



**VIRGINIA CLEAN ENERGY
INNOVATION BANK**

Powered by Virginia Energy 

VIRGINIA NUCLEAR SIMULATOR CAPABILITIES OVERVIEW

Prepared by VCEIB Staff | August 2026

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Table of Contents

Executive Summary.....	1
Light-Water SMR Simulators: NuScale E2 Centers.	3
PWR & Multi-Reactor Simulation: Generic PWR & Fusion Pathway.	6
Advanced Reactor Simulation: Terrapower Sodium Simulator.	9
Dominion Energy Simulators.....	12
U.S. Navy Simulators.	14
Conclusion.....	16

Executive Summary

The Virginia Clean Energy Innovation Bank ([VCEIB](#)), housed within the Virginia Department of Energy (Virginia Energy), has invested in nuclear simulator infrastructure at several Virginia universities to support advanced nuclear workforce development and further position the Commonwealth as a premier destination for small modular reactor (SMR), advanced fission, and fusion projects. In addition, private nuclear simulators operate within the state.

Virginia currently generates 83% of its clean electricity and 33% of its total electricity from nuclear energy. The Virginia Innovative Nuclear Hub ([VINHub](#)) is a nonprofit research organization established in 2023 by the Virginia Nuclear Energy Consortium ([VNEC](#)). It facilitates collaboration between industry and academia on energy, economic, environmental, and national security challenges. VNEC, created by the Virginia legislature in 2013, represents Virginia's nuclear energy stakeholders and advances the Commonwealth's nuclear industry through business development and state and federal advocacy.

Virginia's simulators provide realistic control-room environments for current and next-generation reactor designs, supporting the creation of a pipeline of qualified operators and engineers to service the state's existing fleet and pioneer the advanced reactors of tomorrow. This report provides an overview of the technology, roles, and community impacts associated with these simulators across the Commonwealth.



APPENDIX	VTCRC NATRIUM SIMULATOR*	VCU GPWR SIMULATOR*	UVA WISE NUSCALE SIM.*	GMU NUSCALE SIMULATOR*	DOMINION SIMULATORS	US NAVY SIMULATORS
Date Commisioned	Q4 2026 (projected)	Sep. 2022	Jan. 2026	May 2025	1988 (Surry), 1988 (Anna)	Not public
Technology	Sodium-cooled Fast Reactor (SFR) / Advanced PWR	Generic Pressurized Water Reactor (PWR)	Small Modular Reactor (SMR): Light Water PWR	Small Modular Reactor (SMR): Light Water PWR	Full-Scope Plant Reference Simulators (PWR)	Naval Nuclear Propulsion Plant Simulators
Technology Details	TerraPower Advanced Sodium- cooled Fast Reactor (SFR). First of its kind in the world; expands operator exposure beyond light water reactor training.	Current: GSE Generic PWR based on 3-loop commercial reactors. Future: R&D to establish advanced nuclear reactors and prototype fusion energy systems.	Full-scale NuScale VOYGR-12 SMR; 12 modules at 77 MWe each. Extends SMR training to Southwest Virginia, a future SMR deployment region.	Full-scale NuScale VOYGR-12 SMR; 12 modules at 77 MWe each. Largest NuScale E2 Center in the US; serves the NOVA corridor.	Plant reference and GPMS simulators for North Anna and Surry Reactors. Comprehensive plant-specific training for Virginia's existing reactor workforce.	Naval nuclear propulsion and power training hub for submarine and carrier operators in Hampton Roads.
Metrics	7 operator station seats, 2 instructor station seats, 100+ users annually	6 operating stations, 150+ undergraduates impacted, 2 ongoing R&D projects	4 operator workstations	16 operating stations, capacity for 32 trainees	70 licensed operators/ station annually; 160 hrs/year in training, 60+ hrs in-simulator	Not public
Workforce developmentD	Training access for VT students, partner schools, industry, & government	Pipeline to North Anna and Surry reactors & fusion operator training	Supports future SMR workforce within SW Virginia	Provides training for students & industry while supporting research	NRC mandated licensed operator training capabilities	Established pipeline to Dominion Energy reactors in VA
Community Impact	Creates pathways into high-wage careers with TerraPower in Virginia and the greater US	Upgrades expand student capacity by almost 100% and public access by 100x original levels	Provides nuclear education opportunities to surrounding energy communities	Lab tours for 20+ organizations and demonstrations for over 350 people to date	Free programs available to schools and organizations by appointment	Provides hundreds of highly trained nuclear personnel to the VA workforce
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Address	Secure Energy Future Center @ VTCRC, 900 N Glebe Road, Arlington, VA	Mechanical & Nuclear Engineering, 601 W Main St. Richmond, VA 23284	SMR Operations and Control Lab, 16620 E Riverside Dr. St. Paul, VA	Fuse at Mason Square, 3351 Fairfax Dr. Arlington, VA	North Anna: 1022 Haley Dr, Mineral, VA 23117 / Surry: 5570 Hog Island Rd, Surry, VA 23883.	Naval Station Norfolk, 1530 Gilbert Street, Norfolk, VA 23511-2722

** Funded wholly or in part by the Virginia Clean Energy Innovation Bank*



Funded by VCEIB

Light-Water SMR Simulators: NuScale E2 Centers

NUSCALE POWER AT GMU ARLINGTON & UVA WISE

Funded by VCEIB Virginia hosts two [NuScale Energy Exploration \(E2\) Centers](#) that provide full-scale simulation of the NuScale VOYGR SMR plant. [George Mason University's E2 Center](#) in Arlington was deployed in May 2025 **as the first NuScale simulator on the East Coast**, bringing a key educational asset to the highest concentration of data centers in the world. [The second E2 Center was installed at the University of Virginia's College at Wise](#) in Southwest Virginia, providing a strategic location to support the region's educational role in developing talent for future nuclear deployments. These simulators link two regions of the Commonwealth to establish a connective SMR training platform. Both of these simulators were funded by VCEIB.

NuScale Power is a publicly traded nuclear company (NYSE: SMR) that is developing a pressurized-water SMR design based on its NuScale Power Module. Each module is rated at 77 MWe, which is scalable to 924 MWe in a 12-module configuration for larger plants. In 2020, NuScale became the first SMR developer to receive U.S. Nuclear Regulatory Commission's Standard Design Approval, and has since received further validation from the federal regulators.

TECHNOLOGY & CAPABILITIES

The GMU and UVA Wise E2 Centers use the same full-scale control-room simulator platform configured around the NuScale VOYGR-12 plant design capable of supporting normal operations, abnormal conditions, and emergency scenarios. The system includes alarm functions, automated and manual procedures, and instructor-controlled malfunction scenarios, allowing users to study plant behavior and crew coordination under realistic conditions.

Since both simulators use the same technology, they provide a consistent training experience while serving different parts of the Commonwealth. The GMU E2 Center is the largest NuScale E2 Center in the United States, and is housed in the 345,000-square-foot Fuse building at Mason Square. UVA Wise operates a new SMR Operations and Control Simulation Lab at the Oxbow Center in St. Paul, extending access to Southwest Virginia.

ROLE & LIMITATIONS

The presence of two identical NuScale control-room simulators in one state expands Virginia's capacity to develop a NuScale-focused workforce. GMU offers visibility and access to Northern Virginia's technology, policy, and industry networks, while UVA Wise expands access into a region closely connected to discussions about future advanced nuclear deployment. UVA Wise is positioned to support workforce preparation for NuScale's partnership with the Tennessee Valley Authority ([TVA](#)) to deliver 6 GW of nuclear energy to the region, the largest SMR deployment in US history.

These simulators are designed to replicate a single vendor's light-water SMR design and are thus not configured to be easily repurposed for non-NuScale advanced reactors or for broader experimentation across multiple reactor concepts. Nevertheless, the skills this pair of simulators reinforces are widely applicable and are a valuable foundation for SMR operators and staff to understand standard protocols.

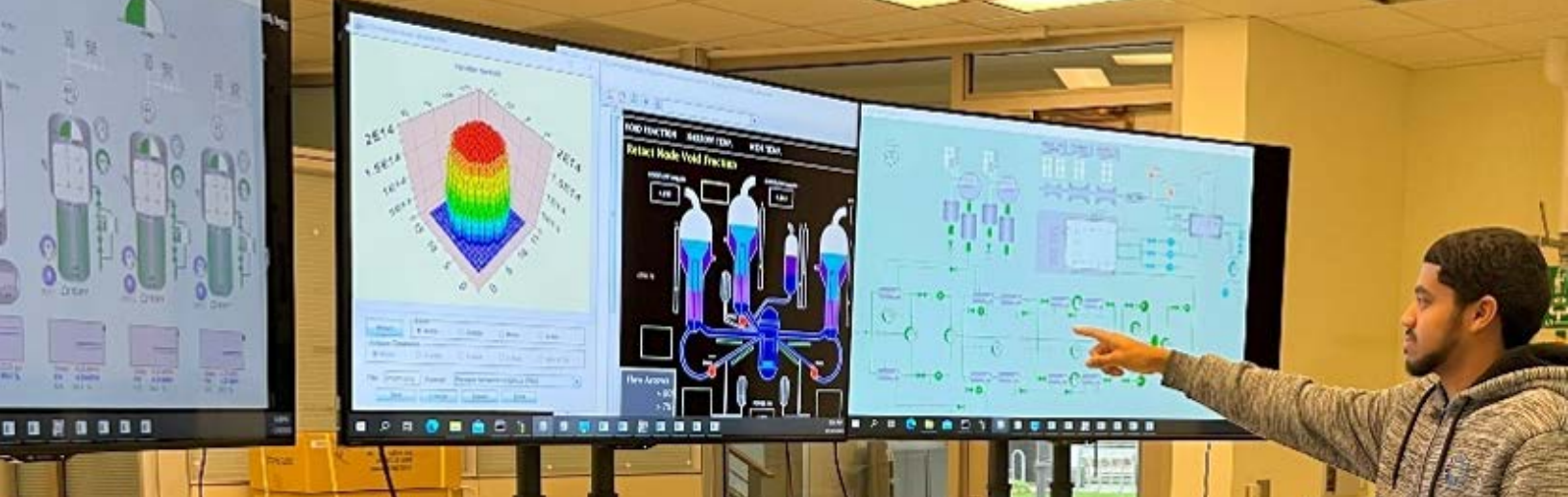
WORKFORCE DEVELOPMENT & COMMUNITY IMPACT

The NuScale E2 Centers are designed around workforce preparation for SMR operations and engineering roles. At GMU, faculty plan to continue developing SMR curriculum modules for statewide adoption while advancing research on SMR-data center-grid integration and operation. The location has 1,250 sq ft of dedicated simulator space, which has been used to host guided lab tours for 20+ organizations and engaged over 350 participants in demonstrations. At UVA Wise, the simulator supports local students and incumbent workers that may participate in future reactor deployment and supply-chain activity. Together, the two sites create a pipeline of SMR-literate graduates in both Northern Virginia and Southwest Virginia.

Both sites support K–12 STEM activities, open houses, and public education that are available free of cost. Contacts found at the bottom of this report may be used for details regarding this programming.

FUTURE EXPANSION

GMU and UVA Wise are expected to coordinate SMR teaching materials and exercises with VINHub and VNEC, helping to serve as connectors between the universities. At GMU, faculty have plans for continued development and publication of SMR curriculum modules for use across the Commonwealth. At UVA Wise, the development of a permanent facility in Wise County for the SMR lab is under consideration as part of future workforce development efforts.



Upgrades Funded by VCEIB

PWR & Multi-Reactor Simulation: Generic PWR & Fusion Pathway

GSE SOLUTIONS AT VCU

Virginia Commonwealth University operates the Nuclear Reactor Simulator Laboratory ([NRSL](#)), built around a GSE Solutions [Generic Pressurized Water Reactor \(GPWR\) simulator](#). This system models a commercial three-loop PWR similar to Dominion Energy's North Anna and Surry nuclear power plants, and is currently being upgraded with support from VCEIB funding.

GSE Solutions is a nuclear simulation and training company that has operated in the industry for several decades. It built the first commercial full-scope nuclear reactor simulator in 1971 and has since delivered more full-scope simulators than any other company in the U.S.

TECHNOLOGY & CAPABILITIES

The GPWR is a full-scale PWR simulator that supports regular and irregular scenarios across a full operating spectrum. It includes interactive plant schematics and real-time operator workstations that allow users to observe how changes in control inputs affect the reactor core, primary loop, secondary systems, and turbine-generator. VCEIB-funded upgrades will add large overview

displays, more interactive control capability, and an improved space for group viewing of exercises in the lab.

ROLE & LIMITATIONS

The VCU NRSL is designed to be flexible in supporting different reactor concepts and scenarios. Unlike simulators dedicated to a single reactor vendor, the NRSL can serve as a testbed for control-room technology and scenario analysis across multiple reactor concepts. However, since it is not officially commissioned by an SMR developer, it may lack some of the advanced functionality provided for those specific reactors. VCU and its vendor partner also plan to expand the platform through development of an integrated fusion energy systems simulator in the near future.

The advanced fission modules this simulator is expected to support are still in development. In the near term, the simulator functions as a PWR training platform, and as a research environment tied to Virginia's existing nuclear fleet.

WORKFORCE DEVELOPMENT & COMMUNITY IMPACT

VCU's Department of Mechanical & Nuclear Engineering maintains a direct pipeline to the Commonwealth's and region's nuclear engineering industry. The simulator supports core courses, senior design teams, and graduate research at the university. Before VCEIB-funded upgrades, the simulator reached 124 undergraduates and 3 graduate students and faculty annually. After the upgrades, those figures are projected to grow to 246 undergraduates and 12 graduate students and faculty.

The simulator can also support Virginia's fusion workforce in the future. With additional upgrades, the simulator poises VCU to be a key workforce and educational partner for the world's first commercial fusion power plant with the arrival of Commonwealth Fusion Systems in Chesterfield County. As fusion capabilities are added, the NRSL can help prepare the fusion workforce by providing early exposure to plant operations and human-machine interaction. The lab supports training related to the current PWR fleet and Virginia's preparation for an emerging fusion industry.

VCU is also expanding the NRSL's use for public outreach through K–12 STEM events, community college visits, and open houses. The Richmond location provides convenient access for residents across Central Virginia. Following the VCEIB-funded upgrades, the NRSL is projected to engage approximately 1,000 public and K–12 participants annually, and the expanded physical space will allow for a larger, more dynamic environment that makes the simulator more accessible and understandable to a wider audience.

FUTURE EXPANSION

After the current upgrades are complete, VCU plans to implement advanced fission modules and continue development of the fusion simulator. The long-term vision is a multi-platform training and research environment that can support collaboration among utilities, advanced fission vendors, and fusion companies entering Virginia.



Funded by VCEIB

Advanced Reactor Simulation: Terrapower Natrium Simulator

SECURE ENERGY FUTURE CENTER AT VTCRC - ARLINGTON, VA

Hosted by the Secure Energy Future Center ([SEFC](#)) and the [Virginia Tech Nuclear Engineering Program](#), the TerraPower Natrium Technology Operations Simulator will be the first of its kind in the world. The simulator will be located in Arlington at the [Virginia Tech Corporate Research Center](#), with connectivity to the larger Virginia Tech Corporate Research Center and Virginia Tech statewide ecosystem assets in Northern Virginia, Hampton Roads, Blacksburg, and Roanoke.

TerraPower is an advanced nuclear company developing several advanced non-light water reactor technologies, including the Natrium reactor – an advanced sodium-cooled fast reactor integrated with a novel molten-salt thermal energy storage system to provide flexible, grid-responsive power.

TECHNOLOGY & CAPABILITIES

The [Natrium simulator](#) is designed as a digital twin of TerraPower's Natrium plant, a 345 Mwe sodium-cooled fast reactor with molten-salt thermal energy storage that can boost output to roughly 500 Mwe for several hours. The simulator will model reactor kinetics, sodium thermal-hydraulics, storage behavior, control

logic, and human-system interfaces, giving users exposure to another reactor class in addition to Virginia's light-water platforms. It will include up to seven operator positions and up to two instructor positions, in addition to multiple control room consoles and instructor systems.

Supported by a VCEIB investment and in collaboration with VINHub, the simulator will establish an Integrated Advanced Nuclear and Energy Storage Hub (The Hub) linking multiple Virginia regions. This capability will enable investigation of novel decoupled nuclear and energy island architectures in which the nuclear island operates independently from flexibly energy-use systems. The platform will support studies of flexible energy utilization, including hydrogen production, process heat applications, thermal energy storage, and grid-interactive operations, expanding the Commonwealth's simulator portfolio beyond conventional PWRs and light-water SMRs into advanced fast reactors and integrated storage operations.

ROLE & LIMITATIONS

The Hub is designed as a multi-institutional training and research center serving Virginia Tech students, partner universities, community colleges, military personnel transitioning to civilian careers, researchers, government, and other public and private organizations. The facility will offer academic instruction, professional development, short courses, and certificate programs focused on advanced reactors, grid resilience, hybrid energy systems, hydrogen production, microgrids, and industrial process heat.

The simulator is being developed as an engineering grade simulator designed for education, training, testing, and research. The simulator is intended to provide Virginia with early experience in workforce development and research for grid-interactive advanced reactors with built-in storage. The simulator development is planned to continue far beyond the VCEIB project lifecycle with full training and research value emerging over the years to come.

Phase 1 of construction, planned for December 2026, will deliver an installed, commissioned simulator that supports initial instruction and user interaction. Phase 2 in 2027 will add additional transient scenarios and full validation.

WORKFORCE DEVELOPMENT & COMMUNITY IMPACT

The Hub, anchored by the Natrium simulator, will strengthen Virginia's advanced nuclear workforce by supporting university and K-12 education and professional training, industry workforce development and training programs, and general public education and awareness goals. These activities will help build a workforce that is familiar with advanced reactor operations, energy storage integration, and hybrid energy systems. The Natrium simulator will feature 7 operator station seats, 2 instructor station seats, and serve over 100 users annually. Typical training cohorts are expected to consist of 5 – 10 participants per session, with the simulator supporting dozens to low hundreds of users annually across academic, workforce, and external stakeholder engagement programs.

The Hub and Natrium simulator are also intended to serve as a public-facing demonstration space where visitors can observe advanced reactor behavior in a controlled environment. The Arlington location provides a highly visible venue and is well positioned to reach audiences in Northern Virginia's technology and policy community, supporting public education and workforce development in one of Virginia's most economically significant regions. Additionally, as an asset of the Secure Energy Future Center (a VTCRC initiative), the hub will have impacts for other regions across the Commonwealth through its connectivity with other VTCRC and Virginia Tech partner institutions and programs.

FUTURE EXPANSION

Future enhancements may include AI-enabled digital twins and expanded modeling capabilities. These efforts will build upon Virginia Tech's ongoing research in physics-based, AI-assisted multi-physics modeling for real-time nuclear reactor simulation, integrated with the development of a high-fidelity reactor instrumentation and detection systems and immersive virtual reality (VR) visualization environments. Together with the Natrium simulator, these capabilities will create a comprehensive virtual reactor platform for advanced research, operator training, reactor design, safety analysis, digital engineering, and human-system interaction. The virtual reactor capability will also complement the proposed Virginia Research and Education Reactor (VA-RER) under study by VINHub and university partners, by enabling operator training, scenario development, virtual prototyping, and digital validation before implementation on a physical reactor.



Dominion Energy Simulators

DOMINION ENERGY AT NORTH ANNA POWER STATION & SURRY POWER STATION

Dominion Energy operates full-scope nuclear reactor simulators at both its [North Anna](#) and [Surry power stations](#). North Anna's simulator was completed in September 1983 and certified for operator training in September 1988. Surry's simulator dates to the 1970s and was similarly certified in 1988. These simulators are currently used by Dominion to train its workers. Limited opportunities for public tours and educational outreach may be available from time to time, subject to station availability, applicable policies, and security requirements.

TECHNOLOGY & CAPABILITIES

Dominion operates plant reference simulators and Grid Power Management System (GPMS) simulators at both of its reactors. These are full-scope, plant-specific simulators replicating the exact control room environments of each station, which are used to certify licensed reactor operators under NRC requirements.

ROLE & LIMITATIONS

Because these simulators are exclusively designed for training within Dominion's operating plants, use is restricted to Dominion employees and licensed operator candidates. Occasional public tours and educational visits may be offered in accordance with station policies, operational needs, and security requirements, but currently, they are not generally available for university instruction or research activities. These simulators play a critical role in servicing the nuclear workforce for the Commonwealth's existing nuclear assets that will continue to play a vital role in the clean energy transition.

WORKFORCE DEVELOPMENT

Dominion's simulators form the backbone of licensed operator training for Virginia's two operating nuclear plants, which make a substantial contribution to Virginia's electricity generation portfolio and carbon-free energy production. At North Anna and Surry, initial license candidates train in cohorts of 12 to 16 over the course of 18 months to meet NRC licensure requirements. The continuing training program covers approximately 70 licensed operators annually at each station, each required to complete 160 hours of training per year, with at least 60 of those hours logged in the simulator across a repeating five-week cycle.



U.S. Navy Simulators

U.S. NAVY AT NAVAL STATION NORFOLK

The U.S. Navy operates nuclear propulsion simulators at Naval Station Norfolk through the Submarine Learning Facility Norfolk ([SLFN](#)) and the Fleet Interactive Display Equipment (FIDE) program.

TECHNOLOGY & CAPABILITIES

The SLFN operates a full-scale motion simulator of a Virginia-class nuclear-powered submarine, allowing submariners to train on the controls, sounds, and interfaces of an operational boat. The facility also houses casualty response trainers for fire and pipe burst scenarios. The FIDE is a dedicated nuclear propulsion control room simulator replicating the maneuvering room of nuclear-powered submarines and aircraft carriers, developed and maintained by the Naval Nuclear Propulsion Program.

ROLE & LIMITATIONS

Both the SLFN and FIDE are restricted military training assets. Access is limited to Navy personnel and cleared contractors. They are used exclusively for Navy training and are not used for civilian workforce development or university partnerships. Detailed technical specifications remain classified.

WORKFORCE DEVELOPMENT

The SLFN services 17 submarines homeported in Norfolk and maintains a staff of approximately 60 instructors covering nuclear reactor operations, damage control, and combat systems training. The FIDE program extends nuclear propulsion proficiency training to watch teams across submarine and carrier fleets, supporting the Navy's record of zero reactor accidents since USS Nautilus first went underway on nuclear power in 1955.

Conclusion

Virginia's simulator portfolio provides nuclear companies with multiple platforms for collaborative research and training across current and next-generation reactor technologies. These simulators support workforce development, engineering education, public outreach, and preparation for future reactor deployment across multiple technology classes.

VNEC and VINHub play an important coordinating role in turning these separate assets into a statewide ecosystem. These institutions can connect simulator assets with relevant companies, help align institutions, and support workforce development in a way that allows students and trainees to gain experience across multiple reactor types rather than a single platform. **Through VCEIB's strategic investments, VNEC's stakeholder coordination, and VINHub's research initiatives, the Commonwealth has positioned itself as a regional and national leader in advanced nuclear workforce development and research.**



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