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# Nuclear engineering program marks 10th anniversary

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VCU is the only university in Virginia with an accredited undergraduate nuclear engineering major concentration, as well as M.S. and Ph.D. programs in mechanical and nuclear engineering



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Ten years ago, Virginians who wanted to study nuclear engineering at the graduate level had to leave the state to do so. It was a situation that made for a brain drain – and an opportunity to prepare students for careers with companies like Dominion Resources, the energy giant headquartered in Richmond.

“Around 2007 or so, Dominion’s nuclear business unit employed a lot of people who had come in with bachelor’s degrees, but they had to leave the state to go any further into their

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education,” said Kerry Basehore, the company’s director of nuclear analysis and fuel from 1997 to 2016. “We looked at the situation, and at the fact that the VCU School of Engineering had opened 10 years earlier, and we said, ‘Why don’t we start a night program?’”

Basehore and colleagues from Dominion met with Russell Jamison, Ph.D., dean of the Engineering School, and the team hashed out a plan. VCU Engineering would begin by offering M.S. courses in nuclear engineering. The classes would be held in the evening, and many would be taught by Ph.D. nuclear engineers from Dominion.

One of those colleagues was Sama Bilbao y León, Ph.D., currently an associate professor and director of nuclear engineering programs at VCU. In fall of 2007, she was a nuclear safety analysis engineer with Dominion and instructor in the school’s first nuclear engineering course.

“Historically, Virginia is a pioneer in the area of nuclear engineering, but we were losing talent after a year or two. We had to stop the attrition problem,” Bilbao y León said. “In those early meetings, it was clear that both VCU and Dominion would benefit.”

Today, it’s clear that the benefits to both academia and industry have been dramatic. VCU is the only university in the commonwealth with an accredited undergraduate nuclear engineering major concentration, as well as M.S. and Ph.D. programs in mechanical and nuclear engineering. Over the past decade, VCU has graduated 197 students and attracted more than \$5 million in research grants. The program’s hallmark has been its ability to balance theory and application in its approach to nuclear engineering education.



Associate Professor Sama Bilbao y León, Ph.D., director of nuclear engineering programs at VCU

“Sama really is the perfect person to head our nuclear programs because of her vast industry and policy experience,” said Gary Tepper, Ph.D., who has chaired the Department of Mechanical & Nuclear Engineering since 2009. He said adding nuclear engineering to the department’s offerings has boosted enrollment.

“In 2009, we had about 300 students. When we added the nuclear concentration, we went to nearly 600 students in a short time. It gave the program visibility and gave students options. They said, ‘At VCU, I have lots of choices,’ and that was obviously attractive to them,” Tepper said.

The program’s progression has been steady and strategic:

- Two years after VCU’s first M.S. nuclear engineering courses in 2007, the department added an undergraduate nuclear engineering concentration option to the mechanical engineering bachelor’s degree.
- In 2010, the VCU Department of Mechanical and Nuclear Engineering was formed.
- In 2012, the nuclear concentration was accredited by the Accreditation Board for Engineering and Technology.
- The following year, VCU enrolled the first students into the Ph.D. in mechanical and nuclear engineering. That degree remains the school’s newest doctorate and the country’s only hybrid mechanical/nuclear Ph.D.

“At every level, our program is distinguished by hybridization and integration,” Tepper said. “It’s a very good partnership for our graduates, as well. They can earn an undergraduate degree in mechanical engineering, for example, but with an ABET-accredited nuclear concentration. This gives them flexibility in how they market themselves. Feedback from companies indicates

To date, VCU's nuclear energy program has garnered more than \$5 million in research funding.

that they like that, too.”

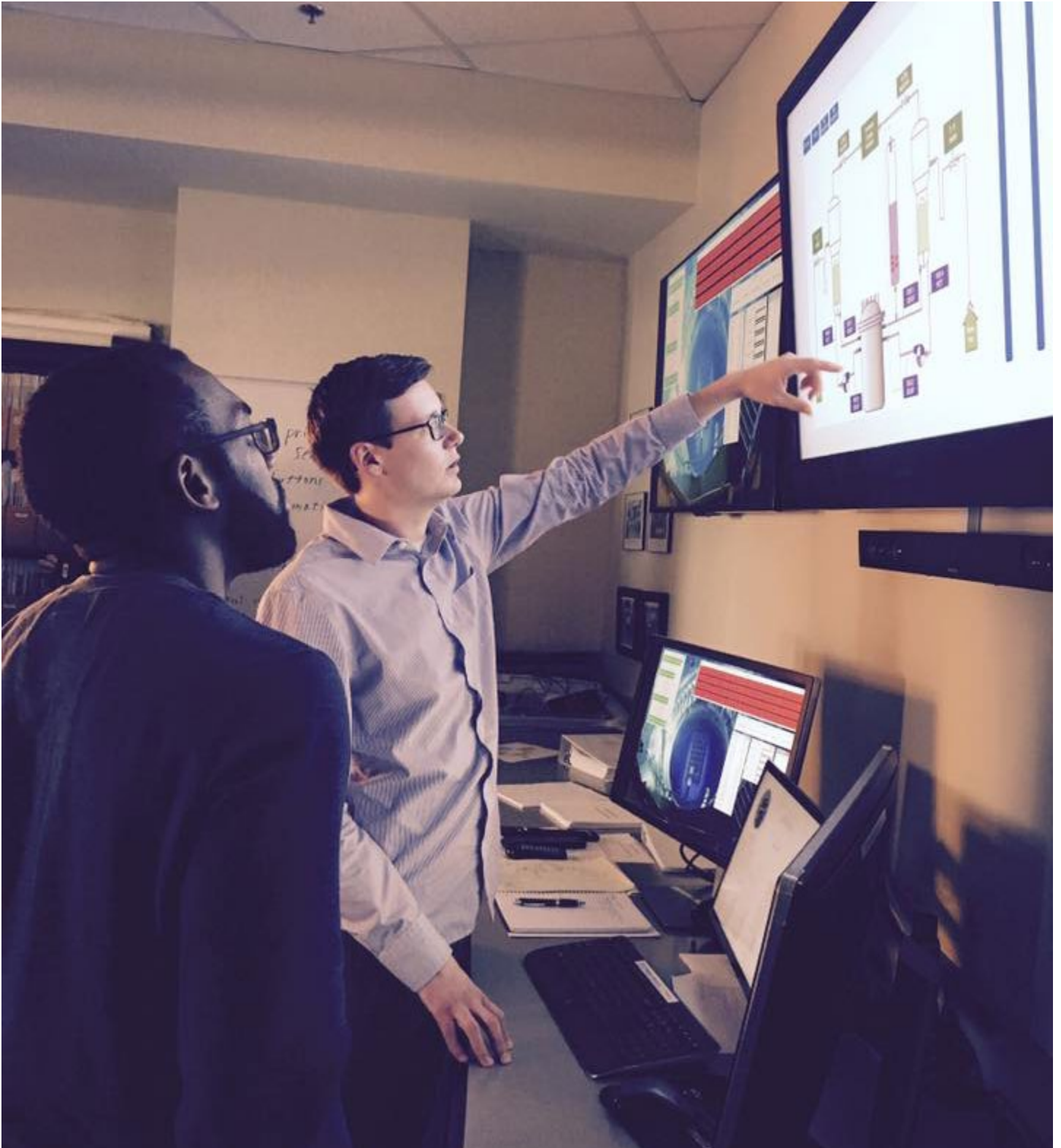
Bilbao y León said the marriage of nuclear and mechanical engineering is also conceptually strong because the two disciplines share many foundation courses including thermodynamics, fluid mechanics, heat transfer and material science. Surveying those synergies and the program's steady growth, she has a clear vision for its next phase.

“We have five research faculty members now and would like to see that number double. Our faculty and graduate students have been awarded a good number of Department of Energy research grants, and this is helping us develop in the right areas to eventually become a powerhouse. VCU has strong expertise in a few core areas that could make us become a go-to program in areas including energy and environmental policy, security and nonproliferation, advanced reactor design and fuel cycle advanced technology.”

To date, VCU's nuclear energy program has garnered more than \$5 million in research funding. Highlights include Tepper's 2010 study of uranyl soil extraction and fluorescence enhancement by silica gel, which advances testing for environmental radioactivity by providing a new method to allow fast and sensitive measurement of uranium in soil.

Bilbao y León's 2012 project titled “Re-Branding the Nuclear Energy Cycle” offers a comprehensive approach to communicating with the public about nuclear energy and building a better understanding of the nuclear fuel cycle.

In 2016, Supathorn Phongikaroon, Ph.D., associate professor of nuclear engineering, and his team developed a method to measure and produce near real-time measurements of



Nuclear engineering senior Kevin Jeunang, left, and Ph.D. candidate Daniell Tincher validate calculations on VCU's nuclear reactor simulator.



Ph.D. candidate Daniell Tincher is one of two VCU students to receive a U.S. Department of Energy fellowship in the 2016 round. Tincher's dissertation project is a redesigned nuclear reactor simulator.

the elemental concentration of salts in nuclear electrorefiners using laser-induced breakdown spectroscopy. This process helps ensure material accountability and safeguards of special nuclear materials.

Students are also contributing to VCU's stream of nuclear engineering research. In 2016, two Ph.D. candidates received highly competitive U.S. Department of Energy fellowships totaling more than \$300,000. Hunter Andrews is using his fellowship to develop a method that uses electrochemistry and lasers to reprocess used nuclear fuel. Daniell Tincher is using his fellowship to develop a methodology that makes legacy nuclear codes more usable and user friendly, enabling real-time, event-driven modeling and simulation.

Every summer, VCU's nuclear engineering students can study reactor theory and operate an experimental nuclear reactor in a VCU study-abroad course. Bilbao y León developed the three-credit intensive course in partnership with the Technical University of Dresden, Germany. It features the AKR-2 training reactor, Germany's most modern research nuclear reactor. For two weeks, the students perform startup, shutdown and power maneuvers, as well as several neutron activation and isotope identification exercises.

Bilbao y León and Tepper see a promising horizon for nuclear engineering at VCU. Given the discipline's growth, they look toward expanding the faculty and continuing to build expertise in power generation, national security, radiation detection and nuclear medicine.

It's a continuation of the innovation that took place in 2007 when industry and academia came together to build something new and necessary. Tepper and Bilbao y León look forward to

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helping write — and disseminate — the next chapter of that story.

“My goal now is to keep advancing VCU’s name among the U.S. nuclear engineering programs. More and more people are seeing how good our program is,” Bilbao y León said. •

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