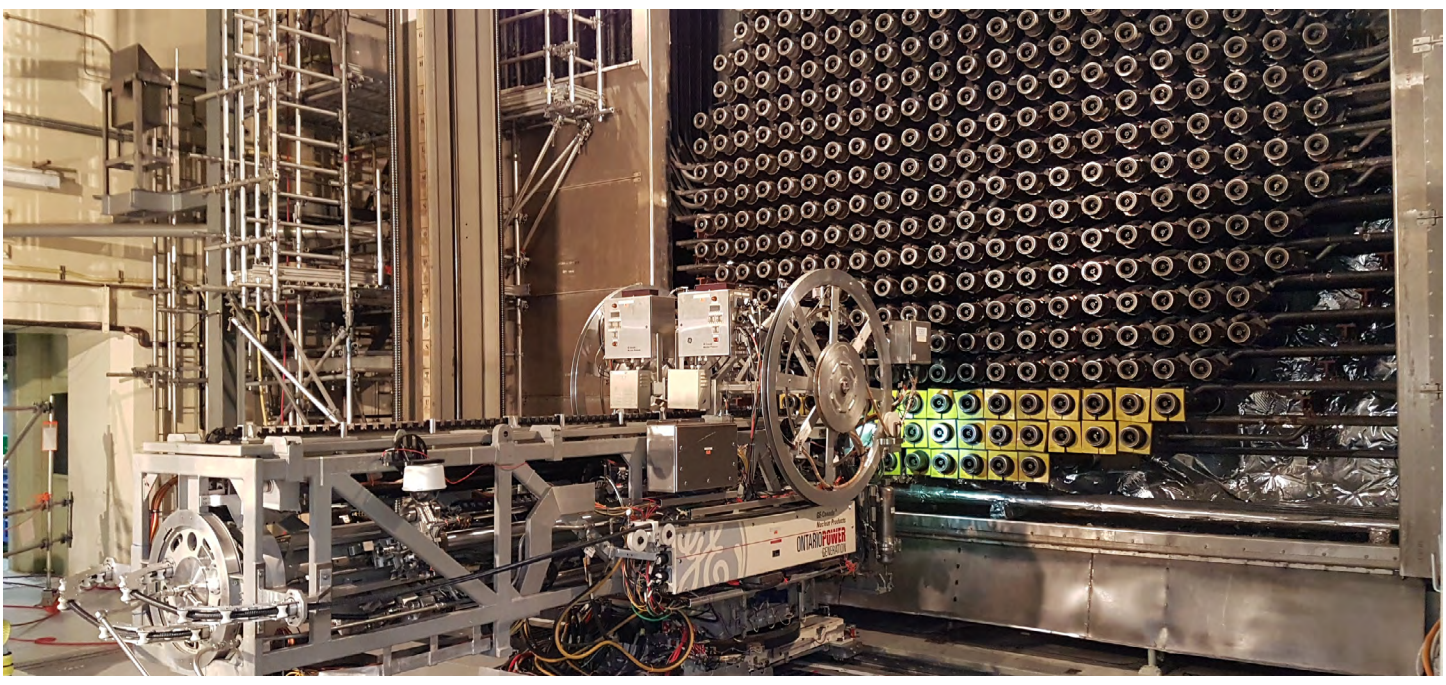

The Universal Delivery Machine (above) is used for offline fuel channel inspection at the reactor face. Ontario Tech students presented an approach that could contribute to an eventual on-line inspection solution, reducing reactor outage time. *Photo courtesy of OPG.*

Students give fuel channel inspection a fresh look

Nuclear engineering students tackle industry challenges with a CANDU Owners Group capstone project.

Ben Breeden, a recent Ontario Tech University nuclear engineering grad says he and his classmates were excited but a little nervous about their final undergrad capstone project.

"This was our last project in our last year of engineering school," says Breeden. "Our group had to put forward a project application to COG. If accepted, it was going to be a good experience to solve an industry problem and have our work looked at by industry experts for feedback. But we weren't 100 per cent guaranteed this project."

COG accepted the project application.

Breeden's capstone team, which included classmates Sriram Saravanabavan, Michael Mai and James Liang, was one of a dozen Ontario Tech student-led projects supervised by professors from the school's faculty of energy systems and nuclear science, as part of the annual nuclear engineering capstone course. One-third of the student teams are partnered with industry sponsors like COG, Ontario Power Generation (OPG), Canadian Nuclear Laboratories (CNL) and Kinectrics looking at real issues faced by these organizations. This was COG's second year sponsoring an Ontario Tech nuclear engineering capstone project.

The project teams are challenged to address a complex problem, develop a methodology and propose a solution, applying everything learned in their undergraduate studies. John de Grosbois, COG Program Manager, Research & Development and Ontario Tech Sessional Lecturer, co-supervised Breeden's capstone project and challenged the students to come up with "strategic design improvements for sustainable long-term life of CANDU plants.

"As a group, they have to understand the problem domain, characterize the requirements, do the background research and analysis," says de Grosbois. "It helps build graduates that have tasted the challenge and rewards of complex systems engineering in a nuclear environment. The benefit to industry is not necessarily in the project outcome but the fact that it's forming competent professionals that will soon be employed in our various technical environments."

As the project team's main COG contact, de Grosbois provided the students with a list of potential areas for improvement in the current Canadian CANDU reactor fleet. They also consulted with industry representatives from OPG, Kinectrics, BWXT and Promation. Breeden and his classmates began looking at issues related to CANDU plant inspections.

"Currently, all inspection work is done off-line. We wanted to find a way to do it on-line," says Breeden. "Reactors have to be shutdown, de-fueled and dried. It's a big process to get these inspections done. Fifteen channels have to be inspected during each outage. You can only inspect one or two channels per day. The biggest challenge, for us, was coming up with a solution for this."

The project team developed a design for an on-line pressure tube inspection device providing reactor safety data while reducing inspection outage time and decreasing lost revenues (stemming from the extended outages). Current pressure tube inspection processes involve sending an instrument down the tube to measure how much it has sagged. The project team developed a testing tool design that could be used while a reactor is operating, an approach which had previously been dismissed and wasn't considered possible.

Markus Piro, Assistant Professor and Canada Research Chair in Nuclear Fuels and Materials, co-supervised the capstone project. He was joined by de Grosbois and Daniel Hoornweg, Associate Dean and Professor within the faculty of energy systems and nuclear science. Piro, who joined the university three-years ago, after serving as CNL's head of fuel modelling and fission product transport section, believes the capstone course helps respond to what he sees as a "disconnect between academia and industry."

"The disconnect can happen when our students graduate," says Piro. "We want to ensure they are practical and aware of industry best practices, they understand quality assurance and reliability. Our intent with this capstone course and by having industry partners, like COG, is to hopefully deliver something meaningful for our industry partners, to really bridge the gap between academia and industry."

Breeden sees value for all sides in the capstone experience.

"The capstone let us touch all points in the engineering design process. [Students] can develop solutions from a fresh perspective," says Breeden. "In other courses, no one other than your professor might look at your work. But for an industry project, it is much more meaningful, and if it works, it can have an impact in the real world. It's not something that's purely theoretical."

Breeden and de Grosbois agree current technological limitations mean the on-line inspection solution the capstone project team developed for COG will remain theoretical, for now.

The experience gained could still benefit the nuclear industry. Breeden is pursuing a master's degree, specializing in nuclear fuel safety under severe accident scenarios, in partnership with Sandia National Laboratories. He will be studying under Piro.

"I'd like to get into more research and potentially work for a lab," says Breeden. "In the future, it would be interesting to tackle more problems."




From left: John de Grosbois, COG and Ontario Tech University, Markus Piro and Dan Hoornweg, Ontario Tech University and Ben Breeden, recent Ontario Tech grad. Breeden and his fellow capstone students were supervised by de Grosbois, Piro and Hoornweg on their culminating project which blended theory with industry learning experiences.