Nuclear Energy University Programs - NEUP

2013 Program and Success Factors

Workshop Webcast

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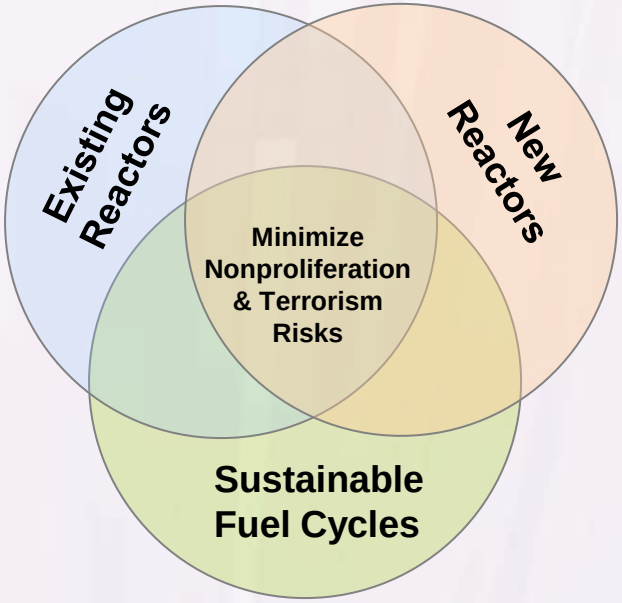
NEUP Mission Supports Roadmap and Implementation Requires Partnership Approach



Engage the U.S. university community to conduct program directed, program supporting, and mission supporting research and development, related infrastructure improvements, and student fellowship and scholarship support to build world class nuclear energy workforce capability as an integral component of the Office of Nuclear Energy.

NEUP Purpose – Develop Workforce and R&D Through Collaborative Partnerships

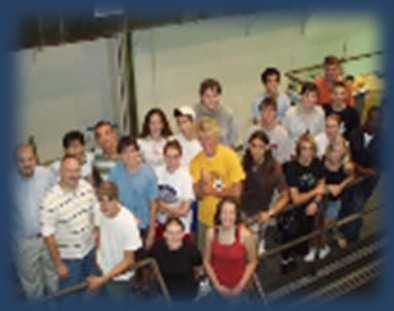
DOE-NE Funding for Universities

- **Up to 20% of the NE R&D budget will be used to support university-based activities**
  - Support for infrastructure, students, and research and development are all components of the NEUP scope
  - Requirement for university cost share has been waived for NEUP
- **Other NE University Investments Outside NEUP**
  - NE funds fuel management support for university-based research reactors
  - National laboratories use NE R&D funds to support specific R&D or support efforts at universities
  - NEET Crosscutting solicitation to develop innovative materials
    - NEET workscopes and solicitations will be closely coordinated with NEUP starting in FY13.

Funding is Program Driven

DOE-NE HQ

Universities



High

DOE-NE Program Drivers

Low

Program Directed Funding

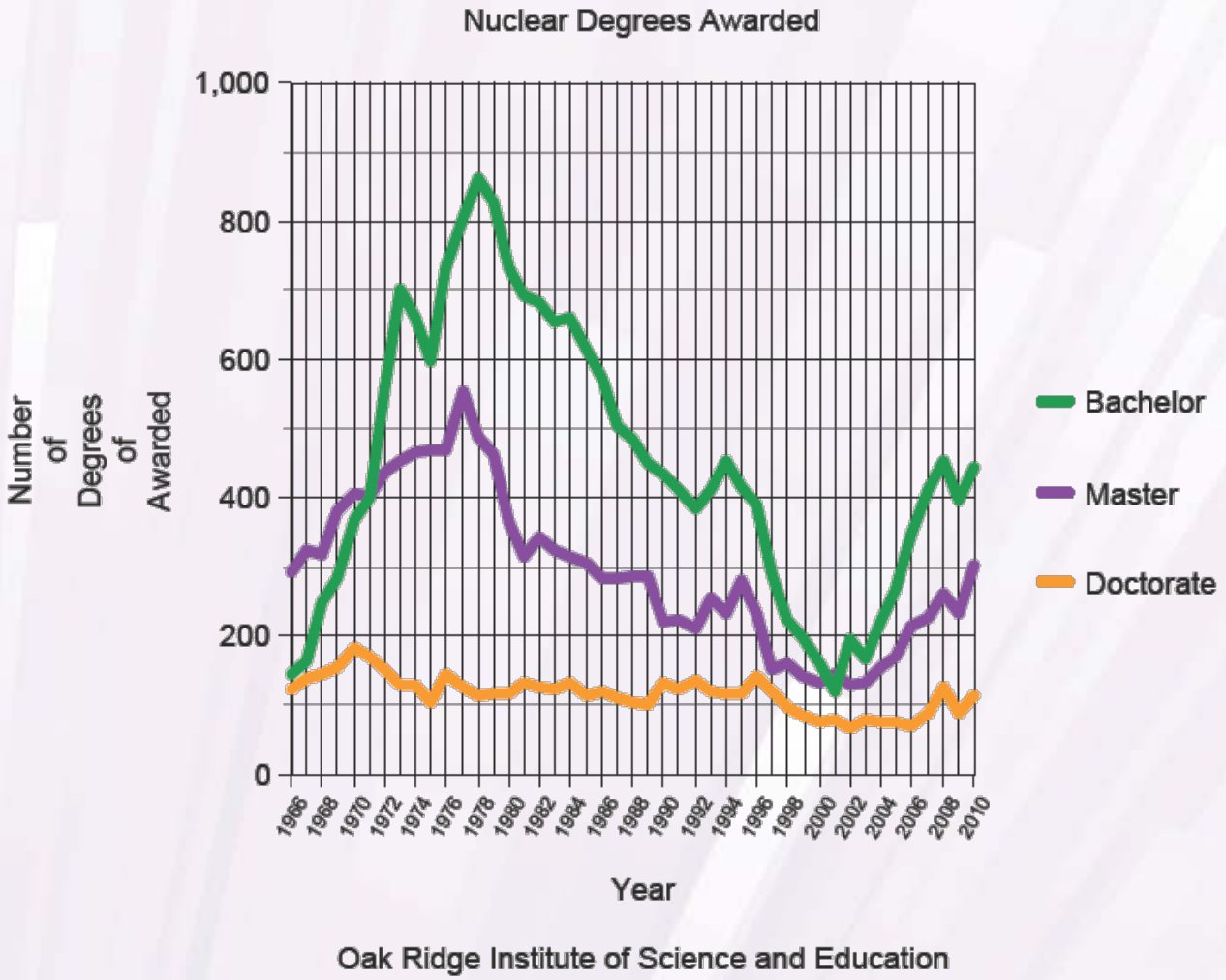
Program Supported Funding

Mission Supported Funding

Relevancy Review

Technical Peer Review

The Nuclear Renaissance is Apparent to Students



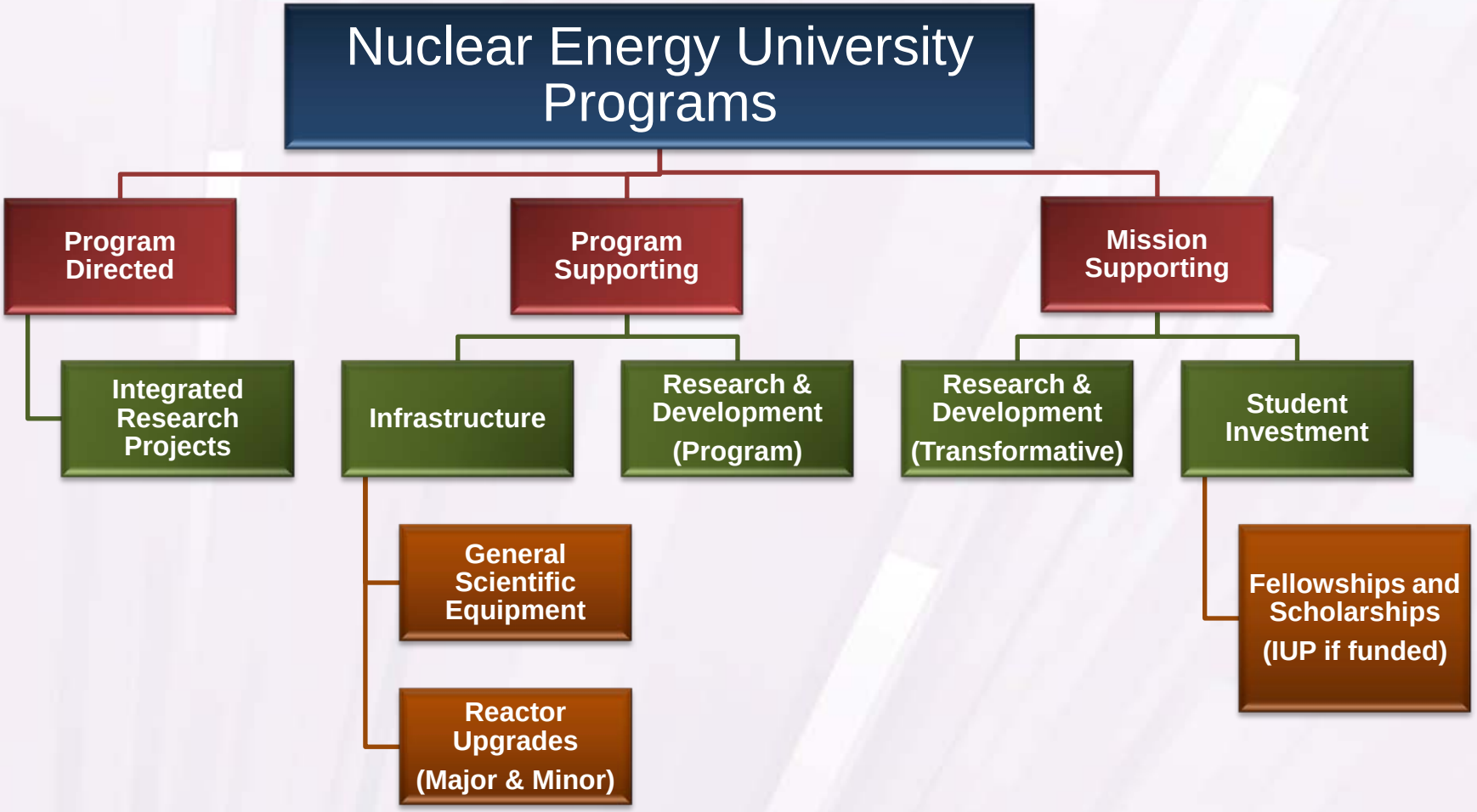
How NEUP Works in 2011-13

NEUP offered four funding opportunities

All Peer Reviewed, Relevancy and Technical

- Research & Development (R&D)
- Integrated Research Projects (IRP)
- Capabilities, Infrastructure & Equipment
- Scholarships & Fellowships (IUP)
  - $155K for Grad Fellowships (3 years)
  - $5K for Scholarships (1 year)

FY 2013 NEUP Structure

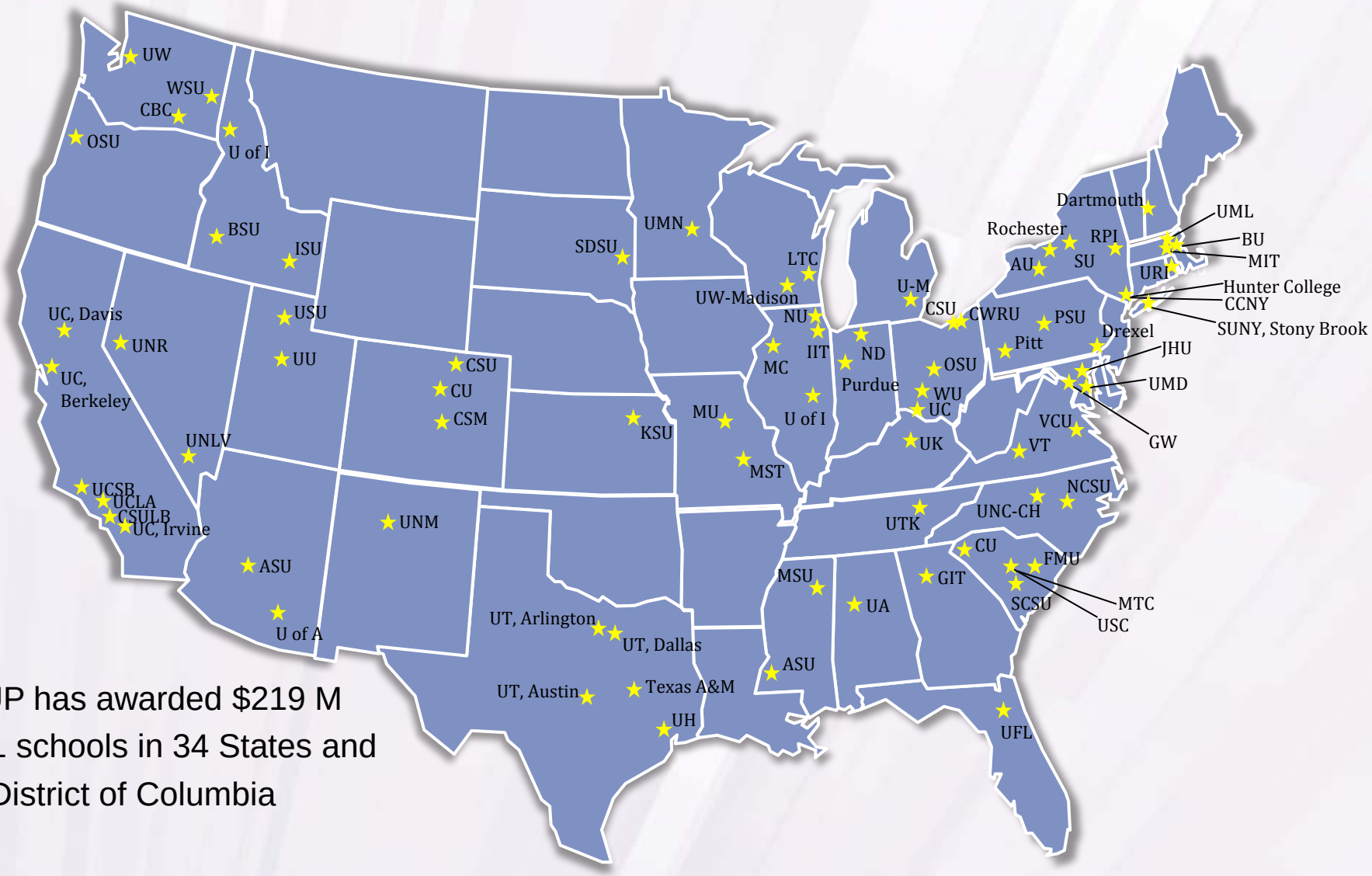


Awards	FY 2009	FY 2010	FY 2011	FY 2012
University Research & Development (R&D) Awards	$44 million 71 awards 31 schools 20 states	$38 million 42 awards 23 schools, 17 states	$44 million 56 awards 30 schools 21 states	$37 million 48 awards 32 schools 22 states and DC
Integrated Research Projects	N/A	N/A	$12 million 2 awards 10 schools 9 states	Up to $13.9M (in process) 3 project areas
University Infrastructure Awards	$6 million 29 schools	$13.2 million 39 schools	$5.69 million 21 schools	$6 million 23 schools
University Student Fellowship and Scholarship Awards	$2.9 million 16 fellowships 70 scholarships	$5.0 million (IUP) 32 fellowships 85 scholarships	Not Offered (IUP)	$5 million (IUP) 31 fellowships 39 scholarships
Total	**$53,000,000**	**$56,200,000**	**$61,000,000**	**About $62,000,000**

R&D Awards Past Average vs. 2012

- Overall – Awards/Full Submissions – 26%(past), 24%(2012)
- Awards to PIs for first time – 60%, 58%
- Awards to junior faculty – 38%, 38%
- Awards to Nuclear Engineering Faculty – 47%, 42%
- Awards in materials and waste – 65%, 69%
- Awards that are experimental – 67%, 65%
- Number of universities receiving awards – 30, 32
- Number of awards with lab partners – 44%, 64%
- Interdisciplinary awards – 30%, 29%
- Number of universities receiving awards for first time – 17%, 23%

NEUP Award Recipients FY 2009 – May 2012



NEUP has awarded $219 M to 81 schools in 34 States and the District of Columbia

Examples of Previous Interdisciplinary R&D Awards

- Modeling Solute Thermokinetics in LiCl-KCl Molten Salt for Nuclear Waste Separation – MSE, NE
- Monitoring Microstructural Evolution of Alloy 617 with Nonlinear Acoustics for Creep Fatigue – MSE, Civil E
- Development of Scanning Microscale Fast Neutron Irradiation Platform – Chem. Engr, EE, NE
- Heat Transfer Salts for Nuclear Reactor Systems – Civil E, NE
- Development of Thermal Transient Flow Rate Sensors for High T, Corrosive Environment – EE, ME
- Novel Methods of Tritium Sequestration – MSE, Chem. and Bio Engr.
- Precursor Derived Nanostructured SiC-X Materials – MSE, Aero. Engr.
- Understanding of Irradiation Behavior of Zirconium Carbide – NE, MSE
- Novel Engineered Refractory Materials – NE, MSE

NEUP Proposal Development

Guidelines to Writing a Competitive Proposal

2 NEUP Proposal Development

The Nuclear Energy University Programs (NEUP) funds nuclear energy research and equipment upgrades at U.S. colleges and universities through an annual competitive proposal solicitation, review, and award (subject to available funding allocated to NEUP). Because this is a competitive process, it is in the interest of the individual proposer to ensure their proposal is well developed, written, and understood. **The following is guidance only and does not guarantee a successful award.**

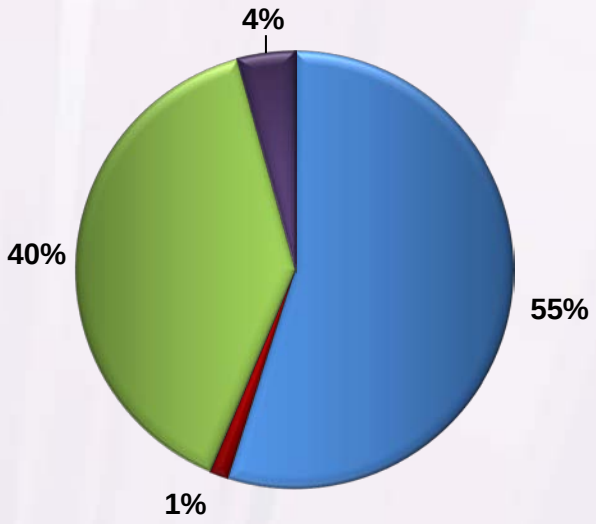
Proposal success depends on how the reviewers perceive your proposal in terms of the selection criteria set forth in the solicitation. Your chances of success are greatly reduced if your proposal is unclear or confusing to the reviewers. Below are some actions and elements ascribed to successful proposals.

Realistic Success for PIs

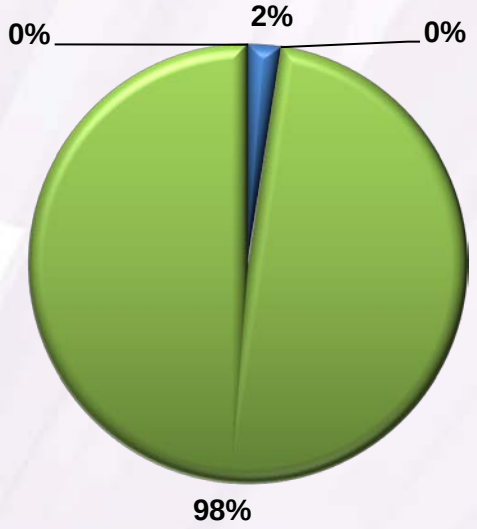
- Is the NEUP program right for you? Will it allow you to accomplish your research goals? Do you have the right equipment and/or access and expertise?
- NEUP is DOE-NE programmatic and mission driven, not NSF.
- Please read the solicitations and workscopes.
- Communicate with Technical Points of Contacts and seek feedback.
- Adapt your proposal to address DOE-NE needs.
- Consider submitting to several workscopes if appropriate.
- Keep trying and do not give up.

Status of No Cost Extensions

- NEUP research is in direct support and compliment of NE programmatic work that is ongoing throughout the DOE complex.
- NEUP policy does not favor NCEs
- Obtaining information as anticipated is important:
  - Enables integration of information with programmatic R&D
  - Demonstrates the importance and need of the DOE investment
  - Ensures the flow of information to support decision making



FY 2009 (71 Projects)



FY 2010 (42 Projects)

Proposed Changes to NEUP Processes

- R&D Solicitations
  - More limits on researcher/PI project participation
    - Set limit on total projects for PI at any time
    - Preclude new awards to PIs with existing no-cost extensions
  - Evaluate NEUP/NSUF alignment

- International Collaborations Increased Importance
  - British and others interested in IRPs and R&D collaboration
  - UK has proposed $5M for collaboration through RCUK

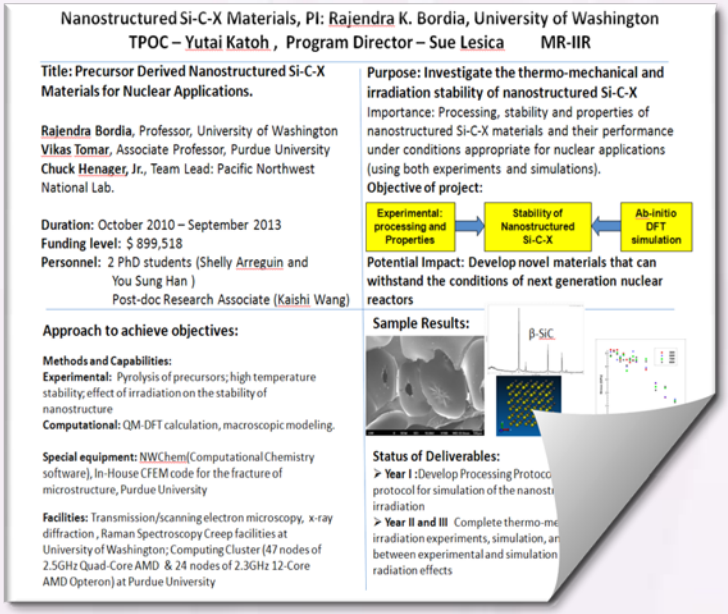
- IUP Performance metrics implemented via social media

Proposed Changes to NEUP Processes (cont'd)

- Funded projects must continue to provide a publicly releasable final report for OSTI posting

- All competitive NE R&D will be coordinated
  - Coordination of workscope development and announcement
  - Opportunity for joint solicitations

Proposed Changes to NEUP Processes (cont'd)



Nanostructured Si-C-X Materials, PI: Rajendra K. Bordia, University of Washington
TPOC – Yutai Katoh , Program Director – Sue Lesica MR-IIR

Title: Precursor Derived Nanostructured Si-C-X Materials for Nuclear Applications.

Rajendra Bordia, Professor, University of Washington
Vikas Tomar, Associate Professor, Purdue University
Chuck Henager, Jr., Team Lead: Pacific Northwest National Lab.

Duration: October 2010 – September 2013
Funding level: $ 899,518
Personnel: 2 PhD students (Shelly Arreguin and You Sung Han)
Post-doc Research Associate (Kaishi Wang)

Purpose: Investigate the thermo-mechanical and irradiation stability of nanostructured Si-C-X
Importance: Processing, stability and properties of nanostructured Si-C-X materials and their performance under conditions appropriate for nuclear applications (using both experiments and simulations).
Objective of project:

Experimental: processing and Properties → Stability of Nanostructured Si-C-X ← Ab-initio DFT simulation

Potential Impact: Develop novel materials that can withstand the conditions of next generation nuclear reactors

Approach to achieve objectives:

Methods and Capabilities:
Experimental: Pyrolysis of precursors; high temperature stability; effect of irradiation on the stability of nanostructure
Computational: QM-DFT calculation, macroscopic modeling.

Special equipment: NWChem(Computational Chemistry software), In-House CFEM code for the fracture of microstructure, Purdue University

Facilities: Transmission/scanning electron microscopy, x-ray diffraction , Raman Spectroscopy Creep facilities at University of Washington; Computing Cluster (47 nodes of 2.5GHz Quad-Core AMD & 24 nodes of 2.3GHz 12-Core AMD Opteron) at Purdue University

Sample Results:

β-SiC

Status of Deliverables:
➢ **Year I :**Develop Processing Protocc
protocol for simulation of the nanost
irradiation
➢ **Year II and III** Complete thermo-me
irradiation experiments, simulation, ar
between experimental and simulation
radiation effects

- Reporting requirements may be altered to better align with program needs and to ensure appropriate levels of reporting.
- Reports will include a "Quad Chart" executive summary
- Travel notification and approval

Testing of Performance of Optical Fibers Under Irradiation in Intense Radiation Fields when Subjected to High Temperature

PI: Dr. Thomas Blue, The Ohio State University, blue.1@osu.edu, 614-292-0629

Technical Area Workscope Identifier: G4M-1, **TPOC:** Dr. Frances Marshall, **Program Manager at DOE-HQ:** Sue Lesica

Purpose/Objective: Quantify the broadband attenuation in silica optical fibers, in-situ, operating to 1000°C during reactor irradiation through experiments and modeling. The results will determine the feasibility of extending optically based instrumentation to high temperature, radiation environments for future NGNP application.

Other Personnel:
Dr. Wolfgang Windl, co-PI, OSU Materials Engineering
Dr. Bryan Dickerson, Luna Innovations, Inc.

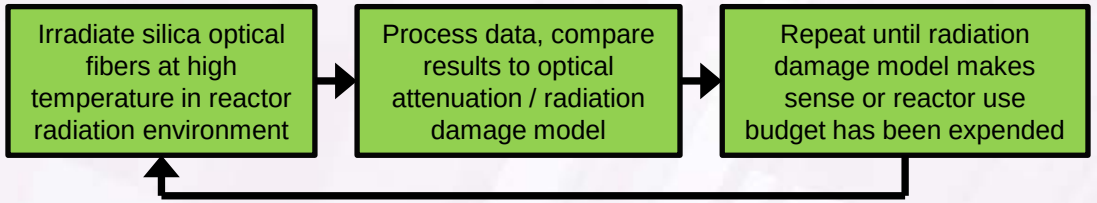
Student Personnel:
David Hawn, PhD, nuclear
Chris Petrie, PhD, nuclear
Harish Govindarajan , MS, materials science
Bryan Blake, MS, nuclear
Nikolas Antolin, PhD, materials science

Duration: October 2009 – September 2012

Total Funding Level: $525,832

Importance/Relevance: The project will provide experimental data & modeling results for survivability of COTS silica optical fibers in a high temperature reactor radiation environment. This will help determine the feasibility of extending COTS optically based sensors & instrumentation to high temperature radiation environments.

Logical Path: This project is nearly finished. Multiple high-temperature experiments are planned & start in May. The optical attenuation/radiation damage model will be updated based on experimental results.



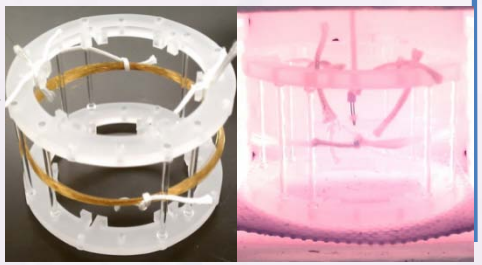
Impact Areas: Advanced instrumentation is needed for the high temperature, high pressure radiation environments expected in GenIV reactor designs. This project will help determine the applicability of optical instrumentation to these environments.

Special Tools/Methods and Facilities being used:

Experimental:
- High-temperature (1000°C), low-activation furnace for optical fiber irradiation in a reactor environment
- Automated broadband (200nm-2400nm) multi-channel optical fiber transmission measurement system
- Luna OBR Model 4600 with multiplexer
- 500kW research reactor & Co-60 irradiator on campus

Computational Modeling or Theory:
- Molecular dynamics damage modeling to relate specific defects to characteristic optical attenuation.
- Ohio Supercomputer Center HPC Resources

Facilities/Equipment:
- 10m of silica optical fiber spooled on custom quartz holder (left) & operating at 1000°C (right)
- We can achieve this temperature during reactor irradiations



Summary of Results:
- Unirradiated silica optical fibers survive optically & mechanically to 1000°C, possible long term operation at 900°C for 850nm, 1300nm & 1550nm. For some fiber types broadband attenuation slowly increases with time at 1000°C.
- Gamma irradiated silica optical fibers survive optically & mechanically. Induced attenuation above 800nm is negligible at room temperature & the gamma induced attenuation decreases with increased operating temperature at all wavelengths.

Status of Deliverables:
- Modeling completed, comparison with experimental results in progress
- 530hr, 600hr & 14hr in-situ thermal-only experiments to 1000°C completed
- In-situ gamma irradiation experiment to 600°C with 6.07Mrad total dose (in silica) completed
- High temperature reactor irradiation facility approved for operation, experiments starting in May

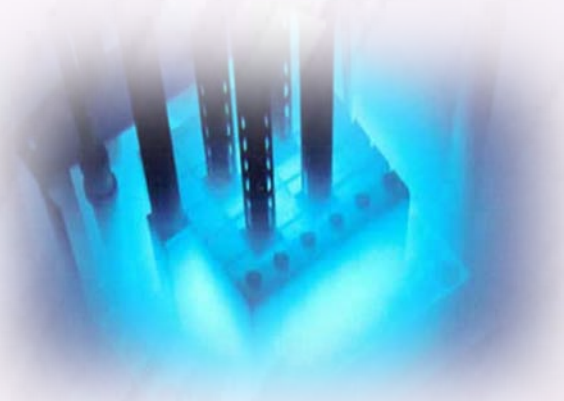
Selected Presentations/Publications:

- Hawn, Petrie, Blue & Windl. "In-Situ Performance of Optical Fibers Heater to 600°C during Gamma Irradiation." *ANS Transactions.* (June 2012)
- Petrie, Hawn, Blue & Windl. "In-Situ Performance of Optical Fibers Heated to 1000°C." *ANS Tr.* (June 2012)
- Govindarajan, Mishra & Windl. "Atomic-Scale Modeling of the Effects of Irradiation on the Optical Properties of Silica Glass Fibers." *ANS Transactions*. 104. (2011): 33-34
- Petrie, Blue & Kulisek. "Modeling High Temperature Radiation Damage to Optical Fibers." *ANS Transactions*. 104. (2011): 269-270

Proposed Changes to NEUP Processes (cont'd)

Scholarship and Fellowship

- GRE scores will be required for fellowship applicants
- Applicants holding a 3.4 cumulative GPA or lower no longer eligible to apply for a S&F award
- Eligibility essay now a mandatory requirement for S&F award



Infrastructure

- Considering change to funding allocations between areas (Major, Minor, GSI) to better meet university needs

Continuous Improvement

- Feedback from annual survey
- Effective outreach/workshops, evaluation forms
- NEUP IO Exec Committee
  - Corradini (NEAC), Aldemir(NEDHO), Butler (TRTR), Nash, Fentiman, Hines
- Meetings with NEAC, NEDHO, TRTR, NEI, universities, others
- Integration with Labs, other agencies, industry
- Congressional and public advocacy

NEUP Issues for FY 13

- Impact of NE Budget Uncertainty on NEUP Funding and Priorities – Set Priorities in Case of Cuts
- Student Investment
  - IUP requires Congressional action to continue
  - Research-Based Fellowship Program still an option, but will exacerbate projected > 20% reduction in R&D funds in FY 13
  - Effective implementation of Fellowship internships at national labs
  - Performance metrics
- Effective Oversight of University R&D Projects
  - 50% of 2009 projects have/requested no cost extensions
  - Significant under-run in costing
  - Quad charts and highlighting of results

Thank You