



NuScale Simulator - An Integral Part of Design Certification Application (DCA)

Executive Summary

Part of the economic feasibility of NuScale's next generation reactor design is based upon a new control room operating and staffing philosophy. To convince both regulators and potential customers of the feasibility of the control room design, NuScale decided to "show" the design in operation. GSE's simulator is an integral part of the DCA to the US NRC to prove the design and operational concepts.

All previous DCA's have had limited Human Factors Engineering (HFE) programs normally stopping at the development of implementation plans or methodology documents. Having a high-fidelity simulator has allowed NuScale to more fully develop the HFE program and reap the benefits of doing so. This includes having regulatory certainty on the number of reactors that can be operated in a single control room, the minimum licensed operator staffing and getting an early start on developing the licensed operator training program.

NuScale's HFE program is at the maturity level of those normally seen during plant construction largely due to the extensive use of their simulator.

Challenges

Current regulations require a minimum number of operators per reactor and a limit of 2 reactors per control room. With a potential of 12 reactors being operated from a common control room and a minimum staffing of six licensed operators, these requirements posed a challenge to the approval of the NuScale approach. How do you design a control room with a new operating philosophy,



NuScale is commercializing a safe, modular, and scalable light water reactor nuclear plant with up to 12 - 50 Megawatt electric (MWe) modules for a total of up to 600 MWe.

and new operator interface to optimize the number of operators without sacrificing safety? NuScale decided to build a full scale simulator consisting of 12 nuclear reactor modules and common plant systems, to provide an interactive environment to test operating schemes, and an entirely new operator user interface. One of the main challenges was building a simulator for a plant that didn't exist.



We are pleased that NuScale chose the GSE platform and GSE team to assist them in testing out key control room design decisions as part of the DCA process.

KYLE LOUDERMILK
President & CEO
GSE Systems, Inc.

For the first forty years of nuclear power plant control room simulator technology, the traditional, and many times only, use of the simulator was to train and license operators. Using data from the reference plant, the simulator was developed using software tools developed by GSE and its predecessors specifically for the task at hand.

NuScale needed a different approach and the use of technology that could reasonably “predict” the behavior of the plant design, not replicate the behaviors [as the plant didn’t exist]. GSE’s ability to bring Idaho National Laboratory’s (INL) RELAP5-3D code into an interactive, real-time simulation environment, and integrate with other codes such as Studvik’s S3R reactor core model and GSE’s JADE™ Simulation toolset, resulted in a very accurate model of the new reactor design. For the balance of plant systems, which had not been designed, GSE used its experience in modeling smaller fossil plants to provide a good representation of the balance of plant. As system designs matured, so did the simulation models and accuracy of the entire simulator.

How Product Helped

The result was an interactive platform that NuScale could use for a variety of engineering and human factors purposes:

- Control room layout
- Control room staffing
- Concepts of automation
- Alarm and notification management



At NuScale we believe that the simulator is much more than a training tool. Early development of the simulator gives us the opportunity to integrate the design features, develop and refine operating concepts, and demonstrate the inherent safety. It’s exciting to collaborate with GSE to take advantage of their industry expertise and adaptable platform to advance nuclear power.

DUSTIN GREENWOOD
(Acting) Vice President,
Operations & Plant Services
NuScale Power

- Computer based procedure development
- Critical safety function monitoring
- Multi-module monitoring and control
- Control system initial design
- Interactive Human Factors testing

Results, Return on Investment and Future Plans

Beyond the tangible engineering benefits gained throughout the simulator development project, NuScale recognized many other benefits.

- A demonstration platform to show regulators control room design in virtual operation
- A marketing and demonstration tool for potential customers, investors, and state and federal politicians
- An interactive platform enabling NuScale to consider a variety of control schemes and procedures
- The catalyst to get real operators involved early in the design process, discovering issues when they are the least expensive to fix

Investment in the simulator development has been only a small fraction of the cost to develop the DCA, and will continue to provide benefits to NuScale well into the future.



The inherent safety and simplicity of the NuScale design has provided the unique opportunity to make quantum leaps forward in areas related to the operation of a nuclear power plant.

GSE’s capable and adaptable platform, technical expertise, collaborative culture, and dedicated customer support have provided NuScale with a powerful tool with which to demonstrate the future of nuclear power.

TIM TOVAR
Manager, Plant Operations
NuScale Power

About GSE Systems

GSE Systems, Inc. is a world leader in real-time high-fidelity simulation, providing a wide range of simulation, training, consulting and engineering solutions to the power and process industries. Its comprehensive and modular solutions help customers achieve performance excellence in design, training and operations. GSE's products and services are tailored to meet specific client requirements such as scope, budget and timeline. The Company has over four decades of experience, more than 1,100 installations, and hundreds of customers in over 50 countries spanning the globe.

Information about GSE Systems is available at www.gses.com.

Worldwide Locations



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