Sloan Career Cornerstone Center

Nuclear Engineering Overview

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The Field

Nuclear and radiological engineers research and develop the processes, instruments, and systems for national laboratories, private industry, and universities that derive benefits from nuclear energy and radiation for society. They devise how to use radioactive materials in manufacturing, agriculture, medicine, power generation, and many other ways. Many nuclear engineers design, develop, monitor, and operate nuclear plants used to generate power. They may work on the nuclear fuel cycle -- the production, handling, and use of nuclear fuel and the safe disposal of waste produced by the generation of nuclear energy. Others research the production of fusion energy. Some specialize in the development of power sources for spacecraft that use radioactive materials. Others develop and maintain the nuclear imaging technology used to diagnose and treat medical problems.

Preparation

Photo courtesy of US Department of Energy

A bachelor's degree in engineering is required for almost all entry-level engineering jobs. College graduates with a degree in a physical science, chemistry, or mathematics occasionally may qualify for some engineering jobs, especially in specialties in high demand. Most engineering degrees are granted in electrical, electronics, mechanical, chemical, civil, or materials engineering. However, engineers trained in one branch may work in related branches. For example, many aerospace engineers have training in mechanical engineering. This flexibility allows employers to meet staffing needs in new technologies and specialties in which engineers may be in short supply. It also allows engineers to shift to fields with better employment prospects or to those that more closely match their interests. Most engineering programs involve a concentration of study in an engineering specialty, along with courses in both mathematics and science. Most programs include a design course, sometimes accompanied by a computer or laboratory class or both. A degree in Nuclear Engineering might include the following types of courses: engineering fundamentals in radiation production, interactions and measurement, design of nuclear systems, thermal-fluid engineering, electronics, and computer methods.

Admission Requirements


Photo courtesy of NASA

Admissions requirements for undergraduate engineering schools include a solid background in mathematics (algebra, geometry, trigonometry, and calculus) and science (biology, chemistry, and physics), and courses in English, social studies, humanities, and computer and information technology. Bachelor's degree programs in engineering typically are designed to last 4 years, but many students find that it takes between 4 and 5 years to complete their studies. In a typical 4-year college curriculum, the first 2 years are spent studying mathematics, basic sciences, introductory engineering, humanities, and social sciences. In the last 2 years, most courses are in engineering, usually with a concentration in one branch. Some programs offer a general engineering curriculum; students then specialize in graduate school or on the job.

Co-ops

Supervised practical training such as internships, group programs and coops provide students with great opportunities to gain real-world experience while still in school. In addition to giving students direct experience in the field they are considering, interaction with others in the field can help provide perspective on career path options.

Alternate Degree Paths

Some engineering schools and 2-year colleges have agreements whereby the 2-year college provides the initial engineering education, and the engineering school automatically admits students for their last 2 years. In addition, a few engineering schools have arrangements whereby a student spends 3 years in a liberal arts college studying pre-engineering subjects and 2 years in an engineering school studying core subjects, and then receives a bachelor's degree from each school. Some colleges and universities offer 5-year master's degree programs. Some 5-year or even 6-year cooperative plans combine classroom study and practical work, permitting students to gain valuable experience and to finance part of their education.

Graduate Training

Graduate training on the doctoral level is essential for engineering faculty positions at universities and many research programs at national laboratories, but is not required for the majority of entry-level engineering jobs. Many engineers obtain graduate degrees in engineering or business administration to learn new technology and broaden their education. Many high-level executives in government and industry began their careers as engineers. It is important to select a degree program that has been accredited. After working in the field, many young professionals enhance their careers by taking the professional engineering exam to become licensed engineers, earning the distinguished designation of "professional engineer" or PE.

Accreditation

Those interested in a career in nuclear engineering should consider reviewing engineering programs that are accredited by the Accreditation Board for Engineering and Technology, Inc. (ABET). ABET accreditation is based on an evaluation of an engineering program's student achievement, program improvement, faculty, curricular content, facilities, and institutional commitment. The following is a partial list of universities offering accredited degree programs in nuclear engineering.

- Air Force Institute of Technology
- University of California, Berkeley
- University of Florida
- Georgia Institute of Technology
- University of Illinois at Urbana-Champaign
- Massachusetts Institute of Technology
- University of Massachusetts Lowell
- University of Michigan
- Missouri University of Science and Technology
- University of New Mexico
- North Carolina State University at Raleigh
- Oregon State University
- Pennsylvania State University
- Purdue University at West Lafayette
- Rensselaer Polytechnic Institute
- University of Tennessee at Knoxville
- Texas A & M University
- University of Wisconsin-Madison

Day in the Life

Beginning engineering graduates usually work under the supervision of experienced engineers and, in large companies, also may receive formal classroom or seminar-type training. As new engineers gain knowledge and experience, they are assigned more difficult projects with greater independence to develop designs, solve problems, and make decisions. Engineers may advance to become technical specialists or to supervise a staff or team of engineers and technicians. Some may eventually become engineering managers or enter other managerial or sales jobs.

Teams and Coworkers

Almost all jobs in engineering require some sort of interaction with coworkers. Whether they are working in a team situation, or just asking for advice, most engineers have to have the ability to communicate and work with other people. Engineers should be creative, inquisitive, analytical, and detail-oriented. They should be able to work as part of a team and to communicate well, both orally and in writing. Communication abilities are important because engineers often interact with specialists in a wide range of fields outside engineering. Writing and presentation skills are also vital so engineers can share their research and experiences with colleagues through topical meetings, professional associations, and various publications.

Tasks

Nuclear engineers research, design and develop the processes, instruments, and systems used to derive benefits from nuclear energy and radiation. They develop, monitor, and operate nuclear plants used to generate power. They may work on the nuclear fuel cycle -- the production, handling, and use of nuclear fuel and the safe disposal of waste produced by the generation of nuclear energy -- or on the production of fusion energy. Some specialize in the development of nuclear power sources for spacecraft; others find industrial and medical uses for radioactive materials, such as equipment to diagnose and treat medical problems.

The Workplace

Nuclear engineers held about 16,000 jobs in the US 2002. Almost half were employed in utilities, one-quarter in professional, scientific, and technical services firms, and 14 percent in the federal government. Many federally employed nuclear engineers were civilian employees of the U.S. Navy, and others worked for the U.S. Department of Energy or the Nuclear Regulatory Commission.

Earnings

According to the U.S. Bureau of Labor Statistics, the median annual earnings of nuclear engineers are about $90,220. According to a 2007 survey by the National Association of Colleges and Employers, bachelor's degree candidates in nuclear engineering received starting offers averaging $56,587a year. Those with master's degrees received starting offers averaging $59,167a year.

Employment

According to the U.S. Bureau of Labor Statistics, nuclear engineers hold about 15,000 jobs in the U.S. This represents 1% of the 1.5 million jobs held by engineers in the U.S.
Almost half were employed in utilities, one-quarter in professional, scientific, and technical services firms, and 14 percent in the Federal Government. Many federally employed nuclear engineers were civilian employees of the U.S. Navy, and others worked for the U.S. Department of Energy or the Nuclear Regulatory Commission.

In addition to the nuclear power industry, Nuclear Engineers also find employment in other sectors, such as in medical equipment manufacturers, engineering and construction firms, national laboratories, research facilities, and consulting firms. Nuclear Engineers may work in medical applications, focus on fission or fusion energy, and may be involved in radioactive waste management. The following is a partial list of employers of Nuclear Engineers:

- American Electric Power
- American Tank & Fabricating
- ANATECH Corporation
- ARCO
- Argonne National Laboratory
- Arizona Public Service Co.
- Assurx, Inc.
- Battelle Memorial Institute
- Bechtel Power Corp.
- Bigge Crane and Rigging Co.
- BKW FMB Energie Ltd.
- Black & Veatch
- BNFL, Inc.
- Boeing
- Brackett Green U.S.A., Inc.
- Brookhaven National Laboratory
- Burns & Roe Enterprises, Inc.
- BWX Technologies, Inc.
- Exelon Corporation
- Federation of Electric Power Companies of Japan
- General Atomics
- General Dynamics
- General Electric
- Halliburton
- Honeywell
- Kansas City Power & Light Company
- Knolls Atomic Power Laboratory
- Lawrence Livermore National Laboratory
- Lockheed Martin Corporation
- Los Alamos National Laboratory
- Martin Marietta
- Mass General Hospital
- McDermott International
- Morgan Stanley
- Motorola
- NASA

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Note: Some resources in this section are provided by the American Nuclear Society,
and the US Department of Labor, Bureau of Labor Statistics.

- Cardinal Health
- Central Research Laboratories
- Chrysler Corporation
- Cogema, Inc.
- Constellation Energy Group
- CP&L and Florida Power-Progress Energy Companies
- Defense Threat Reduction Agency
- Detroit Edison Company
- Dominion Generation
- Dow Chemical Company
- DuBose National Energy Service
- Duke Energy Corporation
- Eagle-Picher Industries, Inc.
- Ederer, Inc. (Subsidiary of PaR Systems, Inc.)
- Electric Power Research Institute
- Emerson Electric Company
- Enanta Pharmaceuticals
- Entergy Operations Inc.
- Entergy Operations, Inc.
- EXCEL Services Corporation
- Oak Ridge National Laboratory
- Oak Ridge National Laboratory
- Olin Corporation
- Pacific Gas & Electric
- PricewaterhouseCoopers
- Procter & Gamble
- Progress Energy
- R. Brooks Associates
- Raytheon Company
- Sandia National Laboratories
- Tennessee Valley Authority
- Texas Instruments
- The Atlantic Group
- US Air Force
- US Army
- US Central Intelligence Agency
- US Department of Energy
- US Department of Transportation
- US Environmental Protection Agency
- US Naval Research Lab
- US Navy
- US Nuclear Regulatory Commission
- Westinghouse

Career Path Forecast

According to the U.S. Department of Labor, Bureau of Labor Statistics, Nuclear Engineers are expected to have employment growth of 7 percent over the projections decade, about as fast as the average for all occupations. Most job growth will be in research and development and engineering services. Although no commercial nuclear power plants have been built in the United States for many years, nuclear engineers will be needed to operate existing plants and design new ones, including researching future nuclear power sources. They also will be needed to work in defense-related areas, to develop nuclear medical technology, and to improve and enforce waste management and safety standards. Nuclear engineers are expected to have good employment opportunities because the small number of nuclear engineering graduates is likely to be in rough balance with the number of job openings.

Professional Organizations

Professional organizations and associations provide a wide range of resources for planning and navigating a career in Nuclear Engineering. These groups can play a key role in your development and keep you abreast of what is happening in your industry. Associations promote the interests of their members and provide a network of contacts that can help you find jobs and move your career forward. They can offer a variety of services including job referral services, continuing education courses, insurance, travel benefits, periodicals, and meeting and conference opportunities. The following is a partial list of professional associations serving nuclear engineers and employers.

- **American Nuclear Society** (www.ans.org)
  The American Nuclear Society, established in 1954, is a professional organization of scientists and engineers devoted to the application of nuclear science and technology. It was established by a group of individuals who recognized the need to unify the professional activities within the diverse fields of nuclear science and technology. Its 10,500 members come from diverse technical disciplines ranging from physics and nuclear safety to operations and power, and from across the full spectrum of the national and international nuclear enterprise, including government, academia, research laboratories and private industry.
- **Canadian Nuclear Society** (www.cns-snc.ca)
  The Canadian Nuclear Society (CNS) was established in 1979 as "the technical society of the Canadian Nuclear Association (CNA)." The CNS is dedicated to the exchange of information in the field of applied nuclear science and technology. This encompasses all aspects of nuclear energy, uranium, fission and other nuclear technologies such as occupational and environmental protection, medical diagnosis and treatment, the use of radioisotopes, and food preservation.
- **European Nuclear Society** (www.euronuclear.org)
  The aims of the European Nuclear Society are to promote and to contribute to the advancement of science and engineering in the field of the peaceful uses of nuclear energy by all suitable means.
- **North American Young Generation in Nuclear** (www.na-ygn.org)
  The North American Young Generation in Nuclear unites young professionals (35 and under) who believe in nuclear science and technology and are working together throughout North America.
- **Nuclear Energy Institute** (www.nei.org)
  The Nuclear Energy Institute is the policy organization of the nuclear energy and technologies industry and participates in both the national and global policy-making process.
- **Society of Nuclear Medicine** (www.snm.org)
  The Society of Nuclear Medicine is an international scientific and professional organization founded in 1954 to promote the science, technology and practical application of nuclear medicine. Its 15,000 members are physicians, technologists and scientists specializing in the research and practice of nuclear medicine.