A Minor Program With Major Rewards

THE UNIVERSITY OF TENNESSEE'S MINOR PROGRAM IN NUCLEAR DECOMMISSIONING LAYS THE FOUNDATION FOR CAREERS IN D&D.

By Wes Hines

The University of Tennessee's (UT) Nuclear Engineering Department recently developed an education program to offer an undergraduate minor in Nuclear Decommissioning and Environmental Management (NDEM). The minor is a partnership between UT's Nuclear Engineering and Civil and Environmental Engineering departments and was developed to provide Bachelor of Science graduates with a specialty that would prepare them for a successful career during a time of nuclear plant closings that potentially would reduce career opportunities in traditional nuclear engineering fields. The success of the program is greatly attributed to the partnerships formed with local industry.

In July 2015, I was asked to introduce a good friend and department board member, Dr. Eric Ablequist, at the Friday morning meeting of the East Tennessee

Photo courtesy of UT

Harold Connor discusses decommissioning topics with UT students pursuing an NDEM minor.

Economic Council. Ablequist is the executive vice president of Oak Ridge Associated Universities and was a primary author of MARSSIM, the Multi-Agency Radiation Survey and Site Investigation Manual. His presentation that day was titled "A decommissioning renaissance," and the subject hit home as a potential investment for our department. I learned that the Department of Energy's Office of Environmental Management budget (about $7.5 billion for fiscal year 2020) is about seven times that of the DOE Office of Nuclear Energy (under $1.6 billion for FY 2020), and the amount of decommissioning work throughout the country and world would require several generations to complete.

The decommissioning field seemed like an open opportunity for trained students to find challenging and productive careers upon graduation. I especially liked his last slide, which stated: "Nothing is certain but death and taxes . . . and DECOMMISSIONING."

Curriculum Development

Shortly after Ablequist's presentation, which sparked the idea of career opportunities in NDEM, the idea for a specialized education program materialized in a meeting between UT staff and executives at UCOR, a local DOE cleanup contractor for the East Tennessee Technology Park, Oak Ridge National Laboratory, and Y-12 National Security Complex.

Following that meeting, UCOR put together a list of foundational educational attributes required for a recent graduate to be successful in the decommissioning field. One topic identified was the planning and management of construction projects. It was this need that led to the integration of civil engineering courses into the NDEM curriculum.

The department embraced the new direction and felt that the integration of nuclear decommissioning into our educational offerings was not only supportive to national cleanup needs, but also very supportive of the nuclear power industry. Nuclear decommissioning costs are an important part of the total nuclear power life cycle costs, and if we cannot do a good job on the back end, utilities will not invest in new, safer, and more cost-effective nuclear plants. The University of Tennessee Nuclear Engineering (UTNE) department tag line is, "Study Nuclear Engineering and Save the World." Nuclear decommissioning has resonated with current students who are invested in making our planet a better place with sustainable, clean power.

"Decommissioning nuclear power plants efficiently and effectively enables the nuclear industry to remain a viable, sustainable energy solution," said Ken Rueter, president and chief executive officer of UCOR. "This specialized training is preparing students to participate in this fast-growing decommissioning industry valued at well over $100 billion in the next several decades."

Under Rueter's leadership, UCOR has developed methods to manage decommissioning costs, an essential step in making the next generation of advanced reactors more cost competitive as a carbon-free, sustainable energy source.

In 2015, the NDEM minor was developed through collaboration with industrial partners, and the university approved the program in 2016. The 15-credit-hour minor requires the student to complete three required courses:

- *CE 340: Construction Engineering and Management I*
  An introduction to construction management concepts, including developing an understanding of the goals and objectives of various construction stakeholders, delivery and procurement methods, types of construction contracts, planning, quality assurance and control, health and safety, estimating and scheduling.
- *NE 404: Nuclear Fuel Cycle*
  This course covers all relevant components of the commercial nuclear fuel cycle, including methods for mining and milling, physics of uranium enrichment, fuel fabrication, in-core management strategies, reactor physics, spent fuel storage, reprocessing, and disposal of high-level radioactive wastes.
- *NE 233/433: Principles of Health Physics*
  Students will gain an understanding of radiation quantities, limits and risk assessment, external and internal dosimetry, biological effects of radiation, radiation detection, radiation interactions and decay, applications.

Students can then select two electives from the following:

- *CE 441: Construction Engineering and Management II*
  Fundamental calculations and case studies associated with construction methods and equipment, including selection, productivity, and operations, are covered.
- *CE 581: Construction Estimating*
  This course offers comprehensive coverage of construction project cost estimation, including quantity take-off, associated market pricing conditions, and the techniques used for assessing cost of labor, material, and equipment.

■ *NE 406: Radiation Shielding*
Students will learn types of radiation sources, fundamentals of gamma ray and neutron attenuation, biological effects, approximate methods of shield design, and use of modern analysis tools.

■ *NE 542: Management of Radioactive Materials*
Technology for processing, treatment, handling, and storage of radioactive nuclides is covered, along with analytical and numerical methods for evaluating environmental impacts of radioactive materials. Licensing and regulation issues are also covered.

■ *NE 552: Radiological Assessment and Dosimetry*
This course covers the transport of radionuclides in environment, food chain pathways, internal dosimetry, and personnel dosimetry.

It is one thing to offer a specialized curriculum such as a minor; it is entirely another to get students interested in the subject and pursue the minor. To achieve that goal, it is necessary to show students that the minor will provide them with great career opportunities upon graduation. We knew that this was the heavy lift, would take several years, and would take strong partnerships to accomplish.

Partnerships

Very few impactful activities are performed by single entities. Vince Lombardi once said, "Individual commitment to a group effort—that is what makes a team work, a company work, a society work, a civilization work." As you will see, this program was envisioned, founded, and nurtured through collaboration and partnerships with local industry.

UCOR not only assisted with the curriculum development, but they also invested their time and resources by:

■ Providing graduate seminars that focus on the cleanup activities at East Tennessee Technology Park and, of course, industrial safety

■ Sponsoring college student society dinners and speaking to undergraduates on nuclear decommissioning and environmental management career opportunities

■ Hosting field trips to a work site, giving students firsthand experience on the types of work being conducted

■ Providing summer internship opportunities

■ Funding senior design projects

■ Through their major partner, AECOM, funding scholarships to reward and further engage NDEM students

AECOM representatives presented scholarships to four students pursuing UT's Nuclear Decommissioning and Environmental Management minor in 2019. Pictured, from left to right: Joe Aylor, AECOM business development director; Ashley Saunders, UCOR chief of staff; Ken Rueter, UCOR president and CEO; UT students Parth Patel, Assam Iysheh, John Wagner, and Joseph Galan; Wes Hines, Nuclear Engineering Department head; and Harold Connor, UCOR senior advisor to the office of the president.

Photo courtesy of UT

Roger Petrie of the East Tennessee Technology Park talks with students during a field trip to the Oak Ridge site.

Photo courtesy of UT

In parallel with developing the educational program, UTNE established a strong partnership with the Energy Technology and Environmental Business Association (ETEBA), a nonprofit trade association representing approximately 170 small, large, and mid-sized companies and affiliate members that provide environmental, technology, energy, engineering, construction, and related services to government and commercial clients.

ETEBA Executive Director Tim Griffin and ETEBA board member Chuck Bernhard were enthusiastic in partnering with us to grow the program, while helping meet the workforce needs of ETEBA members and providing opportunities for our students. ETEBA provided free entry to its annual conference, organized a student session for our students to present their work, hosted a career fair, and set up a career matchmaking functionality on their website. Additionally, ETEBA set up a fund to provide resources to support the NDEM program for student travel, senior design, student scholarships, and other educational needs. This win-win partnership has been extremely rewarding and has again assisted our students to become more aware of the career opportunities available in this area.

Results

The NDEM program enrollment has steadily grown. Last year, we graduated six nuclear engineering students with the NDEM minor, and this year we graduated an additional four. This coming fall we have 18 of our 200 undergraduate nuclear engineering students pursuing the NDEM minor, and we expect this number to continue to grow as stories of UT graduates getting exciting and meaningful jobs get back to the first-year and sophomore students. One of this year's graduates told me that he got his job at Oak Ridge's Y-12 site because they were impressed with his summer NDEM-related internship and minor.

Another student, recent graduate John Wagner, will be applying the knowledge from the minor to help decommission the San Onofre Nuclear Generating Station in Southern California. "I started my full-time position with EnergySolutions this week and can safely say the nuclear decommissioning minor was a big reason I was hired," he said. "The minor has enabled me to get my foot into the door of the growing nuclear decommissioning industry."

Through the strong industrial partnerships between the University of Tennessee, UCOR, AECOM, ETEBA, and several other local companies, the UT Nuclear Engineering and Civil and Environmental Engineering departments have developed an educational program in decommissioning. The partnerships have provided students with a vision of the "light at the end of the tunnel," resulting in continuous growth and career opportunities for graduates. The goal of diversifying our students' educational backgrounds is being met with the near-term results of "jobs at graduation." This is one step toward our long-term goal of improved decommissioning economics to support our nation.

Last year, U.S. Rep. Chuck Fleischmann (R., Tenn.), who heads the House Nuclear Cleanup Caucus, described the new degree as a great example of how UT is responding to the current nuclear industry workforce landscape. "As a proud University of Tennessee grad, I am happy that my alma mater leads the pack when it comes to preparing today's young people for careers in the nuclear industry," Fleischmann said.

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