

Mid-Cycle Program Review

DEPARTMENT OF NUCLEAR ENGINEERING

Tickle College of Engineering

The University of Tennessee, Knoxville

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THE UNIVERSITY OF
TENNESSEE
KNOXVILLE

DEPARTMENT OF
NUCLEAR ENGINEERING

2018 Annual Program Review Overview and Responses/Updates:

On April 9-12, 2018, the University of Tennessee Nuclear Engineering Department underwent its 10-year academic program review. The 2018 reviewer report summarized the strengths of the program, addressed areas of concern, and provided recommendations for future growth and sustainability of the program. The 2018 review team included

Dr. Yassin Hassan
Department of Nuclear Engineering
Texas A&M University

Dr. Ronald Gilgenbach
Department of Nuclear Engineering and Radiological Sciences
University of Michigan

Dr. Leon Tolbert
Department of Electrical Engineering and Computer Science
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Dr. Bamin Khomami
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Dr. Hanno Weitering
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The 2018 summary statement was very complimentary of the department's performance, vision, and leadership. The team noted several concerns and opportunities for improvement which will be addressed in this section:

1. "there is a need for at least two or three additional faculty positions (on top of the current fifteen) to accommodate the continuing increase in graduate enrollment"
 - The faculty has grown and we will have 18 faculty by January 2023, one search underway, and several more hires planned within in the next two years.
2. "there will be a need to increase the number GTAs (plus increased stipend) to reduce the significant grading load for the faculty. At some point, the growth in enrollment will compromise the quality of the educational experience at UT. We recommend that the department and college develop enrollment targets for their undergraduate and graduate programs."
 - The department's strategic plan (2014, and yes we have a plan to update it in the near future) is to graduate at least 35 undergraduates per year and continuously fund 5 graduate students or post docs per full time equivalent faculty member (FTE). Our undergraduate average graduation rate over the last 5 years is 39 and the average number

of PhD students per faculty member over the last three years has been 7.8. These exceed our targets.

- The number of GTAs has been reduced from 17 to 16 over the last five years. The college GTA allocation is through a formula based on T/TT faculty numbers and credit hours taught. Since we are growing as a faculty, we expect to gain GTA positions in the future. Each of our classes with significant enrollment are assigned a GTA. We do not have faculty stating that they need a GTA and don't have one.
 - We increased PhD student stipends to \$33K/year and now pay their \$1400/semester fees.
3. "We have some concerns about the succession plan for the next department head. There are currently too few full professors who can take over the helm when the Head steps down. Dr. Hines indicated that one of his faculty members will attend UT's leadership training in 2018-19, but it would be highly desirable to increase the number of senior faculty, so as to have a strong pool of internal candidates for the next Head search."
- The department is focused on developing internal leadership talent but is also aware that the next head may be an external candidate. Two faculty (Drs. Hayward and Coble) were made Associate and Assistant Department Heads several years ago, and this year the department changed to having three Assistant Heads (Drs. Coble, Brown and Lukosi). Each of these faculty have expressed a desire for leadership opportunities and we divided duties into Undergraduate Studies and Service, Graduate Studies, and Research and Facilities; so that each faculty could receive an opportunity for leadership growth.
4. "The department holds regular weekly seminars but not all graduate students attend the seminars regularly. For building departmental cohesion, it is recommended to bring in more speakers, not associated with UT and ORNL and require all graduate students to attend, for instance by having them sign up for course credit. It would also help the department increasing its external visibility and recognition."
- The department now has a seminar course (NE 501) that all graduate students are required to attend for 2 or 3 semesters, depending on their program. These credits can be applied to graduate requirements. We do not have the space to require all of our students to attend each semester of their course of study as it would require a room to hold over 150 students. We feel requiring new students to take 2-3 semesters of seminar is a good compromise. The diversity of our speakers has increased and we also integrate seminars focused on safety, diversity, civility, and mental health into our offerings.
5. "Mentoring and support of junior faculty is excellent, but there should be a program to prepare faculty on how to best mentor their graduate students."
- We have integrated several activities to address graduate student mentoring:
 1. We established a requirement for each research group to outline expectations in writing. Outlining expectations is of course an essential component of mentorship- people need to know what is expected of them and that they are not being evaluated arbitrarily.
 2. We added ~5 pages to the graduate handbook that explains the kind of mentorship that graduate students should expect from their advisor. This narrative included input from the faculty and students. This is on page 6-11 of the current handbook.

https://ne.utk.edu/wp-content/uploads/sites/19/2021/08/Nuclear-Engineering-Graduate-Handbook_2021.pdf

3. We developed the Nuclear Engineering Graduate Student Assembly (NEGSA) which is a student group whose mission is to *“serve as a collaborative forum that enables University of Tennessee graduate students in the Nuclear Engineering Department to initiate and engage in discussions, events, and programs hosted by the organization to better the department and its graduate students”*. We utilize this group to help us identify and understand the mentoring needs of grad students and best practices. They partner with us on developing methods and materials to meet these needs.
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6. “There is an immediate, urgent need for a technical staff person to manage the potential regulatory and safety issues in the new building that will be under construction. In order to increase the department’s external visibility, it is furthermore recommended that a staff position be created for external communication and alumni relations. In particular, the department’s graduate ranking in USN&WR could be enhanced by improved publicity of their outstanding accomplishments to other NE programs in the nation.”
 - To increase safety and building support, we have taken several steps:
 1. We promoted Dr. Eric Lukosi to Assistant Department Head for research and facilities. Eric is uniquely qualified as he manages a recharge center that involves hazardous chemicals, he is on the campus radiation safety committee, and he is on the campus core facilities committee.
 2. We hired a new staff person to reduce Scott Emert’s workload. Scott is our departmental safety officer and this will provide him with more time to dedicate towards safety.
 3. We have been budgeted half the salary for a new employee who will be hired to oversee the licensing and operations of NE safety related facilities. We are looking for the right opportunity to make this hire and networking to identify a strong candidate pool.
 4. We instituted a “Safety Day” prior to school starting each fall semester.
 - To improve our departmental external communications, we hired Elan Lloyd who did a great job writing stories for both NE and CEE. Elan recently left and we hired a new writer: Izzie Gall. The TCE communications staff has grown and we also have a person specifically dedicated to digital communications: Adria Amos. I feel we have much better support and we have a solid plan for communicating to our external stakeholders.
 7. “It would greatly benefit the department if it could make target of opportunity hires at any time and not be restricted to the academic hiring calendar or a specific rank. Once a diversity candidate is included during the regular search, he or she will have to compete with many other stellar candidates.”
 - We have hired several female faculty but still need to increase diversity. I think part of the issue here is that we don't have a great mechanism to hire someone we identify as a potential colleague if we don't have a position open already. I think this is a college / university issue, and there's not much we can do about that from the department level. With that said, we have worked hard to recruit applicants for open positions from a variety of backgrounds.

7. “There is no funding mechanism to cover upgrades of the undergraduate laboratories. The University’s technology fee program is largely limited for the purchase of computers and software.”
 - We are working to develop a relationship with ORTEC and it appears the tech fee program has loosened up a little. We are very strong financially and have a departmental fund we can use to make necessary upgrades.
8. “There is a recurring concern with the unilateral termination of Joint Faculty by ORNL, which most recently has affected the nuclear engineering department. This effectively results in loss of faculty lines and places additional financial burden on the department and College.”
 - This has hit us pretty hard, but our UT system administration does not seem inclined to advise ORNL to operate any differently.

Departmental Academic Changes Since 2018

The department has made several changes to improve its curriculum, better meet student needs, and give them a competitive advantage in career searches. The ideas for these changes mostly came from exit interviews, our biannual town hall meetings, Board of Advisor members, and potential employers.

- We developed NE 250 - Mathematics and Computational Methods in Nuclear Engineering, which is a core requirement. This course provides sophomores several specific skills that are needed to be successful in their junior years such as Python, error analysis and counting statistics, MCNP, and linear algebra, to name a few.
- We developed NE 340 - Materials Science and Engineering Mechanics for Nuclear Materials, which is a core requirement. This course replaced an introduction to materials science course which was not well suited for the topics our students need and it also replaced a mechanical engineering mechanics course that was taught the last semester of their senior year which may have been too late to have impact. Student feedback on the new course has been very positive.
- At the graduate level, several courses have been developed in Fusion, Isotopes, and Space Radiation.
- **Nuclear Safety Minor:** We teamed with Bechtel to offer a minor in Nuclear Safety. It consists of four core classes and an elective. We also moved the NE 421 criticality safety course to the Spring so that juniors can take it and better prepare them for an internship in that field.
 - Core:
 - NE 360 - Reactor Systems and Safety
 - NE 402 - Nuclear Engineering Laboratory
 - NE 486 - Nuclear Licensing
 - NE 485 - Process System Reliability and Safety
 - Electives (Choose 1):
 - NE 421 - Introduction to Nuclear Criticality Safety
 - NE 483 - Introduction to Reliability Engineering

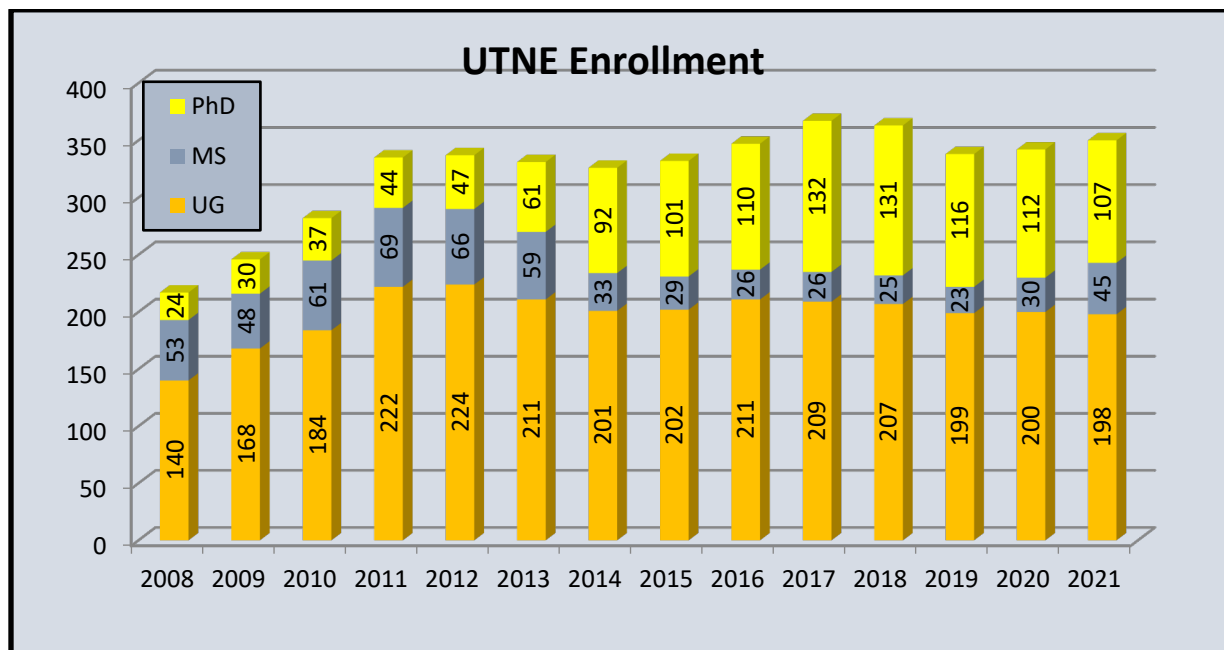
- NE 584 - Introduction to Fire Protection Engineering

This minor is in addition to our other nuclear-related minors:

- Concepts of Cybersecurity
- Nuclear Decommissioning and Environmental management
- Reliability and Maintainability Engineering.
- **Medical Physics:** We developed a program in Medical Physics that consists of an MS degree in Medical Physics and a Graduate Certificate, which is for students who already have a PhD in another area. The program is accredited by CAMPEP. We had our first group of graduate students enter in the fall of 2020 and they graduated in 2021 and 2022. Our initial goal was 6 new students per year but we had more demand than expected and are limiting our incoming class sizes to 10 students due to clinical experience class size limitations. The program has been very successful with all graduates who want a residency receiving offers. Our first graduate in December of 2021 accepted a residency at Vanderbilt.

Enrollment:

The departmental enrollment remains strong and fairly constant over the last 5 years. Undergraduate student body hovers around 200 students with 20% female students.



Our freshman class has 55 students with 33 from out of state.

Our graduate incoming class is 44 students with 39% women and 30% minorities.

Student Success:

We have developed a few new programs in the department to promote student success:

- The department supports paid tutors for all Sophomore and Junior NE core classes.
- The department has a new mentor program with Freshmen and Sophomores mentored by upperclassmen and Junior and Seniors mentored by graduate students and industrial leaders.
- The department has a new student service award program which rewards UTNE Volunteers each month with a \$500 award.
- We continue to focus on our undergraduate high impact practices:
 1. 64% were involved in undergraduate research prior to graduation
 2. 45% had an internship or Co-Op, that is down from 67% due to COVID
 3. 55% were involved in student societies
 4. Our study abroad was put on hold during COVID

Faculty:

The college has given NE several faculty lines over the last five years and we have made five new hires to our faculty bringing the total to 18.

- Dr. Vlad Sobes was hired as an Assistant Professor in 2019. He is a graduate of MIT and was working at ORNL in their criticality safety and nuclear data group. His research covers a broad spectrum of reactor physics. Research interests currently span several major areas from nuclear physics to reactor design. With a background in nuclear data, he continues to work on problems in the nuclear data pipeline with a particular interest in the application of Artificial Intelligence (AI)/ Machine Learning (ML) algorithms.
- Dr. Sandra Bogetic was hired as an Assistant Professor in 2021. She is a graduate of the University of California, Berkeley and came to us after completing a Postdoctoral Research position at Lawrence Livermore National Laboratory. Research covers a broad spectrum on development of numerical methods in reactor core analysis, tailoring neutron beams characteristics, high-performance computing, biomedical application (BNCT), and nuclear security and nonproliferation.
- Dr. Livia Casali was hired as a Zinkle Fellow and Assistant Professor in 2021. She is a graduate of the Max Planck Institute for Plasma Physics/LMU University Munich, Germany. Prior to joining our faculty, she was a Scientist at the General Atomics DIII-D National Fusion Facility. Her research includes Fusion Energy Science and Plasma physics, specifically radiative and detached divertors, divertor optimization, pedestal dynamics and core-edge integration solution to achieve high core performance scenarios with mitigated heat loads in magnetically confined fusion devices.
- Dr. Ivis Chaple was hired as an Assistant Professor in 2022. She is a graduate of the University of Alabama at Birmingham and finished a Postdoctoral Research Associate term at Los Alamos National Laboratory. Her research is focused on developing novel radiopharmaceuticals for diagnosis and treatment of various disease states, such as cancer. She conducts radiochemical assays for radiopharmaceutical development, and *in vitro* and *in vivo* studies for determination of successful cellular targeting.
- Dr. Khalid Hattar was hired as an Associate Professor to start in January 2023. He is a graduate of the University of Illinois at Urbana-Champaign. He was hired to direct the Ion Beam Materials Laboratory. He spent the last 18 years at Sandia National Laboratory as a Principal Member of the Technical Staff – CINT Scientist. His research includes elucidating the response of microstructures to overlapping extreme conditions via combinations of in situ electron microscopy techniques and utilizing film growth and ion

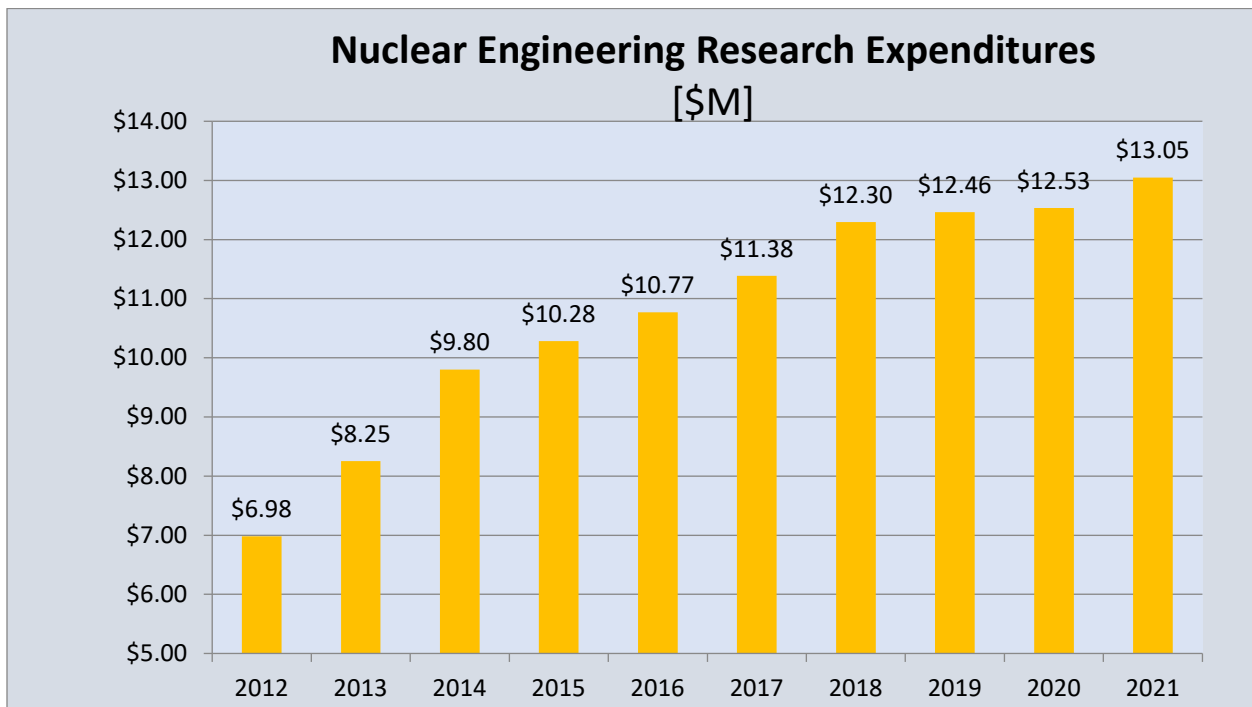
beam modification techniques to produce nanostructured systems with tailored thermal, electrical, and mechanical properties

Of note is that three of the last five faculty hires have been female. This raises our female faculty percentage to 22% which is slightly higher than that of our student body percentage. We have been working for many years to better network with underrepresented groups and we are seeing the results of those programs.

We have also been chosen by the college to move forward with a cluster hire in the area of radioisotopes. The cluster of 3 faculty (Full, Associate, and Assistant) will allow NE to partner with efforts at ORNL and UT-ORII in creating a center for isotope research, development, and production. Efforts are underway to attract businesses into the area that will partner with the isotope center and improve the economic vitality of the region. The mini-cluster hires are expected to fill gaps at UTK and expand our impact throughout the university, providing facilities and capabilities to broaden this scope of research. The U.S. government recognizes the economic benefits of radioisotopes across many applications while also recognizing the need to reduce the nation's dependence on foreign supply of those isotopes. As such, funding for isotopes, radiochemistry, and other related fields is growing and will remain strong.

Research:

Research remains strong and growing. The departmental expenditures have grown to over \$13M per year with funding in a broad spectrum of areas including fuels and materials, fusion, radiation detection and measurement, reactor safety, nuclear security, and radiological sciences.



Facilities:

We began teaching classes in the new Zeanah Engineering Complex on August 18th, 2021 and our faculty, staff, and students moved into the building in November of that year. We have 27 new

laboratories in the \$128M building of which about 50% are complete. We hope to have all labs completed and operational by January of 2023.

The University is making a major investment to develop a world class Ion Beam Materials Laboratory to conduct nationally impactful research. The vision is:

Transform UTK's IBML to one of the best and most impactful facilities in the world competing with MIBL facility at the University of Michigan, IBML at Los Alamos National Lab, the IBL at Sandia National Labs, and the JaNNuS facility at the University of Paris, Orsay, France.

The original investment is near \$4M and the new investment is over \$3.5M. We hired Dr. Khalid Hattar from the Sandia National Laboratory as the director and Miguel Crespillo as the Operations manager. This laboratory will now be under the leadership of Nuclear Engineering.

Accolades:

- UT-Knoxville was chosen to host the 2023 ANS Student conference on April 13-16, 2023.
- Our students continue to win prestigious awards. Some of the last year include:
 - **Reyes Zacarias** won IAEA's Marie Sklodowska-Curie Fellowship
 - **Neal Gaffin and Alexandre Solomon** received Innovations in Nuclear Technology R&D Awards
 - Alum **Micah Folsom** won the Best National Laboratory Collaboration Award at the Defense Nuclear Nonproliferation Research and Development University Program Review
 - **Yan-Ru Lin** was recognized with the American Nuclear Society's Mark Mills Award
 - **Cordell Delzer** was recognized by Nuclear Science and Security Consortium Outstanding Thesis for Radiation Detection
- Our faculty also continue to win prestigious awards and grants. Some of the last year include:
 - **Dr. Livia Casali** was selected for DOE Early Career Award, named ITER Scientist Fellow for Fusion Research, and was selected for NRC Faculty Development Grant
 - **Dr. Belle Upadhyaya** received the Engineering Asset Management Lifetime Achievement Award
 - **Dr. Steve Zinkle** received Minerals, Metals and Materials Society (TMS) Leadership Award
 - **Nick Brown, Ivan Maldonado, and Ondrej Chvala** won an Office of Science Grant to Advance Fusion
 - **Nick Brown, Giovanni Pastore, Jamie Coble, and Brian Wirth** received \$3.2M in NEUP Awards in FY22 and the department has over \$5M in FY23.
 - **Dr. Vlad Sobes** received an NRC Grant for Faculty Development
 - **Dr. Eric Lukosi** won an ARPA-E OPEN Funding to Advance Liquid-Fueled Molten Salt Reactors
 - **Adjunct faculty, Dr. Steven Arndt**, is currently serving as ANS President