Supporting University Health Physics Education in a Changing Environment

– The Nuclear Engineering Experience –

Health Physics Society Meeting
Portland, Oregon

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July 10, 2007
University Program (UP) Early Developments

♦ Pre-UP (before 1992)

- Fuel for university reactors – NE
- International Student Exchange Program (ISEP)
- Fellowships/Scholarships – NE, others
- Support for reactor maintenance – Office of Science
### 1992 → Today

University Program Activities Take Hold

<table>
<thead>
<tr>
<th>Year</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>Matching Grants – Commonwealth Edison (Exelon)</td>
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<tr>
<td>Mid 1990’s</td>
<td>Reactor Sharing, Reactor Upgrades, Formal NEHP Program, “Splitting Atoms” video (middle schools)</td>
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<tr>
<td>Late 1990’s</td>
<td>Nuclear Engineering and Education Research (NEER) Program, Radiochemistry</td>
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<tr>
<td>Early 2000’s</td>
<td>University (Minority) Partnerships, Summer Lab Internships, Innovations in Nuclear Infrastructure and Education (INIE), ANS Outreach (teacher workshops), HP Fellows becomes stand-alone program, “Harnessed Atom” Teaching Module (high school)</td>
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<tr>
<td>2006</td>
<td>Junior Faculty Awards</td>
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<td></td>
<td>Video – “Nuclear Engineering – A Fulfilling Career” (high school)</td>
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</tbody>
</table>
# University Program Timeline (Approximations)

<table>
<thead>
<tr>
<th>Year</th>
<th>Fuel Purchased</th>
<th>Radiochemistry</th>
<th>Matching Grants</th>
<th>Junior Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>International Student Exchange Program (ISEP)</td>
<td>NEER</td>
<td>Reactor Sharing</td>
<td>University Partnerships</td>
<td>Video “Recruitment”</td>
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<tr>
<td></td>
<td></td>
<td>Reactor Upgrades</td>
<td>Summer Internships</td>
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<td></td>
<td></td>
<td>Fellows and Scholars</td>
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<tr>
<td></td>
<td></td>
<td>“Splitting Atoms” video</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>HP Fellows (separate program)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>“Harnessed Atom” Module</td>
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Note: Several of these programs had been funded in the Office of Energy Research (now Office of Science), but were dropped due to lack of interest/funding.
Non-Program Factors That Contributed to Broader Support of Nuclear Engineering Education

◆ Formalized Organization of NE Department Chairs (NEDHO)
◆ Formalized Organization of University Reactor Directors (TRTR)
◆ Employing Professional Organization Infrastructure to help communicate message (American Nuclear Society)
◆ Hiring full-time representative with strong Congressional resume to carry the message forward
◆ Engage international community and organizations (IAEA, NEA) in bringing issues (workforce development/manpower shortages) to world stage

◆ Intangibles
  • Having the head of the Office of Nuclear Energy thoroughly engaged in university nuclear engineering support
  • Champion within the sponsoring agency
Enrollments Grew at a Rapid Rate

- Undergraduate
  - 1998-1999: 690
  - 2000-2005: 1520
  - 2005-2006: 1831
  - 2006-2007: 1933

- Graduate
  - 1998-1999: 220
  - 2000-2005: 1092
  - 2005-2006: 1110
  - 2006-2007: 1153
New and Existing States With Participating Universities

Program Participants

Clark/Atlanta
Clemson University
Colorado State University
Georgia Institute of Technology
Idaho State University
Kansas State University
Livingstone College*
Linn State Technical 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**
Three Rivers Community College
Tuskegee Institute*
Virginia Commonwealth University
Virginia Tech
University of Arizona
University of California-Berkeley
University of California-Davis
University of California-Irvine
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 Wisconsin
Washington State University
West Point Military Academy
Wilberforce University*
Worcester Polytechnic Institute

*U.S. Historically Black Colleges and Universities; **Hispanic Serving Institution
Office of Nuclear Energy Assistance to HP

♦ The Office of Nuclear Energy has supported Health Physics Fellowships at approximately 25 percent of the Fellowship Awards each year since the inception of the program in 1982

♦ For the past seven years (2000-06) 33 HP Fellowship Awards have been made
FY 2006/07 – The Train Derails

♦ OMB “PARTS” University Program
  • Performance measures do not “clear” OMB bar
  • OMB declares program’s overall success yet fails it in the area of “outcome” measures

♦ For FY 2007 Congressional add back ($27M) is used by DOE to pay off existing mortgages and begin new “research program” for universities

♦ DOE/NE attempts to embed infrastructure support (fellowships, reactor support, faculty support, etc.) into research initiative (NERI-C)
NE Supports Universities

The transition from a university program budget line item to embedding university research and support within our mission related R&D programs will provide:

- Greater research opportunities for universities while incorporating infrastructure activities
- Increased funding corresponding to increases in NE’s research program areas
## FY 2006-08 University Funding*

<table>
<thead>
<tr>
<th>Program</th>
<th>FY 2006</th>
<th>FY 2007</th>
<th>FY 2008</th>
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<tbody>
<tr>
<td>University Reactor Infrastructure and Education Assistance</td>
<td>26,730</td>
<td>16,547</td>
<td>0</td>
</tr>
<tr>
<td>Research Reactor Infrastructure</td>
<td>0</td>
<td>0</td>
<td>2,947</td>
</tr>
<tr>
<td>R&amp;D Program Funded Research</td>
<td>24,391</td>
<td>38,252</td>
<td>58,572</td>
</tr>
<tr>
<td>Generation IV</td>
<td>6,067</td>
<td>5,463</td>
<td>5,772</td>
</tr>
<tr>
<td>Nuclear Hydrogen Initiative</td>
<td>5,116</td>
<td>4,300</td>
<td>4,300</td>
</tr>
<tr>
<td>Advanced Fuel Cycle Initiative</td>
<td>13,208</td>
<td>24,489</td>
<td>48,500</td>
</tr>
<tr>
<td><strong>Total Funding for Universities</strong></td>
<td><strong>51,121</strong></td>
<td><strong>54,799</strong></td>
<td><strong>61,519</strong></td>
</tr>
</tbody>
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*These actuals and estimates do not include National Laboratory directed funding for universities. Funding within individual programs may vary depending upon the performance of individual program activities. Total funding for Universities is expected to be as shown.
FY 2007 and Beyond

- Introduced new Funding Opportunity Announcement – NERI-C
  - R&D focused (NERI)
  - University Program elements included
  - Provide an opportunity for U.S. Universities to become directly involved in an integrated teaming relationship with DOE/NE
FY 2007 and Beyond (cont.)

♦ Introduced another Funding Opportunity Announcement: **GNEP University Readiness**

  - Provide an opportunity for nuclear schools to prepare themselves to support GNEP R&D programs
  - $4 million total ($100K/per university)
  - One time award
What is Included in NERI-C for Infrastructure/Health Physics

♦ Within NERI-C solicitation (Funding Opportunity Announcement)

• 10 percent of total score must ensure needed university resources are included so world-class research can continue to occur at universities

• Therefore, “proposal should address support in related areas such as radiochemistry and health physics….”
Teaching/Outreach Success: 
*The Harnessed Atom*

**The Original 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
The Harnessed Atom

The Harnessed Atom’s Success

- Used by over 1.5 million students and translated into at least 4 foreign languages
- Recommended or promoted by leading teacher associations – NSTA, ASCD, NEA
- Called “the gold standard” in nuclear educational material by ANS PA staff
- Widely reprinted by utilities, school systems, private sector, and other countries
The Harnessed Atom

What teachers told us

♦ Students are being short-changed on essential information about nuclear science, health physics, and engineering

♦ In major textbooks, still presented inaccurately or in biased language

♦ Often skimmed over or not taught at all in high school physics classes

♦ Many teachers feel ill-prepared to teach topic, and do not have good classroom materials

♦ Need a high school version

Typical high school physics does not include nuclear science

- One Dimensional Motion
- Projectile Motion
- Forces
- Momentum
- Work-Energy
- Planetary Motion
- Electricity
- Magnetism
- Waves (water, sound, light)
- Optics
- Relativity
The Harnessed Atom
High School Honors Edition

Now, a Re-designed High School Curriculum . . .

♦ For advanced students grades 11-12
♦ Updated content and format
♦ Worked with public schools to review and validate through Pilot Test of the curriculum
♦ ’07-’08 Field Testing a revised edition in regions across the U.S.
♦ Next: Distribute curriculum nationally in partnership with Labs, academic institutions, public and private sector
The Harnessed Atom
High School Honors Edition

The Curriculum . . .

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

♦ 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
This partnership is important

♦ Connects public school educators, professional societies, DOE, research facilities, and private sector to strengthen the teaching of nuclear science

♦ Helps students to become informed decision-makers on energy issues and policy as they become adult citizens

♦ Perhaps most importantly: expands students’ awareness of choices for college majors that they might overlook, including exciting career options in the health physics, nuclear energy, nuclear medicine, research, and engineering
3) Atoms and Isotopes
4) Radiation
5) Nuclear Reactions
6) Nuclear power
7) Nuclear By-products and Waste
8) Assessing Risk

Experiments with radioactive material
- Geiger counters
- Background radiation
- Sources--gas light mantles, uranium ore

MOST IMPORTANT LESSON –
These materials can be handled safely
Walking around Penn State after the tour of the reactor

Ben was extremely excited and said “Mr. Iasella, you’ve messed everything up! I was planning to travel, take off from school, but this stuff is really cool. I want to know how it all works! I never would have thought I would have liked physics in the beginning of school.”

Teachers don’t know what topics would light a fire for individual students

These 2 students are going into the nuclear field

Without this unit, they would never have considered it

2 out of 70 at Schenley High School

Seems small? Typically only 2-5 would even consider engineering or science.
Lessons Learned

- Organization is needed at the “Society” level with defined objectives and programs
- Federal sponsor and champion are important for long-term support
- Frequent interaction with political process by society members, university professors, and Congressional “lobbyist” working together with a uniform message is essential
- Constantly demonstrate and communicate the overall societal need and positives of health physics discipline
- Start with a few modest program requests and gradually build into a dynamic, constantly innovating program
Summary

♦ University Nuclear Engineering Support Program, built steadily, achieved success and is now “evolving”
♦ Administration’s desire to support universities via NE mission-related research is a current political reality that could change in a year or two
♦ Much skepticism in NE community – many prefer NE education programs of the past decade since the perception is that infrastructure, not research, is at risk with revised approach
♦ FY 2008 will be a pivotal year as Congress debates the best way to support nuclear engineering at universities
  • House has funding for NRC ($15M)
  • Senate has funding for DOE ($15M)
  • Outcome? – No one can predict