



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Nuclear Science User Facilities (NSUF) Ion Beam Investment Options Workshop Outcomes

**Alison Hahn
Program Manager, NSUF
Office of Nuclear Energy
U.S. Department of Energy**

June 2016

Outline

Nuclear Energy

- **Issue Background and Status**
- **Database Characteristics**
- **Significant Milestones**
- **Identified Needs**
- **Workshop Outcomes**
- **Path Forward**

Issue Background and Status

- In April 2014, NE-1 approved a formal review recommendation to provide near-term funds to operate the Intermediate Voltage Electron Microscope (IVEM) at Argonne National Laboratory through fiscal year (FY) 2015, and to evaluate identified alternatives to inform future ion beam investment decisions in support of the research community
- Over \$2 million has been provided to operate IVEM from FY 2014-16
- In parallel, NSUF developed the Nuclear Energy Infrastructure Database (NEID) to inform research infrastructure investment decisions. NEID now includes an inventory of all available domestic ion beam irradiation facilities



NEID Database Characteristics

Data



125 Institutions



450 Facilities



804 Instruments

Users



64 Federal
Government &
National Laboratories



31 Universities &
NGOs



23 Nuclear Energy
Industry

NEID Analysis - Identified Needs

- **Irradiation Assisted Stress Corrosion Cracking (IASCC) Test Rigs**
- **Test Reactor Capabilities**
- **Thermal Hydraulic Facilities**
- **Mechanical Testing Capabilities**
- **Ion Beam Irradiation Capabilities**



NEID Significant Milestones

Nuclear Energy

Supported FY2015 FOA	3.30.2015
Private Database Deployment	6.30.2015
FY2015 Gap Analysis Report	9.30.2015
Hired Scientific Support Professional - Jonathan Kirkham	10.1.2015
Public Database Deployment (GAIN)	11.6.2015
Report to the NEAC	12.10.2015
Supported FY2016 (Infrastructure and NSUF work-scopes)	2.22.2016
Ion Beam Investment Options workshop & report	6.30.2016
Supporting FY2017 FOA creation & workflow	7.30.2016
FY2016 Gap Analysis Report	9.29.2016
Merge the NEID and the Nuclear Fuels & Materials Library	9.29.2016



Issue Background and Status (cont.)

- **NSUF hosted the Ion Beam Investment Options Workshop March 22-24, 2016, in Idaho Falls to develop a set of funding recommendations for US domestic ion beam irradiation capabilities for nuclear energy-focused research development & demonstration (RD&D)**
- **Workshop participants included 15 ion beam facility representatives, Electric Power Research Institute, NE laboratory technical leads and DOE-NE management and staff**
- **The ion beam facility representatives established a list of ten criteria and ranked the 15 facilities against those criteria**
- **Workshop results summarize the list of ion beam facilities that are of interest to the NE RD&D community and currently are or are interested in becoming NSUF partner facilities**



Workshop Outcomes

Nuclear Energy

#	Combined Criteria	Relative Weight
C1	Viability for the capability to extend our understanding towards accurately simulating nuclear irradiation conditions (neutrons or fission fragments).	100%
C10	Ability of the facility to produce results that meet the needs of the DOE – Office of Nuclear Energy (including cross-cutting programs) and the nuclear energy industry.	94%
C3	Ability of the facility to provide a variety of well-controlled target environments and conditions.	92%
C8	Ability of the facility to handle radioactive materials (structural materials and/or fuels) in the beams and elsewhere onsite.	89%
C5	Ability of the facility to collect and analyze materials properties and/or perform microstructural characterization data in-situ.	86%
C9	Ability of the facility to produce quality-level data that can support licensing as well as verification and validation of modeling and simulation.	86%
C2	Ability of the facility to provide a variety of ion irradiations (ion types, energies, multiple beams, etc.)	85%
C7	Unique capabilities of the facility including any new technology that has the capability to close technological gaps.	83%
C6	Current or potential productivity of the facility (e.g. fewer high-impact experiments or high-volume sample throughput).	69%
C4	Ability of the facility to collect and analyze materials properties and/or perform microstructural characterization data onsite.	62%



Workshop Outcomes

Nuclear Energy

Ion Beam Facility	C1	C10	C3	C8	C5	C9	C2	C7	C6	C4	Relative Aggregate Score
University of Michigan - Michigan Ion Beam Laboratory	100%	100%	100%	73%	87%	100%	100%	95%	100%	100%	100%
Argonne National Laboratory - Intermediate Voltage Electron Microscope	82%	94%	79%	83%	100%	95%	73%	94%	96%	98%	93%
Argonne National Laboratory - Extreme Materials Beam Line	89%	88%	74%	92%	96%	94%	76%	100%	69%	94%	91%
Sandia National Laboratory - In-situ Ion Irradiation Transmission Electron Microscope	87%	87%	81%	59%	100%	96%	84%	99%	89%	90%	91%
Brookhaven National Laboratory - Ion X-ray Beam	81%	91%	74%	88%	91%	96%	70%	94%	83%	88%	89%
Brookhaven National Laboratory - Ion Irradiation Facilities and Capabilities at the BNL Accelerator Complex	85%	87%	74%	87%	72%	91%	85%	88%	74%	89%	87%
Los Alamos National Laboratory - Ion Beam Materials Laboratory	79%	86%	79%	100%	61%	89%	81%	72%	80%	90%	85%
Texas A&M University - Accelerator Laboratory	80%	84%	78%	60%	72%	87%	94%	75%	90%	90%	85%
Lawrence Livermore National Laboratory - Center for Accelerator Mass Spectrometry	81%	87%	69%	96%	52%	91%	83%	86%	78%	87%	84%
Massachusetts Institute of Technology - MIT Nuclear Materials Laboratory	80%	88%	64%	66%	64%	91%	65%	83%	72%	78%	78%
University of Wisconsin - Wisconsin Tandem Accelerator Ion Beam	73%	75%	68%	63%	53%	76%	76%	67%	73%	89%	74%
University of Tennessee -Knoxville - Ion Beam Materials Laboratory	70%	71%	72%	22%	51%	81%	79%	65%	70%	81%	69%
Idaho State University - Idaho Accelerator Laboratory	55%	59%	52%	77%	32%	65%	67%	46%	60%	57%	59%
Purdue University - Center for Materials Under Extreme Environment	46%	48%	58%	23%	52%	59%	51%	59%	56%	69%	54%
Ohio University - Edwards Accelerator Laboratory	48%	44%	43%	33%	28%	51%	44%	49%	48%	47%	45%



Proposed Ion Beam Partner Facilities

■ Proposed Partner Facilities

- University of Michigan
- Argonne National Laboratory
- Sandia National Laboratory
- Los Alamos National Laboratory
- Texas A&M University
- Lawrence Livermore National Laboratory

■ Future Work

- Ion Beam Roadmap

Institution	Proposed Investment Cost
University of Michigan	\$300,000
Argonne National Laboratory	\$230,000
Sandia National Laboratory	none requested
Los Alamos National Laboratory	none requested
Texas A&M University	none requested
Lawrence Livermore National Laboratory	none requested

Institution	Annual Access Available for NSUF	Percentage of Total Time
University of Michigan	2,000 hours	30%
Argonne National Laboratory	229 days (2015)	100%
Sandia National Laboratory	125 days (2014)	50%
Los Alamos National Laboratory	50-75 days	33-50%
Texas A&M University	75 days	25%
Lawrence Livermore National Laboratory	90 days	25%

Path Forward Summary

Nuclear Energy

- **NSUF users will be awarded no-cost access to the six proposed partner facilities through the NSUF Rapid Turnaround Experiment (RTE) solicitations with proposals awarded three times a year**
- **Users can also request no-cost access through the NE Consolidated Innovative Nuclear Research (CINR) solicitation, issued once a year**
- **No base funding will be provided to maintain ion beam facilities, but up to full operating costs may be recovered through awarded RTE and CINR solicitations and if NSUF budget priorities allow**
- **NSUF management will continue to evaluate ion beam capabilities and assess adding additional capabilities based on factors such as uniqueness of capability and total capability utilization**
- **NSUF will conduct a roadmapping exercise starting in FY 2017**
- **New ion beam capability approach will commence with the next RTE solicitation set to close September 30, 2016**