# NEST:

## An international program supporting nuclear education, skills, and technology

By Antonella Di Trapani, Tatiana Ivanova, and Andreas Pautz

The world needs scientists, engineers, and technologists to ensure the safe, secure, and sustainable use of nuclear energy to meet global energy demands and environmental challenges. Yet, in many countries there are concerns about the potential loss of nuclear expertise and knowledge because of changes in workforce demographics. Much of the tacit knowledge in the sector was generated during the pioneering years of nuclear power. During this period, R&D projects and innovative construction projects were ramping up, and many nuclear power plants were being built. As a result, personnel in the industry were confronted with challenging and groundbreaking projects, as well as the risk of failure. It is this knowledge that is most difficult to harvest and is generally transferred via hands-on experience. In the current nuclear power landscape, where R&D spending is decreasing and innovation slows down as a general trend, this knowledge risks being lost if there are fewer opportunities to acquire hands-on experience work on challenging projects.

The OECD Nuclear Energy Agency (NEA) seeks to address these concerns by creating new approaches to retain, nurture, and expand the nuclear knowledge base and build the new capabilities needed to create and apply innovative nuclear technologies.

With these goals in mind, the NEA launched in 2019 the Nuclear Education, Skills, and Technology (NEST) Framework, a multinational and multidisciplinary program. NEST has been designed to give what we call NEST fellows, mostly students or young professionals, the chance to take on challenging projects and solve

As seen in the June 2022 issue of **Nuclear**News

real-world problems. As a result, they acquire competencies, learn critical thinking, and absorb tacit knowledge by working alongside leading experts in the field. Organizations in 10 countries have already signed on to NEST, with more to follow. A few of the projects to date (full list at www.oecd-nea.org/NEST) have already begun to bear fruit.

One of the first to have started is the NEST hydrogen containment experiments for reactor safety (HYMERES) project, which is addressing safety-relevant phenomena in a containment during an accident. It offers hands-on training opportunities during the experimental test campaigns to be carried out at the PANDA facility at the Paul Scherrer Institut (PSI) in Switzerland, one of the most advanced containment test facilities in the world. Ethan Robert Kirkby, a bachelor of science student at the University of Calgary, is currently working as part of the HYMERES project at PSI under the supervision of Ralf Kapulla.

Ethan Robert Kirkby

"As a [NEST] nuclear thermal hydraulics fellow, I focus on fluid mechanics, specifically, proper orthogonal decomposition analysis," Kirkby explained. "So far, I have helped author an article, taken part in reviewing the academic articles of others, and presented my research topic at a conference. While these are my most prominent activities, much of my hands-on training involves progressing on my own research. In almost all my activities I am learning new skills or refining others."

The crucial role that NEST mentors play was also emphasized by Lea Zimmermann, who spent six months at PSI in 2019 working in the same HYMERES project alongside Kapulla. "I could learn and benefit from the many years of experience Dr. Kapulla has in experimental research," she said. "The relationship with my supervisor was of great importance for my thesis. I could feel that he was very passionate about his research and motivated to pass on his experience, which was very inspiring for me."

Lea Zimmermann

Would Zimmermann recommend the program to other early-career professionals? "The NEST fellowship can be a good start into your career as a researcher. It gives you the opportunity to start to build up your network and to connect with researchers and fellows from other universities sharing the same interests," she said.

Her sentiments were shared by Kirkby, who was even more direct: "Do it."

Fellow Stephen King, who also spent time at PSI in 2019 working on the HYMERES project—under the mentorship of Abdelouahab Dehbi—said, "I most certainly would recommend the NEST program to other researchers in STEM, especially to those like me who would like to get experience at another institute outside of their home country."

Stephen King

So what's in it for the universities that take on NEST fellows? The NEST program benefits member countries by establishing links and networks between universities and industries, research organizations, and regulators, which in turns strengthens university education programs and fosters the dynamics for a shared understanding of the issues at stake. Universities are the first stop for nurturing the next generation of nuclear leaders and professionals. They provide the "know-why," which is the knowledge to understand why something should be done in a certain way and why certain tools and techniques should be used. Industry, of course, tends to be more interested in the "know-how."

Koji Okamoto, a professor in the University of Tokyo Graduate School of Nuclear Engineering and Management and director general of the Japan Atomic Energy Agency's Collaborative Laboratories for Advanced Decommissioning Science, has led the NEST advanced remote technology and robotics for decommissioning (ARTERD) project since its inception. "The framework . . . creates a global network and allows for collaboration at the institutional level," Okamoto said. Exposing NEST fellows to such a wide range of hands-on training activities at the intersection of robotics and decommissioning will, he believes, provide them with unique knowledge, competencies, and skills in a domain that, if solutions are found, could be a breakthrough for the future of decommissioning.

Todd Allen, chair and professor of nuclear engineering and radiological sciences at the University of Michigan and co-lead of the NEST small modular reactors (SMRs) project, is equally enthusiastic about the potential of the program. "Each country has a specific focus for their research programs at universities. In many cases, forming cross-country

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## Current NEST projects

NEST projects are multinational and multidisciplinary to meet specific education and skills development needs. All are rooted in real-world contexts and current challenging problems for both the industry and regulatory bodies, under the guidance of experienced practitioners.

**Hydrogen containment experiments for reactor safety (HYMERES)**
www.oecd-nea.org/NEST-HYMERES

**Small modular reactors (SMRs)**
www.oecd-nea.org/NEST-SMR

**Advanced remote technology and robotics for decommissioning (ARTERD)**
www.oecd-nea.org/NEST-ARTERD

**Radioactive waste management of i-graphite**
www.oecd-nea.org/NEST-I-GRAPHITE

**Medical applications, nuclear technologies, radioprotection, and safety (MANTRAS)**
www.oecd-nea.org/NEST-MANTRAS

**Building competence, expert knowledge, applied techniques, safe decommissioning, train fellows (BEAST)**
www.oecd-nea.org/NEST-BEAST

For more information about the NEST Framework, visit www.oecd-nea.org/NEST.

[international] partnerships adds richness to the student's academic experience that would not otherwise be possible."

Allen also sees a need for the program to evolve and take on the lessons of COVID-19: "We [now] intend to initiate the student exchanges and workshops initially planned for 2020. NEST should take advantage of the new formats created during COVID-19 and continue to use virtual events as make sense. This would extend the ability to interact beyond that allowed by the NEST travel budgets. Video interactions, to be successful, need to be shorter than extended site visits. While the initial NEST discussions envisioned fellows to be designated based on extended site interactions, the NEST Framework should create a category of 'event fellows.' This would allow a larger number of total program engagements with young professionals."


Larissa Shasko

The connections forged between NEST fellows can be just as important as the work they do with their mentors. Larissa Shasko, a doctoral student in the Johnson Shoyama Graduate School of Public Policy at the University of Saskatchewan, participated in the 2020 Small Modular Reactor Hackathon, which was organized under the umbrella of the NEST SMRs project. During an online discussion with NEST fellow Stephen King in April 2021, Shasko said that the hackathon gave her and other participating fellows a better understanding of the international nuclear community and the career opportunities in the global nuclear sector. "It was an opportunity to meet other early-career professionals from places beyond just our own countries," she said, "and I think that's really where innovation stems from. It's this idea of taking the knowledge that we have as a global community and seeing how we can bring that together and grow together instead of trying to each work in our own silo."

During an online discussion with King and Shasko, NEA director general William D. Magwood IV said, "We are very proud of the fact we have so many countries participating in NEST, and we are hoping to grow NEST and expand this experience and make it available to as many students and young professionals as possible. Because [if] the result of NEST is to bring people like the two of you into the field . . . it's very much worth every minute we spent building this program."

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