National Organization of Test, Research, and Training Reactors

University Programs – Update and Outlook

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U.S. Department of Energy

September 15, 2005
# University Reactor Infrastructure and Education Assistance Program

<table>
<thead>
<tr>
<th>Category</th>
<th>FY 2004</th>
<th>FY 2005</th>
<th>FY 2006 Request</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matching Grants</td>
<td>$0.8</td>
<td>$1.0</td>
<td>$1.0</td>
</tr>
<tr>
<td>Fellowships/Scholarships</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Includes Minority Awards)</td>
<td>1.2</td>
<td>2.0</td>
<td>2.4</td>
</tr>
<tr>
<td>University Nuclear Infrastructure</td>
<td>15.2</td>
<td>14.7</td>
<td>14.1</td>
</tr>
<tr>
<td>Nuclear Engineering Education Research</td>
<td>5.0</td>
<td>4.9</td>
<td>5.0</td>
</tr>
<tr>
<td>Fellowships/Scholarships - HP</td>
<td>--</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Radiochemistry</td>
<td>0.3</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>Nuclear Engineering Education Opportunities</td>
<td>0.4</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$22.9</strong></td>
<td><strong>$23.5</strong></td>
<td><strong>$24.0</strong></td>
</tr>
</tbody>
</table>
Program Participants

Clemson University
Colorado State University
Georgia Institute of Technology
Howard University*
Idaho State University
Kansas State University
Livingstone College*
Massachusetts Institute of Technology
Morgan State University*
New Mexico State University**
North Carolina State University
Ohio State University
Oregon State University
Pennsylvania State University
Polytechnic University of Puerto Rico**
Prairie View A&M University*
Purdue University
Reed College
Rensselaer Polytechnic Institute
Rhode Island Nuclear Science Center
South Carolina State University*
Texas A&M University
Texas A&M Kingsville**
Tuskegee Institute*
University of Arizona
University of California-Berkeley
University of Cincinnati
University of Florida
University of Illinois
University of Maryland
University of Massachusetts-Lowell
University of Michigan
University of Missouri-Columbia
University of Missouri-Rolla
University of Nevada – Las Vegas
University of New Mexico**
University of South Carolina
University of Tennessee
University of Texas
University of Utah
University of Virginia
University of Wisconsin
Washington State University
Worcester Polytechnic Institute

*U.S. Historically Black Colleges and Universities; **Hispanic Serving Institution
University Reactor Infrastructure and Education Assistance Program – FY 2005

Total $23.5 Million

- INIE: 39%
- NEER: 20%
- Fuel: 13%
- Reactor Sharing: 3%
- Education Outreach: 2%
- Reactor Upgrades: 4%
- Radiochemistry: 1%
- Matching Grants: 4%
- Fellow & Scholars: 9%
- HP Fellow & Scholars: 1%
- Other: 4%
University Reactor Infrastructure and Education Assistance Program

Graph showing DOE Investment ($ in Millions) and Number of Students from 1990 to 2004.

- DOE Investment:
  - Undergraduate Student Enrollment:
  - HBCU/HSI Student Enrollment:

1990: DOE Investment $10 million, Undergraduate Enrollment 49.
1992: HBCU/HSI Student Enrollment 1,450.
2000: Undergraduate Enrollment increases.
2004: HBCU/HSI Student Enrollment increases.
Nuclear Engineering Department Heads Organization (NEDHO)

- Covered 1999/2000 through 2003/2004 academic years
- Nineteen schools responded
- Shows that undergraduate NE enrollment is rising at an annual rate of 23 percent (NE and HP)
- Graduate enrollment rose only 4 percent
- 38 percent of BS conferred students continued their education
- 29 percent of BS grads is unknown – a point of concern
NEDHO

Undergraduate Enrollment

Year

Number of students

- Nuclear Engineering (NE)
- Health Physics (HP)
- Other
- Total
NEDHO
Graduate Enrollment

The bar chart shows the graduate enrollment at NEDHO from 1999-2000 to 2003-2004.

- **Nuclear Engineering (NE)**
- **Health Physics (HP)**
- **Medical Physics (MP)**
- **Other**
- **Total**

The chart indicates a consistent increase in graduate enrollment over the years, with a notable peak in the 2003-2004 academic year.
Survey of Nuclear Engineering Students

Factors Influencing Their Choice of Nuclear Engineering Education
# Information Sources

When you were considering colleges and universities in high school, which sources of information were most important to you? (select up to three)

<table>
<thead>
<tr>
<th>Source</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>College ranking guidebooks/websites</td>
<td>50.9%</td>
</tr>
<tr>
<td>Campus visit</td>
<td>49.5%</td>
</tr>
<tr>
<td>College websites</td>
<td>30.6%</td>
</tr>
<tr>
<td>Parents</td>
<td>27.3%</td>
</tr>
<tr>
<td>Direct mail from colleges</td>
<td>23.1%</td>
</tr>
<tr>
<td>High school teachers</td>
<td>20.8%</td>
</tr>
<tr>
<td>Students (family or friends in college)</td>
<td>19.9%</td>
</tr>
<tr>
<td>High school guidance counselors</td>
<td>13.4%</td>
</tr>
<tr>
<td>Family friends or community members / Other</td>
<td>10.6%</td>
</tr>
<tr>
<td>Brother/Sister or other family</td>
<td>9.3%</td>
</tr>
<tr>
<td>Graduates of the college of your interest</td>
<td>8.3%</td>
</tr>
<tr>
<td>College fairs at high schools</td>
<td>3.2%</td>
</tr>
<tr>
<td>Direct mail from science teachers’ professional assoc.</td>
<td>5.1%</td>
</tr>
<tr>
<td>High school alumni enrolled in college</td>
<td>3.2%</td>
</tr>
</tbody>
</table>
College Choice

When you made your choice of which college or university to attend, which of the following factors were most important in your final decision? (select up to three)

- Availability of a specific major 55.6%
- Quality of undergraduate education 50.0%
- National reputation 48.6%
- Campus size and location 39.8%
- Total cost to attend the institution 36.6%
- Job opportunities/ placement for graduates 23.6%
- Availability of scholarships 20.8%
- High quality faculty 16.2%
- Availability of financial assistance 15.7%
- Student access to faculty 8.8%
- Quality of graduate education 7.9%
- COOP/ Internship opportunities 6.9%
- Strict admissions standards 5.6%
- Other 4.6%
- Avail. of ROTC programs/Parent is an alumnus 3.7%
When Introduced to the Field

- When did you first hear about majors or careers involving nuclear science/engineering/technology or health physics?
  - 8th grade or before: 21.8%
  - 9th grade: 9.3%
  - 10th grade: 11.6%
  - 11th grade: 21.8%
  - 12th grade: 18.1%
  - Freshman in college: 15.3%
  - Sophomore in college: 2.3%

★ M/F difference is significant
How Introduced to the Field

How did you first hear about majors in nuclear science/engineering/technology, or health physics? (select one)

- Other: 18.1%
- High school teacher: 14.8%
- An intro to engineering/physics class: 14.4%
- Toured a nuclear facility, research center or hospital: 6.5%
- A mailing or brochure: 6.0%
- A college open house/information session while in H.S.: 6.0%
- Friend(s) studying nuclear science or engineering: 5.6%
- Family friend or community member: 3.2%
- An open house/information session while in college: 2.3%
- High school counselor: 0.9%
Attraction to the Field

What attracted you most to the field of nuclear science? (select up to three)

- Intellectually stimulating 55.1%
- Attractive salary 47.7%
- Good job opportunities 36.6%
- Challenging career 32.9%
- Work at the forefront of technology 31.9%
- Work in a cool career 28.7%
- Providing clean energy 28.7%
- Good job security 25.5%
- Importance of national energy independence, or national security 21.8%
- Work in a problem-solving environment 19.9%
- Work in a complex career 16.7%
- Rapid job advancement 10.2%
- Other 4.2%
**Expected Area of Work**

In which area of nuclear science/engineering/technology or health physics do you plan to work after your degree/certificate completion?

<table>
<thead>
<tr>
<th>Area</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Power</td>
<td>23.1%</td>
</tr>
<tr>
<td>Research &amp; development</td>
<td>14.8%</td>
</tr>
<tr>
<td>Nuclear medicine</td>
<td>14.4%</td>
</tr>
<tr>
<td>Other</td>
<td>11.6%</td>
</tr>
<tr>
<td>National lab</td>
<td>8.3%</td>
</tr>
<tr>
<td>Military</td>
<td>6.5%</td>
</tr>
<tr>
<td>Academic (university teaching or research)</td>
<td>4.2%</td>
</tr>
<tr>
<td>Nuclear Regulatory Commission</td>
<td>3.2%</td>
</tr>
<tr>
<td>Major Vendor/Architect/Eng. Organization</td>
<td>2.8%</td>
</tr>
<tr>
<td>Department of Energy</td>
<td>2.8%</td>
</tr>
<tr>
<td>Weapons</td>
<td>2.3%</td>
</tr>
<tr>
<td>Waste management or envir. restoration</td>
<td>2.3%</td>
</tr>
<tr>
<td>Consulting</td>
<td>1.4%</td>
</tr>
</tbody>
</table>

**NOTE:** Academic and National Lab may overlap somewhat in terms of work area, and that these students may not be far enough along in their college career to know the options in these two areas.

Also note that Commercial Power and the category “utility” was added together.
Area of Study

Which best describes your area of study in nuclear science?

- Power plant systems and operations  33.8%
- Engineering physics             17.6%
- Plasma, fusion, laser research   13.4%
- Core design                      10.2%
- Radiation protection (medical)   7.4%
- Medical research                7.4%
- Radiation protection (power)     5.1%
So Now We Know More From All These Surveys And Data Collection, What Are We Doing To Implement Programs To Keep The Pipeline Going?
Examples of Outreach Efforts

Harnessed Atom – Pittsburgh Public Schools

University Partnerships

ANS Teacher Workshops

Morgan State Summer Program

Fellowships and Scholarships

Summer Internships for Nuclear and Non-nuclear Students

Formal Survey of NE Students past BS degree (Messer)
The Harnessed Atom
High School Honors Edition

The Harnessed Atom
- Science educational curriculum developed 20 years ago by DOE Office of Nuclear Energy for junior high classrooms
- Includes a Teacher’s Guide, Student Reader, experiments and activities, and a video in mini-CD format (originally a filmstrip)
- Though designed for junior-high age students, it tested successfully on non-science major students through Junior College level
- 10,000 classroom sets produced by DOE
Objective: Redesign 20-year Old Curriculum

- For more advanced students grades 11-12
- Update content and format
- Work with a Public School system to review and validate through Pilot Test of the curriculum
- Field Test a revised edition in regions across the U.S.
- Distribute validated curriculum nationally in partnership with Labs, academic institutions, public and private sectors
The Harnessed Atom
High School Honors Edition

Why we are updating the curriculum

♦ Helps ensure that United States maintains the technical skill base required to support our energy infrastructure

♦ Increases awareness at the pre-college level for students interested in sciences and engineering, including nuclear engineering

♦ Helps high school students make informed choices about college majors and career options

♦ Supports Department of Energy mission to foster education and understanding of energy technologies and options
The Harnessed Atom
High School Honors Edition

What revised Harnessed Atom will accomplish in classrooms

♦ Strengthens teaching of fundamental nuclear science concepts

♦ Provides critical thinking experiences for students

♦ Teaches basic science of energy production, thermodynamics, radiation, nuclear reactions, and nuclear energy

♦ Provides clear, unbiased information on nuclear topics
The Harnessed Atom  
*High School Honors Edition*

This is a partnership where everyone wins

- Strengthens teaching of fundamental nuclear science concepts at the high school level
- Industry and academic institutions benefit because students are better prepared
- Teachers gain valuable teaching resources
- Students gain knowledge of nuclear science, energy technology and of career options that will help them far beyond high school

Electrostatic Fun for Pittsburgh High Schooler at Oak Ridge Science Museum
Harnessed Atom

Status

◆ Pilot tested program in the Pittsburgh Public School System (2004-2005 academic year)
◆ Looking for an additional 3-5 areas to field test H.A. curriculum
◆ Have interest for next field tests from:
  ● North Carolina – Raleigh Area (GE)
  ● Massachusetts (MIT)
  ● Central Virginia (AREVA)
  ● Idaho Falls, Idaho (INL)
  ● Oregon (Oregon State/WNSA)
◆ Funding provided by DOE/private sponsor
◆ All field tests will include facilities/reactor visit
◆ DOE will continue support of school system after initial field test is completed
FY 2005 Efforts

- Support 6 Innovations in Nuclear Infrastructure and Education (INIE) Consortia
- Provide fresh fuel and spent fuel support for university research/training reactors
- Funded 20 University Reactor Instrumentation
- Funded 22 Reactor Sharing support
- Support 18 new and 33 continuing Nuclear Engineering Education Research (NEER) grants
- Funded 25 Matching Grants
- Grant approximately 130 Fellowships/Scholarships/Internships
- Support >35 Teacher Workshops through the American Nuclear Society
- Fund 3-4 Radiochemistry programs
- Fund 7 University Partnership Programs
- Support 4 “new” nuclear engineering schools – SCSU, USC, West Point, UNLV
- Outreach to High School Students – Pittsburgh Public School System and beyond
- Continue survey of students in an effort to determine when, why and how students make career decisions, and how best to market nuclear engineering and science to students
- Begin detailed survey of past and current students to determine numbers, employment, those that remained in nuclear field, etc.
FY 2006 Budget Changes

- Support Junior Faculty research
- Additional support for INIE Consortia
- Increase University partnerships to eight, totaling 17 universities
- Support of health physics and increased fellowship and scholarship support at NE/HP schools
- Increasing focus on reactor conversion activities for plate type and TRIGA university reactors
Summary

- University Program has come a long way, but increased funding is crucial to the future of nuclear engineering and it is by no means assured.
- Enrollments have soared, but may need to rise even more if the country pursues an activist nuclear energy policy.
- Current programs are working well and new initiatives will help sustain infrastructure.
- DOE/NE is committed to the continued growth of nuclear education in the U.S. through outreach programs like the Harnessed Atom to all sectors of the population.
- Congressional support remains strong, but growth will require significant new funding.
- Federal support of nuclear education is under scrutiny.