefinitely—with no operator action, AC/DC power, or additional water needed.
- Natural circulation for normal operation eliminates the need for large primary piping and reactor coolant pumps.
- NPMs are submerged in a below-grade pool of water housed in a Seismic Category 1, aircraft impact resistant building that serves as the ultimate heat sink for core cooling.
- Each NPM houses approximately 5 percent of the nuclear fuel of a conventional 1,000 MWe nuclear reactor.

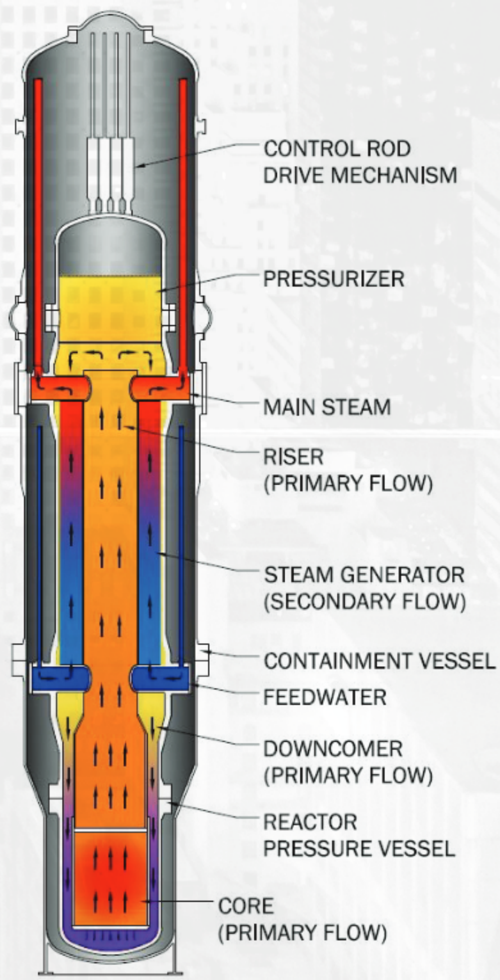
Advanced Design Features	
Integral PWR configuration	Fail-safe emergency core cooling system
Natural circulation of primary coolant	Factory fabrication of entire module
Compact containment vessel immersed in pool	Scalable plant design (1-12 modules)

Defense-in-depth is provided through diverse and redundant systems to shut down and cool the reactor using passive phenomena such as heat conduction, convection, and gravity. Passive safety systems include the Decay Heat Removal System (DHRS), Emergency Core Cooling System (ECCS), and multiple fission product barriers. The containment vessel is submerged in the ultimate heat sink rather than relying on complex external safety systems to bring coolant to the reactor vessel. The design incorporates small diameter piping that eliminates the possibility of large-break loss-of-coolant accidents (LOCA), and limits design basis small-break LOCAs to those that cannot uncover the core.

The containment vessel surface area is sized to ensure complete core decay heat removal without additional safety systems. NuScale has implemented a low power density core of 3.9 kW/ft (12.8 kW/m) inside a reactor vessel that contains four times the water volume per MW of conventional PWRs. A fully redundant passive DHRS operates by isolating a module's main steam and main feedwater lines. Steam from the steam generators is directed to either of two DHRS condensers that are submerged in the reactor building pool. Each DHRS train is capable of removing 100 percent of the decay heat load.

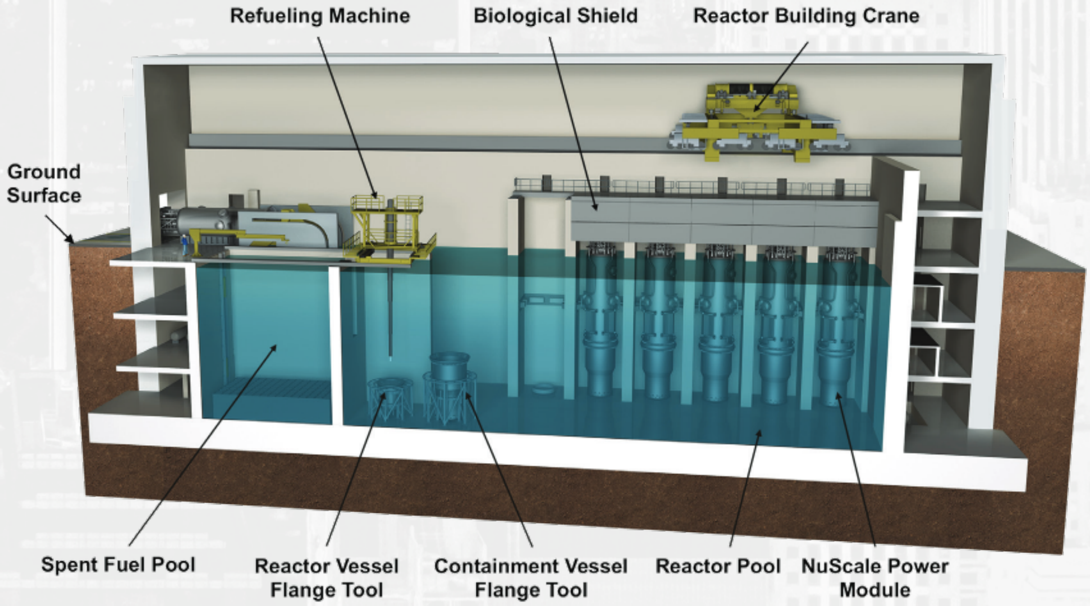
The ECCS operates by opening the vent valves located on the reactor vessel head. Steam from the reactor vessel condenses on the inside surface of the containment vessel which rejects heat to the reactor building pool. When the water level in the containment is greater than the elevation of the recirculation valves located on the side of the reactor vessel, the recirculation valves open to create a natural circulation flow path from the containment vessel to the reactor vessel. The ECCS can operate independently or in conjunction with the DHRS to safely cool the fuel by heat transfer to the reactor building pool, followed by an unlimited period of air cooling.





Both the DHRS and the ECCS can function effectively without the need for pumps, AC power, or additional water. All safety-related equipment required to protect the reactor and spent fuel pool is housed in the reactor building, which is designed to withstand a seismic spectrum with 0.5g zero period acceleration (ZPA). The module is also protected from internal design basis accidents such as pipe ruptures. These factors give the NuScale design a probability of core damage that is orders of magnitude lower than conventional plant designs.

Maturity of Technology: To minimize design, licensing, and deployment risks, the NuScale design uses proven fundamental light-water reactor technology, including the use of the same state-of-the-art materials and coolant chemistry as is used in existing PWRs. More than a quarter of NuScale's systems, subsystems, and components (SSCs) are already at a technology readiness level (TRL) of 9 and more than 80 percent of the SSCs have a TRL of 7 or greater. An aggressive testing and validation program is in place for those components and systems with lower TRL maturity.



CUT-AWAY VIEW OF THE REACTOR BUILDING

Testing and Validation: Unique design features are tested and validated through an extensive testing and validation program using world-class facilities. The NuScale Integral System Test (NIST) facility is a 1:3 scale integral thermal-hydraulic test facility. Operational since 2003 and upgraded in 2015, NuScale has used the facility throughout the design process to confirm the performance of the NuScale safety systems, essential for establishing regulator and customer confidence in the design.

In addition to NIST, NuScale operates a 12-module control room simulator to conduct control design and staffing evaluations. NuScale also constructed a full-scale mockup of the upper portion of an NPM to conduct design, engineering, and spatial interference studies. Complementing these facilities, NuScale utilizes several world-class testing facilities located in the United States, Canada, Italy, and Germany to validate individual components and systems. For example, critical heat flux tests were conducted at Stern Laboratories in Canada and both separate effects and integral tests of the helical coil steam generator design were completed at the SIET facility in Italy.

Construction Methods/Schedule: The construction schedule from first nuclear concrete to fuel load is targeted to be 39 months for the first VOYGR™ plant and 30 months for nth-of-a-kind plants. Fabrication of the nuclear steam supply system (NSSS) module, primary plant systems, and many balance-of-plant systems will be performed in a factory setting. A smaller plant footprint, fewer number of components per module, and a high percentage of modular factory-fabricated components and packages all help to reduce construction complexity and duration. Quality assurance, inspection, and testing activities performed at the factory will also help to reduce potential impacts on the construction schedule and improve cost certainty.

Supply Chain: In 2018, BWX Technologies, Inc. (BWXT) was selected to provide manufacturing input leading to fabricating the first NPMs. The decision followed a rigorous 18-month selection process, with expressed interest from 83 companies based in 10 countries. BWXT and NuScale are collaborating to update the design optimizing for manufacturing and transportation and reducing overall costs of the NPMs. In 2019, Doosan Heavy Industries and Construction Co., Ltd. (DHIC) and NuScale entered into an agreement for strategic cooperation and investment to support deployment of the NPM worldwide. NPM manufacturing trial activities commenced with both companies in 2020.

Advisory Boards: NuScale maintains two major advisory boards to help guide technology maturation and commercial deployment activities. First, the Technical Advisory Board (TAB) is comprised of nationally recognized technical experts in nuclear power plant design, operations, maintenance, regulations, and safety. The TAB ensures that NuScale technology risks are identified, that adequate risk mitigation plans are defined and executed, and that contingency plans can be realistically implemented if needed.

Secondly, the NuScale Advisory Board (NuAB) was formed in 2008 and has had participants from more than 29 power companies. The NuAB provides a strong customer perspective and ensures that the NuScale plant design meets key customer requirements for successful deployment and operations. The NuAB, which includes utilities with and without current nuclear plant experience, functions through routine meetings and ad hoc workshops that focus on specific licensing and deployment issues. Both of these Boards have provided independent verification functions of various aspects of the NuScale design and deployment program.

NuScale Small Modular Reactor: Technical Specifications			
VOYGR Plant Design Objective (Plant Operation)	60 years	Moderator	Light water
Thermal Power (per module)	250 MWt	Steam Generators Number Configuration	2 independent tube bundles integrated into reactor vessel Once through helical
Electrical Power (per module)	77 MWe (gross)	Operating Cycle Length	18 months
Thermal Efficiency	>30%	Outage Duration	10 days
Reactor Type	Integral Pressurized Water Reactor	Containment Parameters: Design Temperature Design Pressure Nominal Operating Pressure Vessel Diameter Vessel Height	 316°C (600°F) 83 bar (1200 psia) <0.07 bar (<1 psia) 4.6 m 23.3 m
Core Fuel Type Fuel Enrichment No. of Fuel Elements Core Height	 UO_2 <4.95% 37 (17 x 17 pin array) 2.0 m	Primary System Parameters: Design Temperature Design Pressure Nominal Operating Pressure	 343°C (650°F) 152 bar (2200 psia) 138 bar (2000 psia)
Coolant	Light water	Secondary System Parameters: Design Temperature Feedwater Temperature Turbine Inlet Pressure	 343°C (650°F) 93°C (200°F) 35 bar (500 psia)

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