

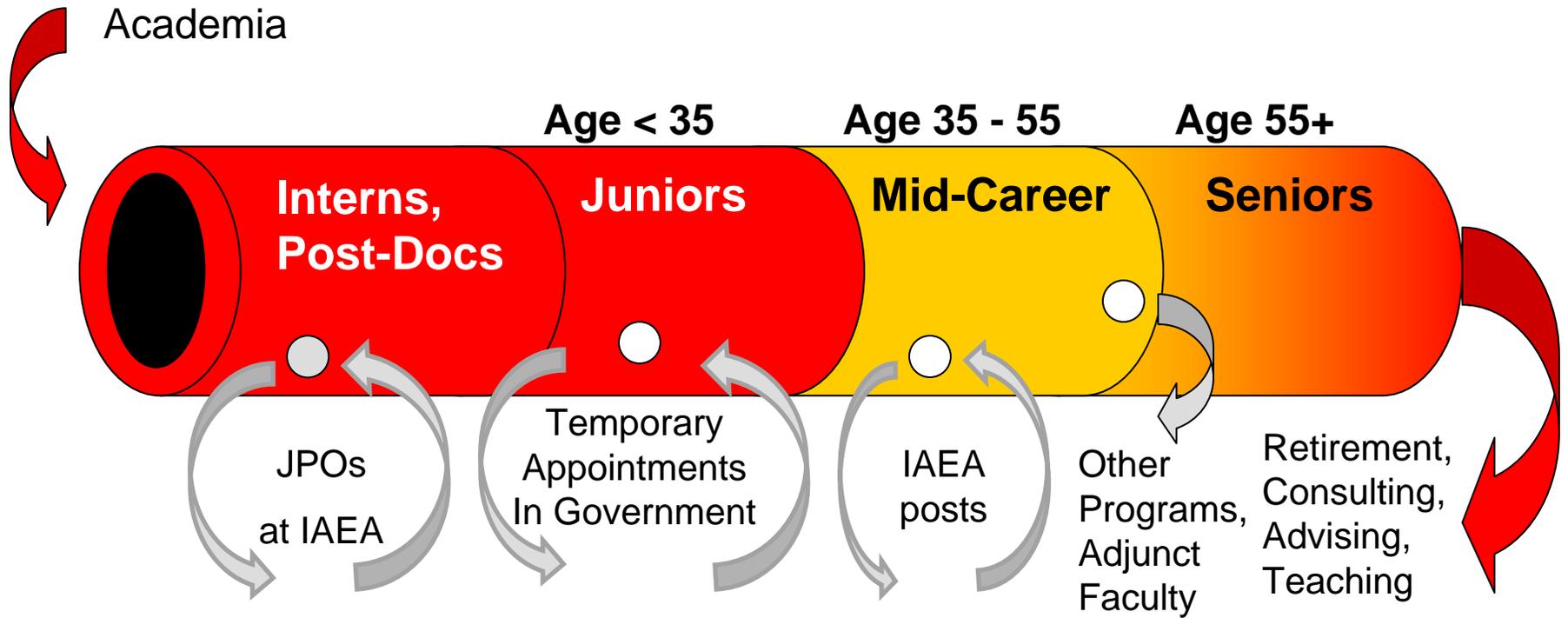
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# PNNL's Approach to Defining, Recruiting, and Developing International Safeguards Specialists

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# Seeing Safeguards as a Career



# Overview of Presentation

- ▶ Identifying the Desired Competencies and Talents (1)
- ▶ Recruiting Model – Connections with Universities (1)
- ▶ Developing Technical - Policy Expertise and Awareness
  - At PNNL through Training and Research (8)
  - At Universities through Course Development and Lecture Series (2)
- ▶ Brief Case Study - Key Elements in University-Lab Partnerships in Nonproliferation & Safeguards Education (7)

# Identifying the Desired Competencies and Skills

# Safeguards Competencies and Priorities

- ▶ PNNL defined “hard to fill” skill sets and created advantageous benefits package for interns & new hires
- ▶ Academic areas include nuclear engineering, radiochemistry, math, physics, EE, ChemE, and various degree combinations (ie., technical plus policy)
- ▶ Recruitment into NGSi internship program focuses on the hard-to-fill plus policy-focused “stars” identified in PNNL-taught courses
- ▶ Integrate academics, competencies and research to ensure each individual sees themselves contributing to the safeguards discipline
  - For example, create a team with a mathematician, nuclear engineer, and international affairs intern to work together on creating a risk-based state evaluation analysis methodology using the nuclear fuel cycle as an organizing framework

# Recruiting Model – Partnerships with Universities

# Recruiting Strategies – Lab-University Partnerships



- ▶ PNNL experts lecture at key universities
  - Michigan, Florida, Oregon State, Ohio State,
  - UW, WSU, etc.
- ▶ PNNL staff teach courses at UW, OSU and WSU
- ▶ PNNL co-directs the IGRSS at UW
- ▶ Continually interacting with students and faculty is the primary means to locate excellent candidates
- ▶ Alumni on staff maintain ties with departments
- ▶ Each technical group identifies needs for contributors to safeguards (interns, post docs, new hires, mid-level, experts)
- ▶ Effectively move people along the career path – with former interns becoming new hires, then mentors, then managers...

# Developing Safeguards Specialists

- 1) Strategic Partners
- 2) PNNL Training
- 3) University Courses

# PNNL's Strategic Partners in Teaching Safeguards

## ► Universities

- Recruit students into relevant academic and graduate programs
- Introduce the topic of safeguards through course modules, guest lectures, fliers, brochures
- Assist with identifying good candidates for internships, post docs
- Support research collaborations in safeguards, to offer students thesis research opportunities and funding
- Develop lab space and equipment for safeguards education and research, including reactors, NDA equipment, radiochemistry labs, etc.

## ► Industry (Areva, ENW)

- Introduce students to operation-scale nuclear plants
- Demonstrate safeguards, security and safety systems first-hand
- Assist with research by allowing measurements of material, test deployment of non-intrusive systems, offering pragmatic advice

# Strategic Partnerships (cont)

## ▶ DOE Facility Stewards

- Historical facilities useful to educate on U.S. nuclear program evolution (ie., B-Reactor, T Plant, 300 Area)
- Shutdown facilities may support training, exercises, demonstrations (FMEF)
- Assist with preservation of material, systems, for use in research or training (ie., FFTF database of materials tests, archived fuels)
- Active facilities such as Hammer, CETE, INL's PP testbed, HFIR, play a crucial role in training students and providing a platform for research

## ▶ Professional Societies (INMM, ANS, WINS)

- Facilitate networking, recruiting, and communications
- Offer a forum for publication and learning about on-going research
- Provide opportunity for leadership and service for students and professionals alike
- Encourage exchange between retirees, staff and students
- Preserve and transfer institutional knowledge

# Teaching Safeguards – a Challenge!

- ▶ Teaching to a diverse group is challenging – students range from very technical post-docs, to well educated nonproliferation policy graduate students
- ▶ Used TAMU’s web-based modules to familiarize policy students with nuclear basics
- ▶ Identified the need to use a similar approach with technical students – read the NPT and receive a safeguards overview
- ▶ Considering “team teaching” – policy students teach intro to safeguards; technical students teach intro to nuclear radiation and fuel cycle
- ▶ Use a combination of web-based learning, lectures, hands-on exercises, and facility tours to reinforce learning objectives
- ▶ Repetition of important topics is crucial
- ▶ Course precedes most of the INL-LLNL lectures, which helps understanding



# Safeguards Course - Learning Objectives

- ▶ **40 hours – 2 facility exercises take 8 hours from that**
  - B Reactor, HAMMER NDA exercises
- ▶ **Learning Objectives adapted from ESARDA course**
- ▶ **Introduction:** The evolution of the Non Proliferation Treaty -regime, safeguards, international control regimes in theory and practice, and present trends in the nuclear nonproliferation efforts.
- ▶ **What is safeguarded and why:** Definition of nuclear material that is subject to nuclear safeguards and related safeguards goals (significant quantity, timeliness and detection probabilities).
- ▶ **Where is it found:** Description of the nuclear fuel cycle from mining to final repository, focusing on enrichment in the front-end and reprocessing in the back-end.
- ▶ **Which legal obligations control its use:** Overview on international and regional Non-Proliferation Treaties and established Institutions and Organizations.

# Safeguards Course Syllabus (cont)

- ▶ **What is the methodology to verify legal use:** Safeguards approaches and verification methods, accountancy and material balance evaluation, national safeguards and physical protection.
- ▶ **How are inspections performed:** Overview on inspector tools and their use to verify the declared nuclear activities (Non Destructive Assay, Monitoring, Containment/Surveillance); additional safeguards measures under the Additional Protocol (complementary access, satellite imagery, environmental sampling) and how they are applied in field (storage facility, process facility, enrichment facility, research institute, spent fuel transfer).
- ▶ **How is nuclear technology transfer controlled:** Guidelines of the Nuclear Suppliers Group, trigger list and dual-use list. Means to combat illicit trafficking, including nuclear forensics.
- ▶ **How is non-compliance discovered:** Collection of open source data and demonstration of some case studies (Iraq, DPRK, South Africa).

# Course Approach - Participants

- ▶ All NGSi interns and post docs (~25)
- ▶ Other “National Security Interns” interested in safeguards (~10-15)
- ▶ Technical mid-career (early career) transition staff (2-5) funded by NGSi
- ▶ Technical Group Managers, staff, program managers who want to better understand safeguards (observers)
- ▶ 41 students in 2009 (2 courses); 31 students in 2010 (1 course)
- ▶ Lecturers are all PNNL staff + retired consultants
- ▶ Two facilitators – Carrie Mathews & Shirley Johnson (policy + technical)

# Course Approach – Awareness

- ▶ Breakout groups for exercises are designed to include technical & policy, interns & staff, differing expertise
- ▶ Lectures are designed to help participants see how their expertise fits into the subject area
- ▶ Exercises are designed to force interaction and participation, draw out all disciplines, and require critical thinking
- ▶ Developing bonds among the students and creating interest in safeguards and nonproliferation as a career

# Research – a Key Component

- ▶ Designing approaches to research that encourage interdisciplinary teamwork
  - Safeguards Implementation Report team includes nuclear engineers, international affairs, chemistry, mathematics/economics, computer science
  - Process Monitoring team includes radiochemists, chemists, chemical engineers, nuclear engineers
- ▶ Difficult to do for mentors – requires close coordination and diligent monitoring/oversight
- ▶ Future need – booklet of thesis research areas; problems requiring attention in the safeguards domain

# Teaching Safeguards at Universities

- ▶ PNNL focuses on 3 universities
  - WSU – Radiochemistry, Materials Science
  - OSU – Nuclear Science and Engineering
  - UW – International Studies (Nonproliferation Certificate)
- ▶ WSU – PNNL developed and taught Introduction to Nuclear Safeguards course in Fall 2008, 400-level, 3-credit Special Topics course (may be repeated in 2011)
- ▶ OSU – Seminar Course (required for grad students) on Nuclear Nonproliferation and Disarmament – targeted Public Policy graduate students and Nuclear Engineering undergrad and grad (will be repeated in Fall, new topic)

# Teaching Safeguards at Universities (cont)

- ▶ University of Washington
  - Institute of Global and Regional Security Studies
  - Located in the Jackson School of International Studies
- ▶ New Course in Spring 2010
  - “Nuclear Energy, Nonproliferation, & International Safeguards”
- ▶ Students: 12 (400 level) 3 (500 level)
- ▶ Evaluation
  - The class was well attended and received, with students confirming demonstrated interest in the course material and enthusiasm for learning the nonproliferation and safeguards topics covered in the course evaluations.
  - Students found the 3 simulation exercises that complemented lecture materials to be particularly helpful in understanding the various safeguards systems.

# Brief Case Study on PNNL-UW Partnership

# Key Elements in Curriculum Development

- Inspiration and Vision
- Faculty and Lab Champions
- Top-Down Legitimacy
- Link to External Sources of Expertise (Often a National Laboratory)
- Funding (External or the Redirection of Internal Resources at the University)
- Eclectic or Creative Organizational Model

# Institute for Global and Regional Security Studies (IGRSS)

- ▶ Policy Program
- ▶ Located at the University of Washington
- ▶ Partnership between University of Washington (UW) and Pacific Northwest National Laboratory (PNNL)
- ▶ Now in its tenth year
- ▶ Mission: Create a nonproliferation curriculum to prepare undergraduate and graduate students to become key personnel for government, NGOs, universities, etc.

# IGRSS Start-up

## ▶ Genesis of Idea

- James Fuller, PNNL (Transitioned Leadership to Mark Leek)
- Responding to Changes in Post-Cold War Security Environment
- Graying of Laboratory Workforce

## ▶ Institutional Partnership

- University Champion—Christopher Jones
- Receptive Administration
- Necessity of Bringing Outside Funding to University

# Faculty Recruitment

- ▶ Faculty Recruited from Outside the University
  - Value of UW/PNNL Partnership in attracting world class scholars and practitioners
  - Development of Co-Instructor Model (one PNNL, one UW)
  - Emphasis on Practitioners from Government and Scientific Community

# Curriculum Development

- ▶ Paradigm for teaching based on the international studies focus of the Jackson School of International Studies
  - Global Nonproliferation as a historical process
  - Scientific/Technical foundations geared to policy-oriented students
  - Nonproliferation as a policy objective of United States and other global powers
  
- ▶ Six core courses in Nonproliferation
  - International Law and Arms Control (Graham)
  - Model UN (Jones)
  - Controlling Nuclear Technology (Kessler)
  - Safeguarding Nuclear Material (Seward/Kessler)
  - Verification Technologies (Fuller)
  - Russian Experience in Nuclear Material Protection, Control and Accounting (Sosnin)

# Course Highlights

- ▶ **Negotiation Simulation (Model UN)**
  - Negotiation of a Weapons Free Zone in the Middle East
  - Negotiating Iraq: Establishing Peace & Security
- ▶ Students are broken into delegations to negotiate in a mock- UN type setting
- ▶ Each group is given a set of goals for their particular state
- ▶ They work for in close consultation with their respective “heads of state” (played by the instructors)
  - **Nuclear Energy, Nonproliferation, & International Safeguards**
  - Exercises designed to help students think about the safeguards options and misuse options under each agreement (66, 153, 540)
  - Frequent submittal of papers and one lengthy report

# Outcomes of PNNL-UW Partnership

- ▶ Nonproliferation Certificate option for IGRSS students
- ▶ Technical subjects addressed in a policy degree program
- ▶ UW has continuous access to PNNL experts
- ▶ UW students created an INMM Chapter
- ▶ 2-3 UW interns employed at PNNL each year, many hired
- ▶ Strong pipeline into NGFP also
- ▶ UW introducing a Nonproliferation PhD program in Fall 2011
- ▶ This program has formed the foundation of international education outreach – MEPhi, TPU, Fudan, Tsinghua, Seoul National University

# Conclusions Based on IGRSS Case

- ▶ An appeal from outside the university to begin a new program in nonproliferation must be accompanied by a commitment of external funding
- ▶ A faculty champion and a laboratory champion (with funding) are both critical to the program's success
- ▶ Given the specialized nature of nonproliferation, it is probable that the interest and commitment from an outside source will come from a national laboratory
- ▶ The nonproliferation technical/policy hybrid all but demands that a policy-oriented school acquire the expertise required to develop new courses from outside