



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Nuclear Science User Facility

Thermal Hydraulics Workshop

Brenden Heidrich

Chief Irradiation Scientist
Capabilities Scientist

NSUF/GAIN TH Workshop
INL Meeting Center
Idaho Falls, ID
July 13, 2017

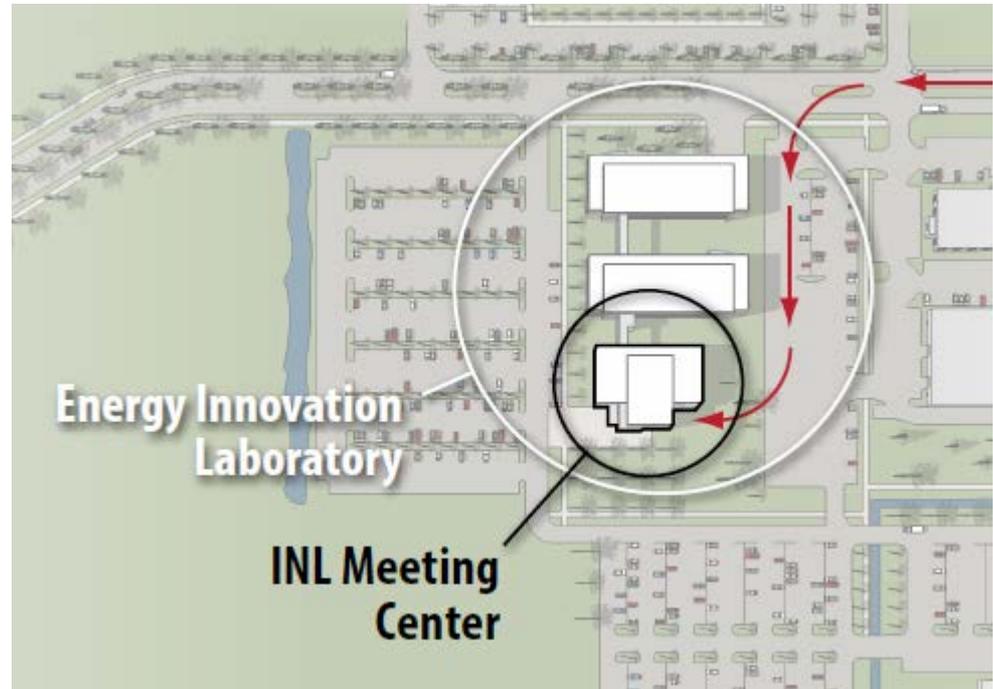


INL/MIS-17-42058



In case of emergency, exit through the south or west doors.

- The assembly area is in the west parking lot towards CAES.
- Please don't try to drive away, it interferes with emergency vehicles.
- No eating or drinking during an emergency situation.
- Restrooms are in the lobby.
- Do not try to enter EIL Bldg. B.
- Smoking areas are outside to the west, 25 ft from the entrances.



- **The meeting is being run by professional INL facilitators:**
 - Jodi Grgich and Alison Conner.
 - They will be running the ThinkTank software in real-time.
 - Presentation time limits are:
 - 10 minutes for the presentation.
 - All questions and comments should go into ThinkTank
- **There are a few additional people participating over the web conferencing system.**
 - Audio only + ThinkTank
 - Audio is fed through the mics in the meeting rooms.
- **Please limit the amount of non-meeting work on laptops and phones during the actual meeting.**

- **GOAL** - to develop a ranked list of US domestic thermal hydraulics testing capabilities for each of the reactor technology groups in support of nuclear energy focused R&D.
 - **Light-water reactors** (LWR) (including small modular reactors (SMR))
 - **Molten salt reactors** (MSR),
 - **High-temperature gas-cooled reactors** (HTGR)
 - **Fast-spectrum reactors** (FR) (including sodium-cooled, lead-cooled, gas-cooled, and molten salt fast reactors).

- **PRODUCT** - a report documenting the results of the workshop will be produced and submitted through the NSUF to DOE-NE by September 30, 2017.

Resources

1. **GAIN Advanced Reactor Technology Working Groups**
2. **National Laboratory expertise and capabilities**
3. **University expertise and capabilities**
4. **Nuclear Industry expertise and capabilities**

Process

1. **Initial Survey for R&D Needs**
2. **Presentation of Needs and Capabilities**
 - Markup in ThinkTank
3. **Discussion and Prioritization of Needs**
4. **Connection of Needs and Capabilities**
 - Offline in ThinkTank

10:30 Darryl Gordon, AREVA

10:40 Wade Marcom, Oregon State University

10:50 Rodolfo Vaghetto, TAMU

11:00 Robert Adams, University of Michigan

11:10 Paolo Ferroni, Westinghouse

11:20 Seungjin Kim, Purdue University

11:30 David Pointer, ORNL

11:40 Darius Lisowski, ANL

11:50 Bren Phillips, MIT

12:00 LWR Technology



12:10 Working Lunch

52-Reactors Experience at INL

INL Mission

Joseph Campbell

Phil Sharpe

1:00 Terrestrial Energy USA

John Kutsch

1:10 Process and Criteria for Prioritizing Thermal-Hydraulic Needs

Alison Conner/Jodi Grgich

1:45 Identification and Prioritization of LWR Thermal-Hydraulic Needs

Alison Conner/Jodi Grgich

3:15 Break



3:25 Brian Woods, Oregon State University

3:35 Sung Uk Ryu, KAERI

3:45 Barton Smith, USU

3:55 Graydon Yoder, ORNL

4:05 Advanced Nuclear Reactors Technology

**4:15 Identification and Prioritization of Thermal-Hydraulic
Needs for Advanced Nuclear Reactor Technologies**

Alison Conner/Jodi Grgich

5:05 Identify Path Forward

Brenden Heidrich

**5:30 Tour/Demonstration of Salt Preparation and Purification
Facility**

James O'Brien



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THINKTANK SURVEY



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PATH FORWARD



Process

- 1. Initial Survey for R&D Needs**
- 2. Presentation of Needs and Capabilities**
 - Markup in ThinkTank
- 3. Discussion and Prioritization of Needs**
- 4. Connection of Needs and Capabilities**
 - Offline in ThinkTank (open until 7/31/2017)
 - Facility owners can make their case for meeting the needs.
 - Additional facilities can be proposed where existing ones cannot meet the needs.
- 5. Report to DOE-NE**
 - Will document the workshop data and results and make recommendations.

■ Capabilities RFI (DE-SOL-0008318)

- seeking information regarding capabilities needed by researchers to accomplish nuclear energy R&D

■ CINR Workscope RFI (DE-SOL-0008246)

- seeking ideas in the areas of research, information, comments, feedback, and recommendations from interested parties for future work scopes for the major NE-funded research programs.

■ Infrastructure FOA (DE-FOA-0001516)

- Applications will be due November ??, 2017 at Grants.gov
- GSI - \$2,000,000 total funding, \$250,000 awards
 - more with 50/50 cost match



What is a User Facility?



- *Regional, national or international facility with unique experimental capabilities.*
- *Access is typically cost-free through a competitive proposal process.*
- *The goal is to connect the best ideas with the capability regardless of geographical separation.*



Advanced Photon Source (ANL)



Spallation Neutron Source (ORNL)

There are currently 50 DOE user facilities in the U.S.

- Advanced scientific computing research
- High flux synchrotron and neutron sources
- Electron beam characterization
- Nano-scale science
- Biological and environmental research
- High energy and nuclear physics
- Fusion energy science

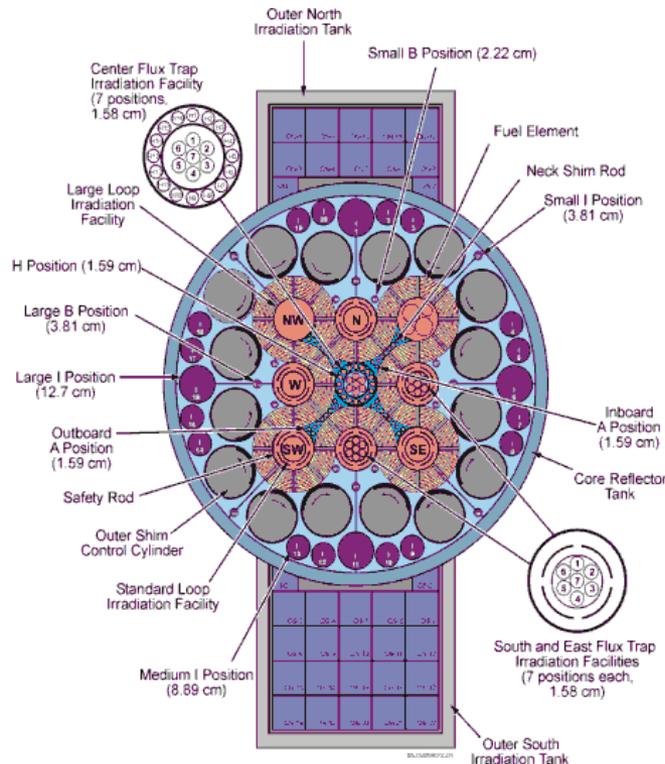
*.....**But before 2007 there were no user facilities to address the unique challenges of nuclear energy.***

Then came the Advanced Test Reactor National Scientific User Facility!



Allow the research community access to excess test reactor space and existing post-irradiation examination facilities

Advanced Test Reactor



Post Irradiation Examination (PIE) Facilities at Materials & Fuels Complex (MFC @ INL)





What does NSUF (currently) study?



In-Reactor Degradation Behavior of Nuclear Fuels and Materials

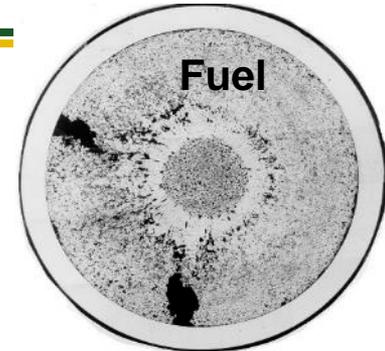
■ Maintaining fleet of current reactors

- Life extension for commercial reactors
- Developing accident tolerant nuclear fuels

■ Developing the next generation of safer more efficient reactor systems

- Materials resistant to high levels of radiation damage
- Reduced enrichment fuels for test reactors
- High temperature gas reactor fuels and materials
- Liquid metal cooled fast reactors for transmutation

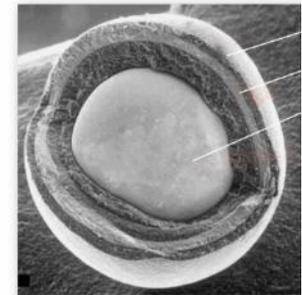
Restructuring in U-Pu-Zr Metallic Fuel



Radiation Damage Effects in Cladding and Structural Materials

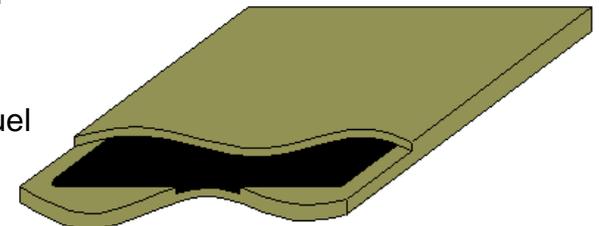


Austenitic Stainless Steel Following Irradiation in EBR II Fast Reactor



Gas Reactor Coated-Particle Fuel

U-Mo Plate Fuel





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NSUF – a consortium

A group formed to undertake an enterprise beyond the resources of any one member



2007	2008	2009	2010	2011	2012	2013	2016	2017
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Expanded capabilities

- Need for additional capabilities outside INL recognized early
- Partner facilities program established in 2008

Under review

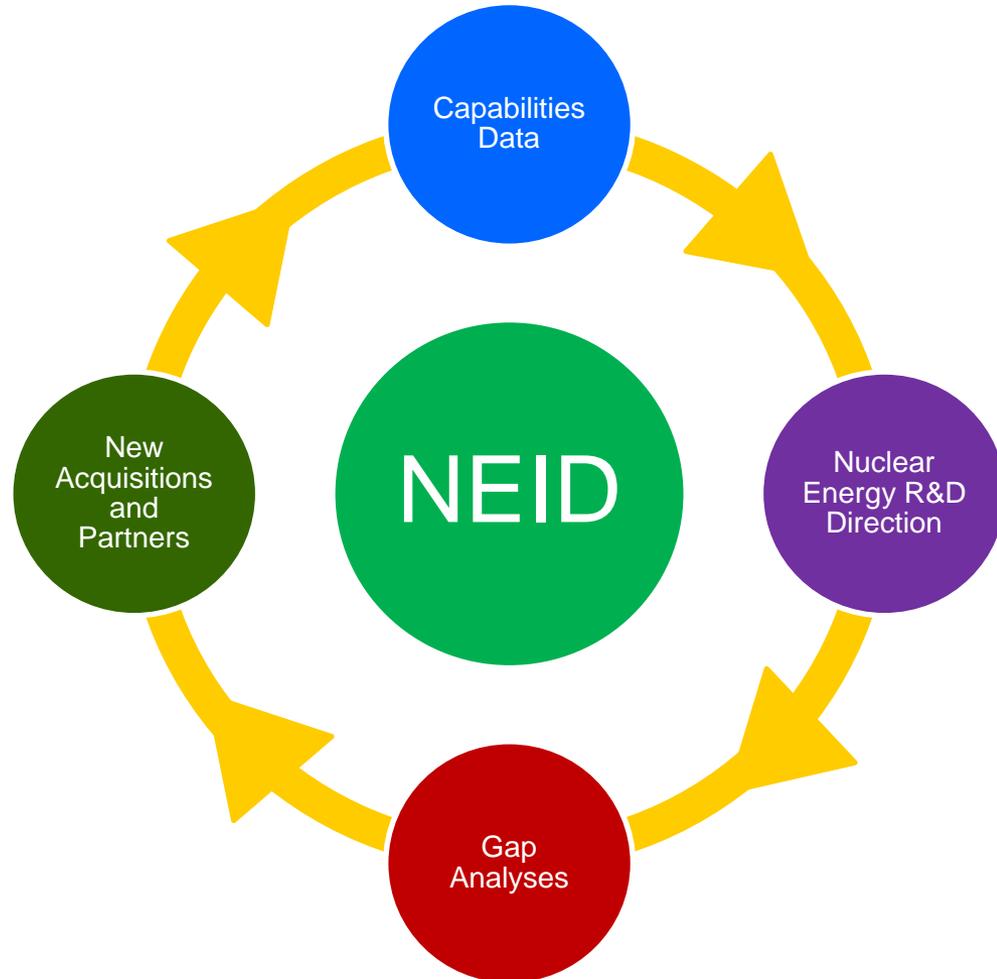




Infrastructure Management Program



1. Gather Data on Nuclear Energy R&D Capabilities
2. Estimate Near, Mid and Long-term R&D Directions
3. Use these to perform gap analyses for Nuclear Energy R&D.
4. Assist funding decisions and incorporate the results into the NEID.

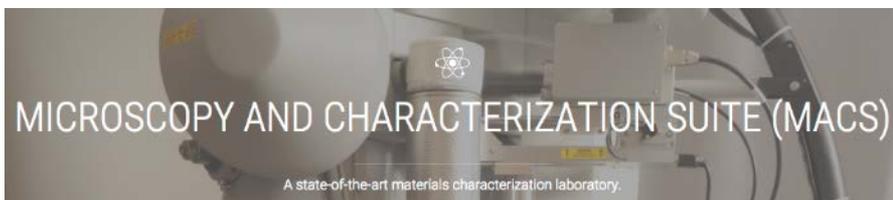




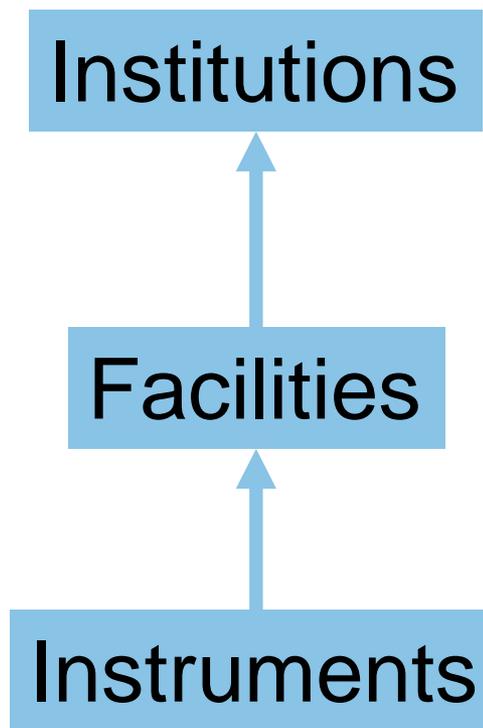
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NEID Organization



FEI Quanta 3D FEG
Focused Ion Beam
SEM Microscope





NEID Database Characteristics



Data

Users



140
Institutions



Federal Government
& National
Laboratories



500
Facilities



Universities &
NGOs



1000
Instruments



Nuclear Energy
Industry



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World-wide nuclear energy R&D capabilities





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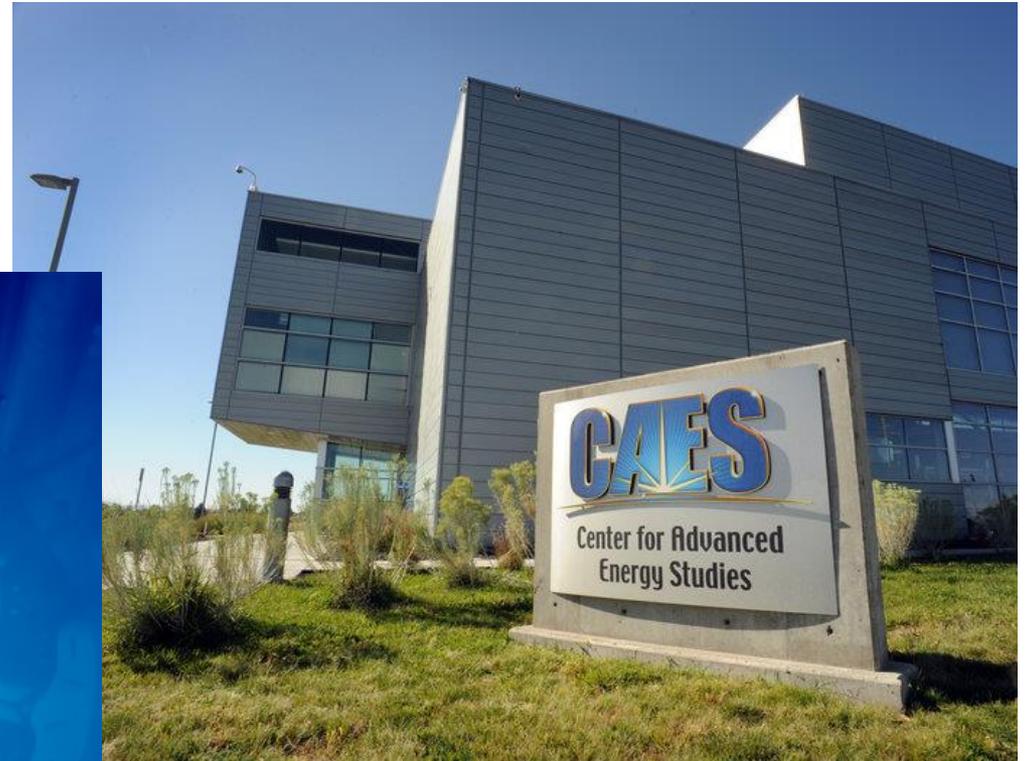
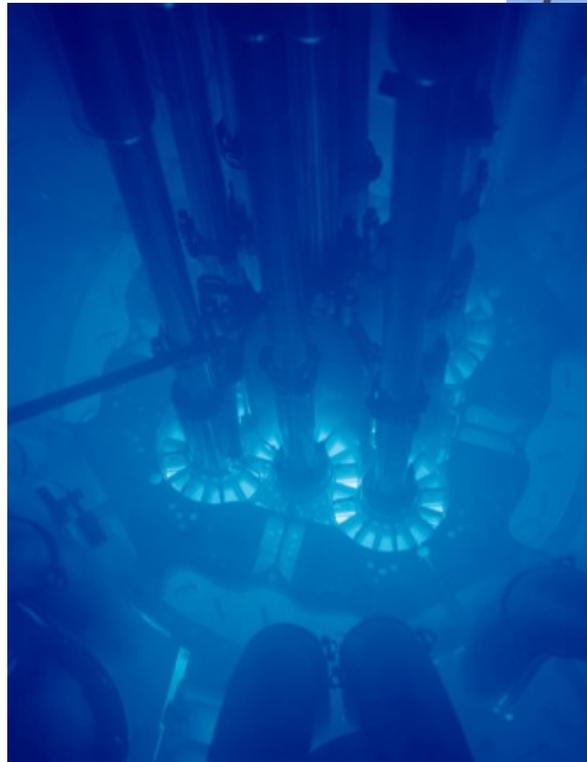
Contact Information



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Nuclear Science
User Facilities

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