Multidisciplinary Educational Approaches for the "Renaissance" Engineer

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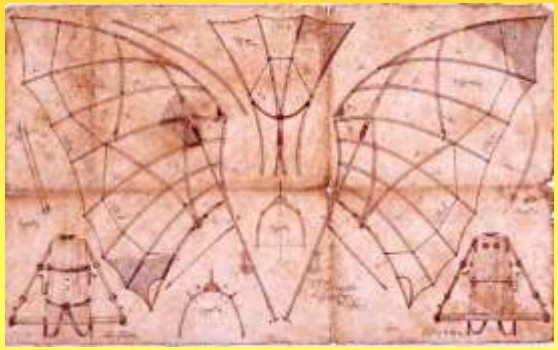
U.S. Women In Nuclear Region II Conference

February 6-9, 2011

Overview of "Renaissance" Education

Changing Global Environment



Demand for Multidisciplinary Education

Domestic and International Emphasis

Unique Role of Domestic Facilities

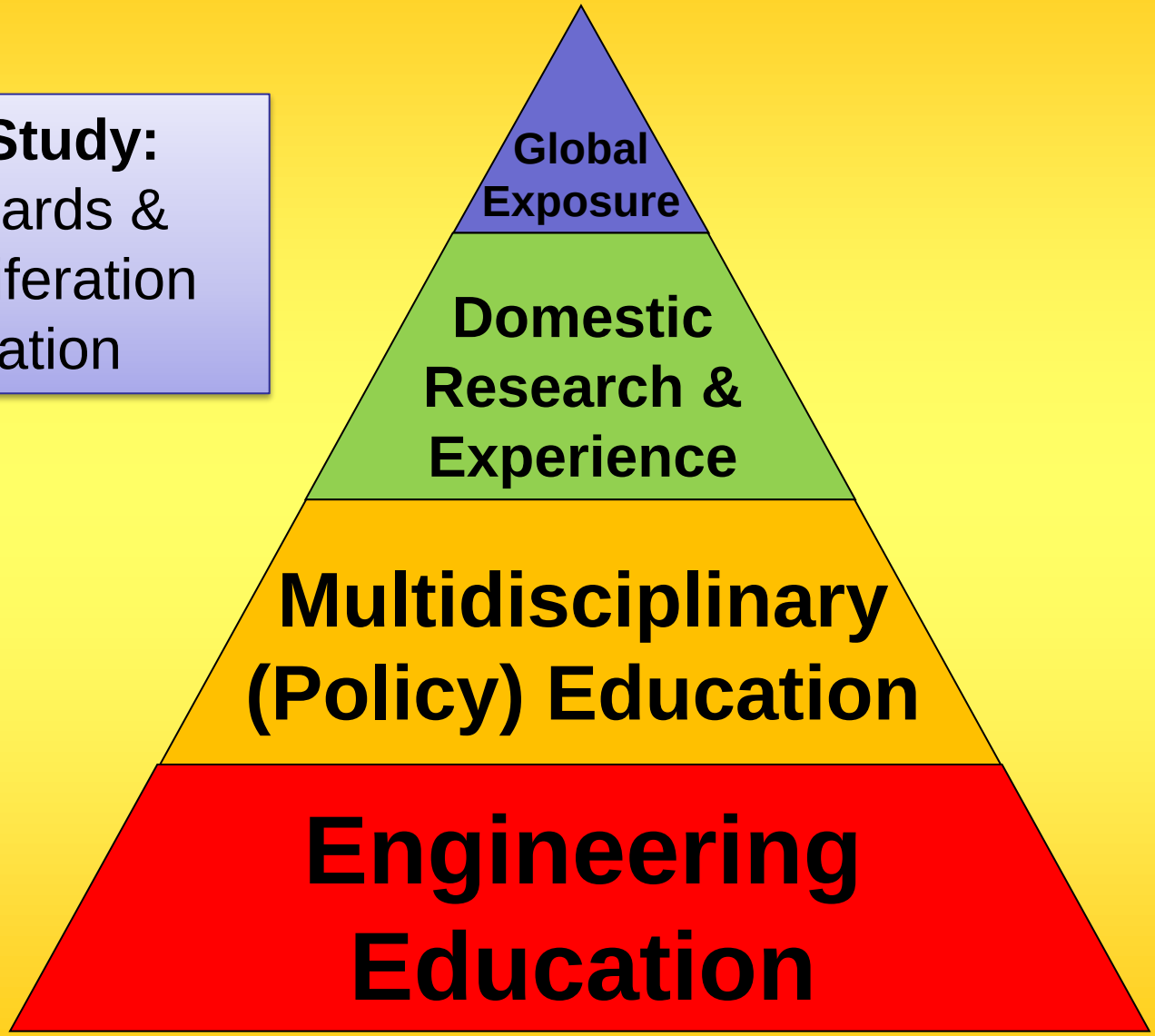
Recruitment and Retention

Introduction

- Nuclear Engineering Programs are growing rapidly given increased domestic interest in nuclear power
- Seek to establish a **strong academic curriculum in the nuclear fuel cycle, waste management and nonproliferation** with particular emphasis on the **technical and policy challenges**
- Address the need for students to have a **multidisciplinary** understanding of the future nuclear power expansion in the **United States & globally**
  - Energy security, waste management, proliferation concerns
- Become **globally aware** engineers

Making a "Renaissance" Nuclear Engineer

Case Study:
Safeguards & Nonproliferation Education



I – Safeguards/Nonproliferation Engineering Education

NRE 4803: Nuclear Safeguards & Security in the 21st Century

- 1. Fuel Cycle (with emphasis on material flow and quantities)
- 2. Future Directions for Nuclear Power
- 3. The Evolution of International Safeguards
- 4. Highly Enriched Uranium Fuel
- 5. Nuclear Proliferation (including some history)
- 6. Nuclear Energy: The International Dimension
- 7. Nuclear Power and the Weapons Threat – Links, Potential
- 8. Nuclear Weapons Basics (Brief Review of atomic bombs)
- 9. Nuclear Material Measurement Technologies
- 10. International Safeguards Inspection
- 11. Nuclear Weapons and Strategy
- 12. Safeguards for Plutonium Processing

II – Multidisciplinary/Policy Education

INTA 8000 : *Seminar on Science Technology, and International Affairs*

- 10 Sam Nunn Security Fellows
  - 8 Pre-docs
  - 2 Faculty
- 8 Schools from 3 Colleges
- + 3 INTA Grad Students

III – Domestic Facilities & Research

Georgia Tech Spring 2010 NUCLEAR SAFEGUARDS & SECURITY IN THE 21ST CENTURY

ORNL Safeguards Laboratory

III – Domestic Facilities & Research (2)

ORNL NESLS Program (2010)

- Student Tours
- Student Seminar Series
- Student Bellefonte Tour
- Student Poster Session
- Student Participation at 51st INMM Meeting

IV– International Experience

- ***NRE 8803 – Fall 2009***

  NUCLEAR TECHNOLOGY, ENERGY & POLICY
  - **Georgia Tech – Lorraine Campus, Metz, France**
  - **Nuclear technology & policy for engineering students**
  - **Policy-relevant topics**
    - **Proliferation of Nuclear Weapons and Evolution of Safeguards & NPT**
    - **"Global Zero"**
    - **Nuclear Renaissance: Balancing Nuclear Energy and Security**
    - **EDF Cattenom Reactor Field Trip**

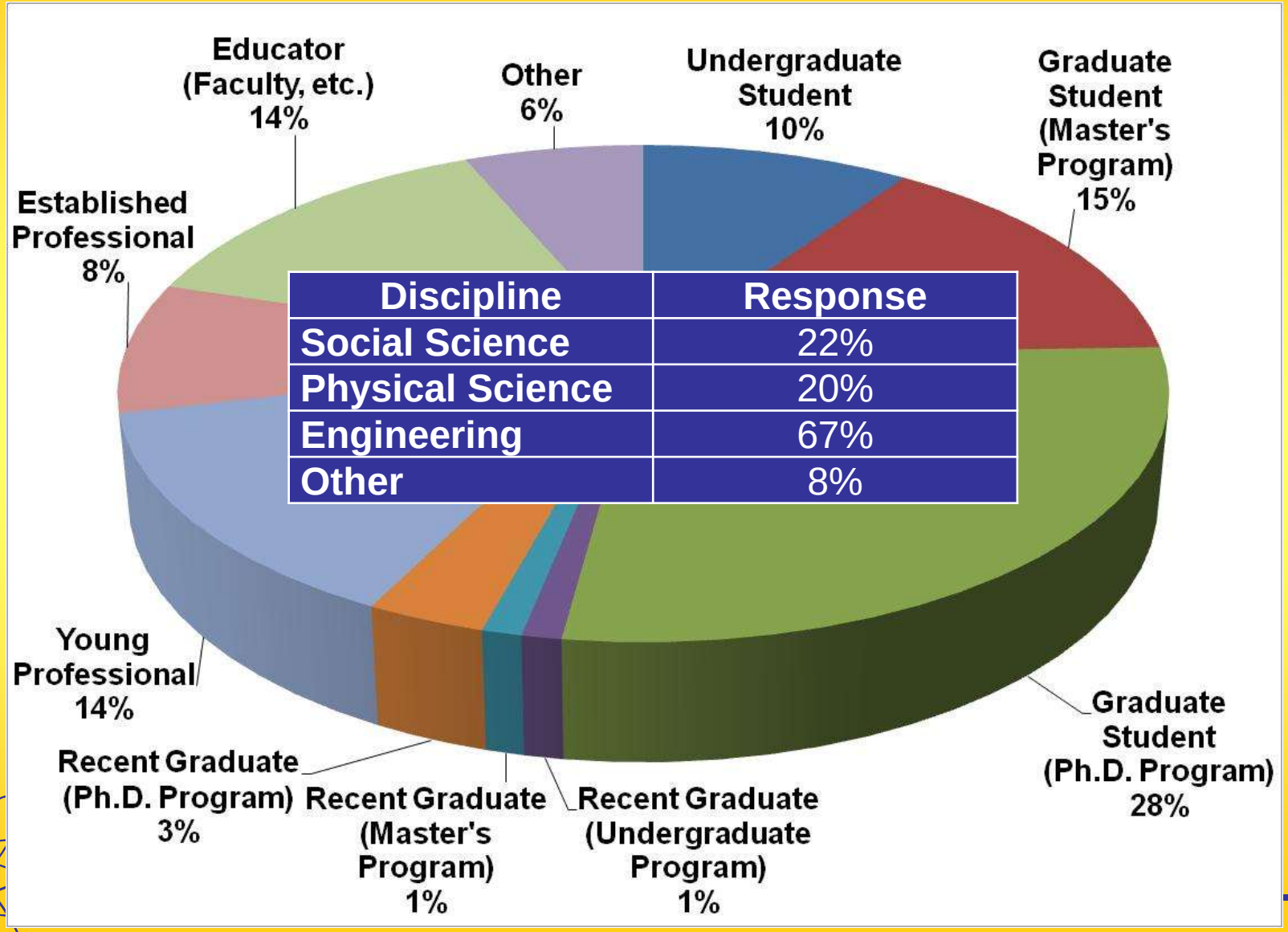
V - Recruitment & Retention

Safeguards & Nonproliferation Education Survey (*July 2010*)

- **Target:** *Students/Recent Graduates/Young Professionals*
- **Running tally:** *95 (presently 179)*
- **32 Questions**
  - **1-Respondent Background**
  - **2-Safeguards & Nonproliferation Background**
  - **3-Assessing Safeguards/Nonproliferation Program Structures**
  - **4-Program Technical Curricula**
  - **5-Instruction and Audience**
  - **6-Pedagogical Approaches**
  - **7-Demographics**

V - Recruitment & Retention

Part 1: Respondent Background



Discipline	Response
Social Science	22%
Physical Science	20%
Engineering	67%
Other	8%

V - Recruitment & Retention

Part 2: Safeguards & Nonproliferation Background

Sources of Safeguards/Nonproliferation Education

	Response
University (normal course)	44%
University-sponsored program	14%
National Laboratory	42%
Non-Governmental Organization	7%
International Organization (Specify)	5%
N/A	12%
Other	16%

V - Recruitment & Retention
Part 2: Safeguards & Nonproliferation Background

- **Laboratory-Affiliated Courses & Internships:** PNNL, BNL (NNSS), LANL, MIIS/CNS/LLNL, ORNL Safeguards Laboratory

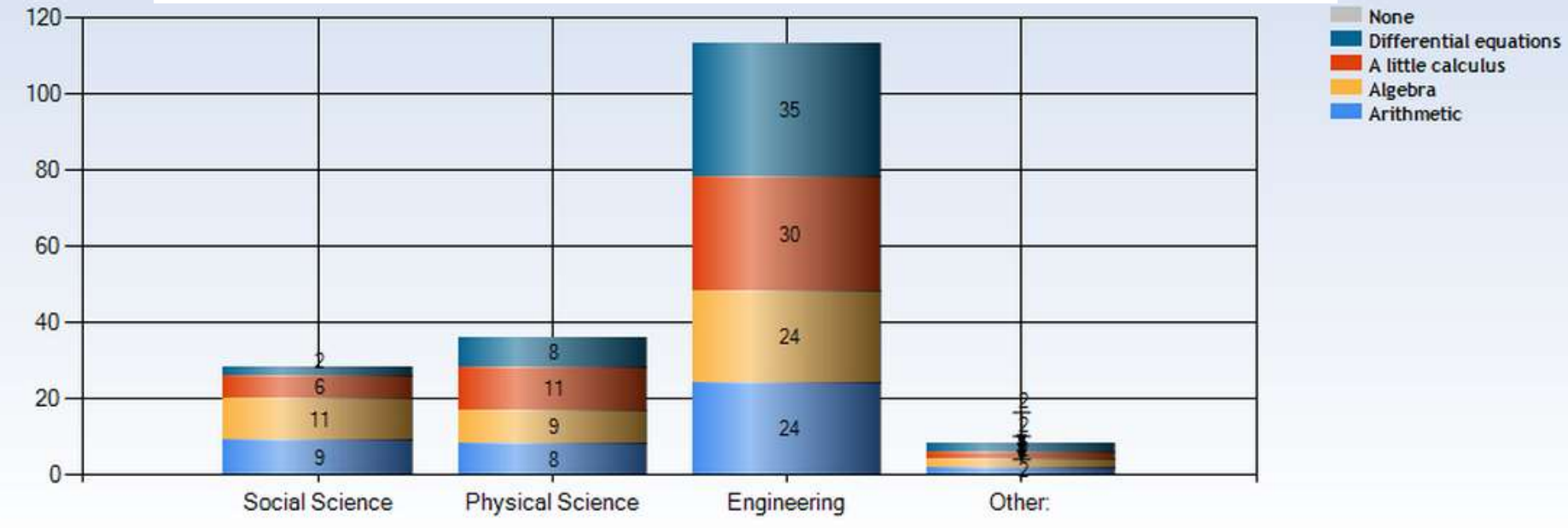
- **University Programs:** IGCC-Public Policy & Nuclear Threats; MIIS

- **International Experience:** IAEA; World Nuclear University

V - Recruitment & Retention

Part 3: Assessing Program Structures

What level of mathematics would you feel comfortable with in a safeguards/nonproliferation course? Check all that apply.



Action Item: Start putting social science students in the training labs with the engineering students.

1-Develop technical aptitude
2-Exposure to facilities
3-Communication

V - Recruitment & Retention
Recommendations

What speaks loudest:

- **Recruitment**
  - Semester-long courses (basis)
  - Supplemented with laboratory & industry programs (course supplementation/research)
  - Accessibility & funding for opportunities
  - Too many cooks…
- **Retention**
  - Sharing experience
  - Follow-up to programs
  - Professional society involvement

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