American Nuclear Society

Position Statement #85

Education, Training, and Workforce Development for Nuclear Science, Engineering, and Technology

The American Nuclear Society (ANS) supports comprehensive and long-term stewardship for nuclear education and training programs. To maintain the nation's competitiveness, we believe that it is essential that federal and state governments, industry, foundations, educational institutions, unions, and other stakeholders support education in the fundamentals of nuclear technology, university programs in the field of nuclear science and engineering (NSE), and technical education and training for crafts specific to the nuclear field trades and skilled labor. Human resources are essential for enabling nuclear technology's contributions to our nation's energy supply, environment, health care, and national security.

A comprehensive approach, as supported by ANS, includes the following elements:

- Scholarship and grant programs that will build strong foundations in science, technology, engineering, and math (STEM) concepts in K-12 education; support the transition from K-12 education to either nuclear training programs or NSE university programs; and help to address disparities in K-12 education and student performance across demographic and socioeconomic categories and geographic regions.
- Scholarship and grant programs to train skilled nuclear workers to support the life cycle of activities necessary for the current generation of nuclear power stations, the next generation of advanced reactor technologies, and the many nonpower applications of nuclear technology (e.g., medicine, industry, agriculture).
- Scholarship, fellowship, and research grant programs and infrastructure funding to support university-based higher education programs that ensure the necessary development of people trained in nuclear technology skills, while simultaneously supporting research that creates new and improved uses of nuclear technology. This must include support to/for underrepresented and under resourced populations.
- Programs to support emerging nuclear nations and encourage them to adopt best practices in safety, safeguards, and security.

Background

STEM K-12 Education

The 2022 report *The State of U.S. Science and Engineering*[1] shows that U.S. students at the precollege (K-12) level performed only slightly above the Organization for Economic Co-operation and Development (OECD) average in science and below average in math. The persistent disparities in K-12 science, technology, engineering, and math (STEM) educational outcomes across demographic and socioeconomic categories and geographic regions present challenges to the U.S. STEM education system. As global competition for a technologically literate and ready workforce grows, there is a corresponding need to strengthen STEM concepts and skills in K-12 education curricula. Recognizing that the field of nuclear science and engineering (NSE) cuts across the physical, life, and earth sciences, as well as applied areas of engineering and public health, a strong STEM foundation is critical for students in making the transition into NSE fields. ANS considers K-12 STEM education a top priority for action by policymakers and plays an active role in developing accessible materials that strengthen STEM education in the K-12 classroom through the Navigating Nuclear program and similar educational programs.

To enable teachers to fulfill their roles in a strong STEM foundation in K-12 education curricula, it is important to adequately train teachers in the STEM curriculum and STEM career pathways. ANS supports in-service teacher professional development by offering workshops focused on nuclear-related STEM concepts. ANS pursues activities that increase public awareness of NSE careers, including supporting efforts to foster outreach to all students, teachers, parents, and guidance counselors. ANS encourages federal and state governments to fund scholarship programs that encourage the transition from K-12 education to either nuclear training programs or NSE university programs.

Nuclear-Skilled Craft Labor Training

Nuclear electric generating stations supply approximately 20% of the nation's electricity as of 2022. A new generation of advanced reactor technologies is on the horizon, aiming to commercialize many new products for many different business applications beyond just large-scale electricity production. With nuclear power anticipated to continue supplying the nation with a significant percentage of carbon-free energy for electric power, plus the expansion of alternative applications of nuclear power such as industrial heat, desalination, and hydrogen production, a skilled and diverse nuclear workforce is an imperative.

A reliable source of technicians, operators, and other skilled workers will help ensure continued safe and reliable operation of the country's nuclear-powered electrical generating stations in the years to come. Furthermore, advanced reactors and the leveraging of hybrid technologies such as using process heat from reactors to generate hydrogen will transform the U.S. nuclear fuel cycle. However, the ability of the nuclear energy sector to successfully deploy these technologies depends on the nation's ability to maintain a robust and diverse nuclear workforce, which requires a proactive approach to recruiting, educating, training, and retaining current and future workers. Programs that collectively work to enhance the long-term viability and competitiveness of the existing U.S. reactor fleet, develop an advanced reactor workforce, and implement and maintain the national strategic fuel cycle and supply chain infrastructure will be critical to meeting the nation's clean energy needs.[2] According to the 2022 *United States Energy Employment Report*, 82% of utilities report difficulties in hiring skilled workers, while 94% of nuclear construction firms report difficulties in hiring skilled workers.[3]

Beyond nuclear power, the broad spectrum of uses for nonpower applications of nuclear technology in our society requires the support of specialty-trained technicians. Roughly two-thirds of the elements in the periodic table have radioisotopes in routine use. Nuclear technology plays an important role in the U.S. economy and is used in agriculture, medicine, materials testing for modern industry, transportation, space exploration, fighting crime and terrorism, arts and sciences such as paleontology and archeology, as well as environmental protection.

ANS recommends long-term stewardship and funding to support the development of skilled nuclear workers. This recommendation applies to four-year college programs, two-year community college technical skills programs, and construction trade skills programs. It is important to ensure that such programs are attracting a diverse population and that programs intentionally support the local communities surrounding existing nuclear facilities or those that may host future nuclear facilities.

University Nuclear Engineering Education

The university programs in NSE and related fields are critical to increasing the value of nuclear technology for the world. These programs provide a unique training ground for key nuclear-specific skills development for a diverse emerging workforce. They also support research and development that creates new knowledge and supports advanced technology development as well as developing the next generation of innovative thought leaders.

ANS supports university-focused federal and state programs that ensure the necessary development of people trained in nuclear technology skills critical to the nation's energy supply, public health, and physical security. The goals of these educational programs must strike a balance between fundamental topics in NSE and the evolving needs of the nation's research program goals. These programs should evolve to ensure early-career professionals gain an appreciation for the social and ethical implications of engineering decisions, while expanding the diversity of the NSE workforce.

ANS supports university-based research programs that provide defined pathways and decision points to move from inception through deployment. In addition to supporting national research program needs, these programs should foster creativity to solve national challenges while maintaining fundamental expertise. Critical data generated from these programs should be included in open databases made available nationally, based on the user facility model, in which many scientists may share the same data.

These programs benefit from a variety of critical and supporting elements. For example, the continued development of and upgrades to critical university infrastructure, including research reactors, is necessary to support the university-based research programs. These facilities should continually be modernized and their capabilities made available nationally. Furthermore, ANS encourages federal and state scholarship programs that focus on supporting the transition from undergraduate education to graduate programs in NSE. The programs should be designed to recruit, educate, train, develop, and maintain a high-performing and diverse workforce,[4] including support for students at minority-serving institutions and minority institutions.[5] Also, in realizing the value of national laboratory, government, and industry-sponsored internship programs to develop national talent, federal and state programs should continue to encourage these exchanges.

International Nuclear Educational Programs

Successful international deployment of nuclear technology requires that host countries have the technical capability and institutional capacity to build, operate, and regulate these systems while maintaining a civil structure that allows for continuous evaluation and discussions about value and risk to the broader community. For countries pursuing nuclear energy for the first time, developing a system for talent creation is critical. International organizations such as the World Nuclear Association, the World Association of Nuclear Operators, the International Atomic Energy Agency, and the Nuclear Energy Agency play a central role in developing leadership, communications, and technical training to support the next generation of nuclear leaders. Countries like the United States with established regulatory bodies and well-developed nuclear education and training programs are critical for assisting the development of nuclear newcomer countries. ANS supports programs that allow U.S. institutions to train the international workforce in ways that support the adoption of best practices in safety, safeguards, and security, while supporting the deployment of U.S.-designed nuclear energy technology. This support could include international schools; fellowships and scholarships that assist international students in attending U.S. institutions; visiting scholar positions for international young professionals at U.S. universities, national laboratories, nongovernmental organizations, and governmental agencies; and support for U.S. students and workers to train and learn at overseas facilities and institutions.

References

1. NSB-2022-1. *The State of U.S. Science and Engineering: Science and Engineering Indicators 2022*. National Science Board, National Science Foundation. Alexandria, Virginia. 2022. Available at https://ncses.nsf.gov/pubs/nsb20221 (Accessed on October 26, 2022).
2. DE-FOA-0002516. *U. S. Department of Energy Idaho Operations Office Fiscal Year 2022 Consolidated Innovative Nuclear Research Funding Opportunity Announcement*. Appendix C, "Work Scopes for U.S. University-Led Integrated Research Project (IRP) R&D." IRP-MS-1, Nuclear Energy Workforce Pipeline Gap Analysis Scope. Available at https://neup.inl.gov/SiteAssets/FY2022_Documents/FY_2022_CINR_FOA_DE-FOA-0002516_Amendment_003.pdf (Accessed on October 26, 2022).
3. *United States Energy and Employment Report 2022*. See Figure 23, p. 40. Available at https://www.energy.gov/media/275712 (Accessed on October 26, 2022).
4. American Nuclear Society Position Statement #66: "Diversity and Inclusion in the Nuclear Profession." October 2018. https://cdn.ans.org/policy/statements/docs/ps66.pdf (Accessed on October 26, 2022).
5. See descriptions of minority-serving institutions and minority institutions at https://www.doi.gov/pmb/eeo/doi-minority-serving-institutions-program; https://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst-list.html; and https://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst.html (Accessed on October 26, 2022).

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