MISSOURI S&T™

Nuclear Engineering and Radiation Science

Undergraduate Handbook

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1. KEY PERSONNEL

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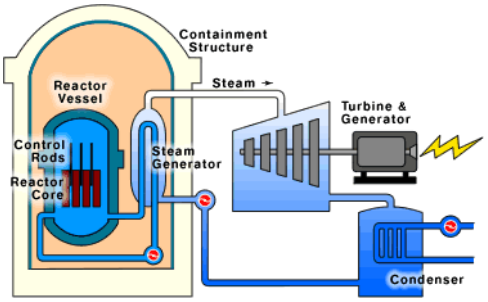
2. Overview of Nuclear Engineering

The Nuclear Engineering (NE) program is offered under the Department of Nuclear Engineering and Radiation Science. The primary mission of the NE program is to provide an outstanding and comprehensive education to tomorrow's leaders in nuclear science and technology. The objectives of the Bachelor of Science program are to provide each student with fundamental knowledge of nuclear engineering and related technologies, analytical and problem solving skills, technical communication skills, professional ethics, leadership skills, capability to conduct research, and the ability to recognize the value of life-long learning.

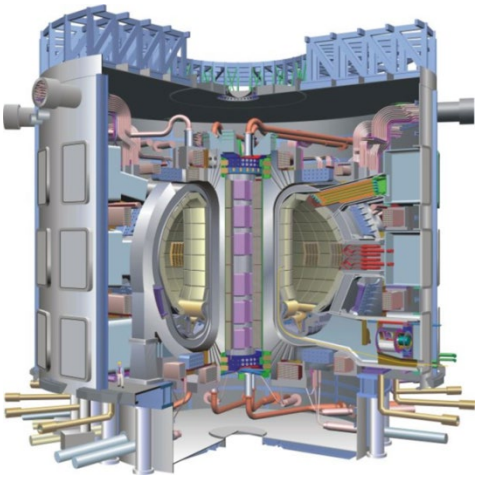
The NE program provides well-educated professionals and leaders to Missouri and the nation, in the commercial nuclear industry, national laboratories, graduate schools, and the nation's defense and federal agencies. Nuclear Engineering is a strong and growing engineering program administered by highly motivated and active nuclear engineering faculty; first accredited in 1960, it is one of the earliest ABET accredited undergraduate programs in the nation and is the only B.S. Nuclear Engineering degree program accredited in the state of Missouri. It is also one of the most productive programs in the nation. Faculty interact with professional societies, national laboratories, and the nuclear industry to promote continuing education, research opportunities, and public dissemination of information about

What do Nuclear Engineers Do?

Nuclear engineers develop and promote the utilization of energy released from nuclear fission, fusion, and the decay of radioisotopes. Currently, there are about 100 nuclear power plants operating in the United States producing about 20 percent of our nation's electricity. These plants use nuclear fission to produce energy and are cooled by ordinary (light) water, hence the name, Light Water Reactors. This technology produces about 60% of our nation's carbon-free electricity, reduces the emission of greenhouse gases like carbon dioxide significantly, and contributes to a cleaner environment. In addition, nuclear reactors are used for the propulsion of submarines and aircraft carriers. In fusion power plants, under development, strong magnetic fields contain a plasma fuel of hydrogen isotopes, such as deuterium, at temperatures hotter than the sun. The deuterium extracted from one gallon of water could produce as much energy as burning several hundred gallons of gasoline. Radioisotopes are used in industry and research, and in medicine for diagnostic and therapeutic purposes. The medical use of radioisotopes



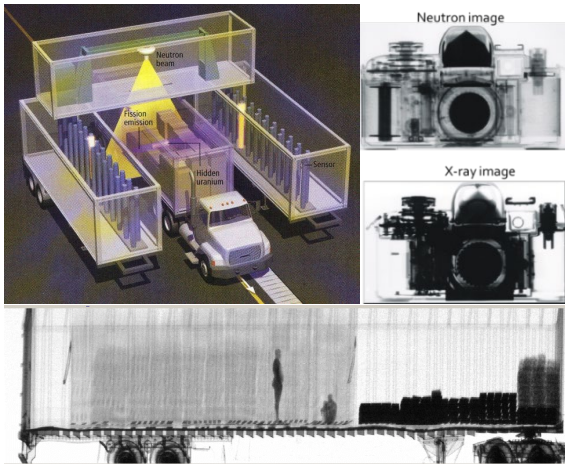
Typical LWR



ITER Fusion Reactor

and X-rays saves hundreds of thousands of lives every year throughout the world. Radioisotopes are also used in small power generators for space flights.

If you choose nuclear engineering, you could work in the areas of nuclear reactor design, plant licensing, plant operation, fuel management and development, radioactive waste disposal, health physics, medical isotope production, medical imaging and treatments, instrumentation and control, fusion research, space nuclear power, and applications of radioisotopes in industry and research. As a nuclear engineer, you might be employed by utilities, reactor vendors, architect-engineering firms, consulting firms, medical device manufacturers, industrial research centers, national laboratories, government agencies or universities.



Radiation-Based Imaging

New Horizons with RTG

The Nuclear Navy

Industrial Applications of Nuclear Technology, Including Food Irradiation, Glow-in-the-Dark Watches and Exit Signs, and Smoke Detectors

EDUCATIONAL OBJECTIVES

1. Our graduates will develop and effectively communicate logical, creative, and ethically sound solutions to complex engineering projects involving nuclear and other technologies while working as part of a multidisciplinary project team.
2. Our graduates will have the ability to obtain relevant professional licenses or pursue advanced degrees, developing engineering solutions or pursuing original research to continue meeting the needs of their profession and community.

STUDENT OUTCOMES

1. The ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meets specified needs with consideration of public health, safety and welfare as well as global, cultural, social, environmental, and economic factors..
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

RESEARCH LABORATORIES AND FACILITIES

- 200 kW pool-type Nuclear Reactor
  - Beam port
  - Active cooling system
  - Thermal column
  - Pneumatic transfer tubes.
  - Internet Accessible Hot Cell Facility
  - Subcritical Pile
- D-D Neutron Generator
- Radiation Measurements and Spectroscopy Lab
- Nanotechnology, Nuclear Forensics, and Radiochemistry Lab

- Thermal Hydraulics Experiment, Modeling, and Engineering Simulation (THEMES) Laboratory
- Hydrogen and Mass Spectrometry Lab
- Nuclear Materials Lab
- Advanced Radiography and Tomography Laboratory

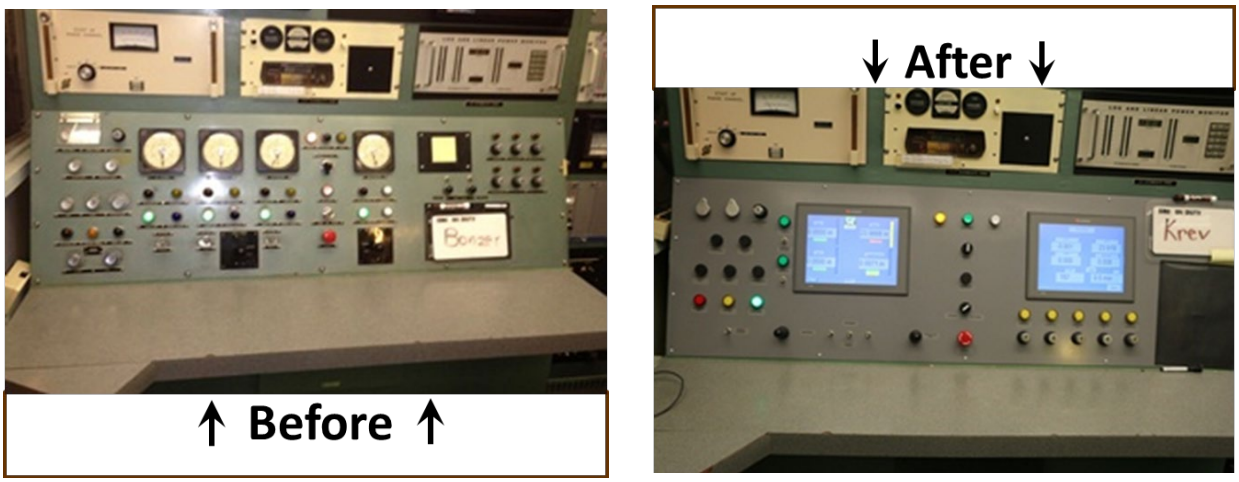
MISSOURI S&T REACTOR (MSTR)

MSTR

The Missouri S&T Reactor (MSTR) is located on the Missouri University of Science and Technology campus in Rolla, Missouri. MSTR provides facilities for experimental research, undergraduate training, and learning about reactor physics and other aspects of nuclear engineering. It is a 200 kW pool-type reactor, and is integral to the education of Nuclear Engineering students through hands-on laboratory activities. The reactor was initially licensed in 1961, and was converted from high-enriched uranium (HEU) to low-enriched uranium (LEU) in 1992.

Recently MSTR has gone through a number of changes. A new active cooling system capable of removing up to 400 kW of heat was installed using funding from the Department of Energy in 2013. In 2014 new digital control room systems were installed, replacing the original systems from 1961 and allowing MSTR to serve as a testbed for new digital reactor control technologies. A distance education system, also installed in 2014, allows our faculty and staff to provide online training through distance education for students around the world. Additional modifications are planned over the next several years, including the installation of new digital recording systems to replace paper records.

New Cooling System



Digital Control Room Update

EMPLOYMENT OUTLOOK

In the US, the average age of the nuclear workforce is just over 50 years – this means that many workers are within a few years of retirement. Utilities, vendors, regulators, and others are hiring hundreds of new engineers – nuclear, mechanical, electrical, chemical, and others – each year to maintain the knowledge and skill base that will be lost with these retirements. In addition to the nuclear power industry, many graduates find positions with companies like consulting firms, non-nuclear component companies, and others that support nuclear power facilities. Other students find work outside the nuclear industry where their skills are in demand including medical device manufacturers, industrial measurement manufacturers, etc. Some students continue their education in pursuit of Master of Science or Doctor of Philosophy degrees. A list of companies that have hired our graduates over the last 10 years is included in Appendix B. Overall about 30% of our students continue to graduate school, another 30% enter the nuclear power industry in some capacity, and the other 40% enter careers with other corporations.

Starting salary for nuclear engineering graduates are among the highest among the various engineering disciplines with yearly averages ranging from $63,000 – $65,000 per year. Your starting salary will vary based on a number of factors including the location of the job and your qualifications (GPA, previous work experience, etc.). Typically our **placement rates** are about 90%, although the placement rates have been around 85% over the last two to three years.

Internships

Internships are increasingly important for students trying to gain real-world experience and get an advantage over their competition. Nuclear engineering students from Missouri S&T have participated in internships with a wide variety of companies in the nuclear power industry and elsewhere, but certain companies like **Transware** and **Callaway NPP** (Ameren UE) specifically seek out S&T students for internships and are good places to apply. **Exelon Nuclear** hires 90 or more interns every year as well, and many of those interns go on to full-time positions after graduation. Other companies that have hired S&T interns in the past include:

- Wolf Creek NPP
- DC Cook NPP
- Kairos Power
- Center for Space Nuclear Research (CSNR)
- Clinton NPP
- NextEra Energy
- Idaho National Laboratory
- Oak Ridge National Laboratory
- Sandia National Laboratory
- Lawrence Livermore National Laboratory
- Omaha Public Power District
- Curium Pharma
- SHINE Medical
- NextEra Energy
- Niowave, Inc.
- National Institute for Standards and Technology (NIST)
- NREIP (Navy Research)

3. ENTRANCE REQUIREMENTS

The Catalog states that students may transfer from Freshman Engineering to departments with up to two of the common freshman year courses not yet completed, provided departments will accept them. The following guidelines are used in evaluating applications for admission to the Nuclear Engineering degree program:

1. A cumulative GPA > 2.0
2. Grade of "C" or better in MATH 1215 and PHYS 1135

Students may take sophomore-level Nuclear Engineering courses in order to satisfy the admission requirements and re-apply for admission. However graduation from the Nuclear Engineering program expects official admission to the program prior to beginning the Junior-year Nuclear Engineering courses.

Special Considerations

Students who do not meet these standards may request special consideration ***only*** for unusual circumstances by including with the application a written statement including motivation for the choice of degree program and justification for special consideration. Consideration of exceptions will be based on convincing evidence of ability to succeed in the program and the availability of space in the program.

4. SCHOLARSHIPS

A number of need and/or merit based scholarships or research awards are available to NE students. Female and minority students qualify for additional scholarships. Over 90% of NE students receive some kind of financial support. Sophomores and Juniors with summer work experience in the nuclear industry can receive scholarships from the National Academy for Nuclear Training (NANT). Sophomores and Juniors can also apply for American Nuclear Society (ANS) or Nuclear Regulatory Commission (NRC) scholarships for the following year. These scholarship may include service requirements, such that you must work in the nuclear industry for a certain amount of time (usually 6 months) per year of support. The following are NE-specific award opportunities:

- National Academy for Nuclear Training (NANT): $2,500/yr, renewable for 3 years
- OURE: $500 scholarships, or $2,000 for interdisciplinary fellowships
- ANS Scholarships (NEED, Minority, Women): $1000-$4000/yr
- NE Program Scholarships: $500-$1000/yr
- NE Research Award: $500-$1000/yr
- NRC Scholarships: Up to $3000/yr; generally undergraduates with GPA > 3.0 qualify

The NE awards and NRC Scholarships (which are administered by the program) are awarded based on the **program's scholarship application**. Applications are online at the Nuclear Engineering web page.

5. UNDERGRADUATE ADVISING

Throughout a student's academic career, the advisor and student will discuss academic progress and career considerations. Problems that affect a student's academic performance should be discussed with the advisor. He or she can provide help to resolve academic performance problems or direct the student to resources on campus. And of course, the two will need to select courses during pre-registration periods.

Faculty in nuclear engineering maintain an open-door policy. Whenever a faculty member's door is open, they are available for walk-in appointments. If necessary, you can always email your advisor to schedule an appointment in advance. In addition to pre-registration advising sessions every semester, your advisors are also available to discuss other topics related to academic or career development.

A typical pre-registration advising appointment might last anywhere from 10 to 20 minutes, depending on your needs, and may proceed as follows:

- Your advisor greets you
- You discuss any concerns you have with your current course load, especially any issues that may affect your future courses
- You discuss your extracurricular activities, and any effect those may be having on your academic performance.
- You discuss the courses you plan to take next semester, where they fit into your plan of study, and any challenges those courses may present.
- You ask your advisor about any additional questions you may have (summer courses, internships, career advice, etc.)

RESPONSIBILITIES OF THE ADVISOR

Some responsibilities of our academic advisors include:

1. Endeavor to know his/her advisee well enough to be able to write a cogent letter of reference if requested to do so.
2. Exhibit good listening and questioning skills in order to identify academic and/or personal problems which may affect academic performance.
3. Discuss career options and interest as they may relate to the student being advised.

4. Assess the student's ability to successfully complete the proposed academic load and offer suggestions for modification when appropriate.
5. Be aware of campus facilities and resources which are in place to assist students and be prepared to refer students to these programs when appropriate. Offer to assist in making appointments and follow ups as appropriate.
6. Be generally aware of campus rules and procedures relating to academic matters. Examples include, but are not limited to, add/drop procedures and deadlines, change of grading option and probationary rules.
7. Be very familiar with the curriculum in which he/she is advising so that students can be assisted in a selection of courses resulting in a degree or other educational goals.

RESPONSIBILITIES OF THE ADVISEE

- Attend all scheduled advising appointments with your academic advisor.
- Be prepared; write down questions and concerns that you may have.
- Check your e-mail on a regular basis and respond to e-mails sent to you by your advisor.
- Respond to Academic Alerts and follow the instructions. See your advisor as soon as you begin to experience academic problems.
- Pick up an Advising Agreement Form from the Registrar's Office or print one off of the web at: http://registrar.mst.edu/classofferings/index.html
- Schedule a meeting with your academic advisor prior to Advising Week scheduling. Prepare for the meeting with your advisor by reviewing your degree requirements using your CAPS report available through Joe'SS.
- Bring a proposed schedule with you to pre-registration appointments; this may not be a final schedule, but provides you and the advisor with a starting point.
- Obtain approval from your advisor for special processing such as pass/fail or hearer status using forms provided on the web for this purpose.
- During advising, your advisor will need to remove your registration advising hold. Your appointment time for registration will be available on Joe'SS.

Coursework Requirements:

- A student must register for 12 credit-hours to maintain full time status (6 credit-hours if registering for summer semester).
- A student can register for a maximum of 18 credit-hours in a semester, unless they have approval of their academic advisor and submit an Excess Hours form to the registrar.

Scholastic Probation:

Students are given an academic standing at the end of each semester. For most students that standing is "Good Standing" meaning they have achieved a semester and cumulative GPA of 2.0 or above. Students who do not meet those requirements may go on probation or deficiency.

Probation-Scholastic: A student is placed on scholastic probation if his/her current semester or cumulative GPA is less than 2.000. If the cumulative GPA is less than 2.000 and the current semester GPA is above 2.200, the student will not be placed on probation. A student on probation is restricted to 13 credit hours and may not hold office in any organization.

Deficiency-Scholastic: A student is considered to be scholastically deficient if he/she has two or more semesters of scholastic probation. Also, he/she is immediately considered scholastically deficient at the end of any semester in which he/she has one or more "U" or "F" grade and no grade higher than a "D". The student's records will be referred to his/her academic department for a decision on continued enrollment at Missouri S&T, with the results forwarded to the student by the Office of the Registrar. Students can appeal denied enrollment by the department to the provost. Students that have preregistered and paid fees will be allowed to keep their schedule, with appropriate modifications, if readmitted to the University.

When students experience academic difficulty in a course they have several options:

1. Remain in the class and utilize the academic resources that are provided on campus. Visit with the professor, form study groups or partners for the course and increase the dedicated hours of study time.
2. Hearer Status: Students are required to pay full fees for classes in which they register as a "hearer." None of the work will be graded and the student is not entitled to credit in the course. The student is required to attend class and may receive a "WD" grade if attendance is not to the satisfaction of the instructor of the class. The course credit will be included in all certifications of enrollment. Hearer status must be declared prior to the end of 6-weeks of class.
3. Dropping the course: It may be recommended to drop a course rather change to hearer status if the student is struggling in multiple courses and needs to dedicate more time to other classes or if the student may not need the course. No courses can be dropped in the last three weeks of class or during finals week. No transcript record is made if the course is dropped within the first six weeks; a "WD" is posted on the transcript if dropped after six weeks.

Students who have gone deficient may be denied readmission by their departments. If that happens a student may apply for readmission to the Undergraduate Advising Office on a temporary basis as an undecided student. The Undergraduate Advising Office has dedicated full-time advisors to assist students in turning around their academic status; they offer resources and guidance on success. The goal is to increase the students' GPA's so that they may apply for readmission to the department.

6. PLAN OF STUDY

The nuclear engineering curriculum consists of three components: general education, mathematics and basic sciences, and engineering topics. The full plan of study is shown on the next page. The students apply the principles of physics, chemistry and mathematics to the study of engineering topics which include statics, mechanics of materials, electronic circuits and machines, thermodynamics, and metallurgy. The knowledge gained in these areas is applied to the understanding of nuclear engineering topics including reactor fluid mechanics and heat transfer, reactor physics, nuclear radiation measurements, radioactive waste management, reactor laboratory and operation, nuclear materials, and nuclear systems design (a capstone design course).

Engineering design is an integral part of a significant number of required courses in the nuclear engineering program. Design topics include but are not limited to reactor cooling systems, radiation protection, structural components, waste disposal and transportation systems, nuclear reactor cores and the design of experiments for radiation detection and measurement. While obtaining experience in these areas the students are prepared for designing a complete nuclear system such as a nuclear plant for electric power generation, space propulsion, desalination, district heating or radioisotope production for industrial, medical or research applications.

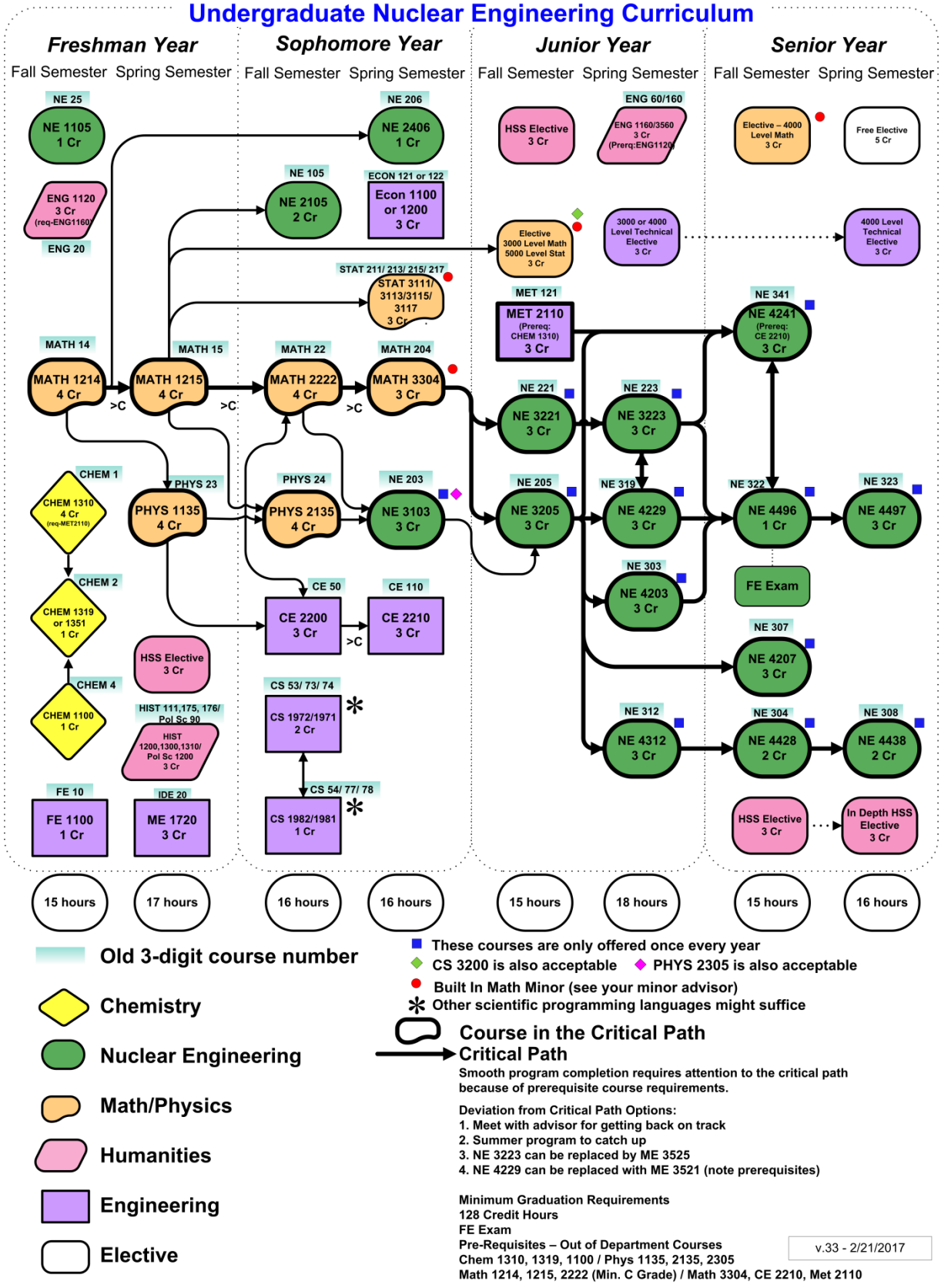
The plan of study shown on the next page should be used in creating your own plan to complete your degree. A few important comments on this process are:

- All necessary forms can be found on the Registrar's web site, http://registrar.mst.edu/forms/
- Note that most Nuclear Engineering courses are only **offered once per academic year**. For students on co-ops, some courses may be substituted for courses offered by other departments. This will require the submission of a substitution/waiver form.
- A full list of undergraduate courses currently offered by the NE program can be found in Appendix A.

HUMANITIES AND SOCIAL SCIENCES REQUIREMENTS

The degree program includes a minimum of 21 credit hours of humanities and social sciences (H/SS) courses as follows:

- ENGLISH 1120
- HISTORY 1200 or HISTORY 1300 or HISTORY 1310 or POL SCI 1200
- ECON 1100 or ECON 1200
- Communication Elective: ENGL 1160, ENGL/TCH COM 1600, ENGL 3560, SP&M S 1185
- The remaining minimum of nine additional credit hours must be chosen from disciplines in the humanities and social sciences.



Plan of Study Flow Chart

Humanities courses are defined as those in: Art, English and Technical Communication, Etymology, Foreign Languages, Music, Philosophy, Speech and Media Studies, and Theatre. Social Sciences courses are defined as those in: Economics, History, Political Science, and Psychology.

Courses in business, education, information science and technology, or any other discipline not listed above will not satisfy the humanities/social sciences elective requirement, although such courses may count toward general education requirements. Transfer credits from other universities in sociology and general humanities may count as humanities or social science electives (check with the Registrar). ENGL 1160, ENGL/TCH COM 1600, ENGL 3560, and SP&M S 1185 do not count toward the remaining minimum of nine additional credit hours in humanities/social sciences electives.

EXPERIENTIAL LEARNING REQUIREMENT

All students at Missouri S&T are required to participate in appropriate experiential learning activities. Experiential learning refers to learning stimulated by a variety of structured activities that differ significantly from the traditional lecture format. Experiential learning activities are designed to require students to go beyond mastering basic skills and knowledge in the application of that material to problem solving challenges. These activities involve collaboration and reflective learning and allow students to learn in environments that align with their aptitudes. To qualify:

1. The activity must be University sponsored or affiliated and the student must receive written approval of the activity from an academic advisor in the student's degree program. Approval of the initial activity does not automatically imply approval of the overall experience.
2. The academic advisor will ensure that the activity is of significant duration, intensity and rigor to demonstrate successful application of learned principles appropriate to the expectations of the degree program.
3. The focus must be on "learning by doing" in a creative and innovative activity that generally falls outside the realm of the traditional lecture classroom experience and contributes significantly to professional and personal development.
4. Finally, a significant experiential learning activity will include a *written summary reflection piece* that will document the experience from the student's perspective; this written reflection piece should be of a quality suitable for inclusion as an attachment to a co-curricular transcript or in an e-portfolio that might be submitted by the student to potential employers or to graduate school admissions committees.

Examples of activities that fulfill the Experiential Learning requirement include, but are not limited to:

- Co-ops or internships with national laboratories, nuclear utilities, vendors, nuclear medical or other relevant companies

- Undergraduate research (OURE, NSF Research Experience for Undergraduates, Honors Academy senior research project, etc.)
- Participation in ANS or other relevant design competition to completion
- Study abroad program
- S&T-sponsored service learning (EWB, Miner Challenge, etc.)
- Leadership positions with student organizations (ANS, NSDT, WiN). Leadership experience must be significant. This type of experience must be endorsed by the other leaders of the organization by signatures of the current officers on the assignment.
- NUC ENG 4438 (Reactor Laboratory II)
- Year-long leadership involvement experiences (Global Leaders Institute, Chancellor's Leadership Academy, Student Leadership Conference Chair, Intercollegiate Athletics Team)

Other types of activities may be considered acceptable with *prior approval*. Upon completing your experiential learning requirement, the Experiential Learning Form (http://academicsupport.mst.edu/media/administrative/academicsupport/documents/experientiallearning/EL%20Activity%20Form.pdf) must be completed and submitted.

In addition to the form, an appropriate reflective essay must be completed. The reflective essay should describe your activity, as well as the benefits you received from participating in the activity that you would not have received from classroom instruction.

Senior Assessment

All programs at Missouri S&T are required to have a senior assessment. The NE program requires all seniors to complete the Fundamentals of Engineering (FE) exam and the senior exit questionnaire prior to graduation. Students are not required to pass the FE exam in order to graduate. The FE exam is the first step in becoming a licensed professional engineer. Additional information on the FE exam can be found at http://ncees.org/engineering/fe/.

Minor in Nuclear Engineering

A nuclear engineering minor enhances the academic credentials of a student and broadens his/her employment choices. A minimum of 15 hours is required for a minor in nuclear engineering. Before the courses listed below can be taken, the student should have completed MATH 3304 (or equivalent) and PHYSICS 2305 (or NUC ENG 3103 or equivalent). Required courses are:

NUC ENG 3205	Fundamentals of Nuclear Engineering	3 Credit-Hours
NUC ENG 3223	Reactor Heat Transfer	3 Credit-Hours
NUC ENG 4312	Nuclear Radiation Measurements and Spectroscopy	3 Credit-Hours

The other 6 hours should be selected from nuclear engineering 3000 or 4000 level courses.

HONORS PROGRAMS

The Missouri S&T Honors Academy offers students the opportunity to be a part of a community of outstanding scholars who are seeking an enhanced educational experience. At Missouri S&T, Honors Academy students are recognized for their academic excellence and are provided with individualized attention and opportunities to establish leadership development skills, interact with faculty members, and participate in special projects including undergraduate research, service learning, and other beneficial experiences.

Incoming freshmen are eligible to apply if:

- ACT score is 29 or higher/SAT is 1440 or above
- Rank in the top ten percent of their high school class or have a minimum GPA of 3.5

Incoming transfer students and students currently enrolled at Missouri S&T are eligible to apply if they have the following:

- A minimum GPA of 3.5
- A minimum of 24 graded, college-level credits

New Student Honors Seminar

To participate in Honors Academy, students participate in New Student Honors Seminar their first year at Missouri S&T. New Student Seminar meets monthly throughout the fall and spring semester. Students have the opportunity to hear from speakers across the campus. To participate, students must apply to the Honors Academy (http://ugs.mst.edu/honors). Once admitted, the office of academic support will enroll the student in the no cost, no credit Honors Seminar. (Transfer students may join New Student Honors Seminar during either the fall or spring semester.)

Honors Academy (Sophomore-Senior Year)

Following their first year, Honors Academy students must maintain a minimum GPA of 3.5 to continue their participation in the program. Honors Academy students will enroll in and complete 15 credit hours of "Honors" course work to include 12 hours of "Honors" course work and three hours of Senior Project. The "Honors" course designation is based on extra work conducted in regular Missouri S&T courses wherein the instructor agrees to approve and oversee the effort. Course requirements include:

- One course must be outside of the major field of study.
- During the senior year, Honors Academy students will complete three hours of Senior Thesis/Project, write a thesis and present their findings to the Honors Committee.
- No more than three credit hours may be individual study courses.

Honors Distinctions

Honors Academy students who graduate with a 3.5 GPA or better and have at least 15 credit hours of "Honors" course credits and present their thesis findings will earn the distinction of "Honors Academy Fellow" at graduation. This distinction will be noted on their diploma,

transcript, and commencement program. For more information, please contact the office of academic support at 573-341-7276.

Reactor Operator Licensing Program

Missouri S&T is unique in that our undergraduate students have the opportunity to become licensed Reactor Operators (ROs) prior to graduation. Students will work with reactor staff, study relevant Nuclear Regulatory Commission (NRC) regulations, learn the fundamentals of how a nuclear reactor works, spend time in the control room, and take the NRC reactor operator's exam. Some students may also have the chance to complete Senior Reactor Operator (SRO) licensing.

This license does not 'travel', so students seeking employment as ROs at other reactors would have to re-license. However this program provides valuable learning, experience, and insight into the process. Students who are interested in the program should contact Ethan Taber (etaber@mst.edu)

Dual Enrollment

The purpose of dual-enrollment is to give S&T students an opportunity to earn graduate credit for courses taken (not required for an undergraduate degree) while still an undergraduate. In general, undergraduates are not permitted to enroll for 5000-level courses. However, an undergraduate may earn credit toward their bachelor's degree for courses normally taken by first-year graduate students (5000-level courses). Students are eligible to enroll when they have:

- Obtained senior status,
- A minimum GPA of 3.5 if two semesters remain, 3.0 if in their final semester.

Dually enrolled students are limited to sixteen total credit hours per semester, but petitions for additional credit hours will be considered by the Provost. Petition forms are available at http://registrar.mst.edu/media/administrative/registrar/documents/dualenrolled.pdf. If a dually enrolled student fails to meet minimum undergraduate scholastic standards, his or her resulting academic probationary status will be that of an undergraduate and will be evaluated without reference to the student's grades in his or her graduate course(s).

To apply for dual enrollment, complete the online application for graduate school admission and choose dual enrollment as your academic level on the application. Missouri S&T undergraduate students applying for graduate dual-enrollment need not pay the graduate school application fee or submit GRE or GMAT scores. These scores will be necessary if you wish to later apply as a full-time graduate student.

General application deadlines:

Fall Semester - July 15
Winter/Spring Semester - December 15
Summer Session - May 1

7. STUDENT ORGANIZATIONS

AMERICAN NUCLEAR SOCIETY

The American Nuclear Society (ANS) is a not-for-profit, international, scientific and educational organization. It was established by a group of individuals who recognized the need to unify the professional activities within the various fields of nuclear science and technology. December 11, 1954, marks the Society's historic beginning at the National Academy of Sciences in Washington, D.C. ANS has since developed a diverse membership composed of approximately 11,000 engineers, scientists, administrators, and educators representing 1,600 plus corporations, educational institutions, and government agencies. It is governed by four officers and a board of directors elected by the membership.

Vision: ANS will be the recognized, credible advocate for advancing and promoting nuclear science and technology.

Mission: ANS provides its members with opportunities for professional development. It also serves the nuclear community by creating a forum for sharing information and advancements in technology, and by engaging the public and policymakers through communication outreach. Mission components can be found in the ANS strategic plan.

Purpose: The core purpose of ANS is to promote the awareness and understanding with regard to the application of nuclear science and technology.

The ANS Student Chapter at Missouri S&T is a student-led professional organization. The mission of the Missouri S&T American Nuclear Society is to promote understanding in, and advancement of, the sciences pertaining to the atomic nucleus in our community, especially those for peaceful applications. The chapter was founded in 1967. The organization creates opportunities to experience Nuclear Engineering outside of the class room and open doors to professional relationships and networking by providing the opportunity to travel to ANS conferences, national laboratories, and so on.

WOMEN IN NUCLEAR

U.S. Women in Nuclear (U.S. WIN) is the premier network of over 8,000 women and men who work in nuclear- and radiation-related fields around the country. The U.S. WIN organization was established in May 1999 with the following strategic objectives:

- To support an environment in nuclear energy and nuclear technologies in which women and men are able to succeed
- To provide a network through which the women and men in these fields can further their professional development
- To provide an organized association through which the public is informed about nuclear energy and nuclear technologies.

U.S. WIN members participate in networking, professional development and outreach activities through local chapters, regional organizations, and the national organization. Local chapters are organized based on company, university/college, or geographic region. In addition, U.S. WIN is an affiliate of the Women in Nuclear Global organization (WiN Global). The WiN-Global organization is made up of thousands of members in more than 100 countries.

Membership is open to both men and women at Missouri S&T. We strive to help provide a network for members to further their professional development, inform the public about nuclear energy and technology, and encourage women and diversity to participate in the nuclear, engineering, and energy fields.

NUCLEAR SCIENCE DESIGN TEAM

Missouri S&T design team experience prepares students for success in whatever endeavor they may choose. These student-led teams learn the organizational problem-solving process essential for the successful development of a market-ready product. Business, marketing, logistics, communications and teamwork skills that design teams incorporate in their day-to-day operations mirror the global design process used in industry world-wide. Design team members network with industry professionals and students from competing schools alike, forming personal and professional relationships that can lead to rewarding careers.

S&T design team veterans "know how to think on their feet, don't mind getting their hands dirty, and are ready to contribute on their first day at work" say many firms who hire our team members, and why so many businesses aggressively recruit S&T students with design team experience.

The Nuclear Science Design Team (NSDT) develops original ideas or concepts related to nuclear science and technology. Final designs or papers are submitted to national competitions, including the yearly ANS student design competition. The purpose of the organization is:

1. Research, design, and build nuclear devices
2. Participate in American Nuclear Society competitions
3. Promote technological advancement, particularly in nuclear fields
4. Expand members' knowledge of classroom concepts
5. Increase awareness of environmental protection and health safety throughout all aspects of developing NSDT next project
6. Develop skills that will prepare members for leadership roles in industry
7. Promote cooperation between multiple scientific and engineering disciplines
8. Promote the University through ANS competitions and public outreach programs

Past projects include construction of an Inertial Electrostatic Confinement (IEC) fusor. The team is always looking for new members. All students are welcome, any major and no experience required.

8. Advice From Previous Students

In order to make the most of your time in Nuclear Engineering, there are a few things that every student should do. Each year we ask the outgoing senior class what advice they would have liked to receive as an incoming Freshmen. Some of the common responses are:

- "Create a study group; GroupMe is a great resource. Start studying in groups as early as possible. Make friends with fellow students. You learn better as a group even if you do not think so."
- "Apply early and often – for internships and jobs. Actively pursue internships or co-ops, it makes it much easier to get a job later."
- "Take some extra coding and logic classes (PHIL 1110, PHIL 1115, CS courses)"
- "Be active in extracurricular activities – everyone takes classes, so doing the minimum won't set you apart."
- "Take MATLAB and MCNP."
- "Get to know the professors, they are not scary and are a great resource."
- "Get involved with ANS and WiN"
- "Make sure you understand the basics from Fundamentals of Nuclear Engineering. The information in this course will be used all throughout the rest of your nuclear engineering courses."
- "You get out what you put in. You have to apply yourself to really learn anything. Don't just skate along."

APPENDIX A: LIST OF EMPLOYERS

UTILITIES			
Associated Electric Cooperative Inc.	www.aeci.org		Springfield, MO
Ameren	www.ameren.com	Callaway	Fulton, MO
Arizona Public Service Co.	www.aps.com	Palo Verde	Phoenix, AZ
Constellation Energy	www.constellation.com	Calvert Cliffs	Annapolis, MD
		Ginna	Rochester, NY
		Nine Mile Point	Oswego, NY
Detroit Edison Co.	www.dteenergy.com	Fermi	Toledo, OH
Dominion Generation	www.dom.com	Kewaunee	Green Bay, Wi
		Millstone	New London, CT
		North Anna	Richmond, VA
		Surry	Newport News, VA
Duke Energy Power Company, LLC	www.duke-energy.com	Catawba	Charlotte, NC;
		McGuire	Charlotte, NC;
		Oconee	Greenville, SC
Emerson Electric			Marshalltown, IA
Energy Northwest	www.energy-northwest.com	Columbia Generating Station	Pasco, WA
Entergy	www.entergy.com	ANO	Russellville, AR
		FitzPatrick	Oswego, NY
		Grand Gulf	Vicksburg, MS
		Indian Point	New York City, NY
		Palisades	South Haven, MI
		Pilgrim	Boston, MA
		River Bend	Baton Rouge, LA
		Vermont Yankee	Brattleboro, VT
		Waterford	New Orleans
Exelon	www.exeloncorp.com	Braidwood	Joliet, IL
		Bryon	Rockford, IL
		Clinton	Bloomington, IL
		Dresden	Joliet, IL
		La Salle	Ottawa, IL
		Limerick	Philadephia, PA
		Oyster Creek	Toms River, NJ
		Peach Bottom	Lancaster, PA
		Quad Cities	Moline, IL
		Texas Site (Green Field)	Victora County, TX
		Three Mile Island	Harrisburg, PA

FirstEnergy	www.firstenergycorp.com	Beaver Valley	McCandless, PA;
		Davis-Besse	Toledo, OH
		Perry 1	Cleveland, OH
Florida Power and Light	www.fpl.com	Duane Arnold	Cedar Rapids, IA
		Point Beach	Manitowoc, WI
		Saint Lucie	Ft. Pierce, FL
		Seabrook	Portsmouth, NH
		Turkey Point	Miami, FL
Indiana/Michigan Power Co.	www.cookinfo.com	D.C. Cook	Benton Harbor, MI
Luminant/TXU	www.luminant.com	Comanche Peak	Fort Worth, TX
Nebraska Public Power District	www.nppd.com	Cooper	Brownsville, NE
Nuclear Management Co.	www.nuclearmanagementpartners.com	Monticello	Minneapolis, MN
		Prairie Island	Minneapolis, MN
Omaha Public Power District	www.oppd.com	Fort Calhoun	Omaha, NE
Pacific Gas and Electric	www.pge.com	Diablo Canyon	San Luis Obispo, CA
PPL Susquehanna, LLC	www.pplweb.com	Susquehanna	Harrisburg, PA
Progress Energy	www.progress-energy.com	Brunswick	Wilmington, NC
		Crystal River	Tampa, FL
		Levy County (Green Field)	Levy County, FL
		Robinson	Florence, SC
		Harris	Raleigh, NC
PSE&G	www.pseg.com	Hope Creek	Wilmington, DE
		Salem	Wilmington, DE
South Carolina Electric & Gas Co.	www.sceg.com	Summer	Columbia, SC
Southern California Edison Co.	www.sce.com	San Onofre	Long Beach, CA
Southern Power	www.southerncompany.com	Farley	Dothan, AL
		Hatch	Vidalia, GA
		Vogtle	Augusta, GA
STP Nuclear Operating Co.	www.stpnoc.com	South Texas Project	Bay City, TX
TVA	www.tva.gov	Browns Ferry	Huntsville, AL
		Sequoyah	Chattanooga, TN
		Watts Barr	Spring City, TN
		Bellefonte	Hollywood, AL
		Unnamed	Oak Ridge, TN
Wolf Creek	www.wcnoc.com	Wolf Creek	South East Kansas
Xcel Energy	www.xcelenergy.com		

ARCHITECTURAL/ENGINEERING/CONSTRUCTION		
Shaw Group	www.shawgrp.com	
Black & Veatch	www.bv.com	Kansas City, MO
Burns & McDonnel	www.burnsmcd.com	Kansas City, MO
Sargent & Lundy	www.sargentlundy.com	
RCS Corporation	www.rcscorporation.com	
Enercon	www.enercon.com	
Areva	www.areva.com	World
Burns & Roe	www.roe.com	New Jersey
URS	www.urscorp.com	San Francisco, CA
K&M Engineering & Consulting Co.	http://kmec.com	Washington, DC
Fluor	www.fluor.com	
Enercon Services, Inc	www.enercon.com	Overland Park, KS
Kairos Power	http://www.kairospower.com	Oakland, CA
MILITARY SUPPORT/DESIGN		
Bechtel	www.bechtel.com	Idaho Falls, ID Kesselring, NY
Bechtel Marine Propulsion	-	Albany, NY Niskayuna, NY Idaho Falls, ID
Knolls Atomic Power Laboratory	www.knollslab.com	
Boeing	www.boeing.com	
Booz, Allen & Hamilton	www.boozallen.com	
DRS Power & Control Technologies	www.drs.com	
Raytheon Company	www.raytheon.com	
NUCLEAR PARTS/SUPPORT		
Emerson	www2.emersonprocess.com	
Ruskin	www.ruskin.com	
Faukse and Associates	www.fauske.com	
NAI	www.numerical.com	
Alion	www.alionscience.com	
Scientech	www.scientech.cwfc.com	
ABS Consulting	www.absconsulting.com	Irvine, CA
Holtec	www.holtecinternational.com	New Jersey, Florida
Flowserve	www.flowserve.com	
Alstom	www.alstom.com	France
Science Applications International Corporation	www.saic.com	McLean, VA

Electrical Power Research Institute	http://my.epri.com	Palo Alto, CA
Flodyne-Hydradyne, Inc.	www.cmafh.com	
FMC Corporation	www.fmc.com	
General Electric	www.ge.com	
Halliburton Services	www.halliburton.com	
Honeywell's Technology Center	www.honeywell.com	
Jason Associates Corporation	http://jason.com/	
PECO Engineering	http://pecovalves.com	
RSO Incorporated	www.rsoinc.com	Baltimore, MD
Tate Engineer Systems, Inc.	www.tate.com	
TransWare Enterprises, Inc.	http://transware.net/	
CSA	http://csai.com/	Idaho Falls, ID
Worley Parsons Group Inc	www.Worleyparsons.com	All over the World
Structural Integrity Associates Inc	www.structint.com	All over the World
NUCLEAR WEBSITES		
NukeWorker	www.NukeWorker.com	
Price Waterhouse Coopers	www.pwc.com	
NUCLEAR FUEL		
USEC	www.usec.com	Bethesda, MD
Global Nuclear Fuel - Americas, LLC		Wilmignton, NC
NAC International	www.nacintl.com	Atlanta, GA
Lightbridge	http://ltbridge.com/	McLean, VA
Nuclear Fuel Services	www.nuclearfuelservices.com	Erwin, TN
NATIONAL LABORATORIES		
Argonne National Laboratory	www.dep.anl.gov	Chicago, IL
Bettis Atomic Power Laboratory		Pittsburgh, PA
Brookhaven National Laboratory	www.bnl.gov	Upton, NY
Idaho National Laboratory	https://inlportal.inl.gov	Idaho Falls, ID
Lawrence-Livermore National Laboratory	https://scholars.llnl.gov	San Francisco, CA
Los Alamos National Laboratory	www.lanl.gov	Los Alamos, NM
Oak Ridge National Laboratory	www.orau.org/ornl	Knoxville, TN
Pacific Northwest National Laboratory	http://science-ed.pnl.gov	Richland, WA
Sandia National Laboratories	http://sandia.gov/	Albuquerque, NM

Battelle Memorial Institute	www.battelle.org	Columbus, OH
Navy Nuclear Laboratory	https://navalnuclearlab.energy.gov/	Charleston, SC
UNIVERSITIES (GRAD SCHOOL)		
UMC Environmental Health & Safety	http://ehs.umc.edu/	Jackson, MS
Missouri S&T	www.mst.edu	Rolla, MO
University of Akron	www.uakron.edu	Akron, OH
University of California	www.universityofcalifornia.edu	Oakland, CA
University of California - Berkeley	www.berkeley.edu	Berkeley, CA
University of Illinois	http://illinois.edu	Urbana-Champaign, IL
University of Michigan - Nuclear Engineering Department	www.umich.edu	Ann Arbor, MI
University of Texas - SW Medical Center	www.utsouthwestern.edu	Dallas, TX
Washington University	www.wustl.edu	St. Louis, MO
Rensselaer Polytechnic Institute	www.rpi.edu	Troy, NY
Texas A&M	www.tamu.edu	College Station, TX
Massachusetts Institute of Technology		Cambridge, MA
Vanderbilt University		
Louisiana State University	www.lsu.edu	Baton Rouge, LA
Purdue University	www.purdue.edu	West Lafayette, IN
NNSA Fellow	http://ngp.pnnl.gov/	Richland, WA
GOVERNMENT/MILITARY		
Defense Nuclear Facilities	www.dnfsb.gov	
NRC	www.nrc.gov	
U.S. Air Force	www.airforce.com	
U.S. Army	www.goarmy.com	
U.S. CIA	www.cia.gov	
U.S. Coast Guard	www.gocoastguard.com	
U.S. Navy	www.navy.mil	
U.S. Navy - NUPOC	www.navy.com/nupoc	
U.S. Dept. of Energy	www.energy.gov	
U.S. Dept. of Transportation	www.dot.gov	
U.S. EPA	www.epa.gov	
NASA	www.nasa.gov	
CSRA	www.csra.com	

NUCLEAR MEDICINE		
NuView Life Sciences		Denton, Texas
NorthStar Medical Radioisotopes		Beloit, WI
Curium	https://curiumpharma.com	St. Louis, MO
Phoenix Nuclear Labs	http:// phoenixnuclearlabs.com	Monona, WI
OTHER		
Lockheed Martin		Plamdale, CA
Ford Motor Company		Dearborn, MI
Honeywell		Kansas City, MO
Newport News Shipbuilding		Newport News, VA
Ruskin		Grandview, MO
PPG Industries	http://corporate.ppg.com	Mt. Vernon, IL
Phase Change Energy Solutions	https://www.phasechange.com/	Asheboro, NC
Superior Pipeline	www.superiorpipeline.com	Tulso, OK
Epic Systems Corp	www.epic.com	Verona, WI
King Abulaziz City for Science and Technology	www.kacst.edu.sa/eng/Pages/default.aspx	Riyadh, Saudi Arabia
Ankara University	www.ankara.edu.tr	Ankara, Turkey