2006-1877: NUCLEAR ENGINEERING FRESHMAN STUDENT
INITIATIVES—LESSONS FROM NC STATE UNIVERSITY

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Nuclear Engineering
Freshman Student Initiatives:
Lessons from North Carolina State University

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Abstract
Enrollment increases in nuclear engineering programs prompts the need to revisit retention mechanisms to ensure students successfully graduate and learning institutions satisfy the demand for nuclear engineering graduates. How do we improve declaration of major prior to the completion of first year and how do we improve matriculation into the discipline? There needs to be a warm hand over from the recruitment-admission process to departmental retention initiatives. This paper will highlight best practices from NC State’s Nuclear Engineering Department. It is a combination of academic and non-academic practices that builds disciplinary affinity. Discussion will revolve around such topics as freshman student advising, early intervention, professional development and freshman research projects.

Keywords
Nuclear engineering; freshman retention; undergraduate retention

Introduction
National enrollment in nuclear engineering programs has increased significantly—from 625 students in 2000 to 1500 students in 2004. NC State’s Nuclear Engineering program has followed this trend—from a total of 37 undergraduate students in 2000 to 133 students in 2005. Of particular interest in this development have been unmatriculated freshman students. How do we encourage matriculation into nuclear engineering from a common first-year engineering program? What academic and non-academic programs need to be in place to foster an environment of learning, leadership and service in the discipline? Overall, what best practices can be shared to continue, what is being called in the industry, a nuclear renaissance? This paper examines undergraduate freshman initiatives to meet these goals.
The Need for Freshman Student Initiatives

At NC State University, as at other institutions, the first year of any engineering program follows a common curriculum. The nuclear engineering survey course, Introduction to Nuclear Engineering, is not taken until the first semester of the sophomore year. Consequently, it is paramount that unmatriculated nuclear engineering students are engaged with their discipline of choice. In addition, the field has generally been associated with nuclear energy and the challenge is to express the diversity of subject matter in nuclear energy production, and at the same time highlight other applications of the technology. Students express the desire to study engineering and present the necessary aptitude but the first year can be disillusioning to some. Engagement with the proposed discipline major starts the orientation process towards the discipline. It provides a transition from outreach and recruitment to retention initiatives at the college and departmental levels. Incoming students require integration into the nuclear engineering program that provides an introduction to the academic material, in addition to interaction with faculty, staff and current nuclear engineering students. The sooner freshman students make this transition and contribute to the field, the likelihood increases that students will matriculate into the discipline and go on to successfully complete the degree program.

When to Start

Retention initiatives start during the admission process. Once students have committed to joining the department, there needs to be interaction with current students and staff. For example, telecounseling is one means of facilitating the interaction among incoming students, current students and nuclear engineering staff. Prior to or during new student orientation, students interact with the department’s freshman student adviser and student ambassadors. It is an opportunity for incoming students, and parents, to become familiar with the department, its services, facilities, research projects and career trends. In conjunction with the College of Engineering orientation program, the department engages in its own orientation to satisfy these objectives. As important is the introduction of students to the professional society, the American Nuclear Society. Freshman students join the student chapter for their freshman and sophomore years dues-free. They participate in the chapter’s activities, interact with professionals and navigate the nuclear engineering arena.

Retention Programs

As the year proceeds students are invited to attend weekly research seminar series, to participate in the freshman student research program as well as the summer undergraduate research program. The seminar series provides new and current students with nuclear-related lectures by faculty, and by industry representatives. A bold initiative to engage first year students in research work starts in the second semester of their first year through the Freshman Research Program. Students are matched with faculty on specific projects. Past areas dealt with—

- Generation of micro and nano particulates using electrothermal plasma source for structuring and re-structuring material surfaces
- Multi-layer protective coatings as an innovative approach for high level waste drip shields
- Plasma interaction with propellants and spectral analysis
• Radiation effects in silicon solar cells

Students selected for the freshman student research program then present their work at the university’s annual Undergraduate Research Symposium. There is also the opportunity for the freshman research project to continue during the Undergraduate Research Summer Program. Modest honoraria are provided in both instances. Students also participate in the annual American Nuclear Society – Student Conference.

The E101, introduction to engineering, course provides an opportunity to work on a research project with the department’s 1-megawatt PULSTAR research reactor. The project is entitled “A Light Sensitive Monitor for the Measurement of Nuclear Reactor Power”. Students design, manufacture and test a light detection system that operates in the blue spectrum, calibrate their device prior to insertion into the reactor pool, extract a suitable signal from this device, install it on the PULSTAR nuclear reactor and test its capabilities with regard to tracking the reactor power level. Instruction about the reactor and the optical and electronic aspects of the design are provided to students in a technical information session, as well as a project description write-up. In 2005, there were thirteen four-person teams involved in this E101 design project. Related to this E101 class is an information session; students are required to visit three departments. Nuclear engineering sees ninety students on average. And, annually nuclear engineering faculty members teach at least two to three sessions of the class. The results of these efforts have been a clearer understanding by unmatriculated nuclear engineering students and the declaration of intent to major in nuclear engineering by other students.

Advising activities are crucial in the retention endeavor. There are two key advising sessions during the year. These sessions are supplemented by group sessions that speak to career services and scholarships. All freshman students are monitored for performance issues and tutorial services provided by our Alpha Nu Sigma Honors Society members.

Students benefit from field exploration and to this end, there are industrial field trips. In the past, students have visited AREVA, GE’s Global Nuclear Fuels and Progress Energy’s Shearon Harris Nuclear Power Plant. They also engage with industry representatives during the dinner meetings of the American Nuclear Society – Eastern Carolina Section. Opportunities to interact with industry representatives at career sessions occur in conjunction with the Minority Career Fair and the College of Engineering Career Fair. Due to our location and relationship with utilities, major vendors and national laboratories, representatives also visit the department directly to recruit for summer internships and full-time positions.

Service activities assist with retention as well. For example, student ambassadors assist the Director of Outreach Programs with school visits, departmental tours, science fairs, Engineers’ Week programming and university/engineering open houses. It provides an opportunity for students to highlight their experiences and learn from public presentation. Social activities also foster a bond that carries into the classroom and project setting. For instance, the ANS – Student Chapter holds regular meetings and the department sponsors excursions.
Metrics

The results seen have supported the expansion of above mentioned programs and new projects spearheaded by the authors of this paper. On average, for every four to five students lost (that is, transferred to another engineering field or college), nuclear engineering gains an equivalent number as transfers (from other engineering fields, the undeclared designation or external transfer students). Attention to incoming freshman students has resulted in 90% matriculation rates, and continued steady growth in the undergraduate program, as shown in Figure 1.\textsuperscript{6}

Future work will examine other nuclear engineering university programs for discipline specific best practices.

![Figure 1: Nuclear Engineering Undergraduate Student Distribution](image.png)

Bibliography

\textsuperscript{1} Enrollment management discussion can be found in Claire Swann and Stanley E. Henderson (eds.) Handbook for the College Admission Profession. Westport, CT, Greenwood Press, 1998. Particular attention should be paid to Michael Dolence’s article “Strategic Enrollment Management”.

\textsuperscript{2} Gutteridge, John. “Workforce and Education Issues – Meeting Industry Needs” at the 12\textsuperscript{th} International Conference on Nuclear Engineering. April, 2004.


\textsuperscript{4} A common first-year engineering curriculum provides continuity of preparatory subject matter needed for any engineering field.

\textsuperscript{5} Although not matriculated into nuclear engineering, during the admissions process they did identify nuclear engineering as a potential discipline. This indication is coded to their student file for advising purposes. Students
who have been admitted into engineering with no intended major are also coded as such information can be directed to them.

6 A much larger senior class than junior class is indicated in Figure 1. This is primarily the result of students not following the intended curriculum guide over the four years and having a larger number of courses to complete before graduation. Students, based on course credits, may be designated as seniors but haven’t completed all senior courses.