Overview of DOE Southwest Regional Innovation Forum and UNM NE Department

New Mexico Legislature Committee on Radioactive and Hazardous Materials Meeting

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UNM Rotunda Room

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Talk outline

- Overview of DOE Southwest Regional Innovation Forum
  - Outcomes from Nuclear Materials Panel
- Overview of UNM Department of Nuclear Engineering

DOE SW Regional Innovation Forum at UNM

- On July 5th, UNM hosted U.S. Secretary of Energy Ernest Moniz in a regional forum on innovations in clean energy
- Participation from universities and industry in New Mexico, Colorado, Utah, Arizona and Texas, along with Sandia National Laboratories, Los Alamos National Laboratory and the National Renewable Energy Laboratory
- Goal was to explore key challenges for energy in the southwest and how to address them through public-private partnerships
- Focus of forum was on *materials technology* for clean energy
  - Four panels on hydrogen technology, advancements in photovoltaics, electrical energy storage, and advancements in nuclear materials

Materials for Advanced Nuclear Energy Systems Panel

- Moderator: Chris Stanek, NEAMS National Technical Director, Los Alamos National Laboratory

- Panelists:
  - John Wagner, Chief Scientist, Idaho National Laboratory
  - Edward Blandford, Assistant Professor, Nuclear Engineering, University of New Mexico
  - Tiangan Lian, Program Manager, Electric Power Research Institute, Palo Alto, California

Key Takeaways from the Panel

- Materials are eventually limiting in all clean energy technologies and present several cross-cutting research opportunities
- Advances in nuclear fuels and materials can have significant implications on the cost and operations of current reactors, future reactors under development, and critical technologies across the nuclear fuel cycle
- Cost and long timeframe are key barriers to develop, demonstrate and license new materials (for example, it is estimated that 15-25 years are required to qualify nuclear fuel once the fuel form is established)
  - Additional barriers include access to the facilities, data, and capabilities that are required to develop new nuclear fuels and materials; Insufficient investments in the facilities, capabilities, and R&D; and “Stove piping” in federal programs

Key Takeaways from the Panel (cont.)

- There exist several opportunities to eliminate and/or mitigate the barriers and advance the "state of the art" in nuclear fuels and materials:
  - Establish a R&D program(s) and funding that is focused on reducing the cost and duration of materials development, testing, and licensing – one that harnesses both the national intellectual capacity and national physical capabilities.
  - Make nuclear material science capabilities (materials, reactors, hot cells, and advanced instruments) available to a wider range of scientific users at reasonable cost (or no cost). For example, make it easier for universities and industry to access and work with the capabilities and expertise in the national laboratory complex. The GAIN (Gateway for Accelerated Innovation in Nuclear) initiative was recently established with this as a goal.

Key Takeaways from the Panel (cont.)

- Better integration between nuclear materials and fuels modeling and simulation (M&S) with experimental efforts across the complex in order to
  - Reduce nuclear materials RD&D timelines and costs,
  - Enable materials breakthroughs through advanced understanding, and
  - Enable the ability to develop and demonstrate predictive M&S capabilities, which could substantially reduce timelines and costs.
  - A suggested example is to demonstrate the full life-cycle of fuel development with integrated experimental and M&S capabilities (Fuel concept/design - fuel fabrication - fuel irradiation – post-irradiation examination – design refinements – scale-up – repeat and include safety testing) to reduce the estimated 15-25 years to something like 5 years or less.

- Strong potential synergies with other clean energy sectors in materials science such as additive manufacturing and nano-engineered materials developments

Next Steps

- Working with UNM Vice President for Research's Office on report to be issued to DOE
- Suggestions on what elements of a potential regional partnership might look like in materials for clean energy technology R&D

UNM Department of Nuclear Engineering Overview

Department History

- UNM has only Nuclear Engineering Program in the State of New Mexico
  - Ranked 15 in US News & World Report (2014)
- Graduate Program came into existence in 1960 as the Nuclear Laboratory
- Department of Chemical and Nuclear Engineering created in 1972
- Department of Nuclear Engineering formed in 2014
- Academic Program:
  - B.S., M.S., and Ph.D. degrees in *Nuclear Engineering*
  - M.S. NE Concentrations in *Medical Physics* and *Radiation Protection Engineering*

Nuclear Engineering Faculty

Edward Blandford
Assistant Professor

Robert Busch
Principal Lecturer

Gary Cooper
Associate Professor

Cassiano de Oliveira
Professor

Mohamed El-Genk
Regents Professor

Adam Hecht
Associate Professor

Anil K. Prinja
Chair and Professor

Assistant Professors
Osman Anderoglu
and Youho Lee
Fall 2016

Faculty Research Programs

- **Mohamed El-Genk**
  - Neutronics, Thermal-Hydraulics and Safety Analysis of Nuclear Reactors
  - Computational Fluid Dynamic Analyses
  - Molecular Dynamics Simulations of Irradiation Effects on Materials
  - Nuclear Fuel and Reactor Materials
  - Boiling Heat Transfer and Two-Phase Flow
  - Space Nuclear Power and Thermal Propulsion

- **Edward Blandford**
  - Accident Tolerant Fuel (ATF) Thermal-Fluids Performance
  - Fluoride Salt-Cooled High-Temperature Reactor (FHR) Technology
  - Cyber-Security and Physical Protection Strategies for Advanced Passively Safe Non-LWR Reactor Technologies
  - New Safeguards Approaches for Advanced Separations Technologies
  - Radioactive waste management

Faculty Research Programs (cont)

- **Adam Hecht**
  - Radiation Detection and Detector Development for Nuclear Energy and Nonproliferation
    - Fission Fragment Spectrometer (collaboration with SPIDER group at LANSCE_LANL)
    - Thin Film Aluminum Antimonide Radiation Detector
    - Optics Based Detectors for In-core Live Time Neutron Dosimetry
- **Gary Cooper**
  - Development and Analysis of Nuclear Diagnostics on Sandia Z-Machine and LLNL National Ignition Facility
- **Robert Busch**
  - Criticality Safety

Faculty Research Programs (cont.)

- **Cassiano de Oliveira**
  - Nuclear Reactor Physics
  - Multiphysics Simulations
  - Optimization and Data Assimilation
  - Radiation Transport

- **Anil K. Prinja**
  - Theoretical and Numerical Methods in Radiation Transport
  - Stochastic Methods for Uncertainty Quantification (RAVEN)
  - Charged Particle Transport
  - Stochastic Neutron and Gamma Populations Driven by Weak Sources (Passive Interrogation, Naval Reactors)

National Laboratory Interactions

- Historically strong ties with Sandia, LANL and INL
- Multiple modes of interactions
  - Graduate Students
    - Internships and GRA positions - summer and year round
    - Contribute to the manpower pipeline
  - Research
    - Collaborations and research funding for faculty and students
    - Use of national lab experimental facilities
    - Faculty summer positions and sabbatical leave
  - Teaching
    - Distance and online delivery of curriculum
    - Lab Staff are source of Adjunct Faculty
- UNM is one of five members of the National University Consortium (NUC) formed by Battelle Energy Alliance at Idaho National Laboratory (INL)
  - The goal of the NUC is to engage in collaborative research that strengthens the portfolios of INL and the universities, and further the nation's strategic nuclear energy objectives.

Employment for our Grads

- LANL and Sandia are main employers of our graduates
  - Criticality Safety group at LANL heavily populated with UNM NE graduates
- Graduate School – UNM and out-of-state (UCB, MIT, Michigan, Texas A&M, N.C. State)
- Industry
  - Palo Verde, V.C. Summer, Vogtle
  - AREVA, Siemens, GE
- NRC, Bettis, Navy

2020 Vision

- Grow full time faculty size to >10
- identify strategic areas to invest in

- Increase undergraduate size (sophomore to senior) from current mid-40s to 60

- Double fulltime graduate population from current ~20 to >40

- Develop modern, adaptive graduate program that serves the nuclear security community in NM and an evolving nuclear industry

Summary (my thoughts)

- A standalone nuclear engineering department is an essential asset to UNM and the State
- Historically done an excellent job at providing a strong undergraduate education and placing students in strong career opportunities
- Current department stratified (national trend) however recent hires provide important youth to ensure longer term success
- The department can do a better job in engaging the State through appropriate channels
- New Mexico is a terrific place for a nuclear engineering department!