Oregon State University OSU College of Engineering

Department of
Nuclear Engineering
& Radiation Health Physics

Report of the Nuclear Energy Research Advisory Committee Nuclear Power Engineering Curriculum Task Force

April 7, 2004

Task Force Members

- Andrew C. Klein, Chair, Oregon State University
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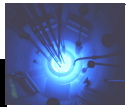
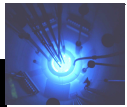
- Gilbert Brown, University of Massachusetts, Lowell
- Harold Ray, Southern California Edison
- Eugene S. Grecheck, Dominion Energy



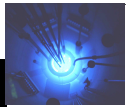
Primary Concern Expressed

- Nuclear engineering curricula had changed over recent times
- No longer producing engineers with training optimal to the needs of the power industry



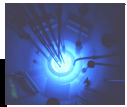
NE Request to NERAC

Form a task force composed of current and former nuclear utility executives and university nuclear engineering professors to discuss and assess this concern



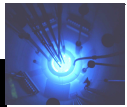
Process Followed

- Request undergraduate curricula from all NE departments
  - Current, and
  - Second half of the 1980's
- Responses from 14 schools with an excellent distribution
  - Geographically
  - Program size
  - From all corners of the U.S.
  - All respondents maintain accreditation of their undergraduate nuclear engineering programs through the ABET.



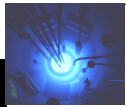
Process, continued

- Task Force members conducted the initial analysis of the curricula independently
- Met in November 2003 to discuss individual findings and direction for further analysis
- Write draft report
- Circulated draft report to universities (NEDHO) and industry (EPRI, NEI, INPO, ANS, others) for comment
- Write final report



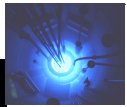
Schools Responding

Massachusetts Institute of Technology
North Carolina State University
Oregon State University
Rensselear Polytechnic Institute
Texas A&M University
University of California, Berkeley
University of Florida
University of Illinois at Urbana-Champaign
University of Massachusetts, Lowell
University of Michigan
University of Missouri, Rolla
University of New Mexico
University of Tennessee
University of Wisconsin



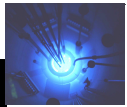
Undergrad Curricula Contents

- All begin with general and basic fundamentals
- Followed by general engineering science
- Finished up with specific nuclear engineering discipline subjects
- All consistent with ABET criteria



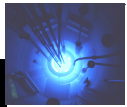
General Content

- Advanced mathematics through differential equations
- Physical sciences in chemistry and physics
- English composition, public speaking, humanities and social sciences
- Some curricula include additional content in areas such as computer programming, numerical methods



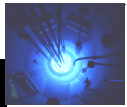
Engineering Science Content

- All curricula include fundamental engineering science
  - statics, dynamics, mechanics, materials, economics, thermodynamics, fluid mechanics, and heat transfer
- Many curricula include additional content
  - electrical fundamentals, control systems and engineering graphics.



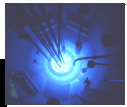
Nuclear Specific Content

- All curricula included content with specialization in the nuclear engineering discipline.
  - atomic and nuclear physics, laboratory classes to measure radiation and radioactivity, interactions of radiation with matter, radiation protection, reactor physics and theory, reactor thermal hydraulics, nuclear engineering design.
- Most also include nuclear reactor laboratories.
- Because of the variety of faculty interests curricula also include more depth of coverage in topics
  - reactor engineering, systems engineering, fuel management, reactor safety, fuel cycles, nuclear materials, nuclear waste management, risk assessment, applied radiation protection, radiation transport, fusion and other diverse topics.



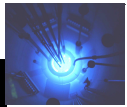
Conclusions

- #1: The nuclear engineering curricula at the U.S. universities have not changed considerably over the past 15 years and are adequate and appropriate to support the needs of the broad nuclear industry.
- It is the observation of the Task Force that the curricula are now stronger, even in the power area, since students are doing more in their first two years of study based on their better math skills, and because faculty are connecting with students early in their programs in order to keep them involved in the nuclear engineering degree programs.
- Furthermore, the ABET accreditation process supports continuous improvement with input from various constituencies, including the nuclear power sector, and has had a positive effect on strengthening these programs.



Conclusions

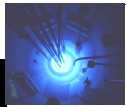
- #2: It is impractical to attempt to establish an "optimal" educational curriculum for all "nuclear engineers" since there is a wide range of needs within the nuclear industry.
- #3: There is no need for a direct role for the US Department of Energy in formulating undergraduate nuclear engineering curricula.
- #4: The one area that could be improved in the education of nuclear engineers is the development of practical engineering work experience and the individual practical skills appropriate nuclear power venues.



Recommendations

- #1: The Task Force recommends that the university nuclear engineering programs consider including at least one practical work experience opportunity in all of their undergraduate programs. It also encourages the nuclear industry to make numerous opportunities available for all undergraduates studying nuclear engineering in the country.

- #2: All components of the nuclear industry should become closely involved in the undergraduate curricula development at universities through their active participation on departmental advisory committees and boards. This also supports the ABET "continuous improvement" requirements.



Recommendations

- #3: All components of the nuclear industry are encouraged to directly support the research programs at universities to develop faculty who will work on industry specific research problems and involve students with industrial interests.

- #4: All components of the nuclear industry are encouraged to support faculty members with research projects, including summer and internship work experiences and sabbatical opportunities for faculty.