Diversity in nuclear—Issues, initiatives, and improvements

BY LARRY R. FOULKE

Women, African-Americans, Hispanics, and Native Americans are still underrepresented in science and engineering in the United States.

IN THE UNITED STATES, women, African-Americans, Hispanics, and Native Americans continue to be particularly underrepresented in science, engineering, and technology (SET). Studies can be found in the literature and on the Internet[1,2,3] that characterize the issues and provide recommendations for improving the situation. In particular, studies conducted by the Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development show root causes for the difficulties in developing qualified diversity candidates. Some of the commission's findings, published in September 2000, include the following:

1. A serious deficiency in educational resources prevents access to high-quality science and mathematics education for underrepresented minority students.
2. Members of underrepresented groups exit the math and science pipeline in large numbers at various transition points.
3. The public image of scientists, engineers, and technology workers is often both inaccurate and negative.
4. The lack of diversity in SET education and careers is an old dilemma, but economic necessity and workforce deficiencies bring a new urgency to the nation's strategic need to achieve parity in its SET workforce.

The *Census 2000 Special Equal Employment Opportunity (EEO) Tabulation*[2] (see accompanying tables) provides a comprehensive look at the diversity of people in engineering, and in nuclear engineering in particular.

Tables I and II show that there is much to do in the nuclear engineering profession to achieve ethnic and gender diversity in our professional ranks. In every category (except for Caucasian males), the diversity of nuclear engineers is less than that of the engineering profession as a whole, and much less than that of the general population. Some of the reasons for this may be a lack of role models, a lack of focused outreach, a lack of nuclear curricula at historically black universities and other minority-serving colleges and universities, and a lack of positive visibility for nuclear science and technology in communities and secondary schools.

TABLE I: TOTAL OF ALL ENGINEERS – 2000 CENSUS[2]

	Engineers	Caucasian	Hispanic	Black	Asian	Other
Total	3 277 360 (100%)	2 548 315 (77.8%)	123 883 (3.8%)	141 000 (4.3%)	402 770 (12.3%)	11 042 (0.3%)
Male	2 723 091 (83.1%)	2 161 860 (84.8%)	100 530 (81.2%)	97 875 (69.4%)	312 525 (77.6%)	8 678 (78.6%)
Female	554 211 (16.9%)	386 455 (15.2%)	23 353 (18.8%)	43 125 (30.6%)	90 245 (22.4%)	2 364 (21.4%)

TABLE II: TOTAL OF NUCLEAR ENGINEERS – 2000 CENSUS[2]

	Engineers	Caucasian	Hispanic	Black	Asian	Other
Total	8 540 (100%)	7 515 (88.0%)	179 (2.1%)	200 (2.3%)	540 (6.3%)	8 (0.1%)
Male	7 808 (91.4%)	6 975 (92.8%)	135 (75.4%)	120 (60.0%)	490 (90.7%)	4 (50%)
Female	718 (8.4%)	540 (7.2%)	44 (24.6%)	80 (40.0%)	50 (9.3%)	4 (50%)

Diversity in a broader context

Diversity is not limited to issues with underrepresented racial, ethnic, or gender groups in our professional ranks. If diversity is considered in the broader context of Shackelford[4], diversity includes any individual who brings unique perspectives or outlooks to the organization. In that sense, diversity also includes elements of age, geography, skill sets, and experience. If a work organization were made up of only elderly nuclear engineers from University XYZ, it would suffer from a lack of diversity of views and perspectives.

An assessment of the current levels of diversity of the membership of the American Nuclear Society is a useful genesis from which to begin new efforts to achieve a stronger, more diverse community.

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ANS diversity

Observations about the diversity of the ANS membership are as follows:

■ The membership is not diverse geographically. Logically, most ANS members live near a nuclear science and technology facility, be it a nuclear power plant or a government laboratory. Therefore, grass-roots outreach to the nation's population is limited.

■ The number of female professionals and students who are ANS members has been increasing. Data from the four-year period 1999–2003 show that the number of female professionals has increased by 16 percent (4.75 percent to 5.53 percent), and the number of female nuclear engineering students has increased by more than a factor of two (1 percent to 2.1 percent of all members). Women make up over 20 percent of our current Board of Directors (4 of 19), and out of the last five presidents, one was a woman.

■ Like America, ANS is aging, and age diversity is skewed toward the elderly. About 15 percent of ANS full national members are of retirement age (66+), while only about 8 percent are under age 35. The average age, not including students, is 50. While this demographic situation provides ANS with great experience and productivity, the Society suffers from the lack of the fresh thinking of youth and is put in the precarious position of incurring the loss of a large number of members—as well as their experience and knowledge—in a short period of time.

■ ANS currently has about 1100 student members. About one-fourth of student members scheduled to graduate convert to full member status upon graduation. Another fourth extend their education and continue as student members. The other half drop their membership after graduating. Student members are treated well by the Society, with financial support and opportunities to go to national meetings and network with experienced professionals. But upon commencement of their first professional position, it seems that their low seniority often precludes their employers' support of active participation in Society activities. Employers generally send older, more experienced workers to professional meetings and allow them the time to participate in the governance of professional societies. Therefore, young professionals not experiencing strong employer support may drop their professional memberships, resulting in an age gap in Society membership and robbing it of fresh, new perspectives and ideas.

■ While ANS members work in a variety of professions, about 59 percent of the members are employed in four sectors: utilities, consulting, education, and the national laboratories. About 30 percent are employed by other government agencies, private labs, or other industries.

■ An examination of the sectors in which ANS members work shows that the largest group of members (18 percent) comes from nuclear utilities. The next largest group is from education (16 percent), 70 percent of which are students. The education sector and the sector of retirees (10 percent) are growing, while all other sectors (utilities, consultants, national laboratories, manufacturers, and government) are declining.

Historically, ANS membership data have correlated to two key drivers in the nuclear industry—R&D funding and plant construction. When these strong drivers stopped, ANS membership dropped abruptly. Further, university nuclear engineering departments saw major drops in enrollment. Some were consolidated into other engineering departments; some were closed. For several years, few students chose nuclear science and engineering as a career, creating an age gap in both the workforce and ANS membership.

Today, with renewed interest in nuclear power and other applications, the resumption of nuclear R&D, and an influx of students, ANS membership numbers have stabilized. The challenge now is twofold: to ensure that there will be a highly qualified, diverse workforce to replace the generation that is retiring, and to retain retirees as members and mentors to the next generation to bridge the age gap that currently exists.

The Society recognizes these issues regarding membership and its diversity. It is working to understand their impact and has initiatives in place to recruit and retain members. The Society is also keenly aware of the need to help reconstitute the science, engineering, and technology infrastructure of the nation. ANS is doing its part in this endeavor, as illustrated below.

ANS initiatives

ANS has undertaken a number of initiatives that concentrate on a broad context of diversity activities, including the following:

■ Sponsoring workshops for high school, middle school, and elementary school science teachers in which, along with information about nuclear science and technology and their applications in everyday life, they are provided with instruments for demonstrating radioactivity in their classrooms, training in hands-on activities, and ideas for integrating nuclear science into their curricula.

■ Mentoring students in undergraduate and graduate nuclear science and engineering programs.

■ Providing approximately $200 000 in scholarships each year to students enrolled in nuclear science and engineering programs.

■ Seeking and stimulating government support for SET educational programs and university research.

■ Sharing knowledge globally and locally through nine international sections, 34 student sections (two international), more than 50 local sections, and 24 plant branches.

■ Nurturing new nuclear engineering programs. Four new ANS student sections were formed in the past three years, at the University of Nevada at Las Vegas, the U.S. Military Academy at West Point, the University of South Carolina, and South Carolina State University, a historically black university.

■ Providing focused action through the ANS Special Committee on the Nuclear Workforce (now the Committee on Workforce Development in the Education and Training Division).

■ Establishing the ANS Young Members' Group for members under 36.

■ Supporting the North American Young Generation in Nuclear (NA-YGN).

■ Stimulating a balance in gender activity through the Professional Women in ANS Committee.

■ Promoting professional diversity through 18 professional divisions, ranging from Biology and Medicine to Radiation Protection and Shielding to Education and Training, and the Aerospace Nuclear Science and Technology technical group.

■ Issuing the position statement "Diversity in the Nuclear Profession," which was approved by the ANS Board of Directors in June.

■ Expanding the Nuclear Engineering Education for the Disadvantaged (NEED) program.

The NEED program

ANS's NEED program is an important diversity initiative that has been in existence since 1969. The program provides educational and professional assistance to the culturally and economically disadvantaged to encourage their participation in nuclear science and technology. Scholarships are given based on the cultural and economic needs of students pursuing a course of study in nuclear science or engineering.

The NEED program also provides financial support for NEED Grants for Academic Programs (NGAP) and Motivational Grants for precollege school programs. Under the NGAP heading, the ANS NEED program makes awards to institutions with nuclear programs for recruitment activities for women and minorities.

NEED provides Motivational Grants for kindergarten through high school programs. The grants are used for equipment and ma-

terials to teach science and math. The funds also are used for tours to nuclear power plants and other nuclear-related facilities. These grants are available to schools that are culturally or economically disadvantaged.

Is the NEED program making a difference? Yes: ANS has provided almost $500 000 in NEED scholarships to more than 170 recipients since the program began and has continued to expand the funding for NEED scholarships for women and ethnic minorities.

Outreach efforts to educators and students are often made by local ANS section members, and in the case of the Pittsburgh Section (the section I belong to), most of our outreach missionaries to schools are women, and we never pass up a chance to go to the less affluent school districts. The impact of this program can be illustrated by the following excerpt from a statement by a recent scholarship recipient from an underrepresented group:

> When I initially enrolled in college during the summer of 2003, I was always worried about not having enough money to continue my course of study, and my living situation made my outlook towards school very negative. There were many times when I felt the need to delay my education (again) so I would be available to work two full-time jobs to make ends meet. . . . Because of your scholarship, I will continue to take every step towards completing my education. Your support is the light at the end of my tunnel.—*VMP,* April 2004

Early engagement

It's no secret. Engage young folks early, and engage them with hands-on play with science equipment. It's an essential investment. Allowing students to learn science experientially through a hands-on, inquiry-based approach grabs them while they're young and keeps them interested.

This approach, which involves the scientific processes of asking questions, hypothesizing, experimenting, analyzing, and testing, helps students become scientifically literate and develop the important critical thinking skills that will serve them well in tomorrow's world. Supplementing this with classroom visits by professionals, encouragement from teachers to raise interest levels, summer camps for latchkey kids, and adoption of schools by major businesses and professional organizations for "themed" events that match curriculum requirements will raise the degree of interest in science and technology.

The most fertile stage for capturing kids is that age at which a young person recognizes some amazing feat of science—such as space exploration to an outer planet. Such an event probably has the most relevance to a student in middle school, and we want them engaged by that time. It is at this stage in the educational process that the students are exposed to the beyond-basics math and science. Kids need motivation to take on and face the science/technology challenges in middle school. If a student feels technologically deficient at this stage, the student will not take the higher-order math and science in high school (and college). So we must get them early—as early as grade school.

We need to intervene at the age when they first start to understand that there is something called science. The problem, especially with underrepresented groups and young girls, is that science and math at young ages is "not cool." If you can get a peer group thinking that it's cool to excel in science and math and it's cool to get good grades, their interest can be captured.

Danger of disenfranchisement

It is important to emphasize to teachers that they not disenfranchise groups. Girls are sometimes ignored in science and math classes because teachers' perceptions are that girls will not "like" the subject or will not be good in science and math (I have daughters, and I know that's not true). But it's a perception that keeps coming back in high school and in college. Minority kids need to be encouraged to "stick to it" and to not be intimidated or overwhelmed, thus deciding to quit and transfer to something "easier" or less threatening, such as liberal arts.

SET internships are great for high school and college students (not flipping burgers is very important). They provide important skills early in career development, such as being responsible (showing up to work every day), and learning the workings of the workplace, the importance of teamwork, and respect for a job well done. The internship doesn't have to involve complicated technical work, but will provide a flavor of what is being done there.

Doing more

Professional societies can begin by coming together on diversity policy statements such as that proposed by ABET (an accreditation board for college and university programs in applied science, computing, engineering, and technology) and the American Association of Engineering Societies and by cooperating at the local level to promote outreach to underrepresented groups.

ANS can also invite more women and minorities to speak on panels, recognize them for national appointments and fellowships, and find mentors for them while they're young. ANS can promote the development of role models from minority groups, targeted outreach, nuclear programs at minority-serving schools, and positive visibility in communities and schools.

It's important to take into account that being "different" in a group can make an individual shy and introverted. We need to be willing to reach out and exert more effort to get women and minorities to feel included and to participate actively. Let us also recognize that women and minorities may have different motivations, may do many things better, and may simply choose a career path other than science and technology. Let us not strive to reach a 50–50 split of men and women in the SET professions, or proportionate numbers of each ethnic and racial group. Instead, let us strive even more to give equal opportunity to education and let each individual decide whether a career in SET is right for them, based on their own abilities and interests.

Reconstituting the nation's SET population requires the support and commitment of the entire engineering community. It is critical to educate parents, businesses, civic leaders, and the general public about the importance of science literacy and the need for science education reform. While science and technology are subjects of interest to Americans, National Science Foundation research[3] reveals that only 27 percent of Americans understand the nature of scientific inquiry well enough to make informed judgments about such issues as the environment, nuclear power, and scientific discovery.

Nuclear science and technology contribute to improving the quality of life for people around the world. To maintain and extend this quality of life to all diverse groups in the world, we must engage the knowledge and talents of a diverse population and increase the viability of nuclear science and technology as a career option for all individuals.

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