



**U.S. DEPARTMENT OF
ENERGY**

Nuclear Energy

US Approach to Competitive Nuclear Energy Research

US/UK Collaboration Successes and Opportunities

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U.S. Department of Energy**

**3rd Nuclear Academics Discussion Meeting
September 3, 2014**



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President Obama's Energy Goals

"We can build the next-generation nuclear reactors that are smaller and safer and cleaner and cheaper."

Ohio State University- March 22, 2012



"Today, I'm announcing a new national climate action plan, and I'm here to enlist your generation's help in keeping the United States of America a leader -- a global leader -- in the fight against climate change."

June 25, 2013, Georgetown University

"...the debate is settled. Climate change is a fact. And when our children's children look us in the eye and ask if we did all we could to leave them a safer, more stable world, with new sources of energy, I want us to be able to say yes, we did."

President Obama's 2014 State of the Union Address





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Secretary Moniz on Nuclear Energy



“The Energy Department is committed to strengthening nuclear energy’s continuing important role in America’s low carbon future, and new technologies like small modular reactors will help ensure our continued leadership in the safe, secure and efficient use of nuclear power worldwide.”

*New Investment in Innovative Small Modular Reactor,
December 12, 2013*

“All-of-the-above is not merely a slogan, but a clear-cut pathway to creating jobs and at the same time reducing carbon emissions, which recently stood at their lowest level in 20 years... President Obama has made clear that he sees nuclear energy as part of America’s low carbon energy portfolio. And nuclear power is already an important part of the clean energy solution here in the United States.”

The National Press Club, February 19, 2014



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Nuclear Energy University Programs (NEUP) Mission

- **NEUP Mission** - As part of NE research and development (R&D) mission, engage U.S. university community, provide resources to conduct Program Directed, Program Supporting, and Mission Supporting R&D, related infrastructure improvements, and student fellowship/scholarship grants supporting university-based nuclear science and engineering research.

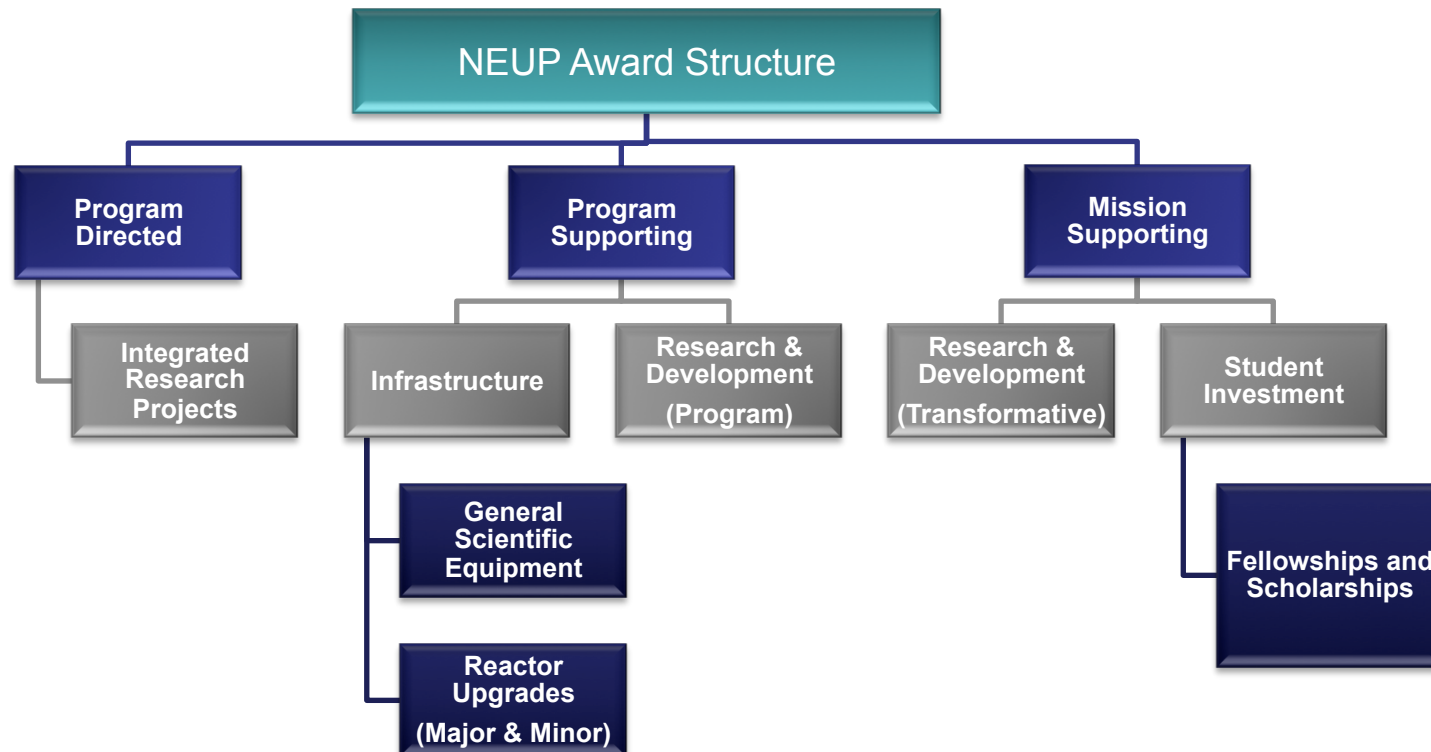




NEUP Structure

Nuclear Energy

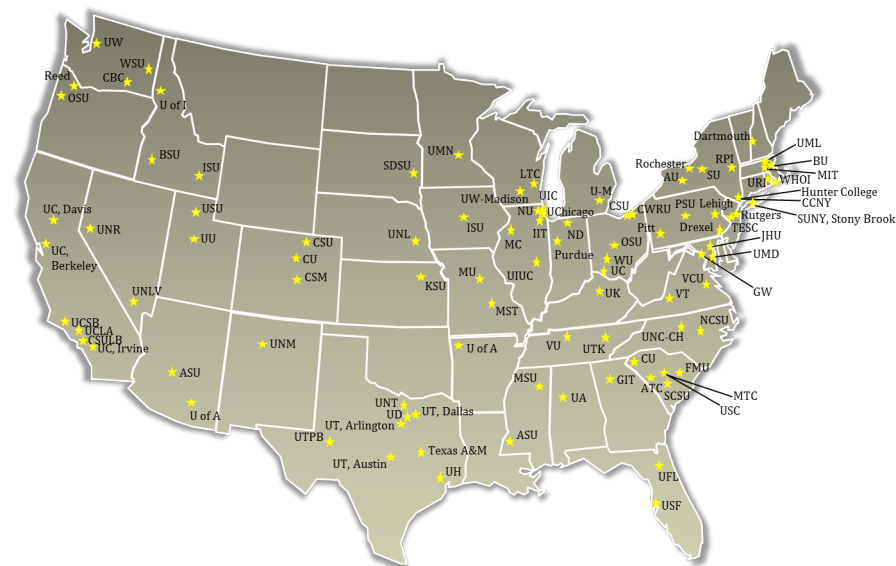
- Competitive process for awarding U.S. University-led R&D and infrastructure projects, and scholarships/fellowships to US or permanent resident students in NE fields of study.
- To date, NEUP has awarded ~\$350M to 97 US universities/schools in 38 states and DC.
- US universities can be supported by **international partners**, US national labs, and industry





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- **The Nuclear Energy University Programs (NEUP) and the Integrated University Program (IUP) have a well established competitive process for awarding R&D, infrastructure and scholarships/fellowships.**
 - FY 2014 IUP awards: 42 scholarships and 33 fellowships, totaling \$5.3M announced on May 9, 2014
 - FY 2014 NEUP awards, 69 projects, totaling ~\$54M for IRP, R&D and Infrastructure projects



Since FY09, NEUP and IUP have awarded \$343M to 97 schools in 38 States and the District of Columbia.



FY 2015 Research Award Opportunities

- US DOE issued its Consolidated Innovative Nuclear Research competitively-awarded research project solicitation on August 18th
- Although all US funding is limited to US universities, national labs and US incorporated industries, **international research partners are strongly encouraged.**
- Each section of the solicitation allows for international partners; however, 3-year, \$400-800K, US university-led research projects described in Appendix A may be of most interest. Topics include: advanced structural materials; MAaD & RISMC Integration: Models for materials degradation; Reactor Concepts RD&D; Material recovery and Wasteform Development; Advanced Fuels; Nuclear materials control and Instrumentation; UNF Disposition; and FC R&D

FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT



U. S. Department of Energy
Idaho Operations Office

Fiscal Year 2015 Consolidated Innovative Nuclear Research

Funding Opportunity Announcement:
DE-FOA-0001129

Announcement Type: Initial

CFDA Number: 81.121

Informational Webinar: August 12-14, 2014
(Video links and presentations will be made available at www.neup.gov)

Issue Date: August 18, 2014

Letter of Intent (Mandatory only for NSUF Applications)
Due Date: September 11, 2014 at 8:00 PM ET

Pre-Application (Mandatory except for IRPs)
Due Date: October 2, 2014 at 8:00 PM ET

Full Application
Due Date: February 19, 2015 at 8:00 PM ET



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Previous UK/US Collaborations

- US and UK researchers have been very successful in previous collaborative research proposals, as illustrated by US DOE Integrated Research Project (IRP) awards announced in FY 2012 and FY 2013 (see following slides)
- US DOE worked closely with the Research Councils UK (RCUK) as both parties enthusiastically established mechanisms for effective and successful UK/US collaboration in 2012. RCUK is to be commended for their strong support to-date, totaling ~\$6M, which resulted in significant research multiplier for US ~\$23M and more diverse research approaches and results.
- US DOE looks forward to continued US/UK collaborations!



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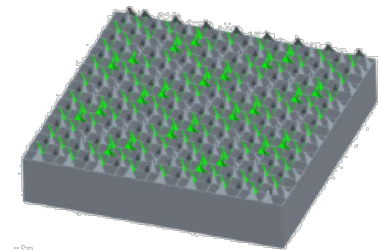
2012 IRP: Accident Tolerant Fuels

Engineered Zircaloy Cladding Modifications for Improved Accident Tolerance of LWR Nuclear Fuel

Lead: Brent Heuser, University of Illinois, Urbana Champaign

Collaborators: University of Florida, University of Michigan, University of Manchester, ATI, INL

US DOE Funding Budget: \$3.5M



Fabricate and evaluate modified Zircaloy LWR cladding under normal BWR/PWR operation and off-normal events using two pathways:

- modification of the cladding surface by the application of a coating layer
- modification of the bulk cladding composition to promote precipitation of minor phase(s) during fabrication



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2012 IRP: Accident Tolerant Fuels

Advanced Accident-Tolerant Ceramic Coatings for Zr-Alloy Cladding

Lead: Kurt Sickafus, University of Tennessee

Collaborators: Pennsylvania State University, University of Colorado-Boulder, University of Michigan, Oxford Univ., Univ. of Manchester, Univ. of Huddersfield, Univ. of Sheffield, Australian Nuclear Science and Technology Organization, Westinghouse, LANL

Budget: \$3.5M

Develop an advanced durable ceramic coating for Zr-alloy cladding that exhibits demonstrably improved performance compared to conventional Zr-alloy clad

- characterize the structural and physical properties of the coated clad samples (especially corrosion) under simulated normal and transient conditions
- assess the effects of such coatings on fuel performance, reactor neutronics, and economics



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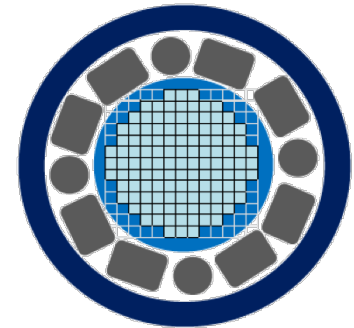
2012 IRP: Inherently Safe Reactors

Integral Inherently Safe Light Water Reactor

Lead: Bojan Petrovic, Georgia Institute of Technology

Collaborators: University of Michigan, Virginia Tech, University of Tennessee, University of Idaho, Morehouse College, Polytechnic University of Milan, University of Cambridge, Westinghouse, Southern Nuclear, INL

Budget: \$6.0M



Large (~1,000 MWe) LWR with inherent safety features. High power density\ compact core design using a non-oxide fuel form

- novel steam generating system is based on very compact printed circuit heat exchangers
- compact design\small plant footprint reduces capital cost and facilitates seismic isolation



2013 IRP Award: Simulation of Neutron Damage for High Dose Exposure of Advanced Reactor Materials



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Questions? Please Contact Us

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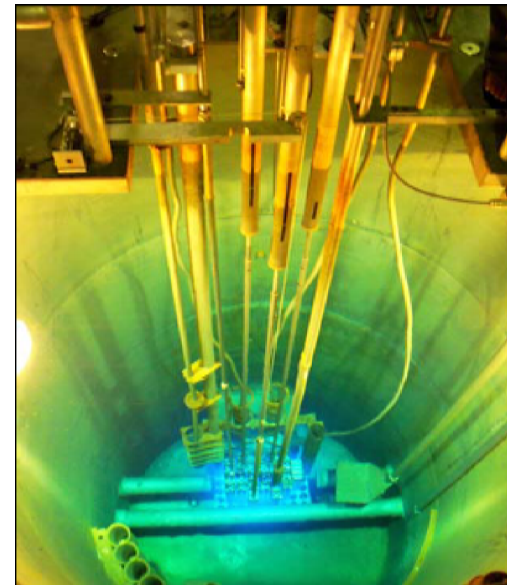
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Global Energy Distribution

