



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Nuclear Science User Facilities

NSUF Overview



J. Rory Kennedy
Director, NSUF

FY 2015 NSUF Annual Program Review
DOE NE Germantown Facility
March 1-3, 2016

Acknowledgements

- **Dan Ogden, Deputy Director**
- **Jim Cole, Chief Scientist**
- **John Jackson, Industry Program Lead**
- **Brenden Heidrich, Capabilities Coordinator**
- **Jeff Benson, Program Administrator**
- **Collin Knight, PIE Management Lead**
- **Sarah Robertson, Communications Liason**
- **Lindy Bean, Planning and Financial Controls**
- **Kelly Cunningham, NFML Support Staff**
- **Jonathan Kirkham, NEID Support Staff**
- **Assel Aitkaliyeva, Project Technical Lead**
- **Thomas Maddock, Project Technical Lead**
- **Donna Post-Guillen, Project Technical Lead**
- **Renae Soelberg, Administrative Assistant**

- **ATR NSUF General**
- **FY 2015 Accomplishments – Milestones**
- **FY 2015 Accomplishments – Highlights**
- **FY 2016 Budget and Milestones**

- The research performed to support nuclear energy development requires specialized (expensive) and increasingly rare capabilities
 - High flux reactors
 - Hot cells
 - Support infrastructure (shipping casks, test fabrication, etc.)
 - State-of-the-Art instrumentation & Expertise
- But also intellectual capital
 - Universities
 - Nuclear Industry
 - Innovative Small Businesses
 - National Laboratories
- The ATR NSUF aims to merge the national nuclear research infrastructure with intellectual capital to pair the best ideas with needed capability
- The ATR NSUF offers access to capabilities and expertise at no cost to the user. The NSUF can fund experiment design, fabrication, transport, irradiation, and post irradiation examination (PIE) activities.
- The ATR NSUF core purpose is to provide an avenue for innovative ideas that address NE mission needs to be realized.

- Established 2007 under INL IFM funding
- DOE Office of Nuclear Energy first and only user facility
- Idaho National Laboratory is lead institution
- Partner Facilities established starting in 2008 (self selection)
 - 8 Universities + 3 universities in CAES
 - 2 National Laboratories (2 under consideration)
 - 1 Industrial
- Total of ~\$122M in DOE support (2008-2015)
- Effective FY2015 budget: ~\$18.5M (\$4.5M increase from FY14)
- 4 types of projects:
 - Irradiation + PIE
 - PIE only
 - “APS” (beamline at other user facilities)
 - Rapid Turnaround Experiments
- University, National Laboratory, Industry, International



- **Total of 27 awarded projects executed**
- **Total of 10 awarded projects currently ongoing (excluding RTEs)**
- **Total of 80 RTEs executed**
- **Total of 30 RTEs ongoing**
- **147 total projects awarded**
 - 103 projects to 25 US universities
 - 40 projects to 5 national laboratories
 - 4 projects to 3 international (Oxford U., Manchester U., ANSTO)
- **143 total projects across 17 states**

- **No personnel changes in FY 2015**
- **Personnel changes in FY 2016**
 - **Jim Cole, Chief Scientist left (10/1/15)**
 - **Jonathan Kirkhall, (10/1/15)**
 - **Kelly Cunningham, (11/4/15)**

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- **Completed all (11) level 2 milestones on time**
 - **Award NSUF Rapid Turnaround Experiments from Summer FY 2014 call - 11/30/2014 (11/12/2014)**
 - **Provide award recommendations for NSUF Rapid Turnaround Experiments for Winter FY 2015 call - 3/27/2015 (3/19/2015)**
 - **Complete irradiation of EPRI-1 in the ATR 2A Center test train - 5/1/2015 (2/17/2015)**
 - **Provide Award Recommendations for NSUF Access in the FY 2015 CINR FOA - 5/27/2015 (5/14/2015)**
 - **Deploy Private Data Base - 6/30/2015 (6/25/2015)**
 - **Complete 80% of the FY 2014 awarded RTE's - 6/30/2015 (6/17/2015)**
 - **Provide award recommendations for NSUF Rapid Turnaround Experiments for Spring FY 2015 call - 8/1/2015 (7/22/2015)**
 - **Enhance the sample library - 9/30/2015 (9/24/2015)**
 - **Retire Mortgages from NSUF Awards made prior to FY 2014 - 9/30/2015 (9/29/2015)**
 - **Perform Gap Analysis for Infrastructure Database - 9/30/2015 (9/28/2015)**
 - **Complete at least four mortgaged experiments (UCSB-2, Utah State, Drexel Max, ISU Mantra, UCB, Penn State, U of I 355) - 9/30/2015 (9/14/2015)**
 - **Completed PEMP Notable Outcome 1.1A “As part of the National Scientific User Facility (NSUF), establish a capability and infrastructure database”**

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- **Completed 9 of 11 level 3 milestones on time**
 - **Hold NSUF Program Review Meeting - 12/31/2014 (12/10/2014)**
 - **Form Infrastructure Database Review Committee - 1/30/2015 (1/28/2015)**
 - **Identify and document major NE R&D capabilities - 3/15/2015 (3/13/2015)**
 - **Deliver report with final analysis of the NSUF FY 2014 Metrics - 3/31/2015 (3/31/2015)**
 - **Hold Users' Meeting for the Advanced Test Reactor National Scientific User Facility - 6/30/2015 (6/22/2015)**
 - **Complete preparations of the HFEF Instron load frame - 7/1/2015 (4/7/2015)**
 - **Publish FY 2014 NSUF Annual Report - 7/31/2015 (7/30/2015)**
 - **Hold ATR NSUF Industry Advisory Committee (ANIAC) meeting - 7/31/2015 (7/1/2015)**
 - **Ready-to-insert SAM-1 - 8/31/2015 (not completed)**
 - **Improving SiC temperature monitor post-processing - 9/30/2015 (9/28/2015)**
 - **Complete Boise State University design review - 9/30/2015 (not completed)**

FY 2015 Accomplishments Highlights

■ NSUF reporting presentations or participation

- Nuclear Fuel Industry Research – NFIR (October, 2014)
- Nuclear Engineering Department Head Organization Meeting – NEDHO (November, 2014)
- NSUF FY 2014 Annual Review Meeting (December, 2014)
- National User Facilities Organization – NUFO (April, 2015)
- NEAC Subcommittee on Infrastructure (May, 2015)
- INL NS&T Directorate Review (May, 2016)
- NSUF Users Organization Meeting (June, 2015)
- Nuclear Engineering Department Head Organization Meeting – NEDHO (June, 2015)
- NSUF Industry Advisory Committee (July, 2015)
- NSUF Scientific Review Board Meeting (July, 2015)
- **UK Academics Discussion Meeting – Sheffield, UK (September, 2015)**

FY 2015 Accomplishments Highlights

■ NSUF general presentations, exhibits, or other

- Nuclear Materials Conference (October, 2014) – exhibit
- ANS Winter Meeting (November, 2014) – exhibit
- EPRI Primary Systems Corrosion Technical Advisory Committee (November, 2014)
- MRS Winter Meeting (December, 2014) – exhibit
- TMS Annual Meeting (March, 2015) - exhibit
- NSUF partner facilities visits (February, 2015 – April, 2015)
 - Purdue U., NC State U., U. Michigan, U. Wisconsin, U. Cal. Berkeley, IIT/MRCAT, MIT, Westinghouse, ORNL, PNNL, NSLS-II/BNL, IVEM/ANL, LANL
- ANS Student Meeting (April, 2015) – exhibit
- International Cooperative Group on Environmentally Assisted Cracking of Water Reactor Materials (April, 2015)
- NSUF Users Meeting (June, 2015)
- ANS Annual Meeting (June, 2015) – panel
- Environmental Degradation Conference - Canada (August, 2015)
- Global Conference – Paris, France (September, 2015)
- Hot Lab Conference – Leuven, Belgium (September, 2015)
- EPRI Nuclear Power Council Meeting (September, 2015)
- Radiation and Reactor Safety Meeting (September, 2015)

FY 2015 Accomplishments Highlights

- **Completed forward funding of all pre-CINR mortgages**
- **Established dedicated NSUF Technical Leads (goal 3-4, >75% FTE)**
 - **Thomas Maddock (100%)**
 - **Assel Aitkaliyeva (~60%)**
 - **Donna Post-Guillen (~25%)**
- **CINR integration**
 - **FY 2014 – integrated NSUF into call**
 - **FY 2015 – performed technical, relevancy, and feasibility reviews**
 - **41 LOIs, 31 pre-applications, 17 full applications**
 - **Awarded 5 projects**
 - 4 NSUF access only
 - 1 R&D + NSUF
 - **Awarded \$4.2M out of \$4.4M available**
 - **Lessons learned to apply to FY 2015 call (FY 2016 reviews and awards)**
 - Programs to dedicate work-scopes to NSUF
 - Only accept invited full proposals

FY 2015 Accomplishments Highlights

■ Irradiation Activities

● Static Capsule Irradiation Experiments

– Completed irradiations FY 2015:

- Pennsylvania State University – “Transducers for In-pile Ultrasonic Measurements of Fuels and Materials Evolution” (MITR)

– On-going irradiations in FY 2015:

- EPRI-ZG-C & EPRI-ZG-D – “Irradiation and Post-irradiation Examination (PIE) to Investigate Hydrogen Assisted Anomalous Growth in Zirconium Alloys”

– Started in FY 2015:

- 269 Boise State University – “High Temperature In-pile Irradiation Test of Single Phase U3Si2”

● Instrumented Lead Experiments

– None

● Pressurized Water Loop (Loop 2A) Experiments

– Completed irradiations in FY 2015:

- EPRI-1 - “Irradiation and PIE of Alloys X-750 and XM-19”

– On-going irradiations in FY 2015:

- EPRI-3 - “Irradiation and PIE of Alloys X-750 and XM-19”
- Nuclear Regulatory Commission – “Irradiation and Testing of Austenitic Stainless Steel in BWR Conditions”

● Hydraulic Shuttle (rabbit) Irradiation Experiments

– None

FY 2015 Accomplishments Highlights

■ PIE Activities

● Materials Projects

– Completed PIE in FY 2015:

- Drexel University – “Advanced Damage-Tolerant Ceramics: Candidates for Nuclear Structural Applications”
- APS – ANL “Synchrotron X-Ray Characterizations of Advanced Accident-tolerant Cladding”
- University of California, Santa Barbara-2 – “High Fluence Embrittlement Database and ATR Irradiation Facility for LWR Vessel Life Extension”
- Atomic Energy of Canada Ltd. (AECL) – “TEM and Micro-hardness of CANDU Reactor Springs”

– On-going PIE in FY 2015:

- Utah State University – “Irradiation Effect on Thermophysical Properties of Hf₃Al-Al Composite: A Concept for Fast Neutron Testing at ATR”
- Illinois 355 – “Post Irradiation Tensile Performance of Fe-Cr Base Alloys”
- EPRI-ZG-A and EPRI-ZG-B – “Irradiation and Post-irradiation Examination (PIE) to Investigate Hydrogen Assisted Anomalous Growth in Zirconium Alloys”
- EPRI-2 – “Irradiation and PIE of Alloys X-750 and XM-19”

FY 2015 Accomplishments Highlights

■ PIE Activities

● Fuels Projects

- Completed PIE in FY 2015:
 - APS – ORNL “Investigation of the chemical state of Ag and Pd in SiC shell of irradiated TRISO particles via XAFS”
- On-going PIE in FY 2015:
 - University of California, Berkeley – “Hydride LWR Fuel Rod Irradiation”
- Started PIE in FY 2015:
 - University of Central Florida-1 – “Low Fluence Behavior of Metallic Fuels”

● Instrumentation Projects

- Completed PIE in FY 2015:
 - Pennsylvania State University – “Transducers for In-pile Ultrasonic Measurements of Fuels and Materials Evolution”

● Nuclear Data Projects

- Completed PIE in FY 2015:
 - Idaho State University – “Measurement of Actinide Neutronic Transmutation Rates with Accelerator Mass Spectroscopy” (MANTRA)

■ Rapid Turnaround Experiments

- 47 proposals submitted from 18 institutions
 - 11 US Universities
 - 4 National Laboratories
 - 3 Foreign Institutions
- 30 experiments accepted from 17 institutions
 - 10 US Universities
 - 4 National Laboratories
 - 3 Foreign Institutions (2 UK Universities)
- 5 NSUF facilities performed experiments
 - 22 CAES
 - 2 University Wisconsin
 - 2 University Michigan
 - 2 University California, Berkeley
 - 2 Idaho National Laboratory



■ Industry Programs

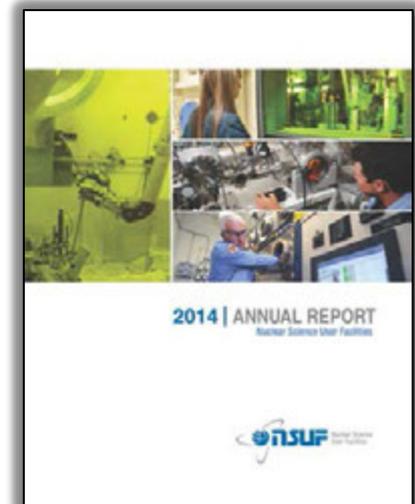
- **Very strong industry interest**
 - **New Irradiation Assisted Stress Corrosion Cracking (IASCC) test system**
 - **First results on EPRI-2 X-750 and XM-19 material (fracture toughness)**
 - **CINR – positive about call open to all (FY14/FY15 – 0 pre-apps; FY15/FY16 – 3 pre-apps, 2 full apps)**
- **On-going projects:**
 - **EPRI-1, -2, and -3**
 - **EPRI-ZG-A, -B, -C, and -D**
 - **AECL PIE**
 - **NRC**



FY 2015 Accomplishments Highlights

■ Communications

- **“Modernization”/Branding**
 - New logo
 - New factsheet
 - Initiated website overhaul
 - Exhibit renovation
 - New look to Annual Report
- **Development of web based tool to track/monitor user progress/activities (publications, conferences, awards, major advances, etc.) on “real time” basis.**
 - Initiated quarterly reporting (users feelings on this are mixed)
 - Updated publications area of website with hyperlink on publication title
- **Enhance communication and interaction**
 - Enhance and distribute monthly report to users org
 - Weekly update teleconferences
 - Annual and semi-annual review meetings (for DOE)
 - Enhance promotion of NSUF and involvement of users
 - Running video of capabilities (including partner facilities)
 - Enhance participation of users at NSUF exhibits – limited success
 - Acknowledgements statement in publications and presentations
 - » In user agreement, on line availability, noticeable increase



FY 2015 Accomplishments Highlights

■ Metrics – all metrics met

- **Efficient use of funding for new awards**
 - >50% funding to new awards
- **Effective use of NSUF capabilities**
 - >20% funding to partner facilities
- **Publications and presentations**
 - >20 peer reviews articles or presentation proceedings
- **Prominence and positive exposure for NSUF**
 - Invited lectures, etc. 5% increase per year
- **Expand and diversify NSUF user community**
 - Analyze data and act on trends

■ Partner utilization

- **Partner facilities are more engaged**
 - Applications were submitted by and/or for all partner facilities except Purdue and UNLV (visits paid off)
- **Partnering interest growing**
 - Argonne National Laboratory/IVEM - meeting
 - Brookhaven National Laboratory/NSLS-II – initiated discussions
 - Los Alamos National Laboratory - visited
 - Sandia National Laboratory
 - Texas A&M University
 - Colorado School of Mines

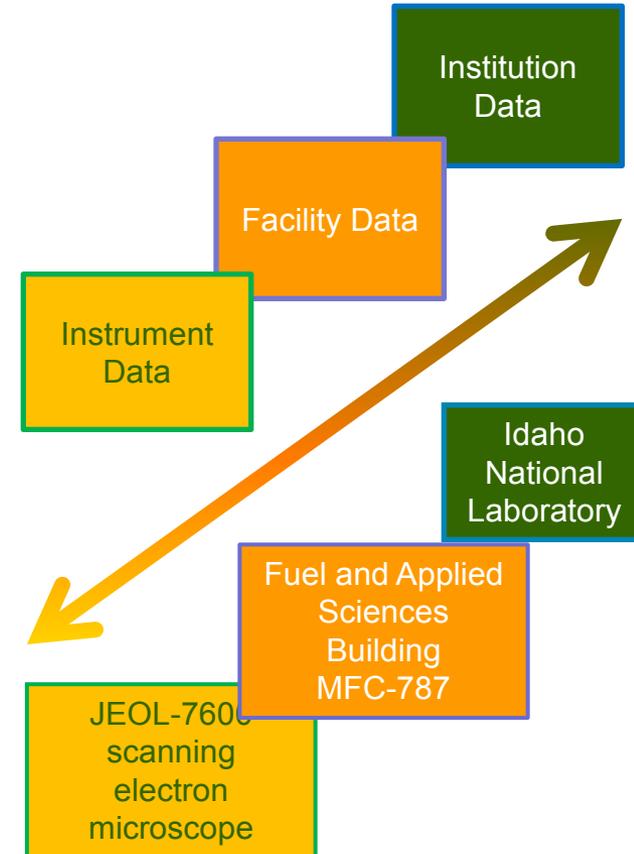
FY 2015 Accomplishments Highlights

■ Infrastructure / Capabilities

- Nuclear Energy Infrastructure Database (NEID) created (updating/expansion continues)
- Over 100 institutions operating over 400 facilities housing over 800 instruments
- Current NEID users include researchers from 34 Federal Government and National Laboratories, 22 Universities and NGOs, and 5 Industry organizations.
- Used to complete initial infrastructure gap analysis

■ Nuclear Fuels and Materials Library (NFML)

- 12 experiments used NFML materials
- Collaboration with UK NNUF material archive progressed. Other international interest developed.
- Established NFML policy
- SAM project planning moved forward



FY 2016

- **Execute awarded projects (CINR, pre-CINR, RTEs, CRADAS)**
- **CINR (FY16 - \$10M, FY15 - \$4.1M, FY14 - \$400K)**
 - 80 LOIs, 67 pre-proposals, 32 full proposals
 - Feasibility reviews – technical leads
 - Engaged programs for better interaction (lessons learned)
- **Rapid Turnaround Experiments (3 calls per year, 30 awarded in FY15)**
- **Nuclear Energy Infrastructure Database (NEID)**
 - Release public version
 - Continue to update
 - Hire NEID support staff
- **Nuclear Fuels and Materials Library (NFML)**
 - Web based interactive similar to NEID
 - Increase capacity and content including SAM series
 - Enable easier and less expensive access
 - Hire NFML support staff

- **Industry**
 - Mechanical testing – IASCC (crack growth, fracture, and tensile testing)
- **TREAT support**
 - Hodoscope refurbishment & data acquisition system
 - Initiate implementation of advanced hodoscope design
- **Knowledge & Validation Center**
 - Initial organizational set-up
- **High Performance Computing**
 - ~30% of cpu time on Falcon machine available through NSUF
 - Incorporate into CINR and RTE calls
- **Infrastructure Call**
 - National Laboratory capability enhancement (competitive)
- **GAIN support**
 - Initial organizational set-up

■ **IVEM**

- ~50% base support
- Offer through CINR and RTE calls
- Ion Beam Workshop

■ **Instrumentation/scientist support**

- Support instrument scientists at ~20% time to maintain or establish international reputation and/or develop/adapt/implement cutting edge techniques
- 13 instruments (2.6 FTEs) at INL

■ **Communication/Training/Development**

- Users Meeting
- Website development
- Exhibits
- Interns

FY 2016 Milestones Level 2

13 L2 Milestones (FY15 – 11)

Milestone Title	Estimated Finish
Conduct FY15 Monthly NSUF Program Performance Analysis and Submit Performance Review Presentations to DOE	10/31/2015
Provide NSUF RTE award recommendations for the FY 16 1st call	11/30/2015
EPRI-3 Ready to Insert	12/24/2015
Deploy the Public Database	12/24/2015
Complete As-run Analysis on NSUF experiment irradiated in ATR.	3/31/2016
Provide NSUF RTE award recommendations for the FY 16 2nd call	3/31/2016
Submit Report for Annual Program Review at a Partner Facility	4/28/2016
Provide award recommendations for the FY 16 CINR FOA	5/15/2016
Complete 85% of FY 15 Awarded RTE	6/30/2016
Ion Beam Investment Options Workshop Report	6/30/2016
Gap Analysis Progress Report for FY16	6/30/2016
Provide NSUF RTE award recommendations for the FY 16 3rd call	7/29/2016
Establish the Sample Library Database	9/29/2016

FY 2016 Milestones Level 3

30 L3 Milestones (FY15 – 11)

Milestone Title	Estimated Finish
Complete UCF-1 Sample Shipment to NSLS-II (Brookhaven National Laboratory)	12/15/2015
UCF-3 Ready-to-Insert in ATR cycle 158B	12/24/2015
SAM-1 Ready to Insert in ATR Cycle 158B	12/24/2015
Complete BSU design review	1/28/2016
Report	1/29/2016
FY 2016 Cycle 1 IVEM Utilization	2/29/2016
Complete practice SCC test in new EIL laboratory with PWR water chemistry	2/29/2016
Compile and Analyze FY 2015 Performance Metrics	3/30/2016
Complete Utah State University (USU) PIE	3/31/2016
Complete Microscopy Analysis for EPRI X-750 tensile specimens	3/31/2016
Provide mid-year HPC Utilization data for NSUF projects	4/29/2016
UCF-2 Ready-to-Insert in ATR cycle 160A	5/16/2016
Complete installation of the HFEF in-cell load frame feedthrough	5/31/2016
Ship first set of samples to APS	5/31/2016
Implement LabView SCC/Fracture control software in CAES or EIL test system	5/31/2016
Complete Design Review	6/30/2016
FY 2016 Cycle 2 IVEM Utilization	6/30/2016
2015 NSUF Annual Report electronic publication on the NSUF website	6/30/2016
Submit NSUF Users Meeting Report	7/28/2016
Perform Type B Experiment Shipment, ATR to HFEF	7/29/2016
Complete procurement and initial mockup of new extensometer for HFEF Instron	7/29/2016
Boise 8242 Ready-to-Insert in ATR cycle 160B	9/21/2016
Complete preparations for insertion of the irradiation capsule in MITR.	9/30/2016
FY 2016 Cycle 3 IVEM Utilization	9/30/2016
Provide year-end HPC utilization data for NSUF projects	9/30/2016
Complete procurement and initial mockup of new, multi-zone furnace for HFEF Instron	9/30/2016
FY 2016 IVEM Annual Report	9/30/2016
Complete UI 355 Testing at MRCAT	9/30/2016
Submit memo to the NSUF Director documenting completion of examination on Set 1 samples	9/30/2016
Complete first set of beamline experiments at APS	9/30/2016

- **1st Quarter (10/1/2015 – 12/31/2015)**
 - 4 Level 2 milestones
 - 3 Level 3 milestones
- **2nd Quarter (1/1/2016 – 3/31/2016)**
 - 2 Level 2 milestones
 - 7 Level 3 milestones
- **3rd Quarter (4/1/2016 – 6/30/2016)**
 - 5 Level 2 milestones
 - 8 Level 3 milestones
- **4th Quarter (7/1/2016 – 9/30/2016)**
 - 2 Level 2 milestones
 - 12 Level 3 milestones

