

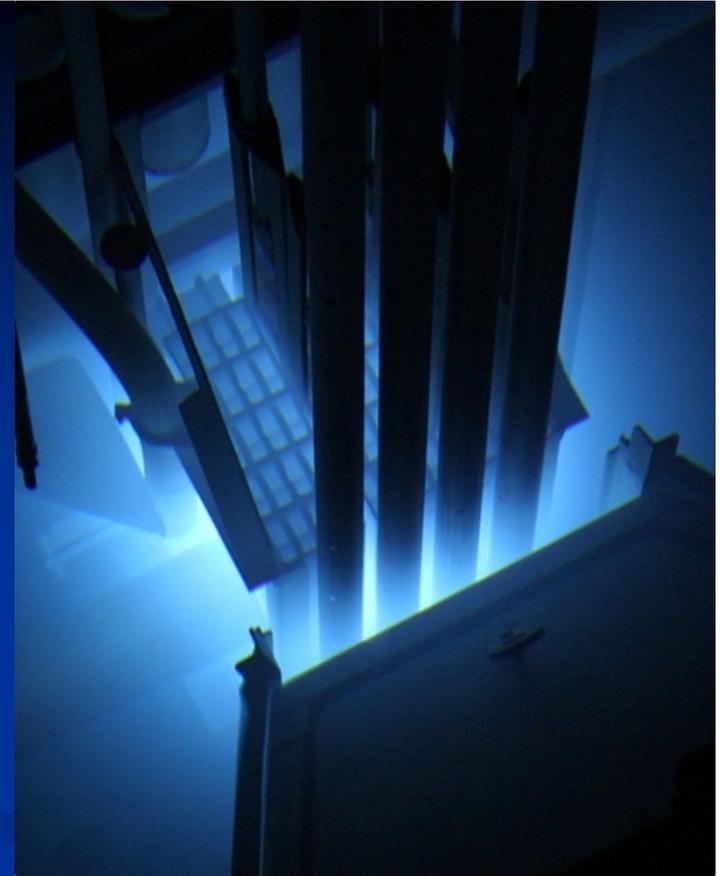
# Activities/Initiatives in Nuclear Security Studies at NCSU

July 20, 2010

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# NCSU NE Department - Past

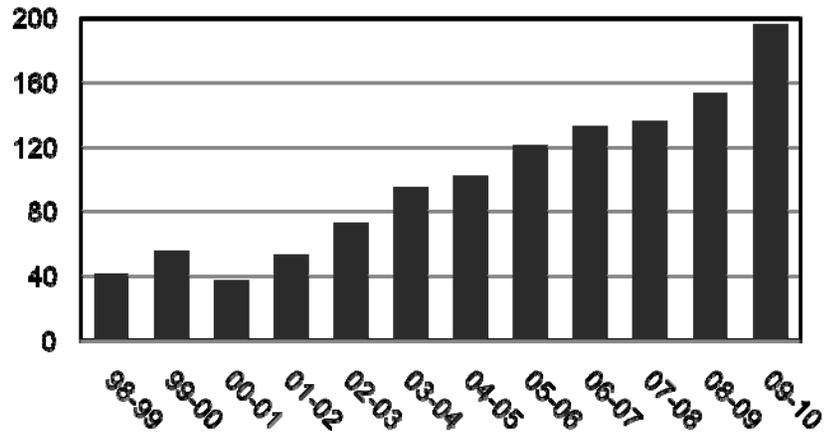
- First NE grad degrees/NCSU reactor ~1950
  - MS & PhD in Nuclear Engineering established in Physics Dept.
  - First batch of MS awarded in 1952
  - Two PhDs awarded in 1955
- Department of Nuclear Engineering, 1962
  - Rapid growth from 4 to 9 NE faculty by 1965
  - Emphasis areas: Fission power reactors & radiation applications
- 1 MW PULSTAR operational, 1973
- Masters in Nuclear Engineering (MNE), 1981
- Plasma/fusion graduate track added, 1983
- Radiological engineering graduate track, 1994
- Combined five-year BS/MNE degree, 1994
- Lead on INIE/MUSIC Consortium, 2003-2008
- MNE Option B: Distance Education, 2008

# NCSU NE Department - Present

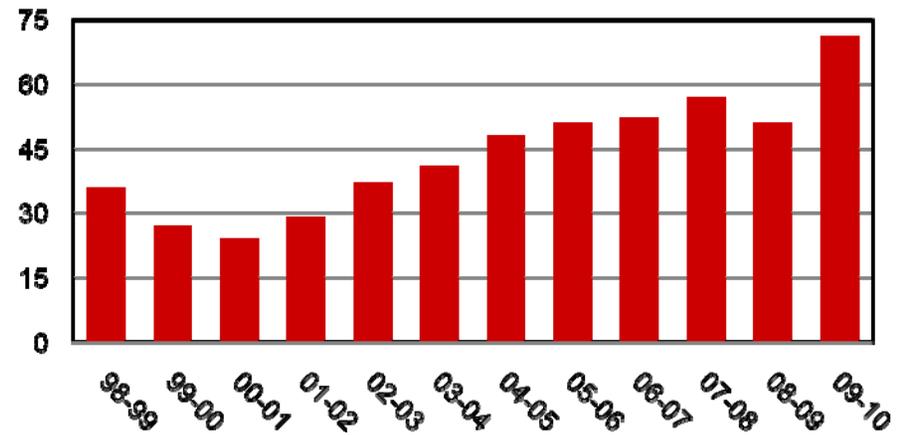
- Faculty grew from 8 (Fall 07) to 14:
  - January 2010: Dan Cacuci joined as Full Professor
  - Additional growth: to 18 by 2014, 2 presently in search
  - 6 Joint Appointments with ORNL/INL
- Students:
  - Enrollment rebounded from bottom in 00/01 to ~72 (G) & 190 (UG)
  - Outreach programs highly successful in recruiting quality students
  - 4 Mark Mills Awards in the last 10 years
- Funding/Infrastructure:
  - Federal research funding (e.g., NEUP - \$5M for next 3 years + base \$3 M/y)
  - Move to new building on Centennial Campus (~5 years?)
  - 2 named Professorships by Progress Energy & Duke Energy
  - Major role in DOE's \$122M NE Modeling & Simulation Hub (\$11M for 5 y):
- Ranked 5<sup>th</sup> & 7<sup>th</sup> in the Nation according to the U.S. News and World Report in 2009 and 2010, respectively.
- Member of the National University Collaborators/Idaho National Laboratory.
- NCSU – a core university in the UT-Battelle Consortium that operates Oak Ridge National Laboratory.
- New activities in nuclear security studies

# Enrolments

## Undergraduate Student Population



## Graduate Student Population



# New Initiatives in Nuclear Security Studies at NCSU

- Collaboration with ORNL/Global Nuclear Security Technology Division
- Collaboration with Triangle Institute of Security Studies
- New course development with support from DOE NNSA
- Establishment of INMM Student Chapter
- New Seminar Series on Engineering, Policy, and Society (College of Engineering & College of Humanities and Social Sciences)

# Collaboration with ORNL in Nuclear Security

- Joint Faculty Appointment (Dr. Yim)
- Graduate students research
  - Border Security/Second Line of Defense
  - Safeguards Effectiveness
  - Proliferation Assessment
  - Currently, five grad students are in direct collaboration with ORNL
- Collaboration in new course development
- Collaboration in international programs for nuclear nonproliferation
  - Collaboration for SHAPE (Summit of Honors on Atoms for Peace and Environment) conference (Dr. Il Soon Hwang, SNU)
  - Nuclear nonproliferation effort in Vietnam

# Triangle Institute of Security Studies (TISS)

- A consortium of Duke, UNC-Chapel Hill, and NC State.
- Affiliated with 3 distinguished HBCU (NC Central, Shaw, and St. Augustine)
- Some 800 members.
- One of the oldest interdisciplinary institutions in the nation (since 1958).
- TISS presents a unique multidisciplinary educational opportunity through their interdisciplinary approach to the problem of national and international security.
- TISS' objective is to advance research and education in the field of national and international security.
- 7-member Executive Committee (Director: Dr. Peter Feaver, *Alexander F. Hehmeyer Professor of Political Science and Public Policy, Duke University*)

# Collaboration with Triangle Institute of Security Studies (TISS)

- Collaboration in new course development (Nuclear Nonproliferation and Safeguards Technology and Policy)
- Collaboration in Nuclear Security Initiative
- Monthly Seminar Series
  - Spring, 2010
    - Dr. Steve Stedman, Director of 'Managing Global Insecurity', Stanford University
    - Dr. Adam Stulberg, Co-Director of Center for International Strategy, Technology, and Policy, Georgia Tech.
    - Dr. John Prados, Director of National Security Archive
  - Fall 2010
    - Dr. Matt Fuhrman, University of South Carolina "Peaceful Nuclear Cooperation."
    - David Schanzer, JD, Center on Terrorism and Homeland Security, "Terrorism and Nuclear Security."
    - Dr. Sean Giovanello, Elon College, "Challenges and Obstacles to Nuclear Arms Control in the United States."
- International Workshop, "Securing our Nuclear Future," Sponsored by Duke Center for International Business Education and Research, September 13-14, 2010.
- Collaboration in other activities in Energy and Security Initiative

# International Workshop, “Securing our Nuclear Future”

Monday, September, 13, 2010, McKimmon Center, NC State	
7:30 am to 8:15 am	Continental Breakfast
8:15 am to 8:30 am	Welcome and Introductions <b>Man-Sung Yim, Bill Boettcher</b>
	Session I: <b>The International Nuclear Landscape</b>
8:30 am to 9:00 am	<b>Mary Alice Hayward,*</b> Director, North American Strategy, Areva, <b>Perspectives of a Multinational Enterprise</b> <b>Charles Ebinger,*</b> Director, Energy Security Initiative, Senior Fellow, Foreign Policy, Brookings: <b>Assessing the Threat in a Global Environment</b>
9:00 am to 10:00 am	Discussion
	Session II: <b>International Solutions - Political</b>
10:10 am to 10:40 am	<b>John F. Ahearne,*</b> Duke University and Sigma Xi, Former Chair of the Committee on the Internationalization of the Civilian Nuclear Fuel Cycle, <b>Multilateral Agreements: Viable and Desirable?</b> <b>J. Christian Kessler,*</b> Senior Advisor, MK Technology, <b>Strategies for Strengthening Non-Proliferation Regimes.</b>
10:40 am to 11:40 am	Discussion
	Session III: <b>Solutions - Technical</b>
12:20 pm to 12:50 pm	<b>Marvin S. Fertel,**</b> President and CEO of the Nuclear Energy Institute <b>Ensuring Security in a Global Environment</b> <b>Carter “Buzz Savage,”* DoE, Proliferation Resistance and Recycling</b>
12:50 pm to 1:50 pm	Discussion
2:00 pm to 3:45 pm	Session IV: <b>Developing a Research/ Education Agenda</b>
3:45 pm to 4:00 pm	<b>Summation and Closing Remarks</b>

# New Course: Nuclear Nonproliferation and Safeguards Technology and Policy

- Offered through DOE NNSA grant (Next Generation Safeguards Initiative)
- Holistic approach to nuclear security and safeguards learning
- Implementation of group projects for policy analysis
- Interactions with subject matter experts
- 1 week field trip to safeguards/detection laboratory at ORNL

# NE591: Nuclear Nonproliferation and Safeguards Technology and Policy - Course Contents

- History of nuclear nonproliferation (1 week)
- Current nuclear nonproliferation regime (1 week)
- Link between nuclear technology and proliferation (1 week)
- Role of technology in nuclear non-proliferation (0.5 week)
- Basic physics and technology of nuclear fuel cycle (1 week)
- International safeguards (2 weeks)
- Materials Control and Accountability
- Physical protection (1 week)
- Nuclear material measurement technologies (1 weeks)
- Irradiated fuel measurements (0.5 week)
- Statistical methods in nuclear nonproliferation (1 week)
- Field trip: Safeguards laboratory training (ORNL) (1 week)
- Proliferation analysis (1 week)
- Role of policy in nuclear nonproliferation (2 week)
- Presentation of case studies (2 weeks)

# NE591: Group Projects

## ■ <Case Study 1>

- Examines the scenarios of nuclear proliferation based on history
  - Pakistan, India, North Korea, Iraq, Iran, Libya, South Korea, Brazil, Argentina, Yugoslavia
- Develop policy lessons for nuclear nonproliferation.

## ■ <Case Study 2>

- Examine the countries of potential nuclear proliferation concerns in the future
  - Syria, Myanmar, Egypt, Turkey, Vietnam, Japan, UAE, Jordan, Indonesia
- Develop recommendations on how the potential proliferation threat of the future can be effectively prevented through the use of technology, policy, and other institutional measures.

# NE591: Invited Subject Matter Experts

Guest instructors	Title/Affiliations	Expertise
William Boettcher	Associate Professor of Political Science and Public Administration, NCSU	Management of risk in foreign policy decision making
Peter Feather	Alexander F. Hehmeyer Professor of Political Science and Public Policy, Duke University	International security and policy, nuclear nonproliferation
George Flanagan	Oak Ridge National Laboratory	Reactor safety and safeguards
Robin Gardner	Professor of Nuclear Engineering and Chemical Engineering, NCSU	Radiation detection and radioisotope applications
Dyrk Greenhalgh	Oak Ridge National Laboratory	Physical protection and security
Chuck Goergen	Savannah River Laboratory	Reprocessing operation/safeguards
William Hopwood	Oak Ridge National Laboratory	Nuclear material control/accounting
Mark Laughter	Oak Ridge National Laboratory	Safeguards by design
Steve McGuire	Oak Ridge Y12 Plant	Statistics in safeguards
Mark Nance	Assistant Professor of Political Science and Public Administration, NCSU	International political economy and international organization
John Oakberg	Senior Information Analyst, IAEA (retired)	International safeguards
Alex Roland	Professor of History, Duke University	Military history and the history of technology and nonproliferation
Mike Struett	Assistant Professor of Political Science and Public Administration, NCSU	International politics, international law, and international organizations
Kris Wheaton	Mercyhurst College	Intelligence analysis
Mike Whitaker	Oak Ridge National Laboratory	Safeguards in uranium enrichment

# Nondestructive Assay (NDA) Applications for International Safeguards

(for North Carolina State University)

Oak Ridge National Laboratory

March 15-19, 2010

# Existing NCSU NE Courses related to Nonproliferation

- Nuclear Fuel Cycles (NE 512)
- Radiation Safety and Shielding (NE 504)
- Radiation and Reactor Fundamentals (NE 520)
- Nuclear Waste Management (NE 531)
- Nuclear Nonproliferation and Safeguards Technology and Policy (NE 591)
- Nuclear Laboratory Fundamentals (NE 721)
- Nuclear Reactor Analysis (NE 723)
- Radioisotope Measurement Applications (NE 726)
- Nuclear Engineering Analysis (NE 727)
- Radiation Detection (NE 761)
- Radioisotope Applications (NE 762)

# Current Research Work in Nonproliferation at NCSU

- Development of Accurate and Fast Monte Carlo Spectral Simulation Algorithms For Proliferation Detection (Dr. Gardner)
- Developing an Inverse Approach to Monitoring for Special Nuclear Materials (Drs. Gardner & Abdel-Khalik)
- Innovative Scintillators for Nonproliferation Applications (Dr. Hawari)
- Fuel Cycle Systems Analysis & Proliferation Assessment (Dr. Yim)
- State-Level Proliferation Risk Modeling (Dr. Yim)
- Enhance Reliability and Sustainability of Radiation Portal Monitors (Dr. Yim)
- Enhancing the Effectiveness of Safeguards Inspections (Dr. Yim)

# Student/Faculty Support for Nuclear Nonproliferation/Security Studies

## ■ ORNL Summer Internship

### ■ 2009

- Steven Skutnik (NGSI), David Addington (NGSI), Nicole Sheppard

### ■ 2010

- Brent Beatty (NGSI), David Addington, Ryne Hevener, Paul Thelen

## ■ Research Grants

- Development of Accurate and Fast Monte Carlo Spectral Simulation Algorithms For Proliferation Detection (PI: R P Gardner) , US DOE NNSA, 1/1/09-12/31/12

- Fuel Cycle Systems Analysis & Proliferation Assessment (PI: M.-S. Yim), The Russell Family Foundation, 10/1/07-9/30/2010

- Critical Analysis for Model Selection for Nuclear Proliferation Predictions (PI: M.-S. Yim), US DOE NNSA, 3/1/2010-2/28/2013

## ■ Fellowships

- NRC Fellowship (Ryne Hevener)

### ■ Under consideration

- Nuclear Nonproliferation International Safeguards (NNIS) Graduate Fellowship
- Nuclear Forensics Fellowship

# Future Plans

- Pursue programmatic funding to support graduate students
- Consider Nuclear Security Certificate Program
  - Teach nuclear security technologies to social science/liberal arts students in the Triangle schools (Duke, UNC, NCSU, etc.).
  - Teach public policy, national/international security and defense policy to NE/engineering students.
- Offer Nuclear Security Educational Curriculum through Distance Education