April 15, 2024

Lindy Bean
CINR Administrator

INL/MIS-24-77360

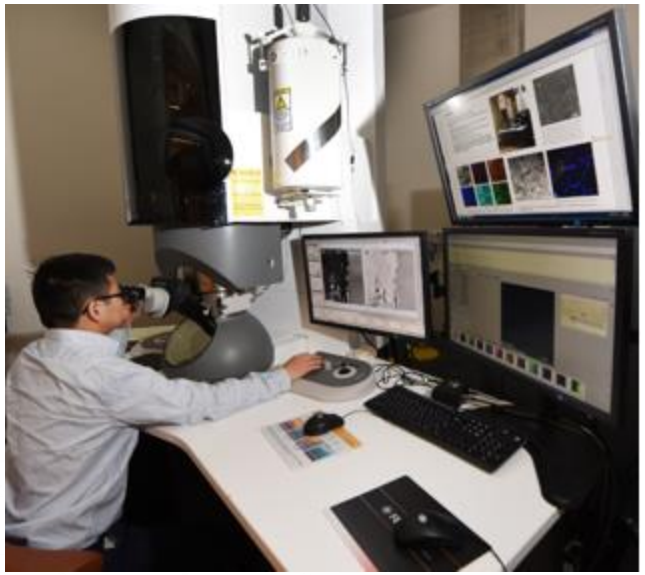
CINR NSUF Access Awards & Status

Nuclear Science User Facilities

NSUF CINR Overview

- Once a year, NSUF seeks proposals that will utilize NSUF irradiation, post-irradiation examination and beamline capabilities through the Consolidated Innovative Nuclear Research (CINR) Funding Opportunity Announcement (FOA).

- Through the NSUF CINR work scopes, NSUF provides no-cost access to world class capabilities to facilitate the advancement of nuclear science and technology. In addition to access to state-of-the-art facilities, NSUF provides technical assistance including the design and analysis of reactor experiments.



NSUF CINR Schedule

	FY23 CINR	*FY24 CINR*
Webinar	August 9, 2022	May 31, 2023
FOA was Issued	August 30	June 22
Letters of Intent	September 15	July 12
Pre-Applications	October 12	July 26
Preliminary Statements of Work	November 30	August 31
Pre-Application Readiness Review	December	mid October
Pre-Application Selection Panel	December 6-7	October 16 (wk of)
Final Statements of Work	January 25	December 6
Full Applications	February 8	December 20
Final Readiness Review	April	February 26 (wk of)
Selection Panel	May 1	March 11
Awards Announced	June 15	~April

FY 2023 CINR Access Awards
Where work is performed

Work performed at						
Award To	# of Awards	ORNL	Michigan	Purdue	WEC	Award Amount (K$)
Laboratory	1	$563	$671	$0	$342	$1,575
University	2	$4,191	$0	$596	$0	$4,787
Total	3	$4,754	$671	$596	$342	$6,362

NSUF FY 2023 Access Awards

Lead Institution	PI	Value, $M	Duration	Title
University of Texas at San Antonio	Prof. Elizabeth Sooby	$2.5	6 years	UN multi-design irradiation campaign: a critical assessment of accelerated burnup and main correlations for mechanistic fuel performance modeling

Objective:

To produce a robust array of uranium mononitride (UN) irradiated samples to serve post irradiation examination (PIE) and demonstrate the significant performance margins and safety of UN. The proposing team, which is comprised of fuels experts from the academic, national laboratory, and industry sectors, aims to probe the impact of fabrication impurities and fuel density as a function of both temperature and burn-up.

Collaborators:

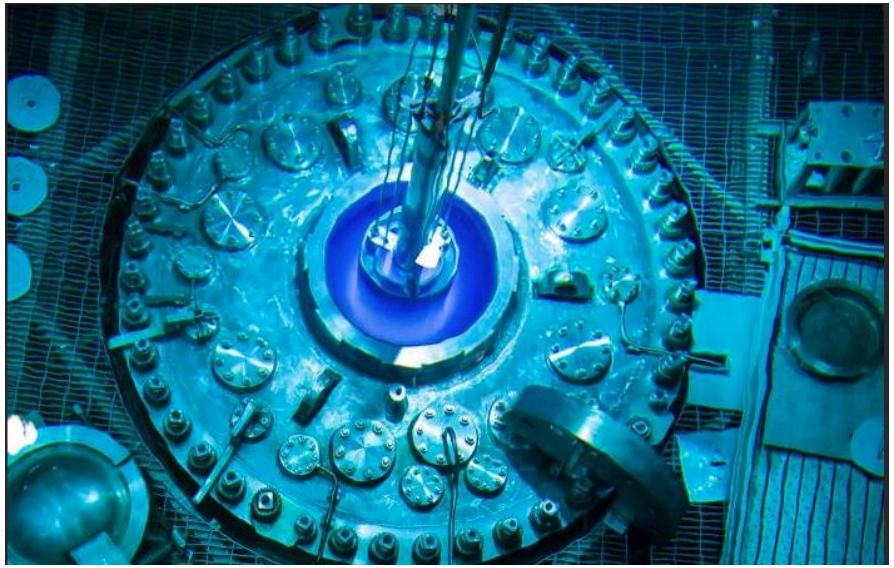
Drs. Joshua White, Michael Cooper - LANL
Drs. Jason Harp, Nathan Capps - ORNL
Drs. Denise Lopes, Luke Olson - Westinghouse

Technical Lead:

Mr. Kory Linton, ORNL

Capabilities:

ORNL - High Flux Isotope Reactor (HFIR), Irradiated Fuels Examination Laboratory (IFEL), and Low Activation Materials Development and Analysis (LAMDA) facilities



NSUF-1.1: Core and Structural Materials and Nuclear Fuel Behavior and Advanced Nuclear Fuel Development

NSUF FY 2023 Access Awards, continued

Lead Institution	PI	Value, $M	Duration	Title
Purdue University	Prof. Janelle Wharry	$2.3	5 years	Irradiation-Corrosion of Alumina-Forming Austenitic Stainless Steels in Static Lead

Objective:

Investigate the performance of alumina-forming austenitic stainless steels in coupled extremes of neutron irradiation and static lead. The results of this work will inform the extent of liquid metal embrittlement of this leading candidate material for lead fast reactor designs. A novel irradiation-corrosion capsule for miniature tensile specimens will be utilized, and post-irradiation/corrosion examination will include structural, chemical, and mechanical characterizations.

Collaborators:

Drs. Bruce Pint, Tim Graening, Timothy Lach, Yukinori Yamamoto and Mr. Kory Linton - ORNL
Prof. Ahmed Hassanein - Purdue
Dr. Michael Ickes - Westinghouse

Technical Lead:

Mr. Kory Linton, ORNL
Prof. Ahmed Hassenein, Purdue University

Capabilities:

ORNL - High Flux Isotope Reactor (HFIR), Irradiated Material and Testing (IMET), and Low Activation Materials Development and Analysis (LAMDA) facilities.

Purdue University's Interaction of Materials with Particles and Components Testing (IMPACT) Laboratory.

NSUF-1.1: Core and Structural Materials and Nuclear Fuel Behavior and Advanced Nuclear Fuel Development

NSUF FY 2023 Access Awards, continued

Lead Institution	PI	Value, $M	Duration	Title
Oak Ridge National Laboratory	Dr. Maxim Gussev	$1.6	3 years	Elemental Effects on Radiation Damage in Tempered Martensitic Steels Irradiated to High Doses at Fast Reactor Relevant Temperatures

Objective:

During several testing campaigns of irradiated materials (past and current), it has been observed that highly irradiated (>10 dpa) austenitic stainless steels can undergo intergranular brittle fracture at ambient conditions. This project is intended to support continued operation of light water reactors via analyzing and mitigating this phenomenon.

Collaborators:

Prof. Gary Was, University of Michigan
Ms. Catherine Cmar, Westinghouse

Technical Leads:

Mr. Kory Linton, ORNL
Prof. Kevin Field, University of Michigan
Ms. Catherine Cmar, Westinghouse

Capabilities:

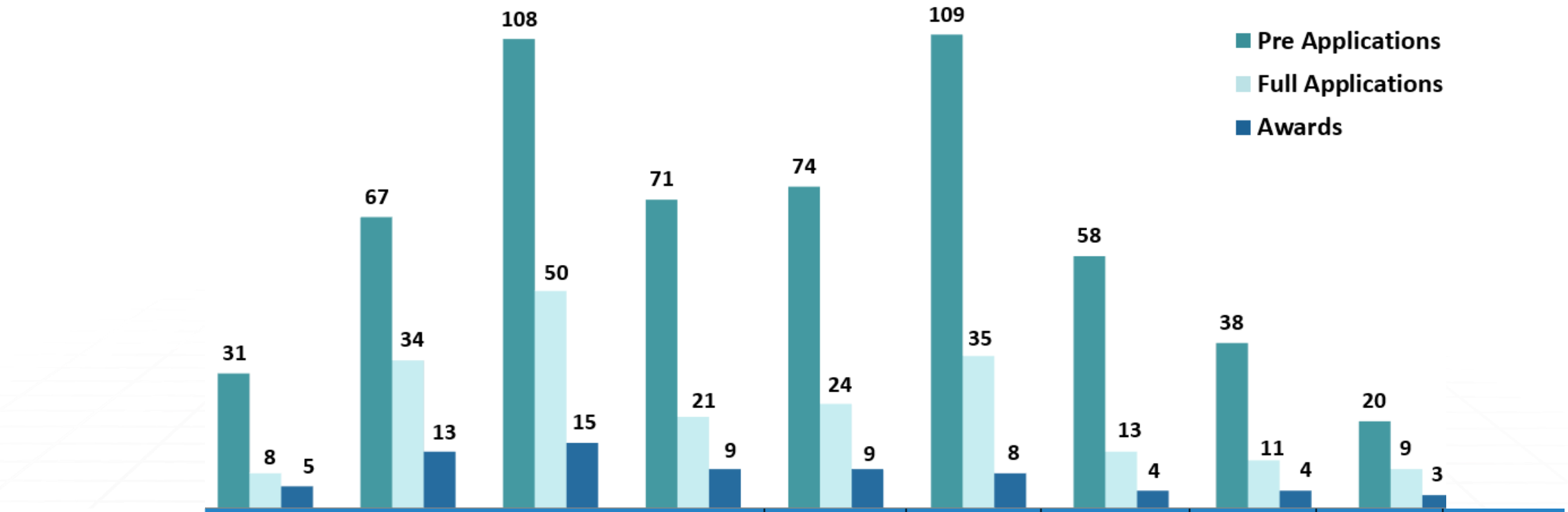
ORNL's Low Activation Materials Development and Analysis (LAMDA) facility

University of Michigan's Irradiated Material Testing Laboratory

Westinghouse Churchill Laboratory Services

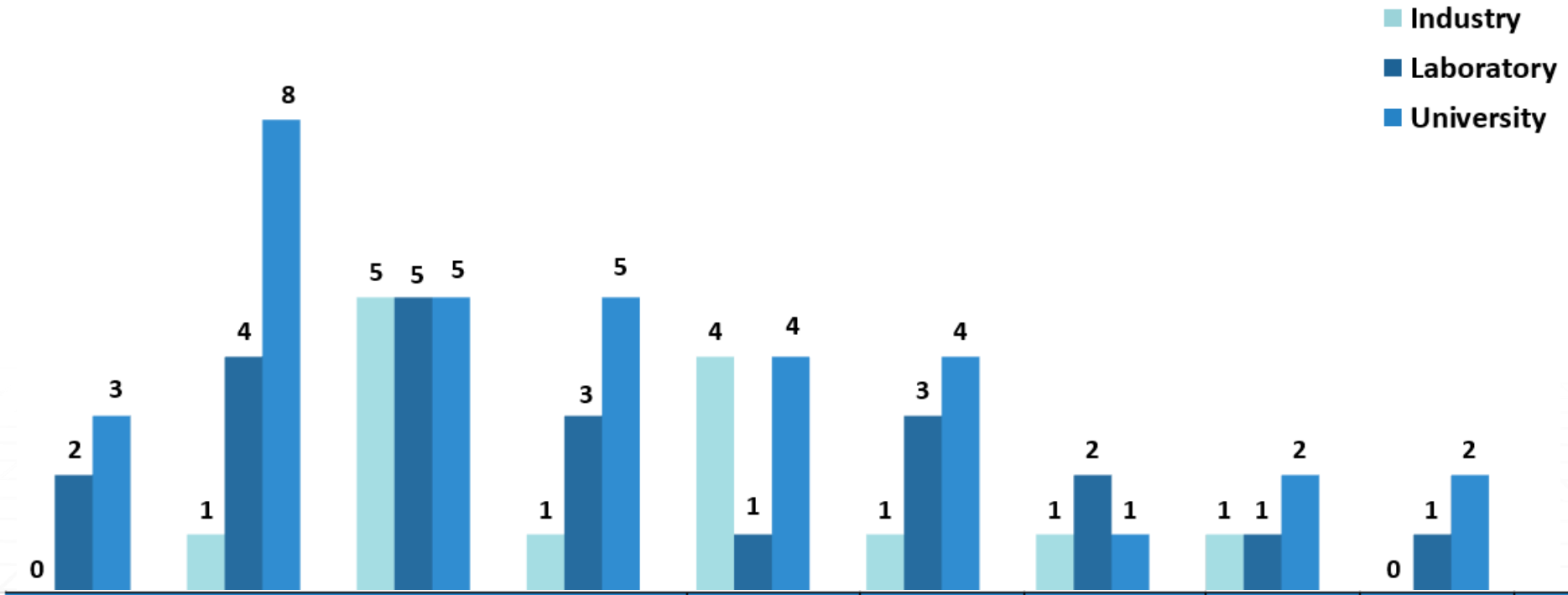
NSUF-1.1: Core and Structural Materials and Nuclear Fuel Behavior and Advanced Nuclear Fuel Development

NSUF CINR Applications to Awards



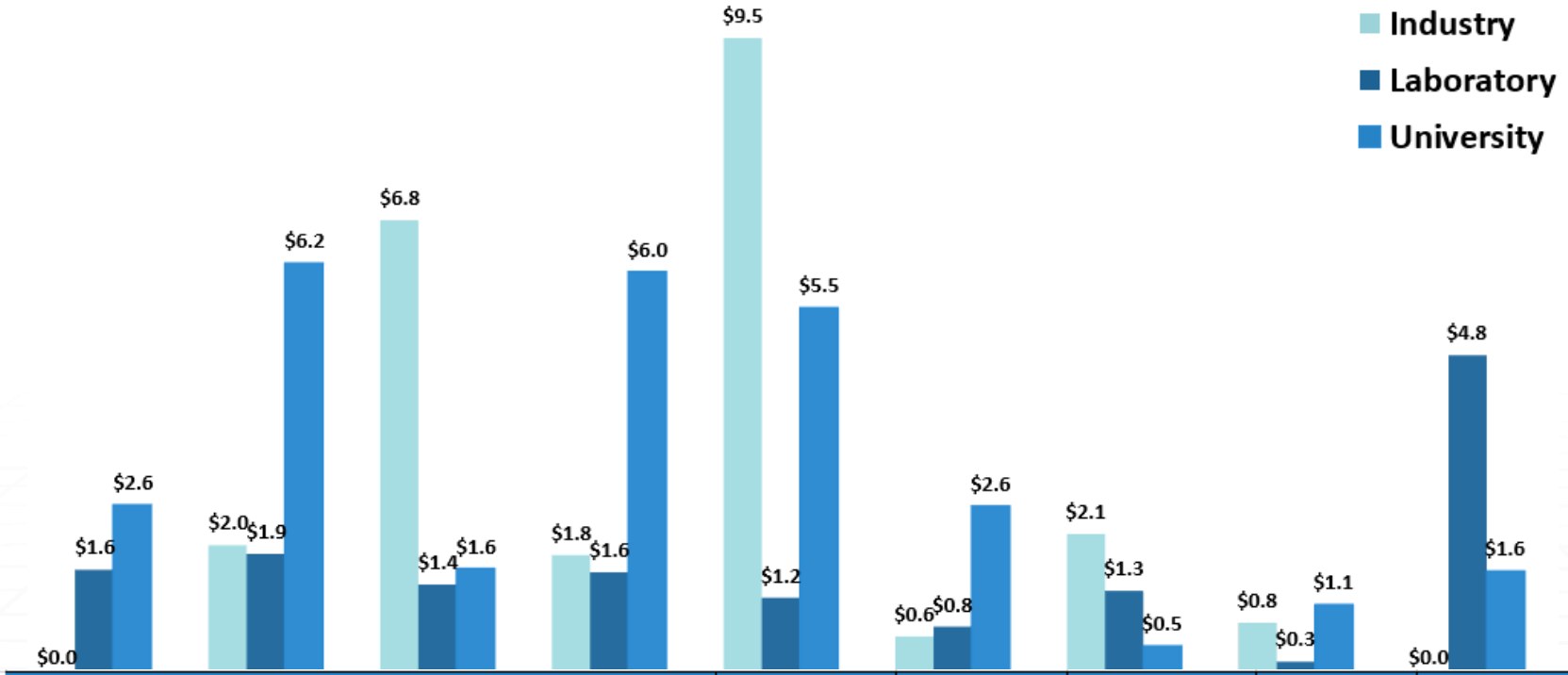
	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Pre Applications	31	67	108	71	74	109	58	38	20	576
Full Applications	8	34	50	21	24	35	13	11	9	205
Awards	5	13	15	9	9	8	4	4	3	70

NSUF CINR Awards by Institution Type



	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Awards	5	13	15	9	9	8	4	4	3	70
Industry	0	1	5	1	4	1	1	1	0	14
Laboratory	2	4	5	3	1	3	2	1	1	22
University	3	8	5	5	4	4	1	2	2	34

NSUF CINR Award Amounts by Institution



	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Awards	5	13	15	9	9	8	4	4	3	70
Awards, $M	$4.2	$10.0	$9.8	$9.5	$16.2	$4.0	$3.9	$2.2	$6.4	$66.2
Industry	$0.0	$2.0	$6.8	$1.8	$9.5	$0.6	$2.1	$0.8	$0.0	$23.7
Laboratory	$1.6	$1.9	$1.4	$1.6	$1.2	$0.8	$1.3	$0.3	$4.8	$14.8
University	$2.6	$6.2	$1.6	$6.0	$5.5	$2.6	$0.5	$1.1	$1.6	$27.7

NSUF Access Awards

Award Year	Awards	Completed	Ongoing
Pre-CINR	31	30	1
FY 2015	5	5	0
FY 2016	13	11	2
FY 2017	15	13	2
FY 2018	9	6	3
FY 2019	9	2	7
FY 2020	8	4	4
FY 2021	4	0	4
FY 2022	4	0	4
FY 2023	3	0	3
Total	**101**	**71**	**30**

NSUF Ongoing Access Awards

ID	Title	Awardee	PI	Award Amt	NSUF Facilities	Ongoing Work
269	High Temperature In-pile Irradiation Test of Single Phase U3Si2	Boise State	Darryl Batt (Univ of Utah)	n/a	ATR, MFC, MaCS	Irradiation - High fluence irradiation to resume in April (ATR down) PIE - expect to complete APT analysis of low fluence U3Si2 fuel clad with FeCrAl by 5-31-24
Pre CINR Total				**n/a**		
15-8242	Irradiation Influence on Alloys Fabricated by Powder Metallurgy and Hot Isostatic Pressing for Nuclear Applications	Boise State University	Janelle Wharry (Purdue)	$1,597,782	ATR, MFC	Completed in FY23
FY 2015 CINR Total				**$1,597,782**		
16-10393	Irradiation Testing of LWR Additively Manufactured Materials	GE Hitachi Nuclear Energy	Myles Connor	$1,981,622	ATR, MFC, MaCS	PIE - cask (GE100 pig) is at HFEF; unload to happen after outage is complete
16-10537	Enhancing irradiation tolerance of steels via nanostructuring by innovative manufacturing techniques	Idaho State University	Haiming Wen (Missouri S&T)	$2,459,295	ATR, MFC, MaCS	PIE - work on 2 dpa is completed; started prep for Kanthal D 6 dpa TEM disks.
FY 2016 CINR Total				**$4,440,917**		
17-12985	Irradiation, Transient Testing and Post Irradiation Examination of Ultra High Burnup Fuel	EPRI	Ken Yueh	$3,588,402	ATR, IFEL, MFC	None
17-13007	Irradiation of Advanced Neutron Absorbing Material to Support Accident Tolerant Fuel	AREVA NP Inc.	~~Jacqueline Stevens~~ Mattieu Aumand	$630,000	HFIR, IMET	PIE - data review and curation underway; expect to have final report on HFIR Irradiation and PIE of Absorber Materials the end of April
FY 2017 CINR Total				**$4,218,402**		

Facility	Institution	
ATR	INL	Advanced Test Reactor
HFEF	INL	Hot Fuels Examination Facility at MFC
HFIR	ORNL	High Flux Isotope Reactor
IFEL	ORNL	Irradiated Fuels & Examination Laboratory
IMET	ORNL	Irradiated Material Examination & Testing facility
LAMDA	ORNL	Low Activation Materials Development & Analysis
MaCS	CAES	Microscopy & Characterization Suite
MFC	INL	Materials & Fuels Complex
MIBL	UM	University of Michigan Ion Beam Laboratory

NSUF Ongoing Access Awards, continued

ID	Title	Awardee	PI	Award Amt	NSUF Facilities	Ongoing Work
18-14717	Rapid Simulation of Irradiation Damage in PWR Internals	Oak Ridge National Laboratory	~~Kevin Field~~ Tyler Gerczak	$323,043	MIBL, LAMDA	Completed in FY23
18-14741	Demonstration of a Methodology for Direct Validation of MARMOT Irradiation-Induced Microstructural Evolution and Physical Property Models Using U-10Zr	Texas A&M University	Sean McDeavitt	$2,079,963	ATR, HFEF	Irradiation - awaiting ATR startup in April to irradiate capsules C & D PIE - expect to complete SEM on capsules A & B by 9-30-24 and begin thermal properties work
18-14783	Nanodispersion Strengthened Metallic Composites with Enhanced Neutron Irradiation Tolerance	Massachusetts Institute of Technology	Ju Li	$2,046,261	HFIR, LAMDA, HFEF	PIE at INL - continue SEM and FIB of TEM lamellae from high dpa specimens
18-14788	Irradiation Testing of Materials Produced by Additive Friction Stir Manufacturing	Aeroprobe	Chase Cox	$1,836,730	ATR, HFEF	PIE at INL - samples to transfer from HFEF to FASB; timing it around an HFEF outage
FY 2018 CINR Total				**$6,285,997**		

Facility	Institution	
ATR	INL	Advanced Test Reactor
HFEF	INL	Hot Fuels Examination Facility at MFC
HFIR	ORNL	High Flux Isotope Reactor
LAMDA	ORNL	Low Activation Materials Development & Analysis
MIBL	UM	University of Michigan Ion Beam Laboratory

NSUF Ongoing Access Awards, continued

ID	Title	Awardee	PI	Award Amt	NSUF Facilities	Ongoing Work
19-16297	Irradiation studies on electron beam welded PM-HIP pressure vessel steel	Purdue University	Janelle Wharry	$2,071,982	ATR, MFC, WEC, MaCS	Irradiation - working on shipment and shipping ESA preparation PIE - setting up WEC contract; hope to ship to WEC soon; PIE at INL, WEC, MaCS
19-16380	High Fluence Active Irradiation and Combined Effects Testing of Sapphire Optical Fiber Distributed Temperature Sensors	Idaho National Laboratory	Josh Daw	$1,205,617	OSURR, MITR	Work at MIT was completed in January; OSURR work was completed in FY21
19-16547	NuScale SMR Materials Irradiation and Testing	Nuscale Power, LLC	~~Hongqing (HQ) Xu~~ Steve Wolbert	$2,481,662	ATR, MFC, WEC	Irradiation - ongoing; first batch of specimens shipped in February to WEC PIE at INL & WEC - cleaning up corroded samples; cataloging is complete; WEC contract is pending
19-16549	Thermal Conductivity Measurement of Irradiated Metallic Fuel Using TREAT	University of Pittsburgh	Heng Ban	$1,895,185	TREAT, MFC	Irradiation - fabricating a one piece heatsink PIE -grinding, polishing samples
19-16583	Neutron Radiation Effect on Diffusion between Zr (and Zircaloy) and Cr for Accurate Lifetime Prediction of ATF	The Ohio State University	Ji-Cheng Zhao (Univ of Maryland)	$1,133,636	TREAT, MFC	PIE - EPMA prep
19-17109	Integral Fuel Rod Real-Time Wireless Sensor & Transmitter Irradiation Test and Post Irradiation Examination	Westinghouse	Jorge Carvajal	$3,097,390	HFIR, LAMDA	PIE - working on shipping
19-17159	High power irradiation testing of TRISO fuel particles with UCO and UO2 kernels in miniature fuel specimen capsules in HFIR	Kairos Power LLC	Ryan Latta	$2,997,454	HFIR, IFEL	PIE - setup the leaching system outside the cell before being inserted in cell
FY 2019 CINR Total				**$14,882,926**		

Facility	Institution	
ATR	INL	Advanced Test Reactor
HFIR	ORNL	High Flux Isotope Reactor
IFEL	ORNL	Irradiated Fuels & Examination Laboratory
LAMDA	ORNL	Low Activation Materials Development & Analysis
MaCS	CAES	Microscopy & Characterization Suite
MFC	INL	Materials & Fuels Complex
MITR	MIT	MIT Reactor
OSURR	OSU	The Ohio State University Research Reactor
TREAT	INL	Transient Reactor Test facility
WEC	WEC	Westinghouse Churchill Laboratory Services

NSUF Ongoing Access Awards, continued

ID	Title	Awardee	PI	Award Amt	NSUF Facilities	Ongoing Work
20-19076	Investigation of Degradation Mechanisms of Cr coated Zirconium alloy cladding in Reactive Initiate Accidents (RIA)	University of Wisconsin	~~Hwasung Yeom~~ WooHyun Jung	$1,683,412	TREAT, HFEF	Irradiation of remaining capsules to start in May; PIE - working baseline capsules report. Cold spray capsules are ready to ship to EML.
20-19122	Effect of neutron irradiation on microstructure and mechanical properties of nanocrystalline nickel	North Carolina State University	Korukonda Murty	$204,169	MFC, PNNL	PIE at PNNL - tensile testing, TEM data analysis
20-19128	Machine Learning on High-Throughput Databases of Irradiation Response and Corrosion Properties of Selected Compositionally Complex Alloys for Structural Nuclear Materials	University of Wisconsin	Dane Morgan	$501,996	UWIBL, IMCL	Irradiation at UW-IBL - testing cold finger assembly for high throughput irradiation stage; irradiation CrFeMnNi_A-B-C-D continues PIE at INL will start when INL receives a plate shipment from UW
20-19163	Synergy of radiation damage with corrosion processes through a separate effect investigation approach	North Carolina State University	Djamel Kaoumi	$175,000	IVEM	Completed in FY23
20-19172	Irradiation of Sensors and Adhesive Couplants for Application in LWR Primary Loop Piping and Components	EPRI	James Wall	$632,417	LAMDA	PIE - continue FIB and TEM characterization
20-19821	X-ray diffraction tomography analysis of SiC composite tubes neutron-irradiated with a radial high heat flux	Oak Ridge National Laboratory	Takaaki Koyanagi	$50,000	LAMDA	Completed in FY23
FY 2020 CINR Total				**$3,246,994**		

Facility	Institution	
HFEF	INL	Hot Fuels Examination Facility at MFC
IMCL	INL	Irradiated Materials Characterization Laboratory
IVEM	ANL	Intermediate Voltage Electron Microscope
LAMDA	ORNL	Low Activation Materials Development & Analysis
MFC	INL	Materials & Fuels Complex
TREAT	INL	Transient Reactor Test facility
UWIBL	UW	University of Wisconsin Ion Beam Laboratory

NSUF Ongoing Access Awards, continued

ID	Title	Awardee	PI	Award Amt	NSUF Facilities	Ongoing Work
21-24020	Understanding irradiation behaviors of ultrawide bandgap Ga2O3 high temperature sensor materials for advanced nuclear reactor systems	North Carolina State University	Ge Yang	$490,011	PULSTAR, MaCS	Irradiation - extracting samples for E+ bulk analysis; characterize second round of samples MaCS PIE - forthcoming
21-24327	Effect of neutron irradiation on friction stir welded Ni-based ODS MA754 alloy	Pacific Northwest National Laboratory	Ramprashad Prabhakaran	$227,446	PNNL	PIE - TEM analysis, preparingTEM Lamellae, shear punch testing
21-24335	Deployment and In-Pile Test of an Instrument for Real-Time Monitoring Thermal Conductivity Evolution of Nuclear Fuels	Idaho National Laboratory	Zilong Hua	$1,079,744	MITR	Second cycle irradiation
21-24397	Assessment of Irradiated Microstructure and Mechanical Properties of FeCrAl Alloy Fabrication Routes	GE Research	~~Andrew Hoffman~~ Haozheng Qu	$2,149,164	ATR, MIBL, MFC	Irradiation - 1st ATR cycle started PIE - to start in FY25
FY 2021 CINR Total				**$3,946,365**		

Facility	Institution	
ATR	INL	Advanced Test Reactor
MaCS	CAES	Microscopy & Characterization Suite
MFC	INL	Materials & Fuels Complex
MIBL	UM	University of Michigan Ion Beam Laboratory
MITR	MIT	MIT Reactor
PULSTAR	NCSU	North Carolina State University PULSTAR reactor

NSUF Ongoing Access Awards, continued

ID	Title	Awardee	PI	Award Amt	NSUF Facilities	Ongoing Work
22-26632	Mechanical response and chemical effects at the fuel-cladding interface of HT-9 and metallic fuel	Purdue University	Maria Okuniewski	$651,854	MFC	PIE at INL to start in FY25
22-26640	Accelerated Irradiation and Evaluation of Ultrastrong and Elastic Glassy Carbon	Idaho National Laboratory	Junhua Jiang (SRNL)	$256,423	TAMU AL, MaCS	Irradiation - 2nd ion beam irradation started PIE - 1st set of samples shipped to MaCS in March
22-26646	Integrated Effects of Irradiation and Flibe Salt on Fuel Pebble and Structural Graphites for Molten Salt Reactors	Kairos Power	Gabriel Meric	$833,191	MITR, MFC	Irradiation - preparing for insertion at MIT PIE - has not started
22-27129	Gamma irradiation effects on the mechanical behavior of seismic protective devices	University at Buffalo	Andrew Whittaker	$451,337	EIL	EIL irradiation for remaining samples. Determining effective dose for irradiated heterogeneous samples.
FY 2022 CINR Total				**$2,192,805**		

Facility	Institution	
AL	TAMU	Texas A&M University Accelarator Laboratory
EIL	INL	Energy Innovation Laboratory
MaCS	CAES	Microscopy & Characterization Suite
MFC	INL	Materials & Fuels Complex
MITR	MIT	MIT Reactor

NSUF Ongoing Access Awards, continued

ID	Title	Awardee	PI	Award Amt	NSUF Facilities	Ongoing Work
23-28959	UN multi-design irradiation campaign: a critical assessment of accelerated burnup and main correlations for mechanistic fuel performance modeling	University of Texas at San Antonio	Elizabeth Sooby	$2,498,000	HFIR, LAMDA, IFEL	Irradiation - neutronics safety document sent for reviews
23-28973	Irradiation-Corrosion of Alumina-Forming Austenitic Stainless Steels in Static Lead	Purdue University	Janelle Wharry	$2,288,974	HFIR, LAMDA, IMET, IMPACT	Irradiation - finished neutronics run, optimizing thermal design
23-29009	Investigation of intergranular cracking of highly irradiated austenitic stainless steels – materials of pressurized water reactors – in ambient conditions	Oak Ridge National Laboratory	Maxim Gussev	$1,575,111	LAMDA, MIBL, WEC	MIBL & WEC - contracts close to being awarded LAMDA - balancing dose and geometry for each sample; small specimen brick selected requires new cuts & dose measurements
FY 2023 CINR Total				**$6,362,085**		
Grand Total				**$47,174,273**		

Facility	Institution	
HFIR	ORNL	High Flux Isotope Reactor
IFEL	ORNL	Irradiated Fuels & Examination Laboratory
IMET	ORNL	Irradiated Material Examination & Testing facility
IMPACT	Purdue	Purdue University Interaction of Materials with Particles and Components Testing
LAMDA	ORNL	Low Activation Materials Development & Analysis
MIBL	UM	University of Michigan Ion Beam Laboratory
WEC	WEC	Westinghouse Churchill Laboratory Services

Questions
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