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University Research Reactor & Infrastructure Awards

Idaho National Laboratory

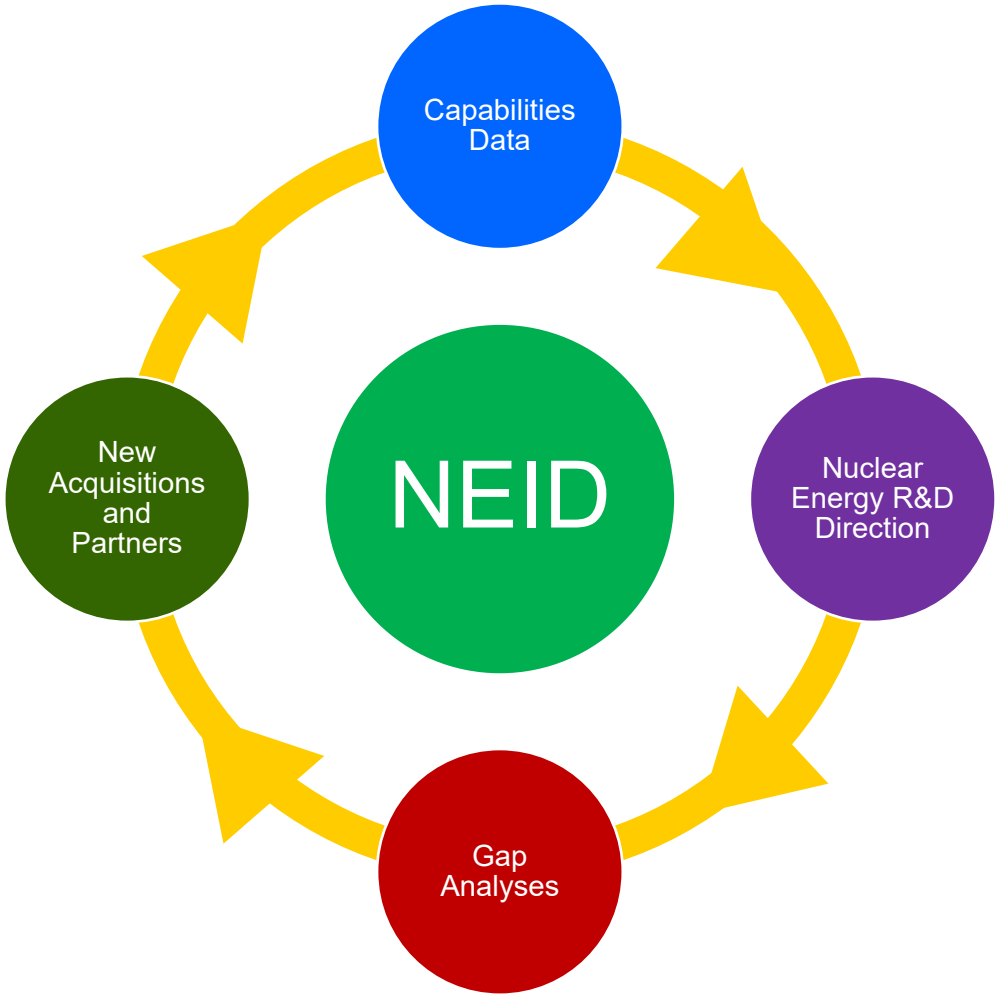
INL/MIS-21-64955

Outline

- FOA Overview & NSUF Integration
- Reactor Upgrades
  - FY 2021 Awards
  - Success Stories
- General Scientific Infrastructure
  - FY 2021 Awards
  - Success Stories

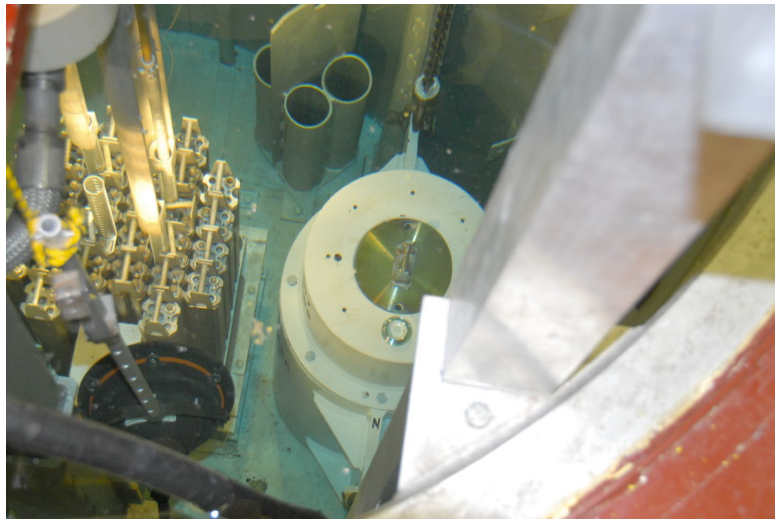
Integrated Infrastructure Enhancement Program

- NSUF has an integrated infrastructure enhancement program to support the DOE-NE priorities.
- NSUF performs periodic R&D capabilities gap analysis, provides expert advice for the University Infrastructure FOA, and maintains the Nuclear Energy Infrastructure Database.
- This process helps to ensure that DOE-NE has the needed capabilities to accomplish its R&D objectives.



FOA Organization

Area 1 – University Reactor Upgrades Infrastructure Support



Area 2 – University General Scientific Infrastructure Support

University Reactor Upgrades (RU)

- **Award Size**
  - Maximum individual award: $5,000,000
  - Expected award range: Up to $1,500,000
  - DOE anticipated to award several smaller awards
- **Estimated Funding Level**
  - Approximately $2.5 million
- **Period of Performance**
  - 1 year (ask for what you need)

Only <u>educational reactors fueled by DOE</u> are eligible

- List can be found in Part I.C.1.1 of FOA
- Each institution is permitted to submit a single, separate application for each research reactor they operate.

RU Review Criteria

Each application receives a merit review by DOE, university peers, and NSUF reviewers

Review Criteria

- (55%) **Safety and/or Security** – Potential of the requested equipment, instrumentation, or modification to:
  - Enhance the safety, performance, control, or operational reliability of research reactor systems; or
  - Increase the quality, safety/security, or efficiency of the operation of the research reactor facility.
- (15%) **Impact** – Potential of the requested equipment, instrumentation, or modification to facilitate, improve, or expand ongoing Office of Nuclear Energy research and training capabilities;
- (15%) **Utilization** – As a result of the proposed equipment, the amount of student and faculty usage of the research reactor facility, and the amount and variety of research and/or services actually provided by the facility;
- (15%) **Execution** – Capability to implement the full scope of the project, including timely project completion, personnel qualifications, budget, and feasibility.

RU Focus Area – Console Spare Parts

- A high priority for this call is the procurement of spare parts and associated hardware for research reactor control consoles.
  - These systems are vital for continued safe and reliable reactor operation.
  - Established vendors are leaving the market.
- Proposals to support continued long-term operation of the university research reactor by purchasing spare parts, subsystems, channels, and detectors will be highly regarded.

Research Reactor Upgrades – FY 2021 Awards (NSUF)

Title	Institution	Estimated Funding	Project Description
Instrumentation for Enhanced Safety, Utilization, and Operations Infrastructure at the **NCSU PULSTAR Reactor**	North Carolina State University	$341,760	This project will upgrade and enhance the safety, operations, and utilization infrastructure at the PULSTAR reactor of North Carolina State University (NCSU); installation of modern reactor console instrumentation to support the continued safe and reliable operation of the PULSTAR reactor and installation of comprehensive and facility-wide radiation protection and moisture/temperature sensor systems.
Enhancement of Availability of The **Ohio State University Research Reactor** for Supporting Research and Education	The Ohio State University	$73,539	This project will support replacement parts for essential OSU Research Reactor (OSURR) control-room equipment that has been in continuous service for decades; custom reactor protection system (RPS) modules for which the lab has no spares.
Acquisition of an Automated Pneumatic Sample Transfer System for Neutron Irradiation at the **University of Florida Training Reactor**	University of Florida	$282,000	The University of Florida will acquire an automated pneumatic sample transfer system to be used for moving samples into the University of Florida Training Reactor for irradiation and transferring the samples to laboratories for experimental use.

Research Reactor Upgrades – FY 2021 Awards (Safety)

Title	Institution	Estimated Funding	Project Description
Furthering **Oregon State University** to Meet Nuclear Science and Engineering Research Challenges Through Reactor Upgrade Investment	Oregon State University	$555,416	This project will upgrade necessary spare items to ensure sustained operation without lengthy unplanned outages for the Oregon State University Mk II Oregon State TRIGA® Reactor (OSTR) at the Oregon State University Radiation Center.
Upgrade to the 1 MW TRIGA Research Reactor Pool Liner at **Washington State University**	Washington State University	$302,657	This project will enhance the safety, performance, and continued operational reliability of the WSU research reactor: 1) Restoring the reactor tank concrete, which is in much need of repair and 2) Replacing the epoxy concrete tank liner with a modern, robust epoxy liner that has already been successfully utilized and is in service at other reactor facilities.
Reed Research Reactor Compensated Ion Chamber Replacement	Reed College	$140,000	This project will improve reliability of the reactor program at Reed College by purchasing a spare compensated ion chamber (CIC) to monitor the reactor power. The CIC allows the reactor operator to monitor and control the reactor power.
Safety and Reliability Enhancements for the **UC Irvine TRIGA Reactor**	University of California, Irvine	$74,950	This project will increase the reliability of the TRIGA reactor instrumentation and control systems, increase the radiation safety for experiments while expanding research capabilities, and improve the fuel surveillance and management program.

Research Reactor Upgrades – FY 2021 Awards (R&D)

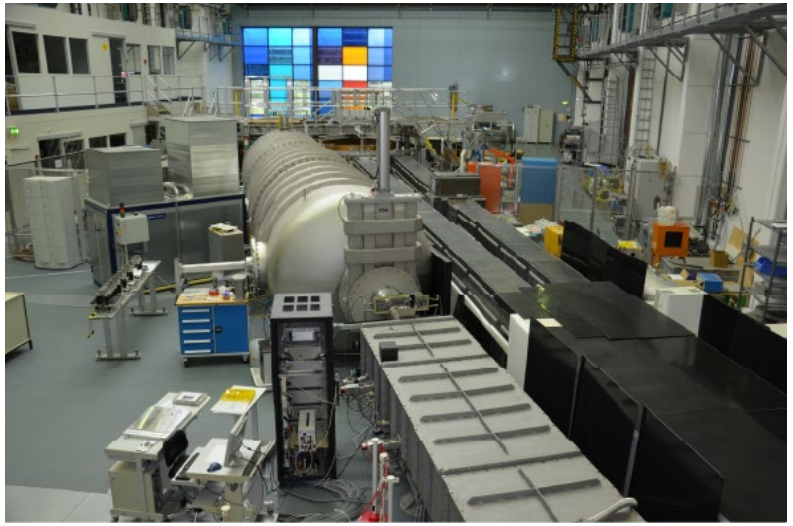
Title	Institution	Estimated Funding	Project Description
Development of Neutron Tomography at the **University of Wisconsin** Nuclear Reactor	University of Wisconsin-Madison	$222,294	This proposal will enhance nuclear energy-related research and development at the University of Wisconsin Nuclear Reactor (UWNR) and associated Characterization Laboratory for Irradiated Materials (CLIM). Proposal seeks to enhance the neutron radiography capabilities at the reactor, by acquiring a high-resolution detector, rotation stage, visualization software and a high-performance computer.
Advancing Radiation Detection Education at the **Maryland University Training Reactor**	University of Maryland, College Park	$208,140	This project will modernize the radiation safety equipment and radiation detection capabilities at the Maryland University Training Reactor.
High-Temperature Molten Salt Irradiation and Examination Capability for the **Penn State Breazeale Reactor**	Pennsylvania State University	$179,715	This project will build and install a permanent, high-temperature, molten salt neutron irradiation and post-irradiation analysis capability at the Penn State Breazeale Reactor (PSBR).

Success Story – Penn State Radiation Science and Engineering Center

- Penn State University's Radiation Science & Engineering Center has received a $9.8 million donation to support advanced neutron beam research through the expansion of the Breazeale Reactor's neutron beam hall.
- The expansion will include installation next spring of a small-angle neutron scattering instrument donated by Germany's Helmholtz-Zentrum, making Penn State the only U.S. university research reactor with a SANS facility.
- Supported by recent CSIS awards:

2020	$306,744	…underground storage tanks will be replaced with aboveground water storage tanks within the expanded neutron beam hall space.
2017	$1,084,000	Replace the existing control console with a system based on nuclear-grade hardware, eventually including a digital safety system.
2013	$1,362,253	…build and install new capabilities, including five neutron beam ports, a core-moderator assembly, reactor core upper and lower grid plates, safety plates, and a new reactor tower structure.

Photo credit to Pennsylvania State University



The VSANS instrument (here in the neutron hall at BER II) will move to Penn State University. © A. Kubatzki/HZB

Success Story – Idaho State University Control Console

- The control console for the Idaho State Aerojet-General Nucleonics nuclear reactor (AGN-201) was upgraded from the 1965 version to a modern console with support from CSIS grants.
- The reactor was donated to the university by INL (then the NRTS) in 1965.
- A ribbon-cutting and dedication ceremony for the new operating console was held on Oct. 20, 2021, as part of Nuclear Science Week activities at the university.

2020	$59,262	… replace the existing control rod drive mechanism with a newly developed alternative design.
2016	$80,805	... replace the BF3 detectors with modern ^{10}B-lined detectors.
2014	$91,741	…modernize radiation detectors, associated instruments, and the sub-assembly.

Photos credited to Idaho State University and Idaho Falls ABC Local News 8

General Scientific Infrastructure (GSI)

- Award Size
  - Maximum DOE funding per individual university award: $5,000,000
    - Anticipated award size $250,000
- Period of Performance
  - 1 year (ask for what you need)
- Eligibility
  - U.S. universities are eligible to submit applications.
  - One application per institution can be submitted to the GSI area of this FOA.
  - University cost match (1:1) required after $250,000.
- Estimated Funding Level
  - Approximately $2.5 million

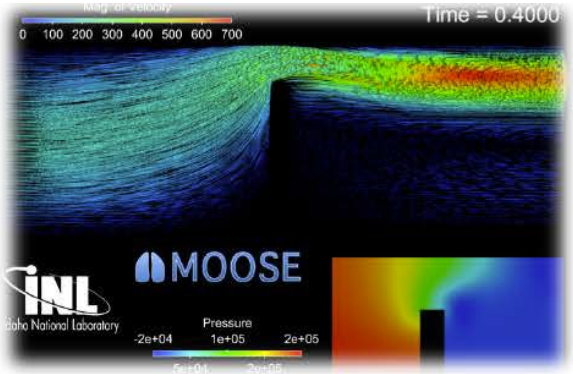
FY 2021 GSI Focus Areas

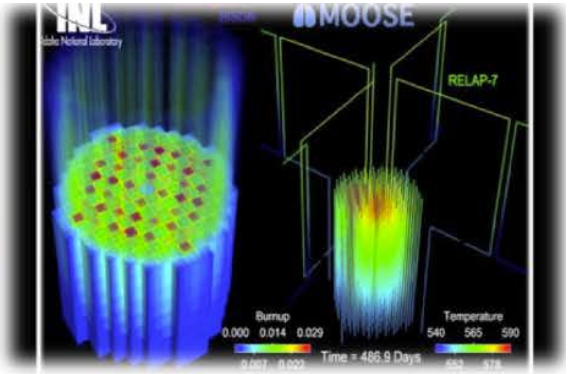
- NSUF performs an annual nuclear energy R&D capabilities gap analysis to identify areas for investment.
  - Applications addressing these identified needs will be given higher priority.
- **For FY 2021, specific areas of interest are:**
  - In situ radiation-enhanced corrosion capabilities (FY 2021 only)
  - Nuclear fuel and materials (characterization) including high throughput characterization (FY 2021 only)
  - Non-LWR environment material testing capabilities (FY 2021 only)
  - Capabilities to perform work on radioactive/irradiated materials (>5 mr/hr @ 30 cm, beta/gamma only)
  - No other specific focus areas for FY 2022.

GSI Reminder of Excluded Areas

NSUF provides access to high-performance computational resources at INL at no cost to users

- Applications requesting to purchase scientific computing equipment (such as institutional clusters, high-performance computing [HPC] nodes, etc.) will not be entertained.
- See **nsuf.inl.gov** or **hpc.inl.gov** for information on accessing HPC resources.





Courtesy of Eric Whiting, Director of Scientific Computing (INL)

GSI Review Criteria

Each application receives a merit review by DOE, university peers, and NSUF reviewers

Review Criteria (FY 2021)

- (25%) **Impact** – Potential of the requested equipment, instrumentation, or modification to facilitate, improve, or expand ongoing Office of Nuclear Energy research and training capabilities;
- (25%) **Utilization** – As a result of the proposed equipment, the amount of student, faculty, or researcher usage of the capabilities, and the amount and variety of research and/or services actually provided by the facility;
- (25%) **Execution** – Capability to implement the full scope of the project, including timely project completion, personnel qualifications, budget, and feasibility;
- (25%) **NSUF Priority** – Importance of the proposed upgrade to the Nuclear Science User Facilities as either improving an existing partner facility or as a potential partner facility.

GSI Review Criteria

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Review Criteria (FY 2022)

- (25%) **Impact** – Potential of the requested equipment, instrumentation, or modification to facilitate, improve, or expand ongoing Office of Nuclear Energy research and training capabilities;
- (25%) **Utilization** – As a result of the proposed equipment, the amount of student, faculty, or researcher usage of the capabilities, and the amount and variety of research and/or services actually provided by the facility;
- (25%) **Execution** – Capability to implement the full scope of the project, including timely project completion, personnel qualifications, budget, and feasibility;
- (15%) **NSUF Priority** – Importance of the proposed upgrade to the Nuclear Science User Facilities as either improving an existing partner facility or as a potential partner facility;
- (10%) **Educational Innovation** – Uses of equipment for educational purposes.

General Scientific Infrastructure – FY 2021 Awards (NSUF)

Title	Institution	Estimated Funding	Project Description
Infrastructure Upgrades to the Texas A&M University Accelerator Laboratory	Texas A&M University	$246,418	…upgrade the Texas A&M University Accelerator Laboratory, an NSUF partner, to acquire the new capability of high dpa (displacements per atom) rate proton irradiation and simultaneous corrosion testing in molten salts.
Development of a Rapid Chemical Assessment Capability for In-Situ TEM Ion Irradiations	University of Michigan	$350,000	… overcome the issue with dynamic observations by establishing a rapid chemical assessment capability for in-situ TEM ion irradiations at University of Michigan's Michigan Ion Beam Laboratory.
High Resolution Scanning Acoustic Microscopy System for High Throughput Characterization of Materials and Nuclear Fuels	North Carolina State University	$290,000	… acquire a state-of-the-art high resolution scanning acoustic microscopy system … to enhance educational and research capabilities in high-throughput characterization of nuclear fuels, sensor materials, cladding materials, reactor structural materials and 3D printed materials.

General Scientific Infrastructure – FY 2021 Awards (advanced reactors)

Title	Institution	Estimated Funding	Project Description
Real-Time In Situ Characterization of Molecular and Complex Ionic Species in Forced-Flow Molten Salt Loops and a Molten Salt Research Reactor	Abilene Christian University	$367,793	… real-time direct chemical analysis capabilities for molten salt systems, specifically adding Raman and gamma spectroscopies to the Abilene Christian University (ACU), the Nuclear Energy eXperimental Testing (NEXT) Lab molten salt and materials characterization tools.
High-Efficiency Electrochemical Test Facility for Corrosion and Hydrodynamic Analysis in Molten Salts	Brigham Young University	$180,269	… purchase of rotating cylinder electrode (RCE) to provide high throughput testing of materials and measurement of physical properties in molten salts. … advance on current methods for interrogating corrosion in molten salts.
A Dedicated Facility for Direct Visualization of Bubble Dynamics in Molten Salts	University of Puerto Rico, Mayagüez	$250,000	… enables experiments to correlate bubbles and bubble clusters size, dynamics, composition, terminal velocity, temperature, environmental pressure and composition and purity at temperatures from operating conditions up to 1000 °C for molten salts systems.
Fuel Fabrication Line for Advanced Reactor Fuel Research, Development and Testing	University of Texas, San Antonio	$286,344	… fabrication and testing of advanced nuclear fuels and materials. Specific focus is the synthesis of novel samples of relevant fuel compounds, like uranium nitride (UN) … as well as fuel compounds such as uranium silicides, carbides, and metallic fuel alloys

General Scientific Infrastructure – FY 2021 Awards (characterization)

Title	Institution	Estimated Funding	Project Description
Dedicated Infrastructure for In Situ Characterization of Structural Materials	State University of New York, Stony Brook	$204,327	…procurement of a suite of equipment dedicated to characterizing radioactive materials. Microscale specimen preparation and property testing equipment is an area of significant need within the nuclear research complex.
Ultrafast Elemental Depth Profiling to Enable High-throughput Characterization of Nuclear Materials and Fuels	Missouri University of Science and Technology	$304,724	… purchase of a pulsed radio frequency glow discharge optical emission spectrometer, with the capability of ultrafast elemental depth profiling. Potential unique capability as a tool for high throughput compositional characterization of nuclear materials and fuels.
High-Temperature Mechanical Testing Platform for Accelerated, Parallelized, and Miniaturized Materials Qualification	University of Texas at El Paso	$250,000	… acquisition of an Instron servo-electric testing system with intelligent furnace control capable of high temperature quasi-static (tensile, creep, stress relaxation, etc.) and dynamic testing (low cycle fatigue, creep-fatigue, etc.).
High-Speed Terahertz Scanning System for AM Ceramic Materials and Composites for TCR Core Materials	Alfred University	$90,000	… procurement and installation of a custom-made high-speed terahertz (THz) dual scanner system that will demonstrate non-destructive imaging of AM ceramic materials and composites for TCR core application.

General Scientific Infrastructure – FY 2021 Awards (misc.)

Title	Institution	Estimated Funding	Project Description
Interrogating f-Element-Ligand Interactions by X-ray Absorption Spectroscopy	Florida International University	$302,826	… purchase of analytical instruments, including an X-ray absorption spectrometer and a probe for NMR spectrometer, to enhance radiochemistry research.
Neutron Irradiation Facility at the Nuclear Science Laboratory (NSL)	University of Notre Dame	$375,332	… development of a neutron irradiation station at the NSL … providing a monoenergetic flux of neutrons in the energy range of a few keV to a few MeV … with R&D utilization expanding from nuclear data to radiation effects studies. The capability will be hosted by NSF-supported facility with a significant postgraduate "hands-on" education program.
CSU Accurate Neutron Dosimetry Research and Teaching Infrastructure	Colorado State University	$39,500	… procuring a new set of neutron detectors (Bonner Spheres) and the ATTILA4MC computer code to provide additional neutron detection capacity and neutron spectroscopy capabilities. Primary utilization is to enhance student education and training in the area of neutron detection and dosimetry.

Success Story – NuScale Simulator at CAES Building (University of Idaho)

The objectives of this project are to provide three NuScale reactor plant simulator facilities at the following institutions:

- Center for Advanced Energy Studies in Idaho Falls, Idaho,
- Texas A&M University (TAMU) in College Station, Texas,
- Oregon State University (OSU) in Corvallis, Oregon

The simulator will provide the CAES universities and national laboratory system an open location to conduct research related to the use of modular reactors for flexible operation, process heat, inclusion in hybrid energy systems, cybersecurity analysis, and electricity generation.

The remote simulator, based on NuScale's simulator technology, will deploy a simulator interface that accepts input from operators in a virtual control room and reflects parameters simulating the plant response with the use of computer models.

2019	$285,763	…build NuScale reactor simulators in multiple universities (Oregon State University, Texas A&M and the University of Idaho) for research, education, K-12 outreach, and public advocation regarding nuclear power and Small Modular Reactor technology.

Photo credit to Idaho Falls ABC Local News 8

Idaho National Laboratory

FOA Highlights

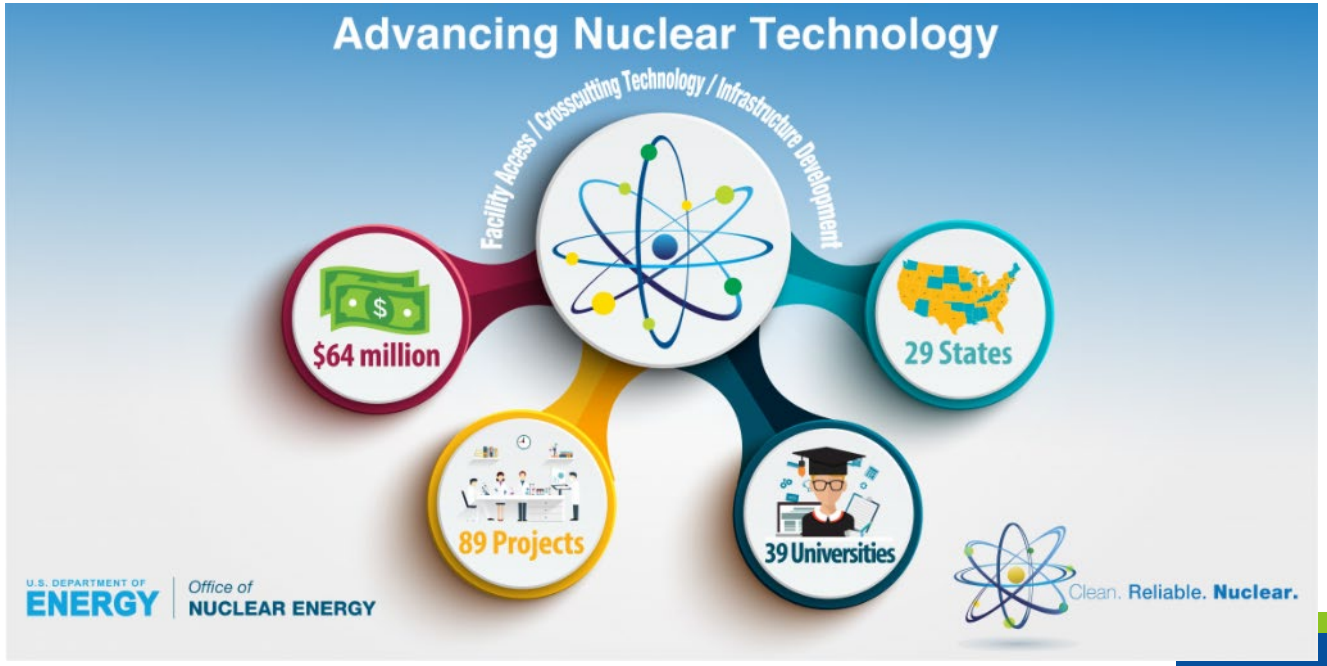
- Funding Mechanism
  - Funding supplied by DOE-NE
  - Grants issued by DOE-ID

- Two Funding Opportunities for U.S. Universities
  - Reactor Upgrades
  - General Scientific Infrastructure

- Find the FOA (DE-FOA-0002362) at www.grants.gov
- Submit applications at www.neup.gov
- Additional information at nsuf.inl.gov/Page/infrastructurefoa

Important Dates

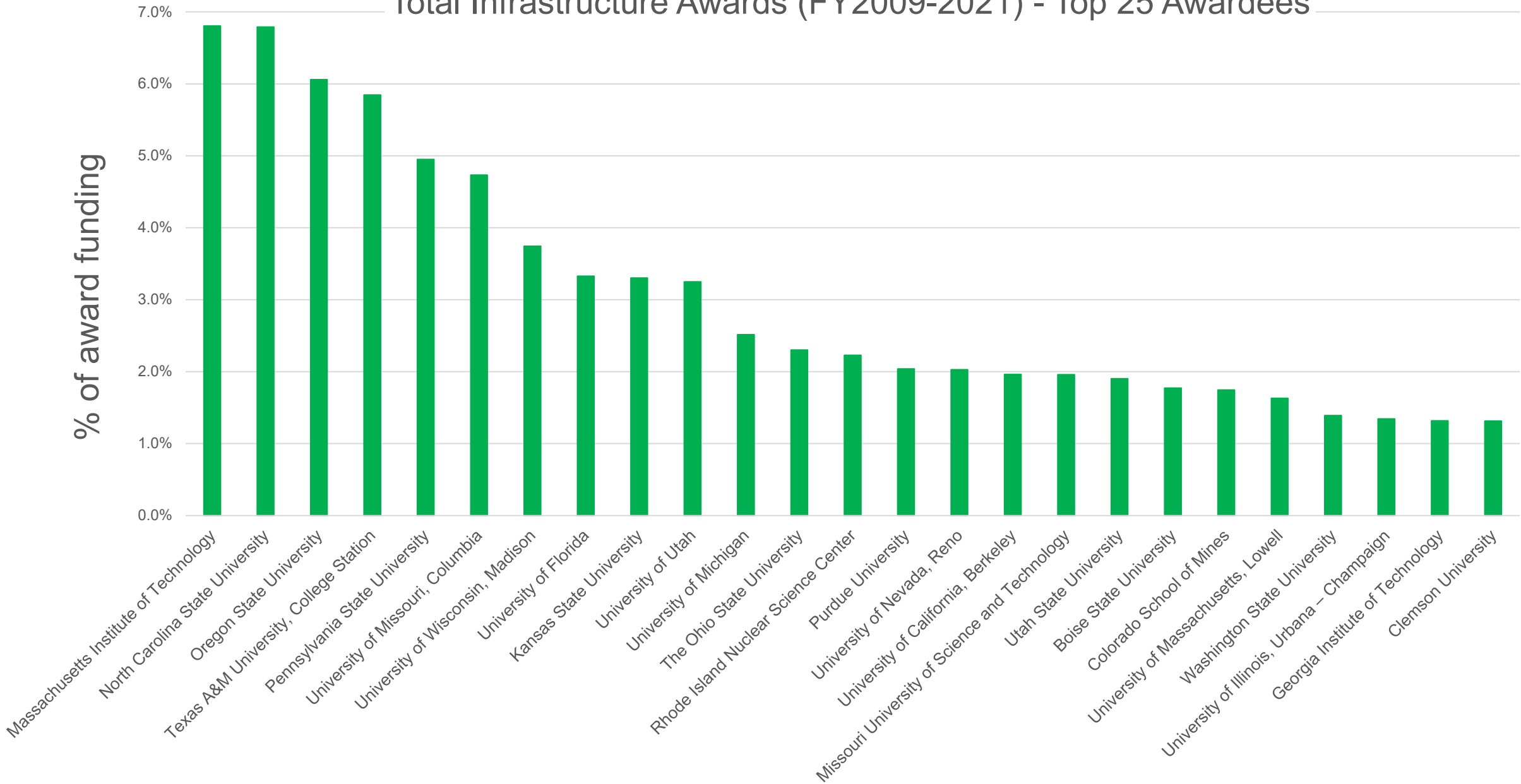
- FOA release date: August 17, 2020 (August 30, 2021)
- Applications due: November 12, 2020 (November 11, 2021)
- Anticipated award announcement: July 31, 2021 (June 2022)



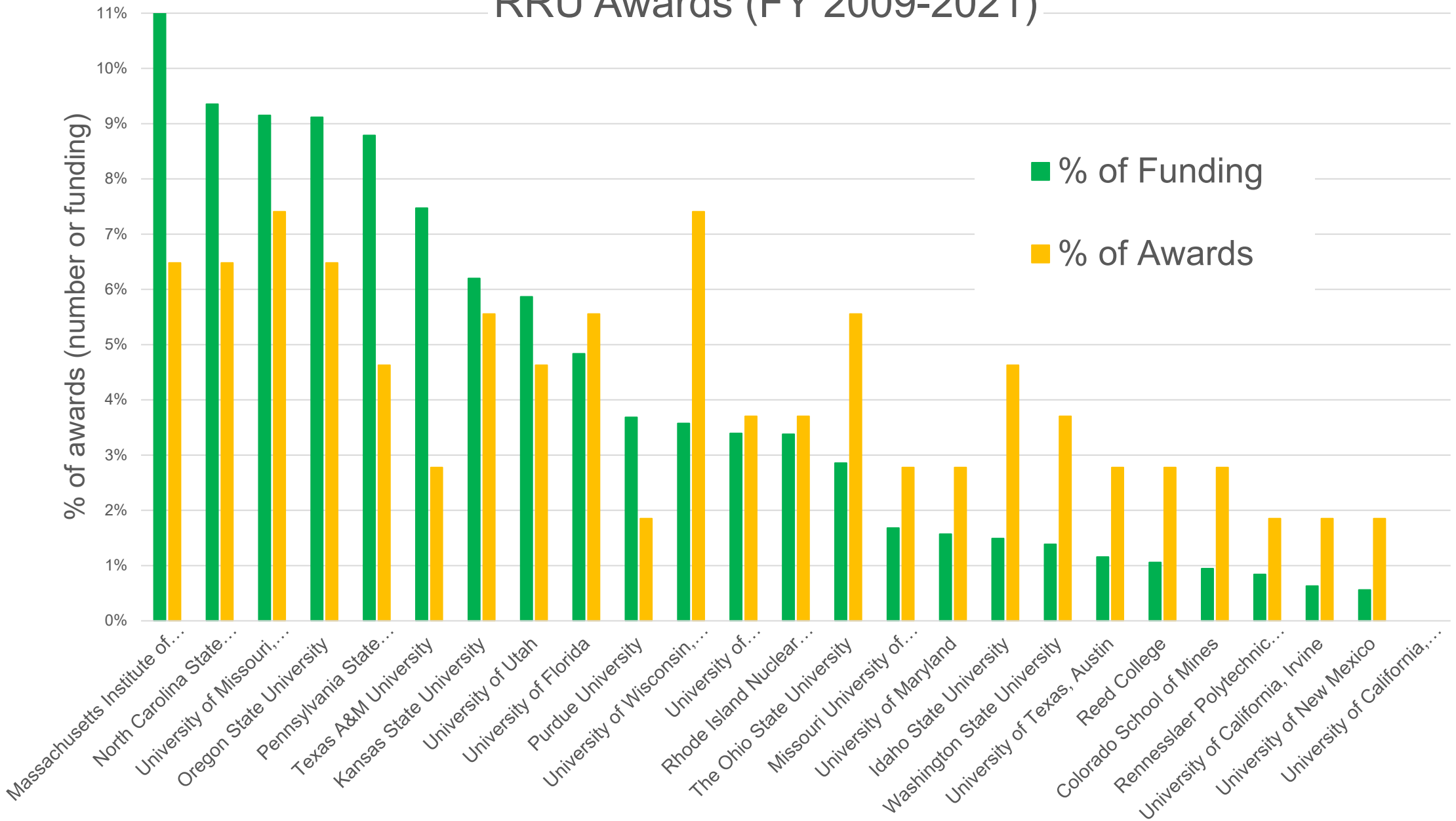
A Unique Opportunity – Surplus ATR ^{60}Co Sources

- The Idaho National Laboratory (INL) had excess Co-60 sources that were made for DOE-Office of Isotopes that are no longer needed.
- These capsules range in strength from <1-5000 Ci.
- A formal RFI (link below) was issued (closed on 9/30/2021).
- Interested parties will receive one or more capsules in a Department of Transportation (DOT) approved shipping cask.
  - INL will pay for the shipping of capsules to applicants.
  - Costs associated with updating any radioactive material license, extra security, etc., are not covered.
  - Responses were received from universities, industry, and national laboratories.

Total Infrastructure Awards (FY2009-2021) - Top 25 Awardees



RRU Awards (FY 2009-2021)



GSI Awards (FY2009-2021) - Top 25 Awardees