Oregon State University
School of Nuclear Science and Engineering
10 Year Review of the Nuclear Engineering Graduate Program
Report of the Nuclear Engineering Review Panel

Overall Recommendation

The panel's recommendation falls somewhere between Maintain and Restructure. The School needs to determine how to maintain and expand their capabilities.

Summary of Findings and Recommendations

The NSE school finds itself in similar situations of most stand-alone nuclear engineering departments at major universities. The business model has changed at research universities, and as a result the percentage of state support of academic programs has dramatically shifted downward. As a consequence, revenue streams to support academic programs are largely driven by formula funding which is based on student enrollment and tuition. Given the demand for nuclear engineers and the number of Nuclear Engineering programs in the U.S., it is difficult to see a way to tremendously increase the enrollment and student-contact hours. The College of Engineering has recognized the contribution of the School of NSE to its reputation and supported the program based upon its research activity and the need for such expertise in the country. Growth in research funding is limited by the number of faculty. Unfortunately, the size of the School may negatively impact the ability of the program to add additional full-time, research-active faculty. The program is faced with difficult choices to find the resources to allow continued growth in research funding while faculty members cover their heavy teaching loads. The School needs to be willing to be innovative as they move into the future. .

Recommendations

1: The goals of the NE graduate program and issues facing the program should be prioritized, an action plan should be developed and faculty members should be assigned to tackle them.

2: Identify and work with support at the College level to identify potential NE applicants from underrepresented groups. Develop and implement a plan for the NE graduate program to increase the recruitment, applications and retention of such students.

3: Work to manage faculty teaching load:

a. Review the curriculum with an eye toward reducing the number of NSE courses that are required at the MS and Ph.D level.

b. Review who teaches undergraduate courses and consider managing the unit's teaching FTE to allow other faculty more time to pursue research.

c. Develop a formal approach to meeting the university's graduate learning outcome on the responsible conduct of research and consider including the University's GRAD 520 course.

4. The lines of communication from the College level to the rank and file faculty in the program should be improved.

5: Rather than physically separating faculty by locating office space in different building on opposite sides of campus, consider physically proximate office locations. If that is not possible, allow faculty to develop acceptable alternatives to suggest to the College of Engineering leadership.

6: The School should consider alternative staffing models and/or funding mechanisms to maintain a high-quality academic program while supporting growth in research while continuing to maintain graduate student satisfaction with their research training

7: Collect data on the job placement of NE graduates on a regular (annual?) basis.

Detailed Findings

Introduction

The Graduate Council and Graduate School at OSU, appointed a team to review the Nuclear Engineering Graduate Program on April 1, 2016. The Review Team included the following: Nolan Hertel (Professor, Nuclear and Radiological Engineering Program, G. W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology), Mitchel Meyer (Director of Characterization and Advanced PIE, Idaho National Laboratory) and Lisa Ganio (Associate Professor College of Forestry, Graduate Council). This review was conducted at the same time as a similar review for the Radiation Health Physics Graduate Program review. The meetings with members of the faculty and students were conducted at the same time, but the programs were reviewed separately. Dr. Jennifer Dennis (Associate Dean Graduate School) hosted the Review Team dinner on the evening of March 31st; this provide an opportunity to meet one another, learn the background associated with review, and share expectations for the evaluation process.

The following morning the team met first with program director Professor David Hamby. This was followed by meetings with Professor Jim Lundy (Exec Associate Dean College of Engineering), the Program Faculty, currently enrolled students in the program and a facilities tour. Once done, the Review Team met in Executive Session to share perspectives on programmatic activities during the past 10 years and the stated perspective of the faculty, students and Dean Lundy. The Review Team prepared a draft of the final report. The completed draft was shared, revised and accepted by all Review Team members prior to submission to Dean Dennis on May 31, 2016.

The NSE department finds itself in a situation similar to most stand-alone nuclear engineering departments at major universities. The business model has changed at universities, resulting in the amount of state support for academic programs dramatically decreasing. Revenues for support of

academic programs are largely driven by a funding formula based on student contact hours. Given the current demand for nuclear engineers and the number of nuclear engineering programs in the U.S., it is difficult to see a way to tremendously increase student-contact hours. Unfortunately, this negatively impacts the ability of the program to add additional full-time, research active faculty at a time when research funding levels and the demand for graduate-level nuclear engineers is healthy. The School of Nuclear Science and Engineering is thus faced with the difficult problem of maintaining high academic standards while growing the College's research portfolio and graduate enrollment in an environment that has faculty hiring constraints. The School needs to be innovative in their approach to this problem as they move into the future.

The faculty feel that their niche is applied engineering and as such offer many hands-on student experiences. The toolset with which students graduate is more tangible than some other graduate programs. The faculty is strongly connected to national laboratories, particularly in the Northwest.

Inputs

Mission

The mission of the Nuclear Engineering program as stated in their 10-year review document is that the "School of Nuclear Science and Engineering provides world-class education so students can become industry, academic, and policy leaders driving the future of nuclear science worldwide." From their review document, to accomplish this mission, the School of NSE has the following five major objectives:

1. To produce graduates with a high level of competency in the Nuclear Engineering and Health Physics core curricula;
2. To produce graduates with a high level of competency in engineering and science;
3. To produce graduates that can work effectively in both individual and team environments;
4. To produce graduates with effective communication skills; and
5. To produce graduates with a high regard for their profession and their responsibility to life-long learning.

The review panel believes that the School is meeting those objectives at present and should continue to do so and that their mission supports the University, Graduate School and College of Engineering missions. That being said, it is apparent that there are challenges that need to be addressed.

The primary goals of the Nuclear Engineering graduate program over the next ten years as stated in the self-study document are:

1. To enhance the academic quality of a diverse student body;
2. To be a national leader in the nuclear science and engineering fields;
3. To increase the population of students at the PhD level;

4. To increase the number of graduate faculty in the School of NSE;
5. To improve the quality of all School facilities; and
6. To sharpen their NSE world-class focus/specialty areas of study

In the self-study document, the School lists the current and future sets of challenges and issues relevant to the nuclear engineering review:

1. Stagnant faculty numbers and the resulting inability to expand research through addressing available funding opportunities, which also impacts their ability to provide adequate external support for graduate students;
2. Challenging growth support for expanding graduate enrollments;
3. Maintaining a high percentage of students receiving research funding;
4. Old office and research space, notably the 40+ year-old double-wide, double-length "temporary" building (Radiation Center E wing);
5. Limited physical space for modern research expansion including both laboratory and office space. Expansion of high-bay and other flexible research areas would allow faculty to expand research and address funding opportunities that are currently limited by space concerns for research facilities, faculty and graduate student offices;
6. Adequate and consistent graduate student financial support (through graduate teaching assistants, graduate research assistants, and graduate fellowships) that would allow them to better compete for top students;
7. Growing staffing needs of the nuclear industry as it ages and expands with the recognition world-wide that nuclear energy will be necessary to aggressively reduce atmospheric carbon emissions thus effectively limiting the impacts of global climate change;

As described below, the faculty is already stretched thinly. The goals and issues listed will be difficult to address effectively without a more structured plan to do so. The list of goals and issues should be prioritized, an action plan developed and faculty be assigned to accomplish them.

Recommendation 1: The goals of the NE graduate program and issues facing the program should be prioritized, an action plan should be developed and faculty members should be assigned to tackle them.

Recruitment and Enrollment Trends

The enrollment and recruitment trends track that of nuclear engineering programs nationally. Compared to other engineering disciplines, it should be kept in mind that the total number of graduate nuclear engineering students nationally is lower than many of the other disciplines found in typical colleges of engineering. The amount of faculty time involved in graduate student admissions seems to be high, but may work well in a small School. The fluctuations in enrollment are typical of a smaller School enrollment.

Admissions Selectivity

The graduate students admitted to the Nuclear Engineering graduate program appear to be of good quality. This is underscored by the research reputation of the School. Without good graduate students, the strong research program found in the School would not have reached its present level. By any measure, student diversity is low but not unexpected in a small program. This presents a challenge to further recruiting without the addition of more faculty members with successful research programs.

Recommendation 2: Identify support at the College level to help with identification of potential NE applicants from underrepresented groups. Develop a plan to increase the recruitment, applications and retention of such students.

Level of Financial Support

The GRA stipends are somewhat lower than at other institutions. However, the cost of living in Corvallis should be of help in this issue. The question is whether potential graduate students are that discerning in their selection of financial aid offers. In recent years, approximately 70-75% of NE graduate students are funded by one form of support or another; the vast majority of those are funded on research projects. A challenge faced by all engineering programs is the requirement that grants and contracts cover tuition remission. The cost of rising tuition is pushing the fully burdened cost of funding one graduate student to the levels that at some other universities faculty are beginning to consider funding a post-doc instead of a GRA since productivity would be higher and costs about the same. So this is not a problem unique to the OSU School of NSE.

Curriculum

The curriculum is strong and typical of graduate nuclear engineering programs nationwide. However, it may be a good time to fully review the curriculum and reduce the number of NSE courses that are required at the MS and PhD level. There are a number of elective courses that are not taught because there aren't faculty members available to teach them. This is often disappointing to students. Although this is a review of the graduate program, in a school of this size, the undergraduate teaching load pays a strong role in the ability to expand and grow the graduate program. Compared to other research universities, the teaching load of the faculty members is on the high side and it is commendable that they still maintain a very strong research program. One of the School's greatest needs is teaching resources in some form to free up the heavily burdened faculty. There are four people in the Radiation Center that help with teaching. The School should consider:

- If more use can be made of the local nuclear engineering professionals to cover many of the undergraduate courses.
- Redefining the faculty to include members who are solely committed to the teaching side of the endeavor, particularly the undergraduate curriculum. The use of 5-year contracted instructors or lecturers is an idea that some universities are now employing to free up the research active faculty member from spending too much time in the classroom.

- Should this discussion include the use of non-tenure-track research faculty?

The ethics training offered by the School is not formal and depends on research advisors to cover material one-on-one with their students. Students were unable to remember any specific topics that their advisors had covered in one-on-one meetings. A more formal approach of meeting the university's graduate learning outcome on the responsible and ethical conduct of research either through existing OSU course work, or more formal training through the NE program is suggested.

Recommendation 3: Work to manage faculty teaching load:

a. **Review the curriculum with an eye toward reducing the number of NSE courses that are required at the MS and PHD level; remove the listing of elective courses that are rarely taught.**

b. **Review who teaches undergraduate courses and consider managing the unit's teaching FTE to allow other faculty more time to pursue research**

c. **Develop a formal approach to meeting the university's graduate learning outcome on the responsible conduct of research and consider including the University's GRAD 520 course.**

Quality of Personnel

The members of the faculty are well-respected and highly productive. Their research productivity is quite impressive, particularly in light of their high teaching loads. They continue to meet the mission and goals of the department, but the current level of individual effort is likely not sustainable (see recommendation 2). As it now stands, when compared to the load on faculty at other research universities, they might be lured away for equivalent salaries to research universities who offer greatly reduced teaching loads. The faculty members appear to be unified in their goals and vision appear to get along well with each other. The lines of communication from the College level to the rank and file faculty in the program should be improved. The faculty members did not seem to be aware of policy changes and initiatives at the College level that may affect them.

The staff also seems to be very collegial and quite knowledgeable. It appears that they work well together and with the faculty and are strong supporters of the School's mission.

Recommendation 4: The lines of communication from the College level to the rank and file faculty in the program should be improved.

Infrastructure

The School is in need of expanded and better quality space. The Associate Dean indicated that they would be given other office space, but completely across campus in the other College of Engineering buildings (at a distance from the present location). For such a small faculty, having some of its members being physically removed from the main School location likely will generate communication challenges among the faculty as well as meeting a need for improved space.

Recommendation 5: Rather than physically separating faculty by locating office space in different building across campus, consider physically proximate office locations. If that is

not possible, allow faculty to develop acceptable alternatives to suggestion to the College of Engineering leadership.

Productivity

Productivity is high by most academic and research standards. The number of publications being produced is high. The research funding is high and the faculty has national and international reputations for their research. The time to an MS degree if as reported to be just under three years, although questioned by the faculty during the panel visit, is rather long and may impact the number of students willing to stay for a PhD. The PhD output per faculty appears to be low but increasing in recent years as the PhD program has been emphasized more.

The NE graduate students are extremely satisfied with their mentoring and education experiences. They seem to have a great rapport with the faculty and largely find their advisors sensitive to their needs. The interaction between faculty and the students seems very positive on an informal level as well. The School seems to be quite unified.

Recommendation 6: The School should consider alternative staffing models and/or funding mechanisms to maintain a high-quality academic program while supporting growth in research while continuing to maintain graduate student satisfaction with their research training

Outcomes and Impacts

It was not clear that records were readily available on the placement of graduates although many went to national laboratories. No complaints were reported by the students about placement; so placement of graduates appears to be successful. The national rankings of the program place it solidly within the top 30% of all NE programs in the country. The program engages in community activities holding a student family day and tours of the reactor and other facilities. Having the American Nuclear Society President on the OSU faculty should also give additional visibility to an already well known NE program.

Recommendation 7: Collect data on the job placement of NE graduates on a regular (annual?) basis.

Conclusion and Recommendations for Improvement

The panel has provided seven recommendations which are given in Section 2: Summary of Findings and Recommendations.

The School appears to be at a healthy size in light of the demand for graduate nuclear engineers, although accurate placement statistics are lacking. Growth in research funding is limited by the number of faculty. The current university funding model will not support growth in the number of tenure track faculty. The School should consider alternative staffing models and/or funding mechanisms to maintain a high-quality academic program while supporting growth in research. Options such as teaching faculty who operate under a multiyear contracts and research professors are possibilities.

The lines of communication from the College level to the rank and file faculty in the program should be improved. The faculty members did not seem to be aware of policy changes and initiatives at the College level that may affect them.

The panel understands the emphasis of OSU on increasing diversity, although it smaller programs will likely need additional resources to increase it. To grow it, given the numbers of potential applicants, would require one or two faculty members committing to building relationships at undergraduate universities to recruit. As an example, to recruit African-American students, a faculty member should establish a relationship with 3-4 HBCUs and visit them at least yearly for the foreseeable future. In addition, recruiting at the meetings of the National Society of Black Physicists can help to make needed contacts (http://nsbp.org/). Recruiting a young female faculty member will probably help in the recruitment of women into the graduate program.