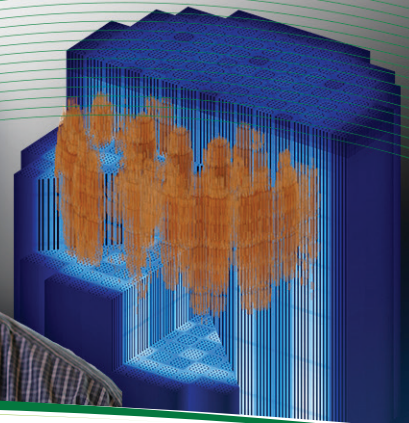




"Our vision is to improve the operation and safety of the existing nuclear fleet to ensure efficient commercial nuclear power generation into the future."

Jess Gehin, CASL Director



CASL: Giving Nuclear Energy More Power

Nuclear reactors generate 20% of America's electricity. However, due to unfavorable economic conditions, many of today's operating reactors could be shut down in the next decade.

To address this challenge, in 2010 the US Department of Energy (DOE) established the Consortium for Advanced Simulation of Light Water Reactors (CASL). Based at Oak Ridge National Laboratory (ORNL), CASL is DOE's first Energy Innovation Hub—an integrated research center focused on a single topic, with the objective of rapidly bridging basic research, engineering development, and commercialization.

Mission and Impact

CASL is a collaboration of the nation's leading scientists, institutions, and supercomputers, with an aggressive 10-year mission to confidently predict the performance of existing and next-generation commercial nuclear reactors through comprehensive, science-based modeling and simulation. Real-world impacts include



- Improving efficiency in nuclear power production by reducing unanticipated plant outages and enabling future increases in operating power, resulting in additional power generation.
- Lowering costs by better understanding how long fuel can reside in a reactor. With improved reactor and fuel burnup estimates, energy providers could save millions of dollars annually.
- Enhancing safety through evaluation of new fuels that can better endure the severe conditions within a reactor.
- Extending the life of existing reactors through improved prediction of the lifetimes of key structural components.

99

Commercial nuclear reactors in the United States

20%

Total US electricity generated by nuclear reactors in 2016, up from 11% in 1980

\$40 billion

Value in electricity sales from commercial nuclear reactors

100,000

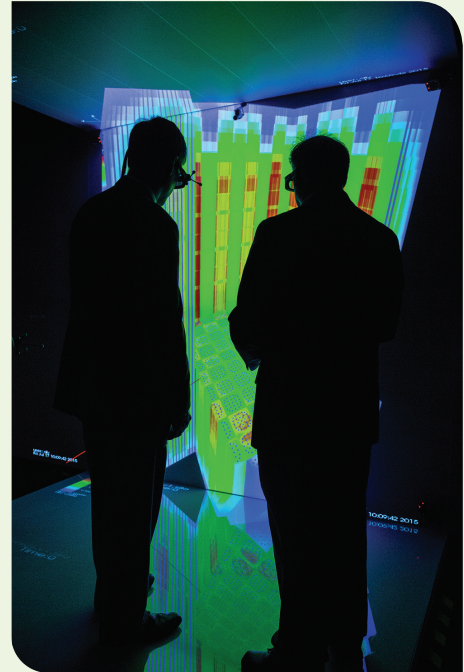
American jobs associated with nuclear energy production*

“Looking” Inside a Nuclear Reactor

The CASL project has developed and tested what amounts to a virtual nuclear reactor. VERA, or the Virtual Environment for Reactor Applications, can simulate the operation of an entire reactor down to the characteristics of a single fuel rod, significantly exceeding the resolution of industry tools. Because some reactors have more than 51,000 rods, predicting individual rod behavior can greatly enhance safety and performance.

VERA has accurately simulated the entire 20-year history of the Tennessee Valley Authority’s Watts Bar Unit 1 nuclear reactor, proving the software’s groundbreaking capabilities. When the Watts Bar Unit 2 reactor started up in 2016, VERA was used to perform hour-by-hour simulations of the new plant’s first six months, with predictions providing important data to support the achievement of full-power operations.

As new reactors come online and old reactors age, such simulations will give energy companies a chance to accurately predict the future performance of their plants—and an opportunity for improvements to avoid costly shutdowns.



CASL provides researchers with 3D images of reactor cores.

Critical Collaboration

CASL’s 10 founding partners—three universities, four national laboratories, and three nuclear industry organizations—and additional contributing institutions provide the technical foundation for the hub. This includes unmatched high-performance computing technology, world-leading nuclear science expertise, state-of-the-art facilities, extensive nuclear reactor knowledge, and consultation on the innovative research taking place.



Taking the Next Steps

By 2019, CASL’s goal is to further improve VERA’s performance and its availability to the nation’s nuclear industry and nuclear-focused universities. In its present format, VERA offers unique simulation capabilities through an easy-to-use interface, but it functions best on supercomputers like those at ORNL and other national laboratories. To address this, CASL’s experts will

- Apply VERA to industry-focused problems to improve operations and safety.
- Adapt VERA for industry and university computers to broaden its use.
- Add predictive capabilities for other reactor types, including boiling water reactors and small modular reactors.
- Continue to engage NRC to ensure that VERA is well understood by the nuclear energy regulatory community.
- Provide ongoing updates and improvements to VERA to meet industry needs.

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**Source: The Nuclear Energy Institute*