INEST

Institute for Nuclear Energy Science and Technology

FUELS AND MATERIALS CORE

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Institute for Nuclear Energy Science & Technology

CORE MISSION

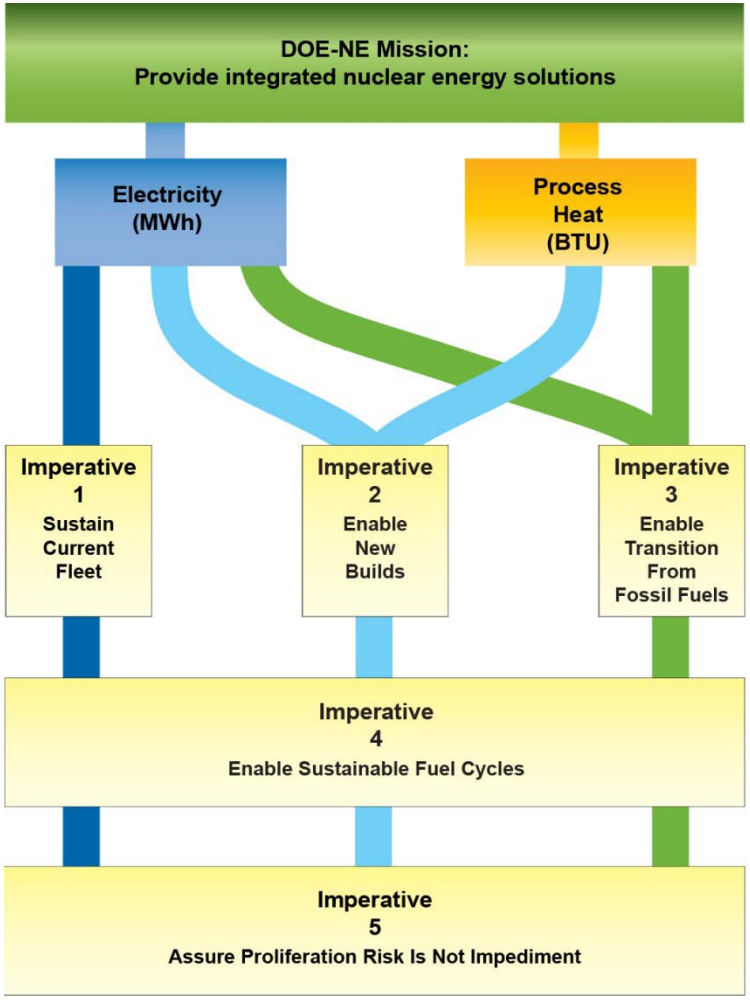
Use INL internal funding to grow technological leadership while building long-term partnerships, capabilities, tools, and techniques to advance nuclear fuels and materials.

- Education programs established to improve knowledge and understanding of LWR fuel and materials research and stimulate collaborations between academia and INL researchers

- Research that bridges basic science and applied technology

DOE Nuclear Energy Program Goals

1) Extend Plant Lifetimes
2) Enable New Builds
3) Reduce Carbon Footprint in Transportation/Industrial Sectors
4) Develop Sustainable Fuel Cycle
5) Understand/Avoid Proliferation Risks



INL Major Programs in Fuels & Structural Materials

INL has vibrant programs in:

- Fuels & Materials for High-temperature Gas-cooled Reactors
- Transmutation Fuels

Growth Areas for INL exist in:

- LWR Core Materials
- LWR Fuels
- Basic Science of Nuclear Fuels

Partnerships with universities help keep the lab vibrant

INL
Nuclear Fuels & Materials Center

Nuclear Fuels and Materials
Basic Science Programs

EFRC's
Internal LDRDs
Collaborations with
basic science labs

Nuclear Fuels and Materials
Technology Development for
National Programs

LWRS, GEN IV
AFCI, RERTR,
etc..

EFRC
Material Science of
Nuclear Fuels

Universities | INL | Industry

Mission: *Translate scientific knowledge to technology solutions using multi-disciplinary, multi-partner teams focused on challenging problems of national interest with specific deliverables over 3 to 5 year schedule.*

NF&M Division (with its
collaborators) performs
technology RD&D once
a technology path is defined

ATR NSUF

Access to
MFC facilities

CAMS

Center Director (INL)
Deputy-Director (NUC)

Steering Committee:
-INL NF&M Director
-ATR NSUF Director
-University reps
-Industry partners

Admin Support
(CAES)

Projects

Fuels & Materials CORE

Identify Critical Technology Limitation

- Stress Corrosion Cracking
- UO_2 Performance
- Zirconium Alloy Performance

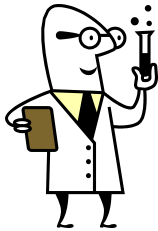
Transition Basic Science Concepts

- Crack Tip (nano-scale) Chemistry
- Segregation
- Dislocation Mechanics

Recognizes a 5-10 year development horizon

Technology Improvement

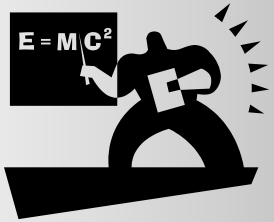
- University Microscopy Center
- Laboratory Computational Center
- ATR User Facility



Leverage Knowledge & Capability

Partnerships

University Faculty



University Students

Each project has a faculty member

Center

Technology Improvement

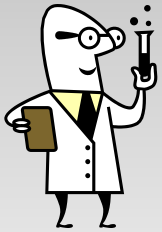
Trained Students

Staff exchanges

Lab Staff

Each project has a lab staff member
- Partial time appointments
- Mini-sabbaticals

Maintain ties to programs
Industry partners encouraged



Current Program Elements

- **Workshop Series**
  - June 2010 Stress Corrosion Cracking Science
  - May 2011 Zirconium Alloy Science
  - April 2012 Uranium Fuel Science
- **Outreach Events**
  - Feb 2011 Regional Workshop (NCSU Raleigh)
- **LDRD**
  - 2010 Stress Corrosion Cracking
  - 2011 Zirconium Alloy Science
  - 2012 Uranium Fuel Science

INEST WORKSHOP QUOTE

"A rare and exceptional workshop. These two days brought together true deep expertise, representing over 100 years of industry experience, and an enthusiastic group of young scientists eager to bring state of the art tools to bear on cutting edge problems. Such a workshop is enormously more efficient than simply letting university researchers try to ferret out the real issues and problems on their own. These two days may have saved months of work on the part of the participants. Workshops of this type and caliber should be the standard for how new research areas are launched and promoted."

Current R&D

- Irradiation-Induced Evolution of Defect and Microstructure in Nanocrystalline BCC Mo (INL, NCSU)
- Development of Positron Techniques to Understand Microstructural Evolution of U and UO2 Under Irradiation (INL, Washington State)
- In situ characterization of an oxide film for prediction of stress corrosion cracking susceptibility (INL, Colorado School of Mines)
- Characterization of the Nanomechanical Response of Material to Determine Key Variables in Stress Corrosion Cracking (INL, Minnesota)
- In-situ micro-Raman spectroscopy and modeling of breakaway oxidation of zircaloy cladding (INL, Mississippi State)
- Observation of zirconium oxidation at atomic level using non-linear optical spectroscopy (INL, Wisconsin, NCSU)
- Protectiveness and stability of the zirconium oxide in early-phase corrosion of zirconium alloys - predictive relations to surface structure and composition(INL, MIT)

INEST LDRD PARTICIPATION

	Number of INEST proposals submitted	Number of INEST proposals submitted with INL-University collaboration that include workshop partners	Number of INEST proposals awarded	Number of INEST proposals awarded with INL-University collaboration that include workshop partners
2010	4	4	1	1
2011	8	4	2	1
2012	12	10	2	2