**Nuclear Energy**
**($K)**

| FY 2022 Enacted[1,2] | FY 2023 Enacted[1,3,4,5] | FY 2024 Request |
|---|---|---|
| 1,654,800 | 1,773,000 | 1,562,620 |

**Overview**

Nuclear energy underpins the President's plan to put the United States (U.S.) on a path to net-zero emissions by 2050. With 92 operating units in 28 states, the U.S. nuclear reactor fleet already helps mitigate the worst impacts of the climate crisis by providing half of the nation's carbon-free electricity with firm power that complements renewables. Expanded deployment of advanced nuclear power, a Net Zero Game Changer, promises to minimize land-use and transmission requirements while offering regional economic benefits, equitable job transitions, and unique capabilities to decarbonize myriad non-electric applications. U.S. nuclear energy leadership also plays key national security and global strategic roles for the U.S., including supporting the highest international standards for safety, security, and nonproliferation while countering the coercive policies of authoritarian regimes.

The U.S. pioneered the development and peaceful use of nuclear power and the nuclear fuel cycle to produce around-the-clock, emissions-free baseload electricity generation. The Office of Nuclear Energy now leads and supports research, development, demonstration, and deployment (RDD&D) enabling (1) continued operation of existing reactors, (2) deployment of new reactors, (3) a secure and sustainable nuclear fuel cycle, and (4) expansion of U.S. international nuclear energy cooperation. NE executes its mission through investments in early-stage RDD&D that leverage the tremendous innovation capacity of the United States' national laboratories, universities, and advanced nuclear technology developers to transform the global energy landscape. Through coordination and engagement with the public, Congress, regional governments, and Tribes, NE also incorporates crosscutting initiatives to advanced diversity in nuclear energy, energy and environmental justice, and jobs and the American workforce. NE is also responsible for ensuring the secure operational availability of Idaho National Laboratory (INL) as a national asset supporting a broad range of civilian and national security research.

The FY 2024 Request helps to advance U.S. leadership in critical technologies, invest in our workforce, and upgrade America's research infrastructure. It supports the diverse civilian nuclear energy programs of the U.S. Government to research and develop nuclear energy technologies, including generation, safety, and security technologies, to assist in unleashing the clean energy transition through strategic, innovative RDD&D. The NE FY 2024 Request will expand the impact of our RDD&D funding through modern, innovative funding mechanisms - such as prizes, competitions, technical assistance, and programs targeted to small businesses.

Additionally, the FY 2024 Request strives to develop and demonstrate the advanced fuel cycle technologies needed to place the United States in a global leadership position of the nuclear industry by addressing gaps in the domestic nuclear fuel supply chain for both existing and advanced nuclear reactors to assure the supply of low enriched uranium (LEU), including high assay low enriched uranium (HALEU), needed by U.S. reactors and those of our allies. The FY 2024 Request also supports spent nuclear fuel management activities, including a consent-based approach to siting interim used nuclear fuel storage which centers energy and environmental justice.

Finally, the FY 2024 Request supports U.S. nuclear energy leadership that enables our bilateral and multilateral civil nuclear energy engagements to promote global decarbonization, achieve energy security, and create synergies for civil nuclear RDD&D cooperation with like-minded partners across the globe.

[1] Funding does not reflect the transfer of SBIR/STTR to the Office of Science.
[2] Funding does not reflect the FY 2022 mandatory transfer of $91.0 million from Naval Reactors for operation of the Advanced Test Reactor.
[3] Funding does not reflect the FY 2023 mandatory transfer of $92.7 million from Naval Reactors for operation of the Advanced Test Reactor.
[4] Funding does not reflect the mandatory transfer of $20 million to the Office of Science for ORNL Nuclear Facilities O&M.
[5] Funding reflects $300 million appropriated under the Ukraine Supplemental Act, 2023 (P.L. 117-180): Advanced Nuclear Fuel Availability ($100 million), National Reactor Innovation Center ($20 million), Risk Reduction for Future Demonstration ($120 million), and ARDP Demonstration Reactors ($60 million).

**Highlights and Major Changes in the FY 2024 Congressional Budget Request**

The NE Budget Requests $1.56 billion to support the President's commitment to put America on a path to achieve net-zero emissions no later than 2050 by investing in resilience, clean energy innovation, and U.S. competitiveness. These investments will leverage the tremendous innovation capacity of the National Laboratories, universities, and advanced reactor developers to transform America's power sector.

- **NEUP, SBIR/STTR and TCF** requests $146.7 million for expanded competitive university led research at universities. The program also provides NE's support for the Small Business Innovation Research and Small Business Technology Transfer SBIR/STTR) programs, the Technology Commercialization Fund (TCF) program, the University Nuclear Leadership Program (UNLP), and University Fuel Services (UFS). Funding levels for SBIR, STTR and TCF are based on legally required percentages of NE's total research, development and Demonstration budgets. Funding for university-led R&D and infrastructure also meets legally required levels, the maximum extent practicable.
- **Advanced Small Modular Reactor RD&D** requests $20.0 million, including $10 million to support the Carbon Free Power Project's commercial demonstration of the NuScale SMR technology.
- **Advanced Nuclear Fuel Availability** requests $120.0 million to fund the near-term activities already underway for the recovery and downblending of DOE material, and enrichment operations at the Piketon facility. The subprogram complements the Inflation Reduction Act activities that will primarily be used to support a long-term, sustainable, diverse, market-driven commercial HALEU supply. Accelerated efforts to prepare EBR-II used as a HALEU feedstock are continued under Material Recovery and Waste Form Development.
- Within its **Infrastructure** Program, NE is requesting $318.9 million for **INL Facilities Operations and Maintenance (IFM)** subprogram. The request will focus on maintaining mission critical facilities to support technical advancements in existing nuclear fleet, reactors, and nuclear fuel cycle. It will also focus on investing in the Advanced Test Reactor (ATR) Complex and the Materials and Fuels Complex to improve reliability and modernize capabilities in support of nuclear energy R&D objectives. Funding for the **ORNL Nuclear Facilities O&M subprogram** is included in the Office of Science Request.
- **Idaho Sitewide Safeguards and Security** requests $177.7 million, an increase of $27.7 million above the FY 2023 enacted level. The additional funding will provide enhanced cybersecurity capabilities at the Idaho National Laboratory as well as initiating replacement of the Entrance Control Facility at the Materials and Fuels Complex.
- The **International Nuclear Energy Cooperation** program requests $13.0 million to provide funding to educate and familiarize small and emerging nuclear states with U.S. nuclear technology and best practices; initiating one or more Front-End Engineering Design studies supporting U.S. nuclear builds in partner countries; and increasing U.S. presence in Eastern Europe, the Baltic States, Southeast Asia, and the Americas, through nuclear workforce capacity building, academic and professional training, joint studies, and regional technical events.

## Nuclear Energy
## Funding by Congressional Control ($K)

| | FY 2022 Enacted[6,7] | FY2023 Enacted[6,8,9,10] | FY 2024 Request | FY 2024 Request vs FY 2023 Enacted ($) | FY 2024 Request vs FY 2023 Enacted (%) |
|---|---|---|---|---|---|
| **NEUP, SBIR/STTR and TCF** | **100,000** | **130,276** | **146,710** | **+16,434** | **+13%** |
| **Nuclear Leadership Development Program** | **6,000** | **0** | **0** | **0** | **0%** |
| **Reactor Concepts Research, Development & Demonstration (RD&D)** | | | | | |
| Advanced SMR RD&D | 150,000 | 165,000 | 20,000 | -145,000 | -88% |
| Light Water Reactor Sustainability | 48,000 | 45,000 | 35,000 | -10,000 | -22% |
| Advanced Reactor Technologies | 59,000 | 49,000 | 43,200 | -5,800 | -12% |
| **Reactor Concepts RD&D** | **257,000** | **259,000** | **98,200** | **-160,000** | **-62%** |
| **Fuel Cycle Research and Development** | | | | | |
| Mining, Conversion and Transportation | 2,000 | 2,000 | 1,500 | -500 | -25% |
| Materials Recovery and Waste Form Development | 30,000 | 45,000 | 39,000 | -6,000 | -13% |
| Accident Tolerant Fuels | 115,000 | 114,000 | 108,900 | -5,100 | -5% |
| TRISO and Graphite Qualification | 37,000 | 32,000 | 25,000 | -7,000 | -22% |
| Fuel Cycle Core R&D | 23,150 | 29,000 | 29,000 | 0 | 0% |
| Advanced Nuclear Fuel Availability | 45,000 | 100,000 | 120,000 | +20,000 | +20% |
| Used Nuclear Fuel Disposition R&D | 50,000 | 47,000 | 46,875 | -125 | -0% |
| Integrated Waste Management System | 18,000 | 53,000 | 53,000 | 0 | 0% |
| **Fuel Cycle R&D** | **320,150** | **422,000** | **432,275** | **+1,275** | **+0%** |

[6] Funding does not reflect the transfer of SBIR/STTR to the Office of Science.
[7] Funding does not reflect the FY 2022 mandatory transfer of $91.0 million from Naval Reactors for operation of the Advanced Test Reactor.
[8] Funding does not reflect the FY 2023 mandatory transfer of $92.7 million from Naval Reactors for operation of the Advanced Test Reactor.
[9] Funding does not reflect the mandatory transfer of $20 million to the Office of Science for ORNL Nuclear Facilities O&M.
[10] Funding reflects $300 million appropriated under the Ukraine Supplemental Act, 2023 (P.L. 117-180): Advanced Nuclear Fuel Availability ($100 million), National Reactor Innovation Center ($20 million), Risk Reduction for Future Demonstration ($120 million), and ARDP Demonstration Reactors ($60 million).

## Nuclear Energy
## ($K)

| | FY 2022 Enacted[1,2] | FY2023 Enacted[6,8,9,10] | FY 2024 Request | FY 2024 Request vs FY 2023 Enacted ($) | FY 2024 Request vs FY 2023 Enacted (%) |
|---|---|---|---|---|---|
| **Nuclear Energy Enabling Technologies** | | | | | |
| Crosscutting Technology Development | 29,000 | 32,000 | 32,778 | +778 | +2% |
| Joint Modeling and Simulation Program | 30,000 | 28,500 | 28,500 | 0 | 0% |
| Nuclear Science User Facilities | 33,000 | 35,000 | 35,000 | 0 | 0% |
| Transformational Challenge Reactor | 25,000 | 0 | 0 | 0 | 0% |
| **Nuclear Energy Enabling Technologies** | **117,000** | **95,500** | **96,278** | **+778** | **+1%** |
| **Advanced Reactor Demonstration Program** | | | | | |
| National Reactor Innovation Center[3] | 53,000 | 70,000 | 34,000 | -36,000 | -51% |
| Demonstration 1 | 30,000 | 0 | 0 | 0 | 0% |
| Demonstration 2 | 30,000 | 0 | 0 | 0 | 0% |
| ARDP Demonstration Reactors | 0 | 60,000 | 0 | -60,000 | -100% |
| Risk Reduction for Future Demonstrations | 115,000 | 120,000 | 120,000 | 0 | 0% |
| Regulatory Development | 15,000 | 10,250 | 11,000 | +750 | +7% |
| Advanced Reactor Safeguards | 5,000 | 4,750 | 6,000 | +1,250 | +26% |
| 23-E-200, LOTUS[3] | 2,000 | 20,000 | 32,000 | +12,000 | +60% |
| **Subtotal, Advanced Reactors Demonstration Program** | **250,000** | **285,000** | **203,000** | **-82,000** | **-29%** |
| **Infrastructure** | | | | | |
| INL Facilities Operations & Maintenance | 295,000 | 318,924 | 318,924 | 0 | 0% |
| ORNL Infrastructure Facilities O&M | 20,000 | 20,000 | 0 | -20,000 | -100% |
| University Fuel Services | 15,000 | 0 | 0 | 0 | 0% |
| Construction | | | | | |
| 16-E-200, Sample Preparation Laboratory | 41,850 | 7,300 | 0 | -7,300 | -100% |
| **Subtotal, Infrastructure** | **371,850** | **346,224** | **318,924** | **-27,300** | **-8%** |

**Nuclear Energy**
**($K)**

| | FY 2022 Enacted[1,2] | FY2023 Enacted[6,8,9,10] | FY 2024 Request | FY 2024 Request vs FY 2023 Enacted ($) | FY 2024 Request vs FY 2023 Enacted (%) |
|---|---|---|---|---|---|
| **Idaho Sitewide Safeguards and Security** | **149,800** | **150,000** | **177,733** | **+27,733** | **+19%** |
| **International Nuclear Energy Cooperation** | **3,000** | **0** | **13,000** | **+13,000** | **+100%** |
| **Program Direction** | **80,000** | **85,000** | **85,500** | **+500** | **+1%** |
| **Total, Nuclear Energy R&D** | **1,654,800** | **1,773,000** | **1,562,620** | **-210,380** | **-12%** |
| Federal FTEs | 265 | 294 | 320 | | |

SBIR/STTR:

- FY 2022 Transferred: SBIR $24,997; STTR $3,515
- FY 2023 Transferred: SBIR $23,385; STTR $3,288
- FY 2024 Request: SBIR $21,314; STTR $2,997

**Future-Years Energy Program**

**($K)**

| | FY 2024 Request | FY 2025 | FY 2026 | FY 2027 | FY 2028 |
|---|---|---|---|---|---|
| **Nuclear Energy (Non 050)** | 1,384,887 | 1,417,000 | 1,449,000 | 1,483,000 | 1,517,000 |
| **Nuclear Energy (050) S&S** | 177,733 | 182,000 | 186,000 | 191,000 | 192,000 |

**Outyear Priorities and Assumptions**

In the FY 2012 Consolidated Appropriations Act (P.L. 112-74), Congress directed the Department to include a future-years energy program (FYEP) in subsequent requests that reflects the proposed appropriations for five years. This FYEP shows outyear funding for each account for FY 2024 - FY 2028. The outyear funding levels use the growth rates from and match the outyear account totals published in the FY 2024 President's Budget for both the 050 and non-050 accounts. Actual future budget request levels will be determined as part of the annual budget process.

Nuclear Energy priorities in the outyears include the following:

- Supporting the five Risk Reduction for Future Demonstration awards and the National Reactor Innovation Center under the Advanced Reactor Demonstration Program.
- Providing limited quantities of HALEU for NE research and demonstration requirements.
- Providing for the secure availability of Idaho National Laboratory for NE, DOE and other U.S. government requirements.
- Expanding access to university based nuclear energy science and engineering opportunities.

**Infrastructure and Investment Jobs Act (IIJA) Investments**

NE was appropriated funds through the Infrastructure and Investment Jobs Act (IIJA) (P.L. 117-58). Not all IIJA activities will be managed by the organization to which funds were appropriated. Activities that will be managed by other organizations are discussed below.

**($K)**

| Nuclear Energy | FY 2022 IIJA Funding | FY 2023 IIJA Funding | FY 2024 IIJA Funding | Managing Organization |
|---|---|---|---|---|
| Civil Nuclear Credit Program | 1,200,000 | 1,200,000 | 1,200,000 | GDO |
| **Total, Nuclear Energy** | **1,200,000** | **1,200,000** | **1,200,000** | |

- **Civil Nuclear Credit Program:** The goal of this investment is to help preserve the existing U.S. reactor fleet and save thousands of high-paying jobs across the country. Under the new program, owners or operators of commercial U.S. reactors can apply for certification to bid on credits to support their continued operations. An application must demonstrate the reactor is projected to close for economic reasons and that closure will lead to a rise in air pollutants and carbon emissions. The program is available for plants that are certified as safe to continue operations and prioritizes plants that use domestically produced fuel. Although funds were appropriated to NE, the Grid Deployment Office (GDO) will continue to execute the Civil Nuclear Credit Program in FY 2024.

**Inflation Reduction Act (IRA) Investments**

Nuclear Energy was appropriated funds through the Inflation Reduction Act of 2022 (IRA). Not all IRA activities will be managed by the organization to which funds were appropriated. Activities that NE will manage, including those appropriated to other organizations, are itemized below.

**($K)**

| Appropriated Funding Organization | FY 2022 IRA Funding | Managing Organization |
|---|---|---|
| Nuclear Energy | | |
| Sec. 50172 National Laboratory Infrastructure (c) Office of Nuclear Energy | 150,000 | Nuclear Energy |
| Sec. 50173 Availability of High-Assay Low-Enriched Uranium | 700,000 | Nuclear Energy |
| **Total, Nuclear Energy** | **850,000** | |

- **Sec. 50172 National Laboratory Infrastructure:** The goal of this investment is to accelerate infrastructure upgrades at the Idaho National Laboratory. FY 2024 activities will see ongoing efforts on general plant projects initiated in FY 2023.
- **Sec. 50173 Availability of High-Assay Low-Enriched Uranium**: The goal of this investment is to accelerate the availability of HALEU to fuel advanced demonstration and commercial reactors. FY 2024 activities will include supporting the U.S. Nuclear Regulatory Commission with criticality benchmark data, assisting industry with transportation package development, and working toward supplying HALEU to industry in coordination with a HALEU Consortium.

## NEUP, SBIR/STTR, and TCF

### Overview

The NEUP, SBIR/STTR, and TCF program consolidates and focuses support to universities and small businesses in areas relevant to the Office of Nuclear Energy's (NE) mission. This program funds university research, infrastructure support and revitalization, workforce development, and commercialization efforts for nuclear energy. Efforts are largely awarded through competitive opportunities for researchers, students, faculty, and small businesses. Additionally, the program provides fuel services, maintenance support, reactor sharing, and safety upgrades of fuel fabrication equipment and facilities for United States (U.S.) university research reactors. This program seeks to ensure equitable access to these opportunities and benefits, specifically seeking ways to include communities that have historically faced limits in access to such capabilities, such as students and faculty at minority serving institutions (MSIs), including Historically Black Colleges and Universities (HBCUs) and Tribal Colleges and Universities (TCUs).

### Highlights of the FY 2024 Budget Request

Consistent with the FY 2023 appropriation, the NEUP, SBIR/STTR, and TCF program includes support for the following: Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) programs, the Technology Commercialization Fund (TCF) program, the Nuclear Energy University Program (NEUP), the University Nuclear Leadership Program (UNLP), and University Fuel Services (UFS).

Under NEUP, the Infrastructure Revitalization element supports competitively awarded, consortium-led efforts to establish and/or enhance nuclear research capabilities at U.S. universities. These activities will not include construction of new reactors, but they may include enhancements to existing reactors and addition of related capabilities such as simulators. This support will help U.S. universities (1) develop a workforce with hands-on experience with commercially relevant advanced reactor concepts, reflective of those being deployed by industry; (2) offer research capabilities that address emerging technical challenges; and (3) ensure that access to the opportunities and benefits of these capabilities are equitably provided, specifically seeking ways to include communities that have historically faced limits in access to such capabilities. These activities are expected to be led by one or more diverse consortia with appropriate expertise to ensure that the new capabilities will support these goals. A goal is to maximize the research and educational value and the broad accessibility of these resources in an equitable and inclusive manner.

A reactor sharing program will be implemented to increase the use of university research reactors through support of expanded partnering and public outreach. The program will increase public engagement with nuclear energy, improve public familiarity with nuclear reactor technologies, enable mutual learning with communities that house research reactors, and stimulate undergraduate and graduate enrollment in nuclear energy related fields. All activities will focus on expanding access to research reactors with a specific emphasis on serving traditionally underserved communities and MSIs.

Under UFS, funding will be used to continue fabrication of 25 new fuel assemblies for the North Carolina State University (NCSU) PULSTAR reactor, which is reaching the end of its current core life. It is estimated that a new fuel core and fuel boxes will be needed by the end of FY 2025 for this reactor to remain operational.

**NEUP, SBIR/STTR, and TCF**
**Funding ($K) (Comparable)**

| | FY 2022 Enacted | FY 2023 Enacted | FY 2024 Request | FY 2024 Request vs FY 2023 Enacted ($) | FY 2024 Request vs FY 2023 Enacted (%) |
|---|---|---|---|---|---|
| **NEUP, SBIR/STTR, and TCF** | | | | | |
| NEUP, SBIR/STTR, and TCF | 100,000[1] | 106,276 | 119,858 | +13,582 | +12.8% |
| University Nuclear Leadership Program | 6,000[2] | 6,500 | 6,630 | +130 | +2% |
| University Fuel Services | 15,000[3] | 17,500 | 20,222 | +2,722 | +15.6% |
| **Total, NEUP, SBIR/STTR and TCF Programs** | **121,000** | **130,276** | **146,710** | **+16,434** | **+12.6%** |

SBIR/STTR:

- FY 2022 Transferred: SBIR $24,997; STTR $3,515
- FY 2023 Enacted: SBIR $23,385; STTR $3,288
- FY 2024 Request: SBIR $21,314; STTR $2,997

[1] FY 2022 funding for Directed Research and Development reflects actual appropriated amount for "NEUP, SBIR/STTR, and TCF".
[2] FY 2022 funding for University Nuclear Leadership Program appropriated as Integrated University Program.
[3] FY 2022 funding for University Fuel Services appropriated as Research Reactor Infrastructure within Infrastructure program.

**NEUP SBIR/STTR and TCF**
**Explanation of Major Changes ($K)**

| | FY 2024 Request vs FY 2023 Enacted |
|---|---|
| **NEUP, SBIR/STTR, and TCF:** | **+13,582** |
| The increase from $106,276,000 to $119,858,000 reflects the selection and initiation of projects to revitalize existing university nuclear research infrastructure, a university reactor sharing program, and additional university-led R&D awards. | |
| **University Nuclear Leadership Program:** | **+130** |
| The increase from $6,500,000 to $6,630,000 reflects continued support for awards and an exchange opportunity with the United Kingdom for fellowship awardees. | |
| **University Fuel Services:** | **+2,722** |
| The increase from $17,500,000 to $20,222,000 reflect additional Training, Research, Isotopes, General Atomics (TRIGA) fresh fuel orders to ensure that a maximum number of fuel elements can be purchased per year, resulting in the lowest average price per element. The increase funding will also be used to continue fabrication of new fuel assemblies in support of the North Carolina State University (NCSU) PULSTAR reactor. | |
| **Total, NEUP, SBIR/STTR, and TCF** | **+16,434** |

## NEUP, SBIR/STTR, and TCF

### Description

The NEUP, SBIR/STTR, and TCF subprogram includes competitively awarded opportunities for small businesses, national laboratories, and universities. The university program seeks to support cutting-edge, innovative research at U.S. universities, with the goal to expand participation with minority serving institutions (MSIs), including Historically Black Colleges and Universities (HBCUs) and Tribal Colleges and Universities (TCUs). Having a single program funding line provides more flexibility to Nuclear Energy's (NE) competitive award process; streamlines program execution; and provides enhanced transparency for small businesses, universities, and other stakeholders.

The principal focus areas for FY 2024 include four elements: (1) Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR); (2) Technology Commercialization Fund (TCF); (3) University-led Research and Development; and (4) University Infrastructure.

1. **SBIR/STTR –** NE supports small business through the Department's SBIR/STTR program. The SBIR/STTR reauthorizing language (Reauthorization Act of 2011 (P.L. 112-81, 125 STAT 1822)) directs the Department to spend not less than 3.2 percent of its extramural research and development (R&D) budget for SBIR and not less than 0.45 percent of its extramural R&D budget for STTR. NE's contribution supports scope relevant to NE's R&D mission, for example technologies for improvements of existing reactors, advanced reactors, and fuel cycle systems.
2. **TCF –** NE supports the transfer of promising nuclear energy technologies developed at the Department's national laboratories to the nuclear industry for commercialization through TCF. The TCF was established under 42 U.S. Code § 16391, which directed the Secretary to "establish an Energy Technology Commercialization Fund, using 0.9 percent of the amount made available to the Department for applied energy research, development, demonstration, and commercial application for each fiscal year based on future planned activities and the amount of the appropriations for the fiscal year, to be used to provide matching funds with private partners to promote promising energy technologies for commercial purposes."
3. **University-led Research and Development –** NE supports the U.S. university community with competitive research and development through yearly competitive solicitations. The program's goal is to support outstanding, cutting-edge, and innovative research at U.S. universities in the areas of nuclear energy science, technology and social impacts through the following funding opportunities:
    a. **Consolidated Innovative Nuclear Research (CINR):** NE will continue to utilize the CINR funding opportunity to align nuclear energy research being conducted at U.S. colleges and universities with DOE's mission, focusing on mission-supporting research as well as the needs and priorities of key NE programs including fuel cycle, reactor concepts, and spent fuel management research. This opportunity will also include Integrated Research Projects (IRPs), which are multi-disciplinary and multi-institutional projects that address near-term nuclear energy research challenges, technology innovation needs, or capability gaps. IRPs are intended to integrate across disciplines to achieve solutions to complex research challenges that cannot be addressed by a less comprehensive team.
    b. **Distinguished Early Career Program (DECP):** NE will continue to utilize its most prestigious opportunity for faculty members, DECP. This program will focus on early career faculty conducting transformative research, education, and leadership aligned with the Office of Nuclear Energy's mission. It will enable awardees to develop innovative, cutting-edge research programs in nuclear energy relevant areas, not only recognizing their demonstrated potential as outstanding researchers but also as transformative educators. This opportunity will support the development of the most promising faculty members nationwide as they advance novel nuclear energy research and train the next generation of nuclear energy professionals. DECP aims to recognize distinguished researchers at the pivotal initial stage of their careers and to support high-impact contributions to nuclear energy research, innovation, discovery, leadership, and dissemination of knowledge.

c. **Innovations in Nuclear Energy Research and Development (R&D) Student Competition:** NE will support four competitions under this student opportunity, which recognizes, and awards published graduate and undergraduate students for innovative nuclear energy research. The competition is a continuation of the "Innovations in Nuclear Technology R&D Awards Program" supported since 2010 by the Office of Nuclear Fuel Cycle and Supply Chain and administered by the University Research Alliance.

4. **University Infrastructure –** Nuclear Energy (NE) supports the infrastructure needed at universities to conduct cutting-edge research and to educate and train the next generation nuclear workforce.

   NE provides competitively awarded funding to universities through solicitations that will include the following elements to revitalize the existing university nuclear research infrastructure.

   a. **General Scientific Infrastructure –** to focus on equipment, instrumentation, and associated non-reactor upgrades that significantly improve or expand research, instruction, and training capabilities at individual universities and colleges.
   b. **Reactor Upgrades –** to improve existing nuclear research and training reactors at individual universities and colleges. It includes the purchase and maintenance of equipment to enhance the safety, security, performance, control, or operational reliability of the research reactor.
   c. **Reactor Sharing Program –** to provide a competitive opportunity to increase the use of university research reactors through support of expanded partnering and public outreach. The program will improve public understanding of nuclear energy, increase public acceptance of nuclear reactor technologies, and build goodwill with communities that house research reactors while also stimulating undergraduate and graduate enrollment in nuclear energy related fields.
   d. **Infrastructure Revitalization –** to competitively award consortium-led efforts toestablish and/or enhance nuclear research infrastructure capabilities at U.S. universities. These activities will not include construction of new reactors, but they may include enhancements to existing reactors and addition of related capabilities such as simulators. This support will helpU.S. universities (1) develop a workforce with hands-on experience with commercially relevant advanced reactor concepts, reflective of those being deployed by industry; (2) offer research capabilities that address emerging technical challenges; and (3) ensure that access to the opportunities and benefits of these capabilities are equitably provided, specifically seeking ways to include communities that have historically faced limits in access to such capabilities. These activities are expected to be led by one or more diverse consortiawith appropriate expertise to ensure that the new capabilities will support these goals. A goal is to maximize the research and educational value and the broad accessibility of these resources in an equitable and inclusive manner.

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **SBIR/STTR**<br>**$26,673,000** | **$24,311,000** | **-$2,362,000** |
| • In FY 2023, Nuclear Energy (NE) plans to provide $26,673,000 for Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) through allocated charges to other research and development (R&D) programs. Awards will be made in areas such as advanced technologies for nuclear energy and used fuel. | • Support competitively awarded nuclear science and engineering small business and technology awards focusing in the areas of advanced technologies for nuclear energy and used fuel. | • The decrease is due to decreased Nuclear Energy research and development funding. |
| **Technology Commercialization Fund**<br>**$8,602,000** | **$5,931,000** | **-$2,517,000** |
| • In FY 2023, NE will provide $8,602,000 for the Technology Commercialization Fund (TCF) through allocated charges to other R&D programs. Awards will be made in areas such as advanced technologies for nuclear energy and used fuel. | • Supports competitive laboratory funding opportunity designed to help commercialize promising nuclear energy related technologies developed at the national laboratories. | • The decrease is due to decreased Nuclear Energy research and development funding. |
| **University Led Research & Development**<br>**$59,001,000** | **$77,873,000** | **+$18,461,000** |
| • In FY 2023, NE will provide $59,001,000 for university led R&D through allocated charges to other R&D programs. Awards will be made for research in areas such as fuel cycle, reactor concepts, and mission supporting research. | • Supports competitively awarded, university-led nuclear energy R&D that focus on the priorities of NE programs, including fuel cycle, reactor concepts, and mission supporting research.<br>• Supports early career awards focused on faculty conducting transformative research, education, and leadership aligned with the NE mission.<br>• Support Innovations in Nuclear Energy Technology R&D Publication Competition focused on graduate and undergraduate students' research published through journal publications and conference proceedings. | • The increase is due to increased Nuclear Energy research and development funding.<br>• The increase will support the Innovations in Nuclear Energy Technology R&D Publication Competition for undergraduate and graduate students. |

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **University Infrastructure** | | |
| **$12,000,000** | **$12,000,000** | **+$0** |
| • In FY 2023, NE used $12,000,000 for university infrastructure Awards supported general scientific infrastructure, reactor upgrades at U.S. universities, and revitalization of existing university nuclear research infrastructure, especially in support of nuclear cyber-physical protection, new digital technologies in advanced nuclear reactors, and the development and safety assessments of small modular reactors. | • Supports general scientific infrastructure, reactor upgrades, reactor sharing, and infrastructure revitalization through competitive solicitations.<br>• Supports competitively awarded, consortium-led activities to enhance nuclear research capabilities at U.S. universities, including establishment of new non-reactor capabilities such as simulators and relevant improvements to existing research reactors. | • No change. |

## University Nuclear Leadership Program

**Description**

The University Nuclear Leadership Program (UNLP) provides undergraduate scholarships and graduate fellowships to students attending two and four-year institutions and supports other internship programs that assist disadvantaged communities.

The Office of Nuclear Energy (NE) UNLP subprogram supports the next generation of the nuclear energy workforce. The subprogram provides important educational support to bolster scientific discovery and innovation in nuclear science and engineering (NS&E) at U.S. universities and colleges.

The subprogram is intended to attract qualified students to nuclear energy professions by providing single-year undergraduate scholarships and multi-year graduate fellowships. Scholarships are awarded for undergraduate study at two and four-year institutions leading to a major or minor degree or certificate and fellowships are awarded for graduate-level work leading to a masters or doctoral degree in the fields or disciplines of NS&E relevant to the NE mission. NS&E disciplines of interest include nuclear engineering, mechanical engineering, electrical engineering, chemistry, health physics, nuclear materials science, radiochemistry, applied nuclear physics, nuclear policy, radiation protection technology, nuclear power technology, nuclear maintenance technology, and nuclear engineering technology work leading to a masters or doctoral degree in the fields or disciplines of NS&E relevant to the NE mission.

In FY 2024, UNLP will expand the opportunity for graduate fellowship students to compete for an opportunity to tour nuclear facilities in the United Kingdom (UK) under the United States (US) / UK bilateral collaboration.

NE has awarded more than $60 million for 1,017 nuclear energy-related scholarships and fellowships at 77 universities and colleges—13 of which are MSIs, including 2 HBCUs—in 32 states since the program was initiated in 2009 under the Integrated University Program. Currently, scholarships are offered at $10,000 for one year to students attending four-year institutions and $5,000 to students attending two-year trade schools and community colleges. The maximum award for a fellowship is $54,000 per year for three years, with an additional one-time $7,000 allotment to fund a minimum 10-week internship at a DOE national laboratory or other designated facility.

All scholarship and fellowship awards are competitively awarded to students attending U.S. institutions of higher education offering NS&E educational programs, including MSIs, HBCUs, and TCUs. Emphasis is placed on increasing the involvement of MSIs, resulting in direct and meaningful investments in the areas of clean energy training and workforce development in support of the administration's goals for equity and inclusion.

<u>OMNI Internships</u>

OMNI Internships, a DOE Office of the Chief Information Officer-led effort, help to build careers for talented cybersecurity and information technology professionals to strengthen the security of the Department, the national laboratories, and the nuclear industry.

**University Nuclear Leadership Program**
**Funding ($K)**

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **University Nuclear Leadership Program** | | |
| **$6,500,000** | **$6,630,000** | **+$130,000** |
| • Support nuclear science and engineering study and research by fully funding approximately 30 or more multi-year student fellowships and 45 or more single-year scholarships in the nuclear energy field of study.<br>• Support a new scholarship program opportunity that targets two-year applied technical degree programs focused on nuclear energy-related topics, all with an increased emphasis on capacity-building and education at MSIs, and institutions in disadvantaged communities. This opportunity will focus on workforce development for nuclear relevant technician training, including nuclear operations, mechanical maintenance, electrical maintenance, chemistry, health physics and other nuclear energy-related topics.<br>• Bolster outreach efforts focused on increasing MSI involvement to include website resources, conference promotion, and university visits.<br>• Support an OMNI internship program that will help build careers for talented cybersecurity and information technology professionals to strengthen the security of the Department, the national laboratories, and the nuclear industry. | • Support nuclear science and engineering study and research by fully funding approximately 30 multi-year student fellowships and 60 single-year scholarships in the nuclear energy field of study.<br>• Support competitive exchange opportunity for University Nuclear Leadership Program (UNLP) fellows to tour nuclear facilities under the bilateral collaboration with the United Kingdom (UK).<br>• Bolster outreach efforts focused on increasing MSI involvement to include website resources, conference promotion, and university visits.<br>• Support an OMNI internship program that will help build careers for talented cybersecurity and information technology professionals to strengthen the security of the Department, the national laboratories, and the nuclear industry. | • The increase reflects fully funding single-year scholarships and multi-year fellowships and maintaining or increasing the number of such awards.<br>• The increase will provide support for a competitive exchange opportunity with the UK for graduate fellowship students, under our bilateral collaboration, which will strengthen students' nuclear international experience. |

## University Fuel Services

**Description**

University Fuel Services (UFS) provides fuel services for U.S. university research reactors. These activities were previously funded within the Research Reactor Infrastructure (RRI) subprogram.

UFS provides fresh reactor fuel to, and removes used fuel from, 25 operating university research reactors at 24 U.S. universities to support their continued operation. This provides continued research and training reactor capability to U.S. universities to ensure their continued ability to support U.S. nuclear energy initiatives in the areas of research, development, and educational opportunities.

The continued operation of U.S. university research reactors directly supports the successful execution of the nuclear energy research mission and plays an important role in developing future scientists and engineers in the U.S. These research reactors provide irreplaceable training, education, and research support to hundreds of students annually, and many hosting universities expand access to these reactors through partnerships with minority serving institutions in underserved or disadvantaged communities, including innovative online opportunities providing direct access to reactor operating data. UFS support ensures continued reactor operations that directly expand diversity of Science, Technology, Engineering and Math (STEM) opportunities. This subprogram sustains unique capabilities for research and development and educational opportunities supporting U.S. energy initiatives. Used nuclear fuel shipments support U.S. and Department of Energy non-proliferation and national security objectives.

UFS provides project management, technical support, quality engineering and inspection, and nuclear material support. Major program deliverables include procuring new plate fuel elements and shipping them to select universities; transporting used fuels from U.S. universities to a DOE site; procuring High Assay Low Enriched Uranium (HALEU) and shipping it to the Training, Research, Isotopes, General Atomics (TRIGA) Fuel Fabrication Facility (TFFF) in Romans, France, for fabrication of TRIGA fuel and procuring new TRIGA fuel elements from the TFFF; and reusing lightly-irradiated TRIGA fuel currently in inventory at Idaho National Laboratory (INL) by retrieving, inspecting and shipping it to universities with the most urgent need.

Commercial TRIGA fuel element production at the TFFF started in FY 2022. In FY 2024, UFS will provide $9.24 million for the procurement of TRIGA fresh fuel elements, to meet the increased fresh fuel requests from the 12 TRIGA research reactors located at U.S. universities, and to take advantage of the significant fuel cost discount provided to the Department if full orders are placed annually. UFS will also continue to ship used plate and TRIGA reactor fuel elements from supported universities to DOE used fuel receipt facilities. The Department will continue its policy, initiated in FY 2017, of reusing lightly irradiated TRIGA fuel in the DOE inventory and will evaluate additional alternative sources.

The existing North Carolina State University PULSTAR reactor fuel is reaching end of its current core life. It is estimated that a new fuel core and fuel boxes will be needed by the end of FY 2025 for this reactor to remain operational. In FY 2024, funding will be used to continue fabrication of 25 new fuel assemblies. Work will include initiating contracts to fabricate 750 fuel pins, to manufacture 25 fuel assembly zircaloy fuel boxes, and to manufacture fuel assembly end fittings.

**University Fuel Services**
**Funding ($K)**

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **University Fuel Services**<br>**$17,500,000** | **$20,222,000** | **+$2,722,000** |
| • Procure 40 and deliver 36 plate fuel elements required annually by University of Missouri (MU) and Massachusetts Institute of Technology (MIT) as determined by need and fuel availability.<br>• As needed, ship up to two cask loads of lightly irradiated 8.5 wt% standard Training, Research, Isotopes, General Atomics (TRIGA) fuel elements from the Irradiated Fuel Storage Facility at Idaho National Laboratory (INL) to select U.S. university research reactor facilities.<br>• Procure up to 90 TRIGA fuel elements annually after the first year from the TRIGA Fuel Fabrication Facility (TFFF). As needed, procure and ship High Assay Low Enriched Uranium (HALEU) metal to the TFFF in Romans, France, to support procurement of TRIGA fuel elements, and ship fuel elements to TRIGA reactor facilities as determined by need and fuel availability.<br>• Complete up to five used fuel shipments to Savannah River Site (SRS) and the INL, pending resolution of moratorium on such shipments to the INL.<br>• Initiate fuel design and engineering studies; modeling, design and licensing of a shipment package, and procurement of fuel assembly boxes and end fittings for the North Carolina State University (NCSU) PULSTAR reactor.<br>• Continue University Fuel Services (UFS) project management, quality assurance, nuclear material accountability, and transportation cask maintenance. | • Procure 40 and deliver between 33 and 36 plate fuel elements required annually by MU and MIT as determined by need and fuel availability.<br>• As needed, ship up to two cask loads of lightly irradiated 8.5 wt% standard TRIGA fuel elements from the Irradiated Fuel Storage Facility at INL to select U.S. university research reactor facilities.<br>• Procure up to 90 TRIGA fuel elements annually after the first year from TFFF. As needed, procure and ship HALEU metal to the TFFF in Romans, France, to support procurement of TRIGA fuel elements, and ship fuel elements to TRIGA reactor facilities as determined by need and fuel availability.<br>• Complete up to five used fuel shipments to SRS and the INL, pending resolution of moratorium on such shipments to the INL.<br>• Procure fuel pins, fuel assembly boxes, and end fittings for the NCSU PULSTAR reactor.<br>• Continue UFS project management, quality assurance, nuclear material accountability, and transportation cask maintenance. | • The increase reflects additional TRIGA fresh fuel orders to ensure that a maximum number of fuel elements can be purchased per year, resulting in the lowest average price per element.<br>• The increase provides funding to initiate contracts for the fabrication of the fuel pins, fuel assembly boxes, and end fittings. |

## Reactor Concepts Research, Development, and Demonstration

**Overview**

The Reactor Concepts Research, Development, and Demonstration (RD&D) program supports conducting RD&D on existing and advanced reactor designs and technologies. This RD&D enables industry to address technical and regulatory challenges associated with maintaining the existing fleet of nuclear reactors; promoting the development of a robust pipeline of advanced reactor designs, technologies, and associated supply chains; and progressing these advanced reactor designs and technologies towards demonstration when appropriate. Program activities are focused on addressing technical, economic, safety, and security enhancement challenges associated with the existing commercial light water reactor fleet and advanced reactor technologies, covering large, small, and micro-sized designs across an array of reactor types including fast reactors using liquid metal coolants and high temperature reactors using gas or molten salt coolants.

To maximize the benefits of nuclear power, the following challenges must be addressed:

- improving affordability of nuclear energy technologies;
- enhancing safety and reducing technical and regulatory risk;
- minimizing proliferation risks of nuclear materials; and
- improving the economic outlook for the United States (U.S.) nuclear industry.

Reactor Concepts RD&D is key to enabling the industry to reverse the downward market trajectory of our nation's nuclear energy sector by regaining a technological and market leadership role. Through cost-shared RD&D activities, related technical assistance, and cross-cutting innovative research and development (R&D), the Department will enable industry to accelerate the timeline for commercialization of new, advanced, and more economic reactor technologies that will help revive and expand the domestic nuclear industry while advancing America's leadership role in the global nuclear sector and meeting our nation's clean energy goals. Reactor Concepts RD&D also makes these technology advancements accessible to the U.S. industry through the Gateway for Accelerated Innovation in Nuclear (GAIN) initiative.

The Reactor Concepts RD&D program continues to support RD&D efforts focused on small modular reactors (SMRs) in FY 2024. The Advanced SMR RD&D subprogram supports cost-shared RD&D activities that accelerate the domestic demonstration of U.S. SMR technologies to facilitate further deployment of U.S. technologies in domestic and international markets, including countries that have expressed interest in near-term SMR deployment. In FY 2024, the program will prioritize supporting the Carbon Free Power Project's commercial demonstration of the NuScale SMR technology.

The Light Water Reactor Sustainability (LWRS) subprogram conducts research in support of light water reactor (LWR) technologies so that LWR-based commercial nuclear power plants can continue to provide safe, clean, and reliable energy. The goal is to enable industry to enhance the efficient and economic performance of current nuclear power plants while enabling their extended operation. A critical element of the subprogram is cost-shared, private-public partnerships to help industry resolve its highest priority and highest uncertainty technical issues where U.S. government partnership is appropriate.

The Advanced Reactor Technologies (ART) subprogram conducts targeted R&D on advanced reactor technologies, including molten salt reactors, liquid metal-cooled reactors, high temperature gas-cooled reactors, and microreactors. The subprogram also supports work on cross-cutting R&D that can be applied to multiple advanced reactor concepts, including non-light water reactor SMRs. This subprogram focuses on efforts in the following areas: fundamental technologies and design methods for advanced reactors, interactions of diverse reactor coolants with materials and components, advanced energy conversion, analysis of reactor response to severe accidents, research to enhance safety and reduce regulatory risk, experimental validation of models, advanced materials development and qualification, and continued international collaborations. Funding will also support competitively awarded projects to assist the progression of emerging advanced reactor designs and technologies.

**Highlights of the FY 2024 Budget Request**

The Advanced SMR RD&D subprogram has successfully completed federal support for the NuScale SMR First-of-a-Kind Nuclear Demonstration Readiness Project and will transition towards supporting the Carbon Free Power Project's commercial demonstration of the NuScale SMR technology.

The Reactor Concepts RD&D program will continue to conduct RD&D activities to address technical, cost, safety, and security enhancement challenges associated with the existing commercial light water reactor fleet and advanced reactor technologies.

**Reactor Concepts Research, Development, and Demonstration**
**Funding ($K)**

| | FY 2022 Enacted | FY 2023 Enacted | FY 2024 Request | FY 2024 Request vs FY 2023 Enacted ($) | FY 2024 Request vs FY 2023 Enacted (%) |
|---|---|---|---|---|---|
| **Reactor Concepts Research, Development and Demonstration** | | | | | |
| Advanced Small Modular Reactor RD&D | 150,000 | 165,000 | 20,000 | -145,000 | -87.9% |
| Light Water Reactor Sustainability | 48,000 | 45,000 | 35,000 | -10,000 | -22.2% |
| Advanced Reactor Technologies | 59,000 | 49,000 | 43,200 | -5,800 | -11.8% |
| **Total, Reactor Concepts Research, Development and Demonstration** | **257,000** | **259,000** | **98,200** | **-160,800** | **-62.1%** |

**Reactor Concepts Research, Development and Demonstration**
**Explanation of Major Changes ($K)**

| | FY 2024 Request vs FY 2023 Enacted |
|---|---|
| **Advanced Small Modular Reactor RD&D:** | **-145,000** |
| The decrease from $165,000,000 to $20,000,000 reflects the completion of federal support for the development of a U.S. SMR technology for deployment in domestic and international markets and the prioritization of programmatic efforts supporting the Carbon Free Power Project's commercial demonstration of the NuScale SMR technology. | |
| **Light Water Reactor Sustainability:** | **-10,000** |
| The decrease from $45,000,000 to $35,000,000 reflects the conclusion of several laboratory projects that are now being adopted by industry and a reduction in competitively selected industry cost shared awards. | |
| **Advanced Reactor Technologies:** | |
| The decrease from $49,000,000 to $43,200,000 reflects completion of funding for the Advanced Reactor Concepts-2020 (ARC-20) awards in FY2023. | **-5,800** |
| **Total, Reactor Concepts Research, Development & Demonstration** | **-160,800** |

**Reactor Concepts Research, Development and Demonstration**
**Advanced Small Modular Reactor RD&D**

**Description**

The Advanced Small Modular Reactor (SMR) Research, Development and Demonstration (RD&D) subprogram supports enabling industry to reverse the downward market trajectory of our nation's nuclear energy sector, reestablishing U.S. leadership in the nuclear technology development and demonstration arena and meeting our nation's climate change and clean energy goals. A range of significant technological challenges remain in developing advanced SMR designs. The Department intends to leverage its appropriate federal role and notable expertise to facilitate industry's development and demonstration of advanced SMR designs that have the potential to provide safe, clean, and affordable energy generation options.

The Advanced SMR RD&D subprogram will support RD&D to assist in maturing SMR concepts toward commercial readiness, including supply chain development. Results will be widely applicable and can be adopted by domestic nuclear reactor vendors for the purpose of accelerating the development and demonstration of their technologies. Funding will support an ongoing award to continue only the most critical activities required to accelerate the domestic demonstration of an SMR technology. Demonstration of the SMR technology will facilitate further deployment of U.S. technologies in domestic and international markets, including countries that have expressed interest in near-term SMR deployment.

The subprogram will leverage ongoing and planned R&D activities supported by the related Advanced Reactor Technologies subprogram.

## Advanced Small Modular Reactor RD&D

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Advanced Small Modular Reactor RD&D**<br>**$165,000,000** | **$20,000,000** | **-$145,000,000** |
| • Completed federal financial support for the NuScale SMR First-of-a-Kind Nuclear Demonstration Readiness Project, which supports the development of a U.S. SMR technology for deployment in domestic and international markets. Specific project activities include:<br>  ○ Completion of a Standard Plant Design, which will support deployments both domestically and abroad.<br>  ○ Submission of the Standard Design Approval Application (SDAA) to the Nuclear Regulatory Commission (NRC) for review and approval.<br>• Continued support for the Carbon Free Power Project, the first domestic demonstration of the NuScale SMR technology, on a timeline to achieve commercial operation of the first module by 2029 and the remaining five modules by 2030. Specific project activities include:<br>  ○ Completion of a Class 3 project cost estimate.<br>  ○ Collection of site environmental data needed for licensing.<br>  ○ Preparation of a Combined License Application (COLA) for submittal to the NRC in January 2024.<br>  ○ Initiation of a Class 2 project cost estimate and site-specific preliminary engineering. | • Supports the Carbon Free Power Project's commercial demonstration of the NuScale SMR technology such that the technology will be considered for future deployments both domestically and abroad.<br>• Competitively supports the nuclear industry in addressing the highest priority design maturation and supply chain needs necessary for the successful deployment of advanced reactors. | • The decrease reflects the completion of federal support for the NuScale SMR First-of-a-Kind Nuclear Demonstration Readiness Project. and continued support for the Carbon Free Power Project's commercial demonstration of the NuScale SMR technology |

**Reactor Concepts Research, Development and Demonstration**
**Light Water Reactor Sustainability**

**Description**

The Light Water Reactor Sustainability (LWRS) subprogram conducts research and development (R&D) on technologies and other solutions that can improve economics, sustain safety, and maintain the technical reliability of the current domestic fleet of commercial nuclear power plants.

The focus of the subprogram is on conducting R&D that addresses the nuclear industry's economic challenges that have led to premature plant shutdowns. LWRS will continue to collaborate with nuclear power plant owner-operators, vendors, suppliers, industry support organizations, other research organizations, and the Nuclear Regulatory Commission (NRC) to closely coordinate research that both supports industry needs and maximizes taxpayer benefit.

Currently, the LWRS subprogram consists of the following R&D areas:

- Plant Modernization: R&D to address nuclear power plant economic viability in current and future energy markets by increasing efficiency through the implementation of digital technologies. The R&D products will enable modernization of plant systems and processes across the industry by enabling a shift from a labor centric to a technology-centric business model that supports improved performance at a lower cost.
- Flexible Plant Operations and Generation: R&D to establish the technical feasibility and economic potential of dispatching thermal and electrical energy to diversify and increase revenue of commercial light water reactors in the U.S. The R&D products, including hydrogen production demonstration activities, will allow the existing fleet of nuclear reactors to readily respond to rapid changes in electricity supply and demand due to the widespread adoption of variable renewable energy resources and demonstrate the ability to repurpose nuclear power reactors into flexible energy sources for low-carbon industrial commodity production.
- Risk-Informed Systems Analysis: R&D to support decision-making related to the economics, reliability, and safety of the existing fleet by providing analysis solutions for integrated plant systems. By applying advanced quantitative methods, these activities support the improvement of plant operational procedures, plant asset management, and operations and maintenance activities. In addition, the R&D products in this area will be used to optimize plant economic performance and safety by incorporating the impacts of physical aging and degradation processes.
- Physical Security Research: R&D that will validate methods and tools which can be used to implement an updated, cost-effective physical security regime. The R&D products are expected to enable companies across the industry to reduce excessive conservatisms in security modeling, leverage automation as force multipliers, optimize security postures, and develop additional means to risk-inform approaches to evaluate security changes.
- Materials Research: R&D to develop the scientific basis for understanding and predicting long-term environmental degradation behavior of materials in nuclear power plants. The R&D products will be used to define operational limits and aging mitigation approaches for materials in nuclear power plant systems, structures, and components (SSC) subject to long-term operating conditions, providing key input to both regulators and industry.

In FY 2024, the LWRS subprogram continues to leverage cost-shared, private-public partnerships and our national laboratory system to conduct R&D to resolve industry's highest priority and highest uncertainty challenges where U.S. government partnership is appropriate. These high priority areas include providing science and technology-based solutions to improve the current business model and associated practices of the current fleet and develop the scientific bases for managing the aging of SSCs to allow existing nuclear power plants to continue to operate safely and cost-effectively.

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Light Water Reactor Sustainability**<br>**$45,000,000** | **$35,000,000** | **-$10,000,000** |
| • Plant Modernization - Completed development of the Integrated Operations for Nuclear business operating model and demonstrate its use with an operating nuclear power plant which will allow utilities to shift their operations from a labor centric to a technology centric business model. Produced an Artificial Intelligence/Machine Learning methodology to achieve a fully automated risk-informed predictive maintenance strategy.<br>• Flexible Plant Operation and Generation - Developed the methods and licensing approach for thermal extraction, thermal energy storage, and distribution. Engineer and simulate operations and control systems for direct use of heat generated from the existing light water reactor fleet. Developed architectural and engineering models, and investor-grade reports to detail the opportunities for providing clean thermal and electrical energy for industrial applications (e.g., hydrogen, ammonia, metals, chemicals, and fuels production).<br>• Risk-Informed Systems Analysis – Enhanced the algorithm used to optimize the reactor core reload process and enable crediting Terry Turbines for extended operation, which will expand the mitigation options available to operators under both normal and emergency conditions. | • Plant Modernization – Collaborate with a partner utility to implement digital infrastructure upgrades and conduct an assessment of the adoption of advanced automation at a nuclear power plant. Develop and demonstrate a set of tools to digitalize work processes at nuclear power plants to streamline the regulatory compliance process and reduce administrative burden.<br>• Flexible Plant Operation and Generation – Conduct regulatory research and risk assessments to support a preliminary Front End Engineering Design for thermal energy extraction and storage systems supporting 50% and 70% of the reactor's output. Evaluate components and processes that enable the end use of nuclear energy in industrial and transportations sectors. Develop a human-machine interface to allow for the dynamic dispatch of heat and electricity from a boiling water reactor to secondary applications<br>• Risk Informed Systems Analysis – Perform an assessment of the economic benefits derived from the extended burnup times and smaller fuel batch size enabled by accident tolerant fuels. Enhance and demonstrate the risk analysis and reliability assessment framework for safety-critical nuclear digital instrumentation and control (DI&C) systems and extend it to incorporate software failures in intelligent DI&C systems. | The decrease from $45,000,000 to $35,000,000 reflects the conclusion of several laboratory projects that are now being adopted by industry and a reduction in competitively selected industry cost shared awards. |

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| • Physical Security - Delivered guidance to industry on the use and implementation of dynamic risk analysis tools to support dynamic physical security risk assessments, reducing utility security cost burdens and improving market competitiveness.<br>• Materials Research - Implemented the reactor pressure vessel predictive embrittlement model through American Society for Testing and Materials (ASTM) and American Society of Mechanical Engineers (ASME) for code acceptance and wide industry use. Published a methodological guideline on concrete degradation for industry and accompany with the public release of Microstructure Oriented Scientific Analysis of Irradiated Concrete (MOSAIC) for industry use. | • Physical Security – Develop and deploy technology to improve the efficiency of the physical security posture at commercial nuclear power plants. Finalize the evaluation of a secure wireless capability during normal, abnormal, and malicious events and its ability to identify the location of jamming sources. Conduct nuclear utility pilot studies which leverage dynamic risk assessment methods to select cost reducing physical security technologies and estimate costs of security system upgrades.<br>• Materials Research – Validate the image construction algorithm used for non-destructive examination of concrete structures. Complete material harvesting from the reactor pressure vessel at the Palisades Nuclear Generating Station to support validation of materials degradation models. | |

**Reactor Concepts Research, Development and Demonstration**
**Advanced Reactor Technologies**

**Description**

The Advanced Reactor Technologies (ART) subprogram conducts essential research and development (R&D) activities to reduce technical risks associated with advanced reactor technologies and systems. The subprogram R&D scope reflects input from advanced reactor stakeholders with a goal of enabling industry to mature and ultimately demonstrate advanced reactor technologies in the 2030s. Innovative advanced reactor concepts have the potential to offer significant benefits versus existing technologies, including possible lower costs, enhanced safety and security, greater resource utilization, and simplified operations. Such advantages could allow nuclear energy to increase its contributions to domestic clean and resilient energy sources and to support the growth of high-paying U.S. jobs. The ART subprogram conducts R&D that can help reduce long-term technical barriers for multiple reactor technology concepts. This subprogram will address the full range of high-value R&D to advance technologies that benefit multiple advanced reactor concepts, including microreactor designs, and stimulate new ideas for transformational future concepts. The ART subprogram supports the Microreactor Applications, Research, Validation and Evaluation (MARVEL) project. MARVEL will be a nuclear microreactor test platform operated at the Idaho National Laboratory (INL) to test microreactor technologies and end-use applications.

ART R&D efforts support innovative reactor concepts, including high temperature gas-cooled reactors (HTGR), fast reactors, and molten salt reactors (MSR) using liquid salt coolants and/or fuels. The ART subprogram focuses on industry-informed R&D priorities that would provide widely-applicable benefits across many different advanced reactor concepts including: fundamental technologies and design methods for advanced reactors; interactions of advanced reactor coolants with materials and components; advanced systems and components that can operate in extreme high temperature environments; research to enhance safety; advanced materials development and codification; cross-cutting areas of support in advanced energy conversion technologies; and research to support microreactors for remote and micro-grid commercial applications. The ART subprogram conducts R&D to enhance the likelihood of future demonstration and commercialization of emergent advanced reactor technologies. The ART subprogram continues support for international collaborations on advanced materials, advanced reactor operations, and safety promoting the development of advanced reactors in the United States (U.S.) and supporting deployment of U.S. technologies in the global marketplace.

Industry-led, cost-shared R&D activities are supported through competitively selected industry awards to reduce technical and regulatory risks associated with advanced reactor designs. Specifically, in FY2021, DOE announced the selection of three awards to support the development of designs that could have significant impact on the energy market in the mid-2030s or later. These projects continue to meet project milestones. The three concepts selected for award were:

- Development of a conceptual design of a seismically isolated advanced sodium-cooled reactor facility - Advanced Reactor Concepts, LLC;
- Development of a fast modular reactor conceptual design with verifications of key metrics in fuel, safety, and operational performance - General Atomics; and
- Maturing the Modular Integrated Gas-Cooled High Temperature Reactor (MIGHTR) concept from a pre-conceptual stage to a conceptual stage - Massachusetts Institute of Technology (MIT).

FY 2024 activities for the ART subprogram will focus on essential research to address the highest priority challenges facing advanced reactor technologies and continued support for innovation through cost-shared partnerships with industry.

## Advanced Reactor Technologies

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Advanced Reactor Technologies**<br>**$49,000,000** | **$43,200,000** | **-$5,800,000** |
| • Fast Reactor Technologies – Performed additional testing of the Thermal Hydraulic Experiment Test Article (THETA) in the Mechanisms Engineering Test Loop (METL) to generate data for fast reactor design and safety code validation. Performed model development and experimental validation activities to support development and licensing activities for fast reactors.<br>• Gas Reactor Technologies – Performed additional experimental validation of normal operation and transient conditions and supported modeling and simulation activities using the water-based reactor cavity cooling system at the natural convection shutdown heat removal test facility (NSTF) at the Argonne National Laboratory (ANL). Supported long term testing to characterize creep behaviors of high temperature alloys.<br>• Molten Salt Reactor (MSR) Technologies – Maintained and expanded the molten salt thermal properties database to aid in the design and licensing of MSRs. Developed and demonstrated online monitoring technologies to meet deployment process control needs with the transition from laboratory scale experiments to the Liquid Salt Test Loop at the Oak Ridge National Laboratory<br>• Microreactor Technologies – Continued qualification and testing of high temperature moderator materials that have the broadest | • Fast Reactor Technologies – Assemble the Gripper Test Article, which simulates the fuel assembly gripper in a compact in-vessel fuel handling mechanism, and initiate preparations for testing in METL. Commission the Flow Sensor Test Article, which is needed for testing flow sensor technologies, for testing in the METL facility and initiate sodium testing.<br>• Gas Reactor Technologies – Complete the full test matrix for the water-based reactor cavity cooling system at the NSTF at ANL**.** Support continued long term testing to characterize creep behaviors of high temperature alloys, such as Alloy 617, necessary for code case acceptance.<br>• Molten Salt Reactor (MSR) Technologies – Develop a roadmap focused on conducting engineering scale molten salt spill tests to validate accident progression models for MSR licensing. Further expand the molten salt thermal properties database to aid in the design and licensing of MSRs.<br>• Microreactor Technologies –Complete construction of the Microreactor Applications, Research, Validation and Evaluation (MARVEL) test platform to enable demonstration of microreactor technologies and end-use applications. Begin testing first non-nuclear power cycle test to provide valuable data on integrated microreactor system operation. Continue production of high-quality data on | • The decrease reflects the completion of funding for the ARC-20 awards in FY 2023 balanced by a greater emphasis on essential research to address the highest priority industry identified challenges associated with advanced reactor technologies and systems. |

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| potential application for microreactor applications. Complete design of nonnuclear integrated testing and validation capabilities for microreactor systems and operation. Began installation of the Microreactor Applications, Research, Validation and Evaluation (MARVEL) test platform (nuclear microreactor test platform to demonstrate the integration of commercial end-user applications).<br>• Industry Awards (ARC-20) – Supported execution of the three ARC-20 projects per established project plans and using current and prior year carryover funds. Specific project activities include:<br>o For the Advanced Reactor Concepts, LLC award: Conducted further pre-application engagement with the NRC. Completed conceptual design report. Initiated activities to support design and licensing.<br>o For the General Atomics award: Conducted further pre-application engagement with the NRC. Completed report documenting analysis of reactor passive safety. Initiated irradiation testing of fuel in INL's Advanced Test Reactor.<br>o For the MIT award: Completed preliminary manufacturing and licensing assessments for the modular integrated gas-cooled high temperature reactor (MIGHTR). Completed reports documenting layout of reactor internal structures, reactor pressure vessel design, reactor building layout and design criteria, and construction sequence. | performance of microreactor technologies to enhance the viability of microreactor concepts and drive down cost.<br>• Industry Awards (ARC-20) – Support execution of the three ARC-20 projects per established project plans and using prior year carryover funds. Specific project activities include:<br>o For the Advanced Reactor Concepts, LLC award: Complete the preliminary design, start detailed final design, and document Preliminary Safety Analysis Report (PSAR) for a generic site. Prepare design specifications for long lead components and develop a procurement schedule.<br>o For the General Atomics award: Complete preliminary cost analysis for the General Atomics fast modular reactor concept. Conduct further pre-application engagement with the NRC. Continue fuel irradiation testing in INL's Advanced Test Reactor and complete fuel testing in INL's Transient Reactor Test Facility.<br>o For the MIT award: Complete MIT ARC-20 project including completion of report documenting the cost basis for the MIGHTR design, completion of assessments of reactor performance during steady power operations, load following, and accident scenarios, and completion of seismic analysis of the reactor building. | |

## Fuel Cycle Research and Development

### Overview

The Fuel Cycle Research and Development (FCR&D) program conducts applied research and development (R&D) on advanced fuel cycle technologies that have the potential to accelerate progress on managing and disposing of the nation's spent fuel and high-level waste, improve resource utilization and energy generation, reduce waste generation, and limit proliferation risk. Advancements in fuel cycle technologies support the enhanced availability, economics, and security of nuclear-generated electricity in the U.S., further enhancing U.S. energy independence and economic competitiveness. The FCR&D program also contributes to the Department's policies and programs for ensuring a secure reliable and economic nuclear fuel supply for both existing and future reactors.

The FCR&D program participates in world-class R&D and employs internationally renowned technical experts. FCR&D subprograms leverage their technical expertise by participating in international collaborations through bilateral and multilateral technical agreements. The program also participates in projects sponsored by the International Atomic Energy Agency and the Organization for Economic Cooperation and Development/Nuclear Energy Agency which provides further leverage in key technical areas.

The program supports R&D and evaluation of spent fuel and high-level waste disposition pathways, covering storage, transportation, and disposal technologies. The program also supports R&D on multiple advanced fuel technologies that hold promise for enhanced performance and improved economics or are an important element in the development of the next generation of reactor designs; making available small quantities of High Assay Low Enriched Uranium (HALEU) in the short term and work with industry to build out commercial HALEU production in the long term to support demonstration of advanced reactor technologies.

### Highlights of the FY 2024 Budget Request

The Advanced Nuclear Fuel Availability subprogram includes limited production of HALEU at Piketon. The FY 2024 Request continues funding the near-term activities already underway including recovery and downblending DOE material and enrichment operations at the Piketon facility. The subprogram complements the Inflation Reduction Act activities that will primarily be used to support a long-term, sustainable, diverse, market-driven commercial HALEU supply. Accelerated efforts to prepare EBR-II used as a HALEU feedstock are continued under Material Recovery and Waste Form Development.

**Fuel Cycle Research and Development**
**Funding ($K)**

| | FY 2022 Enacted | FY 2023 Enacted | FY 2024 Request | FY 2024 Request vs FY 2023 Enacted ($) | FY 2024 Request vs FY 2023 Enacted (%) |
|---|---|---|---|---|---|
| **Fuel Cycle Research and Development** | | | | | |
| Material Recovery and Waste Form Development | 30,000 | 45,000 | 39,000 | -6,000 | -13.3% |
| Mining, Conversion, and Transportation | 2,000 | 2,000 | 1,500 | -500 | -25.0% |
| Accident Tolerant Fuels | 115,000 | 114,000 | 108,900 | -5,100 | -4.5% |
| TRISO Fuel and Graphite Qualification | 37,000 | 32,000 | 25,000 | -7,000 | -21.9% |
| Fuel Cycle Laboratory R&D | 23,150 | 29,000 | 29,000 | 0 | 0.0% |
| Advanced Nuclear Fuel Availability | 45,000 | 100,000[1] | 120,000 | +20,000 | +20.0% |
| Used Nuclear Fuel Disposition R&D | 50,000 | 47,000 | 46,875 | -125 | -0.3% |
| Integrated Waste Management System | 18,000 | 53,000 | 53,000 | 0 | 0.0% |
| **Total, Fuel Cycle Research and Development** | **320,150** | 422,000 | **423,275** | +1,275 | **+0.3%** |

[1] Funded by Ukraine Supplemental Appropriations Act, 2023 (P.L. 117-180)

**Fuel Cycle Research and Development**
**Explanation of Major Changes ($K)**

| | FY 2024 Request vs FY 2023 Enacted |
|---|---|
| **Material Recovery and Waste Form Development**<br>Funding decrease from $45,000,000 to $39,000,000 reflects a reduced effort on hybrid ZIRCEX demonstration. | **-6,000** |
| **Mining, Conversion, and Transportation**<br>Funding decrease from $2,000,000 to $1,500,000 reflects a shift to focus on a limited number of separation technologies to improve in-situ uranium extraction efficiency and resource utilization for the mining industry. | **-500** |
| **Accident Tolerant Fuels**<br>Funding decrease from $114,000,000 to $108,900,000 reflects focus on meeting industry's objectives for developing the near-term ATF concepts. | **-5,100** |
| **TRISO Fuel and Graphite Qualification**<br>Funding decrease from $32,000,000 to $25,000,000 reflects the TRISO fuel qualification program ramping down as it nears successful completion and high-cost activities such as irradiation experiments have been completed. | **-7,000** |
| **Advanced Nuclear Fuel Availability**<br>Funding increase from $100,000,000 to $120,000,000 reflects expanding recovery and downblending at Savanah River Site and limited HALEU production at Piketon of at least 900 kg per year. | **+20,000** |
| **Used Nuclear Fuels Disposition R&D**<br>Funding from $47,000,000 to $46,875,000 reflects a continuation of activities to conduct scientific research and technology development to enable long term storage, transportation, and disposal of spent nuclear fuel and wastes. | **-125** |
| **Total, Fuel Cycle R&D** | **+1,275** |

**Fuel Cycle Research and Development**
**Material Recovery and Waste Form Development**

**Description**

The Material Recovery and Waste Form Development (MRWFD) subprogram conducts applied research and development (R&D) on advanced fuel recycle technologies that have the potential to improve resource utilization and energy generation, reduce waste generation, and limit proliferation risk. The subprogram focuses on developing advanced fuel recycling technologies and addressing fundamental materials separations and recovery challenges that present significant degrees of technical risks and financial uncertainties.

MRWFD provides unique nuclear chemistry expertise and technical capabilities in separation technologies to a broad range of applications by seeking a fundamental understanding of various chemical challenges related to civil nuclear applications. MRWFD stewards the capabilities and knowledge relied upon by policy makers to make informed decisions regarding nuclear fuel cycle options. Such decisions in turn rely on the development of efficient and economical separation methods that can accept the used nuclear fuel containing actinides and fission products to recycle selected actinides, recover valuable by-products, and deliver waste streams that are suitable for disposal. For example, MRWFD supports molten salt chemistry research to support advanced nuclear technologies using molten salts as electrolytes, fuel solvent and coolants. MRWFD funds research on integrated advanced technologies encompassing R&D on off gas capture and immobilization and advanced robust waste form development. The subprogram employs a science-based approach to foster innovative and transformational technology solutions to achieve this objective. Specifically, the MRWFD subprogram will continue to:

- Exploit principles of coordination chemistry to simplify actinide separations;
- Understand and manage radiation effects on materials and processes;
- Develop next generation pyroprocessing technologies and operations;
- Develop advanced salt waste forms to efficiently immobilize fission products; and
- Design robust materials for separation of gas-phase species.

The MRWFD subprogram also supports the development and demonstration of various recycling technologies to make available small quantities of high-assay low enriched uranium (HALEU) materials for advanced reactor fuel-fabrication R&D needs. HALEU can be recovered from feedstock that contains highly-enriched uranium (HEU) by using the molten salt and hybrid Zirconium Extraction (ZIRCEX) processes. Specifically, MRWFD supports the development of simplified salt process and advanced solid cathode technology which improve operations efficiency. The subprogram continues to evaluate the feasibility of recycling federally owned HEU fuels for HALEU production by developing hybrid ZIRCEX technology using a ¼-scale vapor phase demonstration pilot facility at the Idaho National Laboratory. In FY 2024, the hybrid ZIRCEX activity will continue supporting R&D in advanced chlorination agents to improve the economic and efficiency of the process and demonstrating the feasibility of aluminum extraction using unirradiated fuel from the Advanced Test Reactor.

**Material Recovery and Waste Form Development**
**Funding**

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Material Recovery and Waste Form Development** | | |
| **$45,000,000** | **$39,000,000** | **-$6,000,000** |
| • Developed innovative fuel recycling technologies targeting high-value used fuels.<br>• Supported fundamental aqueous and molten salt separation chemistries to address challenges related to civil nuclear energy applications.<br>• Determined efficiency of advanced complexants for simplified uranium recovery.<br>• Developed advanced salt waste form and off-gas technologies.<br>• Continued the accelerated EBR-II fuel treatment to fully fund an anticipated expansion of fuel treatment operations starting in FY 2024.<br>• Continued hybrid ZIRCEX process focusing on cold pilot plant studies and advanced chlorination agents development. | • Continue the acceleration of EBR-II used fuel treatment.<br>• Conduct lab scale demonstration of an innovative aqueous separation technology for simplified uranium recovery.<br>• Determine efficiency of advanced complexants for improved actinide separations.<br>• Initiate a simplified lithium chloride based single salt flowsheet for pyroprocessing technology.<br>• Demonstrate a new salt waste form baseline using iron phosphate technology.<br>• Continue developing innovative sorbent materials for off-gas technologies.<br>• Continue vapor phase extraction and hybrid ZIRCEX technology development. | • Funding decrease reflects a reduced scope in hybrid ZIRCEX technology demonstration. |

**Fuel Cycle Research and Development**
**Mining, Conversion, and Transportation**

**Description**

This subprogram supports R&D that enables technological advances in uranium mining, conversion, and transportation capabilities in the United States as well as conducting evaluations and assessments related to these areas. This subprogram supports activities related to the front end of the nuclear fuel cycle and supply chain.

Mining sites are often located in underserved communities and locations with limited water resources. Improvements to mining technology spurred by R&D may enable local economic opportunities and include environmental justice equities while reducing the amount of water used during uranium production.

In FY 2024, this subprogram will support technical experts at national labs to develop innovative separation technologies to improve in-situ uranium extraction efficiency and resource utilization for mining industry. Site-specific technical support will be provided to the U.S. mining industry.

## Mining, Conversion, and Transportation
## Funding

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Mining, Conversion, and Transportation** | | |
| **$2,000,000** | **$1,500,000** | **-$500,000** |
| • Continued R&D for uranium mining and processing technologies that reduce water usage and/or improve extraction efficiency and resource utilization for uranium production. | • Continue R&D for uranium mining and processing technologies that reduce water usage and/or improve extraction efficiency and resource utilization for uranium production. | • In FY 2024, this subprogram will focus on a limited number of innovative separation technologies to improve in-situ uranium extraction efficiency and resource utilization for the mining industry. |

**Fuel Cycle Research and Development**
**Accident Tolerant Fuels**

**Description**
The subprogram mission is enabling industry's development of one or more light water reactor (LWR) fuel concepts with significantly enhanced accident tolerance through cost shared research and development (R&D).

Following the accident at Fukushima, the Office of Nuclear Energy responding to Congressional guidance initiated a program in collaboration with LWR fuel suppliers, national laboratories, and universities to explore advanced LWR fuel with enhanced accident tolerance, including under severe accidents, to benefit the existing U.S. commercial nuclear power reactor fleet. After five years of feasibility studies, industry interactions, and assessments of potential fuel concepts, the industrial program participants identified promising concepts that have the potential to significantly enhance accident tolerance. To implement the industrial collaboration, competitively-awarded, cost-shared cooperative agreements were established with three fuel vendors and the Department. The program has progressed to testing fuel within operating commercial reactors and in parallel analyzing the performance of vendor selected test fuels at the national laboratories, primarily to address data needed to support licensing.

The U.S. fuel suppliers are developing accident tolerant fuel concepts that the owner/operators of commercial U.S. reactors anticipate will provide substantial performance improvements during accidents and under normal operations. The enhanced performance expected of the accident tolerant fuel may also enable the fuel to operate for a longer period of time in the reactor. This would allow reactors to operate for longer times between refueling outages. Many reactors would be able to increase their cycle lengths from 18 to 24 months, and less fuel would be needed to generate the same amount of electricity resulting in substantially reduced spent nuclear fuel storage and disposal requirements. The use of ATF will also enable utilities to consider additional power uprates, a significant potential for improved utility economics.

This subprogram continues to support the industry's objective to initiate installing the first commercial quantities of accident tolerant fuel by the mid-2020s and also qualify the fuel for use at higher burnup levels. The many facets of the program are progressing at different timelines. These include near-term concepts such as coated cladding, high burnup fuel, higher enrichment levels, and long-term concepts such as fuel with silicon carbide cladding and also the use of higher density fuels. All of this involves cost-shared testing and examination of fuel and cladding material performance to generate data that can be used by industry partners to support: their Nuclear Regulatory Commission (NRC) licensing efforts, research and development of pilot fuel pellet and cladding manufacturing equipment, analysis and redesign of fuel fabrication processes, and revising fuel performance codes and methods.

This subprogram is primarily using the experimental and advanced analytical capabilities, only found at the Department of Energy (DOE) National Laboratories, to provide the U.S. nuclear industry with the data needed to qualify the accident tolerant fuel concepts. This includes fuel use at higher burnup levels, and demonstrating the performance of the fuel to take advantage of the safety and economic benefits that come with these more robust fuel designs. In FY 2024, this includes continuing the modifications at Idaho National Laboratory to expand its experimental capabilities. This involves: (1) the design, fabrication, and testing of experimental capsules to house irradiated fuel samples to simulate loss of coolant accident conditions in the INL transient reactor test facility (TREAT) and (2) the design and installation of a new test loop (I-Loop) in the Advanced Test Reactor (ATR). Both provide world-class experimental capabilities that were lost when the Halden test reactor in Norway shut down. These capabilities involve simulating boiling and pressurized water reactor conditions, highly-instrumented test trains, ramp testing, and dry-out testing. In addition, enhancements of the ORNL Severe Accident Test Station (SATS) will continue to provide licensing data. Also, in FY 2024, the partnership with industry to implement the necessary test plans to develop the data needed to qualify the Accident Tolerant Fuel concepts for higher burnup will continue.

**Accident Tolerant Fuels**
**Funding**

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Accident Tolerant Fuels $114,000,000** | **$108,900,000** | **-$5,100,000** |
| • Continued irradiations of fuel rodlets in the central water loop of the ATR. Initiated advanced instrumented tests to expand data generation for real time fuel performance under irradiation.<br>• Continued partnership with industry to support the Fuel Performance and Testing Technical Experts Group for burnup extension. This includes examination of high burnup fuel rods, furnace testing, re-irradiation of test samples in ATR, and loss of coolant tests in TREAT.<br>• Conducted advanced LWR fuel technology research on ceramic fuel and cladding concepts. This includes fabrication technology development, separate effects irradiation tests in High Flux Isotope Reactor (HFIR) and ATR, and advanced characterization of properties and irradiation performance.<br>• Continued to advance the accident tolerant fuel concepts under development by the three fuel vendor teams under cooperative agreements with the Department. This involves cost-shared testing and examination of fuel and cladding material performance, research and development of pilot fuel pellet and cladding manufacturing equipment, analysis and redesign of fuel fabrication processes, and revising fuel performance codes and methods. | • Continue to support the accident tolerant fuel concepts under development by the three fuel vendor teams under cooperative agreements with the Department. This involves cost-shared testing and examination of fuel and cladding material performance, and appropriate research and development support.<br>• Continue irradiations of fuel rodlets in the central water loop of the ATR.<br>• Continue in partnership with industry to support the Fuel Performance and Testing Technical Experts Group for burnup extension. This includes examination of high burnup fuel rods, furnace testing, re-irradiation of test samples in ATR, and loss of coolant tests in TREAT and SATS.<br>• Perform TREAT tests that: investigate fuel fragmentation, relocation, and dispersal phenomena; investigate reactivity insertion accident induced clad burst performance; and demonstrate power ramp testing in a flowing water loop.<br>• Continue work on the ATR I-Loop to provide vendors with needed testing capabilities, with planned initiation of operation in 2025.<br>• Increase shipments of irradiated fuel from commercial reactors to the national labs for post-irradiation examination to provide data needed to qualify the fuel for use. | • Activities in FY 2024 will continue to focus on meeting industry's objectives for developing the near-term ATF concepts. Support for the development of long-term concepts will be reduced. |

**Fuel Cycle Research and Development**
**TRISO Fuel and Graphite Qualification**

**Description**

The Tristructural-isotropic (TRISO)-coated particle fuel and graphite subprogram includes activities for fuel and material irradiation, post-irradiation examination (PIE) and safety testing, fuel performance modeling, and fission product transport and source term research.

TRISO particle fuel development and qualification activities support prismatic and pebble-bed high temperature fuel designs. Since the onset of the TRISO Fuel Program in 2002, the program has focused on qualification of the fuel design for high temperature gas reactor concepts; However, TRISO fuel also has applications for other reactor concepts such as molten salt-cooled high temperature reactors, and microreactors. Irradiation, safety testing, and PIE of TRISO fuel will provide data for fuel development and qualification in support of industry efforts to establish a domestic commercial TRISO fuel fabrication capability.

The graphite development and qualification efforts provide data to support the use of graphite in high temperature reactor environments. Since historical grades of graphite used in previous high temperature reactors are no longer available, graphite development includes efforts to characterize and irradiate new grades of graphite. These efforts provide non-irradiated and irradiated properties so that the thermomechanical design of the structural graphite in advanced high temperature reactors can be validated. The irradiation experiments span the proposed temperature and dose envelope for prismatic high temperature gas reactors, but also apply to pebble-bed and possibly molten salt-cooled high temperature reactors.

**TRISO Fuel and Graphite Qualification**
**Funding**

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **TRISO Fuel and Graphite Qualification $32,000,000** | **$25,000,000** | **-$7,000,000** |
| • Performed further post-irradiation examination (PIE) of the Advanced Gas Reactor (AGR) -3/4 and AGR-5/6/7 TRISO fuel experiments to characterize fission product inventory and fuel performance in response to varying reactor fluence and temperature to support industry TRISO fuel qualification efforts.<br>• Performed additional safety testing of TRISO fuel to characterize performance in elevated temperatures and fission product transport.<br>• Performed facility modifications and air/moisture ingress experiment (AMIX) furnace installation in the hot cell at the Fuel Conditioning Facility (FCF) at the Materials and Fuels Complex at INL.<br>• Further irradiated high dose graphite experiment in INL's ATR to subject graphite to doses that more closely reflect what would be experienced in pebble bed type reactors.<br>• Performed additional characterization and PIE of graphite specimens to provide qualification data of various grades of graphite for use in high temperature reactors.<br>• Supported additional testing and activities to American Society of Mechanical Engineers (ASME) code qualify nuclear grade graphite and establish design rules for use in high temperature reactors. | • Complete AGR-3/4 PIE and issue final report that will assess fission product retention and transport in reactor graphite and fuel matrix.<br>• Perform further PIE of the AGR-5/6/7 TRISO fuel experiment to support qualification of TRISO fuel for use in demonstration and commercial high temperature reactors.<br>• Perform testing of TRISO fuel in the AMIX furnace to understand performance in a transient scenario.<br>• Complete advanced graphite creep (AGC-4) PIE to provide an understanding of graphite behavior under high temperature irradiation conditions.<br>• Continue to support additional testing and activities to ASME code qualify nuclear grade graphite and establish design rules for use in high temperature reactors. | • Funding decrease from $32,000,000 to $25,000,000 reflects the TRISO fuel qualification program ramping down as it nears completion and high-cost activities such as irradiation experiments have been completed. |

**Fuel Cycle Research and Development**
**Fuel Cycle Laboratory R&D**

**Description**

This subprogram supports research activities that advance knowledge of nuclear fuel cycles and provide transformative innovations to accelerate development of civil nuclear technologies, including consideration of fuel cycle impacts from the potential deployment of advanced reactor technologies. It includes activities in Materials Protection, Accounting and Control Technologies (MPACT), Systems Analysis and Integration (SAI), Innovative Nuclear Materials (INM), Innovative Process Control Capabilities (IPCC) and advanced reactor fuels R&D.

MPACT develops innovative technologies, analysis tools, and advanced integration methods to enable U.S. domestic nuclear materials management and safeguards for emerging nuclear fuel cycles. It also includes assessing vulnerabilities in current nuclear systems while minimizing proliferation risks. Addressing U.S. energy security needs requires innovative approaches to material control and accounting to ensure that nuclear material is not misused, diverted, or stolen.

SAI activities include strategic planning and analysis as well as integrated evaluation of program activities. It provides the critical capability needed to analyze complex fuel cycle system options, assess overall performance under various scenarios, and improve understanding of the interdependencies between various subsystems and associated technologies. In FY 2024, SAI activities will be expanded to support nuclear energy's role in enhancing energy security and achieving a net-zero economy. This includes assessing the impacts of nuclear-sourced clean hydrogen production, deeper assessments of coal to nuclear conversion opportunities, and broad analysis of fuel cycle impacts of HALEU usage in existing and future reactors.

INM activities focus on longer-term materials discovery and development for advanced nuclear energy systems applications. INM seeks innovative experimental approaches to understand, predict, and ultimately discover functional materials targeted for nuclear fuel and fuel recycle applications. The goals are to develop new tools, techniques, and capabilities at national laboratories to accelerate the pace of new materials discovery, building on recent advances in artificial intelligence, machine learning, theory, modeling, and computing, and advanced characterizations. For example, innovative approaches are needed to develop advanced metallic alloys and composite materials that are optimized to meet new reactor performance targets within the reactor core and fuel cladding. It also includes recycling of zircaloy cladding material, which is the second largest mass in used fuel assemblies. Developing recovery process with sufficient Zr purity to permit re-use will reduce the waste quantity as well as enhance resource utilization. Similar recycling approaches will be developed for other high value nuclear materials.

IPCC activities support foundational research to innovate include the development of innovative fuel cycle process control technologies, to enhance process controllability, and to enable predictive modeling capability in advanced nuclear separation systems. For example, a significant fraction of the space in a nuclear fuel recycling plant is occupied by large tanks—used for surge capacity or system redundancy. Implementing advanced process control and modeling technologies into the recycling plant design will reduce the size of such tanks, or even eliminate the need for this tank space. This in turn would directly reduce the cost of plant construction and operations. Many advanced reactor developers are using molten salt based technologies. The activity also supports fuel development and capabilities using advanced processing control technologies in molten salt recycling at the national laboratories. Specifically, IPCC supports innovative process monitoring and performance modeling capabilities for recycling of transuranic-bearing fuel salts.

Advanced reactor fuels activities include continued advances in accelerated fuel qualification activities to support advanced reactor development. In FY 2024 we will propose to build upon the advanced irradiation testing techniques recently developed at the national labs. Those techniques are the Fission Accelerated Steady-State Testing (FAST) approach at INL and MiniFuel separate effects testing at ORNL. Both techniques allow for much shorter irradiation times to gather meaningful data on fuel performance.

In support of advanced reactor developers proposing to use metallic fuel, topical reports for U.S. Nuclear Regulatory Commission review and approval will be developed on the fuel performance of reference metallic fuel alloys and on an

assessment of the BISON fuel performance code for metallic fuel performance. This program will establish a reference fuel performance baseline using legacy data and analyses, improve performance modeling capability in the BISON fuel performance code, and prepare for transient experiments in Transient Reactor Test Facility (TREAT) on legacy EBR-II reactor fuel.

## Fuel Cycle Laboratory Research & Development
## Funding

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Fuel Cycle Laboratory R&D $29,000,000** | **$29,000,000** | **$0** |
| • Continued developing innovative technologies, analysis tools, and advanced integration methods for material control and accounting applications.<br>• Continued innovative on-line process monitoring capabilities for advanced reactors fuel recycling.<br>• Demonstrated high resolution microcalorimeter measurements at INL.<br>• Deployed an acoustic system to monitor uranium and plutonium mass values in aqueous processing.<br>• Continued to conduct performance assessments and economic and market analyses of promising advanced nuclear energy systems and their role in achieving a net-zero economy by 2050.<br>• Continued accelerated irradiation experiments using the ATR and HFIR using Fission - Accelerated Steady-State Testing (FAST) and Mini-fuel Testing, respectively. Continue U.S./Japan joint transient testing of advanced reactor fuel concepts in TREAT.<br>• Initiated a metallic fuel qualification program that supports advanced reactor developers using metallic fuel. This includes establishing a reference fuel baseline, improving performance modeling capability, and preparing for future transient experiments.<br>• Supported molten salt recycling for salt fuels development capabilities at the national laboratories. | • Continue innovative on-line process monitoring capabilities for advanced reactors fuel recycling.<br>• Complete development of nuclear materials accounting and control training curricula that fills gaps identified by industry stakeholders.<br>Document state-of-the-science for molten salt purification, sampling and analysis R&D needs.<br>• Continue national/regional assessments of the role of nuclear energy in achieving a net-zero economy, including providing clean firm electricity and clean energy for decarbonizing the industrial and transportation sectors.<br>• Assess methods to reduce nuclear capital costs, including coal to nuclear infrastructure reuse, factory and supply chain efficiencies, and improved learning rates.<br>• Continue accelerated irradiation experiments using the ATR and HFIR using Fission -Accelerated Steady-State Testing (FAST) and Mini-fuel Testing, respectively. Continue U.S./Japan joint transient testing of advanced reactor fuel concepts in TREAT.<br>• Develop topical reports on the fuel performance of reference metallic fuel alloys and on an assessment of the BISON fuel performance code for metallic fuel performance.<br>• Demonstrate first-of-a-kind probes for quantitative measurement of molten salt basicity.<br>• Complete initial fabrication and screening test of promising new cladding materials and initiate irradiation studies. | • No funding change. |

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| • Initiated cladding materials recycling and develop innovative new materials for next generation fuel cladding materials. | | |

**Fuel Cycle Research and Development**
**Advanced Nuclear Fuel Availability[1]**

**Description**

Advanced reactors are being developed for flexible baseload power generation, providing U.S. leadership in nuclear technology, enabling new markets for export, and reducing greenhouse gas emissions. Many of these reactors are expected to require high-assay, low-enriched uranium (HALEU) fuel. HALEU is uranium with the fissionable isotope U-235 enriched to between greater than 5 and less than 20 percent. Current commercial light water reactors use uranium enriched to up to 5 percent U-235. There are no commercial suppliers of HALEU in the U.S. and advanced reactor developers will need small quantities of HALEU in the near term to support the qualification of their fuel and larger quantities for the first demonstration reactors. Much larger quantities of HALEU will be needed when advanced reactors requiring HALEU fuel are commercialized.

This subprogram will work to make available small quantities of HALEU from limited DOE uranium inventories and leverage the HALEU enrichment demonstration capability in the short term, in coordination with the National Nuclear Security Administration (NNSA), and work with the private sector to establish a commercial U.S. HALEU production and supply chain capability for the long term.

Subprogram activities include initiating the recovery and down-blending of limited excess quantities of DOE uranium inventories to HALEU for DOE's use in research, development, and demonstration programs. In coordination with NNSA, NE will recover and downblend highly-enriched uranium from existing inventories located at the Savannah River Site and NNSA will identify and repurpose unused or scrap material at Y-12 under their Convert subprogram. The NE project initiated in FY 2023 continues in FY 2024, focusing on completing restart preparations for a downblending startup test and meeting regulatory requirements including NEPA compliance. FY 2024 milestones will include a startup test for downblending. Additionally, NE will contract with a conversion or fuel fabricator to procure equipment and plan for the receipt and processing of HALEU shipped from Savannah River Site beginning in late FY 2025 and FY 2026.

DOE transitioned the HALEU enrichment activities in Piketon, Ohio in November 2022, to a new competitively awarded, cost-share program to complete the HALEU Enrichment Demonstration and operate the 16-centrifuge cascade to produce a limited quantity of HALEU by no later than December 31, 2023. Once the initial quantity is produced, DOE will reimburse the contractor to immediately begin producing a minimum of 900 kg of HALEU within one year. Future options to continue the operation of the cascade beyond FY 2024 are subject to the annual budget process. The limited quantity of HALEU produced under this contract will be used for DOE's research, development, and demonstration programs, including to provide blend stock for HALEU fuel produced through the recovery and downblending activities described above.

This subprogram complements the activities funded under Section 50173 of the Inflation Reduction Act of 2022. Inflation Reduction Act activities include supporting the U.S. Nuclear Regulatory Commission with criticality benchmark data, assisting industry with transportation package development, supplying HALEU to industry in coordination with a HALEU Consortium, and providing other supporting activities.

[1] This subprogram complements the activities funded under Section 50173 of the Inflation Reduction Act of 2022. Inflation Reduction Act activities include supporting the U.S. Nuclear Regulatory Commission with criticality benchmark data, assisting industry with transportation package development, supplying HALEU to industry in coordination with a HALLEU Consortium, and providing other supporting activities.

**Advanced Nuclear Fuel Availability**
**Funding**

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Adv Nuclear Fuel Availability $100,000,000** | **$120,000,000** | **+$20,000,000** |
| • Initiated the project for recovery and down-blending of limited excess quantities of DOE uranium inventories to HALEU. In coordination with NNSA, NE will recover and downblend highly-enriched uranium from existing inventories located at the Savannah River Site. FY23 activities include project planning, regulatory compliance activities, and the beginning of equipment reconstitution and flowsheet development.<br>• Continued activities under a new competitively awarded cost share program to operate the 16-centrifuge cascade in Piketon to produce a limited quantity of HALEU for research, development, and demonstration use for one year, with the option to extend in future years. The private sector partner awarded the contract will operate the facility and produce HALEU for DOE's use.<br>• Developed and begin to execute a strategy to address the National Environmental Policy Act requirements. | • Continue the project for recovery and down-blending of limited excess quantities of DOE uranium inventories to HALEU.<br>• Finalize regulatory compliance activities including NEPA, complete most restart preparations, begin a startup test for downblending, contract with a conversion or fuel fabricator to procure equipment and plan for the receipt and processing of HALEU shipped from Savannah River Site.<br>• Continue activities under a new competitively awarded cost share program to operate the 16-centrifuge cascade in Piketon. Produce a limited quantity of HALEU by no later than December 31, 2023, then begin producing a minimum of 900 kg of HALEU within one year.<br>• Complete an Environmental Impact Statement for HALEU Availability Program activities in Support of Commercial Production of HALEU Fuel. | • In FY 2024, recovery and downblending at Savanah River Site will expand and HALEU production at Piketon will shift to a cost-plus incentive fee production effort of at least 900 kg per year. |

**Fuel Cycle Research and Development**
**Used Nuclear Fuel Disposition R&D**

**Description**
The Used Nuclear Fuel Disposition Research and Development (R&D) subprogram conducts scientific research and technology development to enable long term storage, transportation, and disposal of spent nuclear fuel and wastes. The primary focus of this subprogram supports the development of disposition-path-neutral waste management systems and options in the context of the current inventory of spent nuclear fuel and waste.

**Research and Development**
Full-Scale Storage Cask Demonstration – Although the nuclear power industry has used dry storage for many years, this storage option has been for low-burnup fuel; therefore, there is limited data available on the degradation of more contemporary high-burnup fuels. To address this data gap, the Department of Energy (DOE), the Nuclear Regulatory Commission (NRC), and nuclear industry are cooperating to investigate extended storage of high-burnup fuels (≥ 45 GWd/MTHM). DOE, in cooperation with the NRC and industry, is conducting a full-scale demonstration of storage for high-burnup fuel that will be beneficial by: 1) benchmarking the predictive models and empirical conclusions developed from short-term laboratory testing, and 2) building confidence in the ability to predict the performance of these systems over extended time periods.

Storage and Transportation R&D – In addition to the Full-Scale Storage Cask project, DOE will continue to support other lab testing, field studies, and both numerical and physical modeling R&D related to the storage and transport of high-burnup fuel to include: testing of cladding response with hydride reorientation and embrittlement; the effects of atmospheric corrosion on storage welds; measuring the embrittlement of elastomer seals; determining thermomechanical degradation of bolts, welds, seals and poisons; analyzing thermal profiles of stored fuels; determining the stress profiles of fuels and casks; evaluating cask drying processes; laboratory post-irradiation examination and testing of the fuel from the cask demonstration project at the North Anna Generating Station in Mineral, Virginia; and the development of sensors for internal and external cask monitoring. R&D will focus on contributing to the technical knowledge to support long-term storage and eventual transportation of high-burn-up fuels. As the DOE continues to make progress on the accident tolerant fuels and advanced reactor fuels, research will be done to ensure that data are gathered on the new/modified cladding and fuel materials to ensure that they can be stored and transported in the future. Current work also indicates that burnup rates for accident tolerant fuels could go up to 75 to 80 GWD/MTU for which very little if any data exists, so additional R&D will be done to address this gap.

Disposal R&D – Activities continue to further the understanding of long-term performance of disposal systems in three main geologic rock types: clay/shale, salt, and crystalline rock. These activities include collaborations with international partners to leverage and integrate applicable R&D being conducted by other countries into the U.S. disposal R&D portfolio. Also, evaluations will continue to determine the feasibility of directly disposing existing single (storage only) and dual-purpose (storage and transportation) used-fuel canisters in a mined repository. Evaluate the disposal performance characteristics of new accident tolerant fuels and any new high-level radioactive waste glass compositions. Support a pilot program to increase participation of underrepresented groups in research activities related to management and disposal of radioactive wastes.

## Used Nuclear Fuel Disposition Research & Development (R&D)
## Funding

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request Level vs FY 2023 Enacted |
|---|---|---|
| **Used Nuclear Fuel Disposition Research & Development $47,000,000** | **$46,875,000** | **-$125,000** |
| • Continued ongoing disposal R&D.<br>• Evaluated the storage, transportation, and disposal performance characteristics of new accident tolerant fuels and high-level radioactive waste glass compositions.<br>• Supported pilot program to increase participation of underrepresented groups in research activities related to management and disposal of radioactive wastes.<br>• Consistent with the results of an Independent Technical Review continue evaluations to determine the feasibility of directly disposing existing single (storage only) and dual-purpose (storage and transportation) used-fuel canisters in a mined repository.<br>• Continued destructive testing on sibling rods.<br>• Worked with SONGS to install instrumentation on typical canisters used by the nuclear power plant industry.<br>• Continued work to clear hot cells and prepare for acceptance of new accident tolerant fuels. | • Continue ongoing disposal R&D to further advance process and total system performance models for generic geologic repositories.<br>• Evaluate the storage, transportation, and disposal performance characteristics of new accident tolerant fuels and any new high-level radioactive waste glass compositions.<br>• Support pilot program to increase participation of underrepresented groups in research activities related to management and disposal of radioactive wastes.<br>• Consistent with the results of an Independent Technical Review continue evaluations to determine the feasibility of directly disposing existing single (storage only) and dual-purpose (storage and transportation) used-fuel canisters in a mined repository.<br>• Continue Phase I of destructive testing on sibling rods and begin Phase II which is testing on heated rods to bound rod conditions.<br>• Work with SONGS to install instrumentation on typical canisters used by the nuclear power plant industry.<br>• Continue research on Stress Corrosion Cracking for the canisters already loaded and future cans.<br>• Continue work to clear hot cells and prepare for acceptance of new accident tolerant fuels and high burnup advanced reactor fuels. | • No significant funding change. |

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request Level vs FY 2023 Enacted |
|---|---|---|

**Fuel Cycle Research and Development**
**Integrated Waste Management System**

**Description**

The Nuclear Waste Policy Act of 1982 (NWPA) assigns the Department of Energy the responsibility for disposition of U.S. spent nuclear fuel (SNF) and high-level radioactive waste (HLW), and the Department remains committed to fulfilling the Federal Government's legal obligations to properly manage and dispose of that material. The Integrated Waste Management System (IWMS) subprogram supports efforts to develop and implement a Federal interim storage program that uses a consent-based approach to siting as part of an overarching waste management system, as well as storage, transportation, and systems engineering and analysis activities. The activities of this subprogram include developing a consent-based siting process, executing the first phase of consent-based siting for interim spent fuel storage. This phase focuses on capacity building through broad public outreach and engagement, preparing for large-scale transportation of spent nuclear fuel, and working with communities, stakeholders, and governmental entities in the more than 30 states where SNF and HLW is currently stored.

The IWMS subprogram's FY 2024 Budget Request funds critical activities required for effective implementation of consolidated Federal interim storage of the nation's nuclear waste using a consent-based approach. As part of its efforts, the Department will work collaboratively with the public, communities, stakeholders, and governments at the Tribal, state, and local levels to inform and refine a consent-based siting process. Toward this end, the Department will continue to support interested groups, communities, states, and Tribes to explore consent-based siting and interim storage, support mutual learning, and reduce barriers to participation in the consent-based siting process. This work will aim to build public participation into the consent-based siting process, improve the consent-based siting process through mutual learning, and continue development of communications materials and tools. Based on these engagements, the Department will develop a waste management system that incorporates social equity and environmental justice.

In parallel, the IWMS subprogram will continue technical preparations for site characterizations, facility designs, license applications, equipment acquisition, and emergency response training for future transportation routes. Transportation-focused activities include:

- A full-scale package performance test of a rail-sized SNF cask to help build public trust and confidence in the safety of SNF transport to Federal storage and disposal facilities;
- Engaging with State and Tribal partners to cooperatively plan for large-scale SNF transportation, including approaches to emergency response training and vehicle safety inspections;
- Developing purpose-built railcars and security and safety monitoring equipment to support large-scale SNF transport; and
- Beginning acquisition path for transportation casks for SNF, which may require moderate lead times to update cask certificates of compliance and initiate commercial fabrication capacity;
- Evaluating transportation infrastructure at nuclear power plant sites to identify options for removing SNF from the sites.

Meanwhile, other technical preparations will include:

- Developing a project management plan and supporting technical documentation to site, design, license, construct, and operate Federal interim storage facilities and an associated SNF transportation system;
- Analyzing regulatory considerations applicable to interim storage facility design options and siting processes;
- Updating and analyzing detailed data on quantities and characteristics of relevant nuclear waste inventories to inform options analyses and transportation planning; and

- Evaluating the costs and benefits of interim storage facility approaches.

The IWMS subprogram is identifying a Federal interim storage capability for commercial SNF following a consent-based siting process. In FY 2024, IWMS will continue planning and capacity building, including a broad public outreach effort, continuing to provide funding to interested groups and communities through cooperative agreements and sub-grants, engaging in mutual learning, and gathering feedback to further refine the consent-based siting process. Continued development of digital information and communications resources and planning for implementation of future phases of consent-based siting will also occur.

Along with consent-based siting activities, IWMS will continue technical engineering and analysis work on siting, facility design, licensing, construction, and operations of Federal interim storage facilities and associated SNF transportation capabilities. Preparations for large-scale transportation of SNF and HLW include development of purpose-built railcar equipment, design of a safety and security monitoring system for rail shipments, analyzing alternatives for shipment security escort services, assessment of transportation infrastructure and transport options at nuclear power plant sites, employment of state-of-the-science data and software tools to support decision-making and communications, thorough analysis of transportation system operational elements and dependencies, active engagement with State and Tribal government representatives through the Department's National Transportation Stakeholders Forum and associated working groups, and coordination with appropriate Federal agencies on safety and security considerations. These efforts build on successes and lessons learned from previous Departmental radioactive materials transportation programs and campaigns as identified through knowledge management activities.

**Integrated Waste Management System**
**Funding**

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Integrated Waste Management System $53,000,000** | **$53,000,000** | **+$0** |
| • Awarded funding to interested groups, communities, States, or Tribes exploring the consent-based siting process and interim storage.<br>• Developed a prototype siting analysis tool to assist interested communities in exploring interim storage.<br>• Continued development of a plan, schedule, and cost estimate for a full-scale package performance test, including input from State and Tribal partners.<br>• Conducted a demonstration run and deliver one Atlas 12-axle cask-carrying railcar, two buffer railcars, and one rail escort vehicle.<br>• Provided one complete rail consist approved by the Association of American Railroads (AAR) ready to transport SNF in accordance with AAR Standard S-2043.<br>• Began fabrication of one Fortis 8-axle cask-carrying railcar prototype.<br>• Finalized the railcar safety inspection protocol developed in coordination with States and Tribes.<br>• Began work to update DOE's proposed Section 180(c) Policy to provide emergency response training funds and technical assistance to States and Tribes.<br>• Continued and expand upon existing planning, analysis, and outreach work for large-scale SNF transportation.<br>• Started work on a concept of operations for SNF shipment security escort services.<br>• Applied a systems engineering approach to IWMS | • Continue funding to interested groups, communities, States, or Tribes exploring the consent-based siting process and interim storage.<br>• Enhance consultations and cooperation for consent-based siting through funding awardees (consortia), community liaisons, town halls, technical presentations, and other venues.<br>• Prepare initial site suitability analysis resources for future volunteer sites, including digital tools for siting analysis.<br>• Initiate cask acquisition and establish a testing plan for a full-scale package performance test of a rail-sized transportation cask, including avenues to engage the public in the project (the package performance testing is expected to be conducted over a subsequent 5-year period).<br>• Complete fabrication of one Fortis 8-axle cask-carrying railcar prototype and begin performance testing.<br>• Continue work to update DOE's proposed Section 180(c) Policy to provide emergency response training funds and technical assistance to States and Tribes.<br>• Continue and expand upon existing planning, analysis, and outreach work for large-scale SNF transportation.<br>• Continue working on a concept of operations for SNF shipment security escort services, including possible new agency directives, training requirements, and standard operating procedures. | • No funding change. |

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| planning efforts, factoring in early feedback from consent-based siting activities.<br>• Updated computational analysis tools to support systems engineering analyses for an integrated waste management system.<br>• Provided technical information on interim storage and operations to support consent-based siting communications.<br>• Started collecting data on proposed advanced reactor SNF forms and characteristics.<br>• Developed an updated reference concept for a generic Federal consolidated Interim storage facility (CISF), including functions and requirements for facility operations.<br>• Began assembling technical documentation to prepare for Critical Decision 0 - Mission Need for federal consolidated interim storage through the Department's Program and Project Management for the Acquisition of Capital Assets process (Order 413.3B).<br>• Procured a pressure vessel to test inspection procedures for SNF casks.<br>• Developed a NEPA strategy and analysis approach for interim storage and associated transportation. | • Perform additional systems analysis to support expanded siting, transportation, and storage work and associated interfaces.<br>• Update computational analysis tools to include advanced reactor SNF information.<br>• Study the feasibility of using standardized triple-purpose (transportation, aging/storage, and disposal) canisters for Accident Tolerant SNF and TRISO-based advanced reactor SNF.<br>• Refine interim storage facility design concepts based on consent-based siting engagement and feedback, and considerations for cask-handling and receipt volume options.<br>• Pursue Critical Decision 0 - Mission Need for federal consolidated interim storage through the Department's Program and Project Management for the Acquisition of Capital Assets process (Order 413.3B).<br>• Begin evaluating implications for advanced reactor SNF and wastes into the integrated waste management system.<br>• Begin the NEPA process and issue a Notice of Intent for an environmental impact statement (EIS). | |

## Nuclear Energy Enabling Technologies

**Overview**

The Nuclear Energy Enabling Technologies (NEET) program conducts research and development (R&D) and makes strategic investments in research capabilities to develop innovative and crosscutting technologies that resolve nuclear technology development issues. The Crosscutting Technology Development (CTD) subprogram focuses on innovative research that directly supports the existing fleet of nuclear reactors and enables the development of advanced reactors and fuel cycle technologies, including topical areas such as advanced sensors and instrumentation; nuclear cybersecurity; advanced materials and manufacturing technologies; and integrated energy systems. Also, NEET invests in modeling and simulation tools for existing and advanced reactors and fuel system technologies. The program also provides industry, universities, and national laboratories with access to unique nuclear energy research capabilities through the Nuclear Science User Facilities (NSUF) subprogram. By delivering innovative clean energy and advanced manufacturing technologies for nuclear energy systems, NEET-sponsored activities collectively support the Department's priorities to combat the climate crisis, create clean energy jobs with the free and fair chance to join a union and bargain collectively, and promote equity and environmental justice. NEET also makes these technology advancements accessible to the U.S. industry through the Gateway for Accelerated Innovation in Nuclear (GAIN) initiative and private-public partnerships.

**Highlights of the FY 2024 Budget Request**

- The Crosscutting Technology Development subprogram is enhancing its focus on advanced manufacturing technologies of use for advanced reactors, particularly accelerated efforts to support the regulatory approval of additively-manufactured 316 stainless steel.

**Nuclear Energy Enabling Technologies**
**Funding ($K)**

| | FY 2022 Enacted | FY 2023 Enacted | FY 2024 Request | FY 2024 Request vs FY 2023 Enacted ($) | FY 2024 Request vs FY 2023 Enacted (%) |
|---|---|---|---|---|---|
| **Nuclear Energy Enabling Technologies** | | | | | |
| Crosscutting Technology Development | 29,000 | 32,000 | 32,778 | +778 | +2.4% |
| Joint Modeling and Simulation Program | 30,000 | 28,500 | 28,500 | 0 | 0% |
| Nuclear Science User Facilities | 33,000 | 35,000 | 35,000 | 0 | 0% |
| Transformational Challenge Reactor | 25,000 | 0 | 0 | 0 | 0% |
| **Total, Nuclear Energy Enabling Technologies** | **117,000** | **95,500** | **96,278** | **+778** | **+0.8%** |

**Nuclear Energy Enabling Technologies**
**Explanation of Major Changes ($K)**

| | FY 2024 Request vs FY 2023 Enacted |
|---|---|
| **Crosscutting Technology Development:** The increase from $32,000,000 to $32,778,000 reflects acceleration of efforts to qualify additively-manufactured 316 stainless steel with elevated temperatures for nuclear energy applications. | **+778** |
| **Joint Modeling and Simulation Program:** No significant changes. | **0** |
| **Nuclear Science User Facilities:** No significant changes. | **0** |
| **Total, Nuclear Energy Enabling Technologies** | **+778** |

## Crosscutting Technology Development

**Description**

The Crosscutting Technology Development (CTD) subprogram develops innovative solutions to crosscutting nuclear energy technology challenges. The CTD subprogram focuses on foundational research on transformative technologies to maintain the current fleet of nuclear reactors and support the development of advanced reactors and fuels. CTD research and development (R&D) projects include industry, universities, and national laboratory collaborations and it is closely coordinated with the Office of Nuclear Energy's other R&D programs to ensure that developed technologies and capabilities are part of an integrated investment strategy aimed at improving reliability and economics of U.S. nuclear technologies.

Activities within this subprogram include:

- developing new capabilities needed for domestic nuclear energy R&D, with focus on gaps to commercial deployment of advanced reactors;
- conducting high-risk research that could overcome current technological limitations;
- developing enabling technologies that have applicability across multiple technical areas; and
- conducting leading-edge R&D to improve the economics, quality, security, and efficiency of nuclear technologies.

The principal focus areas for FY 2024 include advanced sensors and instrumentation, nuclear cybersecurity research, advanced materials and manufacturing technologies, and integrated energy systems as follows:

- Advanced Sensors and Instrumentation supports R&D of unique sensor and instrumentation technologies that provide enhanced monitoring and control capabilities to the existing reactor fleet, adapt novel sensor types for advanced reactor development and demonstration, and provide expanded capability to fuel cycle and advanced materials development;
- Nuclear Cybersecurity Research develops technologies and methods to address cyber threats to the U.S. nuclear power infrastructure, in coordination with the Department's Cybersecurity, Energy Security, and Emergency Response office, and supports secure implementation of advanced technologies such as wireless control and remote or autonomous operations;
- Advanced Materials and Manufacturing Technologies supports the development of technology-based solutions for advanced materials and manufacturing technologies for use in the deployment of advanced nuclear reactors and sustainment of the existing fleet. This consolidated focus area integrates the cutting-edge research formerly pursued through the Advanced Methods for Manufacturing topic area, the Nuclear Materials Discovery and Qualification Initiative, and the crosscutting research previously performed under the Transformational Challenge Reactor subprogram; and
- Integrated Energy Systems supports R&D to expand the role of nuclear energy, both on and off the electricity grid, to support the industrial, transportation, and commercial sectors. Successful integration of nuclear energy systems will allow the electric grid to continue to rely on the economic benefits, reliability, and emissions-free electricity from nuclear energy while also enabling nuclear energy to contribute to broader decarbonization goals. Integrated nuclear systems will allow clean, affordable nuclear energy to decarbonize industrial, chemical, and transportation applications that currently rely on other energy sources.

## Crosscutting Technology Development

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Change<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Crosscutting Technology Development**<br>**$32,000,000** | **$32,778,000** | **+$778,000** |
| • Conducted research on Advanced Sensors and Instrumentation to address future capabilities needed for advanced reactor demonstrations, fuel cycle and materials testing, and modernization of the existing fleet. Program activities will include development of temperature compensated neutron flux sensors, radiation drift compensated thermocouples, linear variable differential transformer (LVDTs), acoustic-based structural health monitoring, and process control algorithm and instrumentation integration in nuclear digital twin (NDT) platforms.<br>• Developed cybersecurity standards and reference architectures for wireless communication and autonomous control and zero-trust implementation. Pursue additional real-world pilot opportunities for the application of cyber-informed engineering and advanced risk management techniques for advanced reactors under development.<br>• Accelerated the development of advanced materials and manufacturing technologies in support of the existing reactor fleet as well as the deployment of advanced reactors. Program activities will include improvement and optimization of existing materials with minor chemistry modifications to improve use for advanced reactors; development of technical basis for regulatory approval of additively-manufactured | • Develop advanced sensors and instrumentation to enhance existing and novel instrumentation technologies such as temperature compensated neutron flux sensors, radiation drift compensated thermocouples, linear variable differential transformer (LVDTs), and acoustic-based structural health monitoring. These technologies address future capabilities needed for advanced reactor demonstrations, fuel cycle and materials testing, and modernization of the existing fleet. Expand the development of nuclear digital twin (NDT) technologies in partnership with industry stakeholders.<br>• Supports implementation methods for advanced reactor control systems cybersecurity features, such as zero trust architectures, secure wireless architectures, and methods for applying consequence-driven, cyber-informed engineering techniques.<br>• Optimize existing materials and manufacturing technologies to improve use for advanced reactors; accelerate development of technical basis for regulatory approval of additively-manufactured 316 stainless steel; initiate an ASME code qualification plan for Laser | • The increase reflects acceleration of efforts to qualify additively-manufactured 316 stainless steel with elevated temperatures for nuclear energy applications. |

| FY 2023 Enacted | FY 2024 Request | Explanation of Change<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| 316 stainless steel; initiation of ASME Code case development for additively-manufactured 316 stainless steel for elevated temperatures; and identification of specific reactor components with industry that could take advantage of new AM technologies.<br>• Developed integrated energy systems techno-economic assessments; thermal storage and distribution, dynamic controls, and site integration technology for using clean nuclear heat and electricity from advanced reactors to decarbonize distributed industrial applications. Develop thermal quantity and quality requirements, engineering requirements, and safety basis for industrial applications including refining, combined heat and power, hydrogen and synthetic fuels production, and ammonia production. Complete modeling tool development for modeling dynamic integrated energy systems. | Powder Bed Fusion additively-manufactured 316 stainless steel for elevated temperatures; component manufacturing with industrial partners.<br>• Refine economic analyses of integrated energy systems for nuclear energy applications, accounting for requirements developed for each application. Characterize thermal capabilities for a variety of reactor types and configurations to optimize the use of thermal energy. Develop and test thermal distribution components and systems for a variety of heat transfer fluids and validate chemical synthesis or process parameters for economically feasible nuclear energy pathways. | |

## Joint Modeling and Simulation

**Description**

The Joint Modeling and Simulation subprogram, as implemented through the Office of Nuclear Energy's Nuclear Energy Advanced Modeling and Simulation (NEAMS) program, develops and deploys a set of predictive modeling and simulation tools to support and, in some cases, enable improved operation of the current fleet and the development and deployment of advanced reactors. NEAMS engages scientists and engineers in developing state-of-the-art, multi-scale models of physics and chemistry that drive advanced computational methods for simulations of advanced nuclear energy systems. NEAMS empowers researchers and designers to gain fundamental insights that are unattainable through experiment alone, inform experiment selection, drive design, and minimize the cost of research and development. Advanced modeling and simulation capabilities also support the Office of Nuclear Energy (NE) program priorities, such as the development of fuels with enhanced accident tolerance.

The NEAMS has developed a set of analytic modeling and simulation tools that is flexible and able to accommodate different reactor types and designs. Through an enhanced programmatic framework, NEAMS tools support NE's mission priority areas: continued operation of the existing fleet of U.S. nuclear reactors; enable deployment of advanced nuclear reactors; develop advanced nuclear fuel cycles; and maintain U.S. leadership in nuclear energy technology.

For the existing fleet, NEAMS tools address core performance optimization issues and accelerate development of fuels with enhanced accident tolerance to help assure the long-term availability and market competitiveness of nuclear energy. The Bison fuel performance code, and the lower-length scale work that underpins it, helps to provide fundamental insight into how nuclear fuel behaves under normal and extreme reactor conditions, as well as higher fuel "burnup." When coupled with experimental work performed under the Fuel Cycle Research & Development program, this has the potential to accelerate the design and licensing of new fuel forms that can improve or extend the operation of existing reactors.

For advanced reactor technologies, NEAMS tools help industry accelerate development and meet otherwise cost-prohibitive data needs. These tools also help support Nuclear Regulatory Commission (NRC) efforts to address its confirmatory analysis needs. While many existing industry software tools are designed for specific reactor designs, primarily light-water reactors, NEAMS has developed and continues to add capabilities to a suite of tools for reactor physics, thermal hydraulics, fuel performance, materials, chemistry, and system modeling that flexibly accommodate the range of reactor designs currently being considered by industry. Several of these tools are being used, adopted, and modified by industry, universities, and NRC to meet their needs, consistent with the FY 2023 Congressional direction. NEAMS incorporates feedback and inputs from these stakeholders to ensure proper focus on relevant capabilities.

For fuel cycle technologies, continued modeling and simulation tool development provide capabilities that can support future used nuclear fuel research and development, including development of strategies to burn less fuel, and high-fidelity analysis and prediction of fuel and cladding performance through the storage cycle.

## Joint Modeling and Simulation

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Change<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Joint Modeling and Simulation**<br>**$28,500,000** | **$28,500,000** | **+$0** |
| • Enable and accelerate industry's advanced reactor deployment efforts through advanced multiscale and multi-physics modeling and simulation approaches.<br>  ○ Develop fully coupled, full-core simulation of entire microreactor to demonstrate self-regulation and load-following, during transient scenarios.<br>  ○ Conduct graphite structural analysis and behavior for gas-cooled reactors during steady-state and transient conditions including swelling and oxidization as well as multiscale structural materials modeling for metallic structures including piping, heat exchangers, and reactor vessel.<br>  ○ Develop and assemble molten salt reactor modeling capability and data sufficient to support the development of a mechanistic source term to support data safety and licensing.<br>• Implement and demonstrate use of mechanistic tools to assess high-burnup fuel pulverization and burst potential for Light Water Reactor fuels to support licensing process associated with extending fuel burnup limits.<br>• Maintain software tools with strong software quality assurance such that the tools can be used by industry and research institutions in research, design, and ultimately commercial deployment. | • Enable and accelerate industry's advanced reactor deployment efforts through advanced multiscale and multi-physics modeling and simulation approaches.<br>  ○ Increase the capability of steady-state and transient modeling for high-temperature gas reactors with a pebble-shuffler capability for core start-up, steady-state, and transient scenarios.<br>  ○ Develop thermal-hydraulics modeling capabilities for the simulation of fluoride salt-cooled high-temperature reactor (i.e., molten salt reactor with solid fuel) under transient conditions, including system-level fidelity, porous media modeling for pebble bed designs, and computational fluid dynamics for fluid closures.<br>• Complete development of initial light-water reactor high-burnup and accident tolerant fuel modeling capabilities to support industry licensing needs, with full implementation and systematic assessment for impact of high-burnup on fuel reliability in FY 2025.<br>• Maintain software tools with strong software quality assurance such that they can be used by industry and research institutions in research, design, and ultimately commercial deployment.<br>• Continue to provide access to modeling and simulation tools on high-performance computing systems at the Idaho National Laboratory through the Nuclear Computational Resource Center. | • No significant changes. |

## Nuclear Science User Facilities

**Description**

The Nuclear Science User Facilities (NSUF) subprogram is the Nation's designated program to gain access to user facilities for nuclear energy research. As a consortium of partner facilities, the NSUF connects a broad range of nuclear research capabilities, expert mentors, and experimenters. The NSUF represents a "prototype laboratory for the future," promoting the use of unique nuclear research facilities located at multiple sites across the Nation and encouraging active university, industry, and laboratory collaboration in relevant nuclear science research. The NSUF, through competitive solicitations, provides a mechanism for research organizations to collaborate, conduct experiments and post-experiment analysis, and utilize high performance computing at facilities not normally accessible to these organizations. On an annual basis, researchers propose projects to be conducted at these unique facilities, with timelines ranging from a few months to several years. When projects are awarded, the NSUF subprogram pays for experiment support and laboratory services at the partner user facilities. In this manner, researchers benefit from the introduction to new techniques, equipment, and personnel. In FY 2022, the NSUF program supported 108 researchers from 24 different States and three other countries through awards and 892 researchers across 32 States and 13 other countries through access to high performance computing capabilities. Emphasis is placed on increasing the involvement of minority serving institutions, including Historically Black Colleges and Universities and Tribal Colleges and Universities, and institutions in underserved communities, resulting in direct and meaningful investments through project selection and NSUF partnership agreements in support of the Administration's Justice40 Initiative.

The principal focus areas in NSUF for FY 2024 includes irradiation and post-irradiation examination of fuels and materials, high performance computing, and maintenance of the Nuclear Fuels and Materials Library as follows:

- The NSUF program competitively supports all pertinent irradiation and post-irradiation examination activities by providing researchers with access to unique nuclear research facilities. Support includes access to research reactors, hot cells, beam-line capabilities, irradiation capabilities, and irradiation experiment design and fabrication support, expert support, and community outreach.
- High Performance Computing (HPC) supports INL scientific computing capabilities to enable advanced modeling and simulation. These resources support a wide range of research activities, including performance of materials in harsh environments (such as the effects of irradiation and high temperatures), performance of existing light water and advanced nuclear reactors, and multiscale multi-physics analysis of nuclear fuel performance. HPC capabilities are available to industry, universities, national laboratories, and federal agencies to support research and development. Three HPC supercomputers are currently in operation at the Idaho National Laboratory: Sawtooth, Hoodoo, and Lemhi.
- The Nuclear Fuels and Materials Library supports the maintenance of a collection of specialized information and material specimens from past and ongoing irradiation test campaigns, real-world components retrieved from decommissioned power reactors, and donations from other sources. Everything in the Nuclear Fuels and Materials Library is available to the nuclear research community, either through a peer-reviewed proposal process or through direct programmatic request.

## Nuclear Science User Facilities

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Change<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Nuclear Science User Facilities**<br>**$35,000,000** | **$35,000,000** | **+$0** |
| • Competitively solicit and award a limited number of new, fully-funded facility access awards.<br>• Award more than 75 Rapid Turnaround Experiment projects through three competitive proposal periods.<br>• Continue NSUF partnership agreements with universities, industry, and national laboratories to support ongoing irradiation experiments ranging from neutron, gamma, and ion irradiation to post-irradiation examination and incorporate new irradiation capabilities as needs are identified.<br>• Enhance the Nuclear Fuels and Materials Library through the addition of irradiated fuels and materials.<br>• Operate three supercomputers totaling more than 120,000 processor cores and 7 Petaflops of computational performance. Support more than 800 users by providing training, user support, and code optimization. Ensure effective cybersecurity, user access controls, and data collection. | • Competitively solicit and award new, fully-funded facility access awards to accelerate the development of fuels and materials for nuclear energy applications.<br>• Award more than 75 Rapid Turnaround Experiment projects through three competitive proposal periods for prompt NSUF partner facilities access to support emergent and innovative nuclear science and materials research.<br>• Continue NSUF partnership agreements with universities, industry, and national laboratories to support ongoing irradiation experiments ranging from neutron, gamma, and ion irradiation to post-irradiation examination and incorporate new irradiation capabilities as needs are identified.<br>• Enhance the Nuclear Fuels and Materials Library through the addition of irradiated fuels and materials.<br>• Operate three supercomputers totaling more than 120,000 processor cores and 7 Petaflops of computational performance. Support more than 800 users by providing training, user support, and code optimization. Ensure effective cybersecurity, user access controls, and data collection. | • No significant changes. |

## Transformational Challenge Reactor

**Description**

The Transformational Challenge Reactor (TCR) subprogram provided a revolutionary platform to help demonstrate the ability to reduce the deployment costs and timelines for nuclear energy systems and enhanced the development of breakthrough technologies that could manufacture small/micro advanced reactor components using additive manufacturing techniques. A central goal of the TCR subprogram was to demonstrate the ability to exploit advanced manufacturing techniques and digital predictive analysis capabilities to deliver a new approach to nuclear design and qualification for advanced reactor technologies. TCR combined advanced manufacturing with materials and computational sciences to predict optimal performance of components to enable faster innovation and certification.

**Highlights of the FY 2024 Budget Request**

No funding is requested in the FY 2024 Budget for the Transformational Challenge Reactor subprogram. In FY 2024, crosscutting research initiated under the TCR subprogram will continue under the Crosscutting Technology Development subprogram to consolidate all relevant technologies under a coordinated management structure.

## Transformational Challenge Reactor

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Change<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Transformational Challenge Reactor** | | |
| **$0** | **$0** | **$0** |
| • No funding was provided for this program in FY 2023. | • No funding is requested to continue this program in FY 2024. | • No funding is requested to continue this program in FY 2024. |

## Advanced Reactor Demonstration Program

**Overview**

The Advanced Reactor Demonstration Program (ARDP) focuses Departmental and non-federal resources on supporting the development of commercially promising advanced reactors that have the potential for near and mid-term demonstration and commercial deployment and addressing challenges hindering their deployment.

In the FY 2020 Further Consolidated Appropriations Act, Congress established ARDP to demonstrate multiple advanced reactor designs. In the Bipartisan Infrastructure Law (Infrastructure Investment and Jobs Act, P.L. 117-58), multi-year funding for the reactor demonstration elements of this program was provided under the new Office of Clean Energy Demonstrations (OCED). The ARDP research and development elements leading to demonstration remain with Nuclear Energy and include these four major elements:

- National Reactor Innovation Center (NRIC) – Supports testing, demonstration, and performance assessment to accelerate deployment of advanced reactors through development of advanced nuclear energy technologies by utilizing the unique DOE national laboratory facilities and capabilities;
- Risk Reduction for Future Demonstrations – Supports cost-shared (up to 80% government, not less than 20% industry) partnerships with U.S.-based teams to address technical, operational, and regulatory challenges to enable development of a diverse set of advanced nuclear reactor designs for future demonstration;
- Regulatory Development – Coordinates activities with the Nuclear Regulatory Commission (NRC) and U.S. industry to address and resolve key regulatory framework and licensing technical issues that directly impact the "critical path" to advanced reactor demonstration and deployment; and
- Advanced Reactor Safeguards – Evaluates safeguards and security issues that are unique to advanced reactors to help reduce roadblocks by solving regulatory challenges, reducing safeguards and security costs, and utilizing the latest technologies and approaches for plant monitoring and protection.

In FY 2024, the Department focuses on the execution of the Risk Reduction projects selected in FY 2021. For the Risk Reduction projects, funding supports five domestic advanced reactor development partners in resolving technical, operational, and regulatory challenges to enable future demonstration of their concepts. Efforts initiated under the NRIC, Regulatory Development, and Advanced Reactor Safeguards subprograms continue in FY 2024.

The two ongoing ARDP Demonstration projects (funded in the Office of Clean Energy Demonstrations, OCED) and the five Risk Reduction projects (in NE) are working to overcome barriers to future deployments and have the potential to create substantial numbers of new skilled, good-paying domestic jobs with the free and fair choice to join a union. For example, in the early stages of design development and licensing, the reactor demonstration vendors are adding many technical and professional employees to address design, engineering, testing, procurement, and licensing requirements. The construction phase of each reactor is expected to result in hundreds of short-term construction jobs. The eventual operation of these reactors will require the creation of additional long-term operations, maintenance, and security positions with the utility owners. Overall, the deployment and operation of these reactors are expected to have significant positive, long-term, economic impacts on the communities in which they operate.

**Highlights of the FY 2024 Budget Request**

A key FY 2024 activity for NRIC includes support for establishing infrastructure for the testing of multiple advanced reactor concepts. FY 2024 capital line-item funding is requested for the Laboratory for Operations and Testing in the United States (LOTUS) Project (23-E-200, LOTUS) for construction activities.

Funding for the two advanced reactor demonstrations previously included in this budget are now funded, per the Infrastructure Investment and Jobs Act (IIJA), within OCED.

**Advanced Reactor Demonstration Program**
**Funding ($K)**

| | FY 2022 Enacted[1] | FY 2023 Enacted[2] | FY 2024 Request | FY 2024 Request vs FY 2023 Enacted ($) | FY 2024 Request vs FY 2023 Enacted (%) |
|---|---|---|---|---|---|
| **Advanced Reactor Demonstration Program** | | | | | |
| National Reactor Innovation Center | 53,000 | 70,000 | 34,000 | -36,000 | -51.4% |
| Demonstration 1 | 30,000 | 0 | 0 | 0 | 0% |
| Demonstration 2 | 30,000 | 0 | 0 | 0 | 0% |
| ARDP Demonstration Reactors | 0 | 60,000 | 0 | -60,000 | -100% |
| Risk Reduction for Future Demonstrations | 115,000 | 120,000 | 120,000 | 0 | 0% |
| Regulatory Development | 15,000 | 10,250 | 11,000 | +750 | +7.3% |
| Advanced Reactor Safeguards | 5,000 | 4,750 | 6,000 | +1,250 | +26.3% |
| Construction: 23-E-200, LOTUS | 2,000 | 20,000 | 32,000 | +12,000 | +60% |
| **Total, Advanced Reactor Demonstration Program** | **250,000** | **285,000** | **203,000** | **-82,000** | **-28.8%** |

[1] Funding reflects the movement of $2 million from NRIC to 23-E-200, LOTUS per approved PDS.

[2] FY 2023 Enacted levels for base funding include $20 million for the National Reactor Innovation Center, $120 million for Risk Reduction for Future Demonstrations, and $60 million for ARDP Demonstration Reactors that was enacted in Division M, Additional Ukraine Supplemental Appropriations, of the Consolidated Appropriations Act, 2023 (P.L. 117-328). This funding is a part of the total $12.5 billion governmentwide originally intended to be base appropriations that was designated as emergency requirements for purposes of the 2023 Omnibus agreement.

**Advanced Reactor Demonstration Program**
**Explanation of Major Changes ($K)**

| | FY 2024 Request vs FY 2023 Enacted |
|---|---|
| **National Reactor Innovation Center:**<br>The decrease from $70,000,000 to $34,000,000 reflects a ramp-down in funding required for the Demonstration of Microreactor Experiments (DOME) test bed project as it nears completion of construction in early FY 2025. | **-36,000** |
| **Demonstration 1:**<br>No funding is requested for the X-energy advanced reactor demonstration within Nuclear Energy. IIJA provided multi-year funding for this demonstration under the Office of Clean Energy Demonstrations. | **+0** |
| **Demonstration 2:**<br>No funding is requested for the TerraPower advanced reactor demonstration within Nuclear Energy. IIJA provided multi-year funding for this advanced reactor demonstration under the Office of Clean Energy Demonstrations. | **+0** |
| **ARDP Demonstration Reactors:**<br>No funding is requested for the two ARDP demonstration reactor efforts (Demonstration 1 and Demonstration 2) as IIJA provided multi-year funding for both demonstrations under the Office of Clean Energy Demonstrations. | **-60,000** |
| **Risk Reduction for Future Demonstration:**<br>No change. | **+750** |
| **Regulatory Development:**<br>The increase from $10,250,000 to $11,000,000 reflects a ramp-up in activities to help reduce the regulatory risks for advanced reactors as we move closer to the demonstration phase of these concepts. | **+1,250** |
| **Advanced Reactor Safeguards**:<br>The increase from $4,750,000 to $6,000,000 reflects additional funds to accelerate advanced reactor physical protection systems (PPS) and material control and accountability (MC&A) activities and expand vendor engagements. | **+12,000** |
| **Construction:** | |

| | FY 2024 Request vs FY 2023 Enacted |
|---|---|
| The increase from $20,000,000 to $32,000,000 supports completion of design activities and initiation of construction related activities for the LOTUS project (23E-200). | |
| **Total, Advanced Reactor Demonstration Program** | **-82,000** |

## National Reactor Innovation Center

**Description**

The National Reactor Innovation Center (NRIC) mission enables and accelerates the testing and demonstration of advanced reactors by utilizing the unique capabilities of U.S. national laboratories. NRIC provides private sector technology developers with access to the strategic infrastructure and assets of the national laboratories to enable physical validation of advanced nuclear reactor concepts, resolve technical uncertainties, and generate data relevant to safety, resilience, security, and functionality of advanced nuclear reactor concepts. NRIC works closely with R&D programs within the Office of Nuclear Energy to avoid duplication. NRIC does not conduct R&D; it facilitates information sharing and connectivity necessary to enable the demonstration of selected nuclear reactor designs.

The NRIC subprogram activities include interactions with reactor developers who are considering options for demonstrating their reactor technologies as well as development of national laboratory capabilities for hosting advanced reactor demonstrations and tests. While NRIC is led by the Idaho National Laboratory (INL) with significant activities at the INL Site as well as resources at other national laboratories and potential nuclear reactor demonstration sites will play an important role in achieving NRIC's objectives.

NRIC is expected to help accelerate technology readiness from proof of concept through proof of operations. Key support to be provided by NRIC includes:

- Facilitating industry access to key resources, such as materials needed for nuclear reactor fuel, facilities for fabrication of fuel for demonstrations, test reactors such as the Advanced Test Reactor and Transient Reactor Test Facility at the INL and High Flux Isotope Reactor at the Oak Ridge National Laboratory, characterization capabilities such as INL's Irradiated Materials Characterization Laboratory, and access to advanced modeling and simulation codes and high performance computers through the INL Collaborative Computing Center;
- Providing access to national laboratory experts to support technology development;
- Developing complementary technologies, in conjunction with relevant Nuclear Energy R&D programs, such as application of digital engineering philosophies and development and proof of concept of advanced construction technologies, to reduce the cost and schedule risks associated with the deployment of advanced reactors;
- Assisting with National Environmental Policy Act (NEPA) evaluations and DOE authorization related to nuclear facility operations;
- Providing resources for cost-share grants to applicants for the purpose of funding a portion of NRC fees for pre-application and licensing application review activities.
- Developing a resource network of sites, facilities, and capabilities suitable for performing key R&D, experiments, tests, or fabrications, and for hosting advanced reactor demonstrations; and
- Identifying and facilitating resolution of experimental capability gaps which are vital to advanced reactor development and demonstration.

A key FY 2024 activity for NRIC includes support for establishing infrastructure for the testing of multiple advanced reactor concepts. The Demonstration and Operation of Microreactor Experiments (DOME) test bed will be capable of hosting experiments to support testing and development of microreactor technologies. DOME will be located at the former Experimental Breeder Reactor II facility at the INL to support this new mission. Several microreactor developers have expressed interest in using DOME to test their technologies and generate data to support design and licensing activities. Activities to support establishment of the LOTUS test bed are described in the Construction section of the ARDP program. It should be noted that Other Project Costs (OPCs) for the LOTUS project are reflected in the NRIC subprogram, while Total Estimated Costs (TECs) are reflected in line item 23-E-200, LOTUS.

## National Reactor Innovation Center

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Change FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **National Reactor Innovation Center $70,000,000[3]** | **$34,000,000** | **-$36,000,000** |
| • Continued support for establishment of the Molten Salt Thermophysical Examination Capability (MSTEC) at INL to close a vital experimental gap for molten salt reactors (MSRs).<br>• Completed Phase I of the Advanced Construction Initiative (ACT) Initiative to enable development of advanced construction technologies that may reduce the cost and schedule risks associated with advanced reactor construction.<br>• Initiated Phase II of the ACT Initiative to support proof of concept of advanced construction technologies.<br>• Engaged with key stakeholders such as the Nuclear Regulatory Commission (NRC), advanced reactor developers, and potential end-users.<br>• Continued evaluating capabilities and gaps and working with R&D programs to facilitate. coordinated actions to address critical needs.<br>• Initiated construction of the DOME test bed to enable development and demonstration of microreactor technologies.<br>• Initiated the Advanced Nuclear Energy Cost-Share Grant Program, including industry outreach and issuance of solicitation.<br>• Continued OPC activities for the LOTUS project per DOE Order 413.3B. | • Initiate operation of MSTEC at INL to close a vital experimental gap for MSRs.<br>• Continue Phase II of the ACT Initiative to support proof of concept of advanced construction technologies.<br>• Further engage with key stakeholders such as the NRC, advanced reactor developers, and potential end-users.<br>• Continue construction of the DOME test bed to enable development and demonstration of microreactor technologies.<br>• Facilitate access to infrastructure, materials, and expertise to support advanced reactor demonstration.<br>• Continue the Advanced Nuclear Energy Cost-Share Grant Program, including initial award selections.<br>• Continue OPC activities for the LOTUS project, including planning for transition to operations in FY 2026. | • The decrease reflects a ramp down in funding for the DOME project as it nears completion of construction in early FY 2025. |

[3] FY 2023 Enacted levels include $20 million for the National Reactor Innovation Center that was enacted in Division M, Additional Ukraine Supplemental Appropriations, of the Consolidated Appropriations Act, 2023 (P.L. 117-328).

**Demonstration 1; Demonstration 2; ARDP Demonstration Reactors**

**Description**

These subprograms focused efforts on the execution of two cost-shared projects for the eventual construction of advanced reactor demonstrations. In FY 2020, DOE announced awards to X-energy and TerraPower LLC to design, license, construct, and start up advanced nuclear reactors that can be operational within seven years. The awards are cooperative agreements between DOE and the awardee companies with up to 50% cost-shared by DOE. The demonstration projects will deliver first-of-a-kind advanced reactors to be licensed for commercial operations. X-energy's Xe-100 reactor is a high temperature gas reactor that produces 80 MWe and leverages the TRISO fuel particle technology that was developed by DOE. Xe-100 reactor units can be deployed as a "four-pack" to supply 320 MWe and can provide process heat as well as electricity production. X-energy will announce a commercial partner and site selection for the demonstration reactor plants in early 2023. TerraPower's Natrium reactor is a sodium cooled fast reactor that produces 345 MWe and can supply up to 500 MWe with thermal energy storage that is being deployed as part of the plant design. The Natrium demonstration reactor will be located in Kemmerer, WY, providing an energy transition from a retiring coal plant.

The Bipartisan Infrastructure Law provides multi-year funding for the X-energy and TerraPower demonstrations under the Office of Clean Energy Demonstrations. As such, no FY 2024 funding is requested for these efforts within Nuclear Energy.

**Demonstration 1; Demonstration 2; ARDP Demonstration Reactors**

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Change<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Demonstration 1 $0**<br>**Demonstration 2 $0**<br>**ARDP Demonstration Reactors $60,000,000**[4] | **$0**<br>**$0**<br>**$0** | **+$0**<br>**+$0**<br>**-$60,000,000** |
| • No funding was requested for the X-energy and TerraPower advanced reactor demonstrations within Nuclear Energy. | • No funding is requested for the X-energy and TerraPower advanced reactor demonstrations within Nuclear Energy. | • This reflects the transfer of the X-energy and TerraPower advanced reactor demonstrations to the Office of Clean Energy Demonstrations. |

[4] FY 2023 Enacted levels include $60 million for the ARDP Demonstration Reactors that was enacted in Division M, Additional Ukraine Supplemental Appropriations, of the Consolidated Appropriations Act, 2023 (P.L. 117-328).

## Risk Reduction for Future Demonstrations

**Description**

The Risk Reduction for Future Demonstrations subprogram supports advanced reactor concepts with the potential for future demonstration through cost-shared (up to 80% government, not less than 20% industry) competitively awarded (through a financial assistance solicitation) projects that are designed to maximize the utility of the results across the nuclear energy industry. The projects are aimed at reducing risk and technical uncertainty for a broad range of advanced reactor designs. Project activities may include R&D to address technical challenges associated with development of technologies and methods to improve the timelines for advanced reactor deployments, the cost and schedule for delivery of nuclear products, services, and capabilities supporting these nuclear technologies, design and engineering processes, and resolution of certification challenges potentially impeding the introduction of these technologies into the marketplace. This subprogram coordinates closely with the Reactor Concepts Research, Development & Demonstration program and other relevant programs to avoid duplication, leverage existing expertise, and maximize synergies.

In FY 2021, DOE announced the selection of five projects to aid advanced reactor developers in resolving technical, operational, and regulatory challenges to enable potential future demonstration of a diverse set of advanced reactor designs. The Risk Reduction projects support the development of safe and affordable advanced reactor technologies that may have the potential to be licensed and deployed by 2035. Industry partners are providing at least 20 percent in matching funds for their cost share of the program.

The five projects are:

- Kairos Power, LLC (Alameda, CA) will work to design, construct, and operate its Hermes reduced-scale test reactor. Hermes is intended to lead to the development of Kairos Power's commercial-scale fluoride salt-cooled high temperature reactor (FHR), a novel advanced nuclear reactor technology that leverages TRI-structural ISOtropic particle fuel (TRISO) fuel in pebble form combined with a low-pressure fluoride salt coolant;
- Westinghouse Electric Company, LLC (Cranberry Township, PA) will advance the design of a heat pipe-cooled microreactor;
- BWXT Advanced Technologies, LLC (Lynchburg, VA) will mature a commercially viable transportable microreactor conceptual design focused on using TRISO fuel particles to achieve higher uranium loading and an improved core design using a silicon carbide (SiC) matrix;
- Holtec Government Services, LLC (Camden, NJ) will focus on early-stage design, engineering, and licensing activities to accelerate the development of its light water-cooled small modular reactor (SMR); and
- Southern Company Services Inc. (Birmingham, AL) will lead a project to design, construct, and operate the Molten Chloride Reactor Experiment (MCRE), a critical nuclear test bed supporting molten salt reactor systems and components demonstrations.

FY 2024 activities focus on continuing design activities; supporting further interactions with the NRC on high impact regulatory related topics; conducting activities to resolve technical, operational, and regulatory challenges; and developing and executing plans for establishing infrastructure and support capabilities to enable execution of the Risk Reduction projects and future commercialization activities.

## Risk Reduction for Future Demonstrations

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Change<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Risk Reduction for Future Demonstrations**<br>**$120,000,000**[5] | **$120,000,000** | **$0** |
| • Support execution of the Risk Reduction projects per established project plans and using current and prior year carryover funds. Specific project activities include:<br>o For the Kairos project: Conducted activities to support the design, licensing, construction, and operation of an FHR test reactor.<br>o For the Westinghouse project: Scaled-up and enhanced heat pipe manufacturing operations to enable design, procurement, and manufacturing of a microreactor demonstration unit.<br>o For the BWXT project: Continued fabrication of TRISO fuel specimens to support irradiation testing in INL's Advanced Test Reactor (ATR).<br>o For the Holtec project: Initiated long lead procurement activities by selecting the Control Rod Drive Mechanism subcontract supplier which will demonstrate the capability of the existing supply chain.<br>o For the Southern Company Services project: Completed design of the fuel salt synthesis line (FSSL). Continued procurement of long-lead equipment for | • Support execution of the Risk Reduction projects per established project plans and using current and prior year carryover funds. Specific project activities include:<br>o For the Kairos project: Initiate construction activities. Completion of all commissioning and operational milestones for the second Engineering Test Unit (ETU). Completion of all construction milestones for the third ETU.<br>o For the Westinghouse project: Enhance manufacturability of heat pipes. Design capsule for thermal testing of moderator material. Use NRC feedback on white papers and through regulatory engagement to identify future licensing actions and reduce regulatory risk.<br>o For the BWXT project: Initiate irradiation of fuel specimens in INL's ATR. Submit the Fuel Qualification Technical Report to the NRC.<br>o For the Holtec project: Complete the SMR-160 Preliminary Safety Analysis Report.<br>o For the Southern Company Services project: Complete MCRE final design. Complete assembly of a non-nuclear mock- | • No change. |

[5] FY 2023 Enacted levels include $120 million for Risk Reduction for Future Development that was enacted in Division M, Additional Ukraine Supplemental Appropriations, of the Consolidated Appropriations Act, 2023 (P.L. 117-328).

| FY 2023 Enacted | FY 2024 Request | Explanation of Change<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| FSSL. Conducted MCRE preliminary design review. Continued to support the development of nuclear safety basis documentation to enable DOE authorization of MCRE and ensure safe operations. | up of MCRE to de-risk operation of the fueled reactor experiment. | |

## Regulatory Development

**Description**

The Regulatory Development subprogram coordinates with the Nuclear Regulatory Commission (NRC) and industry to address and resolve key regulatory framework issues that directly impact the "critical path" to advanced reactor demonstration and deployment. Part of the subprogram focuses on regulatory modernization activities such as developing adaptations of light water reactor (LWR)-based regulations for non-LWR advanced reactors, finalizing the establishment of risk-informed and performance-based license application guidance, and establishing clear expectations for license application content and review criteria. Other regulatory development activities include resolving the technical basis to support NRC endorsement of codes and standards important for the manufacture of advanced reactor components and expanding access to priority material property data to be used in safety codes and models in support of licensing. The Regulatory Development subprogram supports limited R&D aimed at producing broadly applicable results than can be used by an array of private sector companies to inform their regulatory requirements. Design-specific regulatory gaps for advanced reactors, including fast reactors, gas-cooled reactors, and molten salt reactors, are also addressed.

## Regulatory Development

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Change<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Regulatory Development $10,250,000** | **$11,000,000** | **+$750,000** |
| • Provided support for industry and NRC interactions that are establishing the advanced non-light water reactor regulatory framework.<br>• Continued efforts to address unresolved and high impact NRC regulatory policy issues impacting advanced reactor licensing.<br>• Developed the technical basis for material surveillance technologies to be used by owner/operators to implement a materials degradation management program for MSRs.<br>• Utilized the Liquid Salt Test Loop (LSTL) at the Oak Ridge National Laboratory to test sensors and demonstrate tools in support of MSR development and deployment.<br>• Developed and maintained the fast reactor database to archive historical data for fast reactor fuels and materials to preserve data, knowledge and experience.<br>• Continued development and testing to support inclusion of Alloy 709 (alloy with increased materials performance in high temperature advanced reactor operating environments) in the American Society of Mechanical Engineers (ASME) Code. | • Continue to coordinate with industry and the NRC to identify and resolve technology gaps and high impact challenges associated with advanced reactor regulation.<br>• Continue efforts to establish a risk-informed and performance based advanced reactor regulatory framework.<br>• Submit industry-driven proposals to the NRC on key advanced reactor regulatory topics such as Accelerated Materials Qualification, Establishing the Requirements for Emergency Planning Zones, and Technology Inclusive Risk Informed Change Evaluation.<br>• Complete the quality assurance of the data within the Fuels Irradiation and Physics Database to support fast reactor licensing activities.<br>• Complete the Alloy 709 conservative design guide to help inform industry partners on conceptual component sizing.<br>• Complete construction, dry shakedown, and salt commissioning of the Molten Salt Tritium Transport Experiment (MSTTE) to understand and mitigate tritium migration in MSRs related to permeation through structural materials, evolution into cover gas, and other associated phenomena. | • The increase reflects a ramp-up in activities to help reduce the regulatory risks for advanced reactors as we move closer to the demonstration phase of these concepts. |

## Advanced Reactor Safeguards

**Description**

The Advanced Reactor Safeguards (ARS) subprogram evaluates safeguards and security issues unique to advanced reactor designs and informs and improves advanced reactor designs by addressing issues such as diversion of advanced fuel forms, protection of remotely operated plants, and other proliferation and security concerns. Broadly, the ARS subprogram also helps to reduce security costs by utilizing the latest technologies and approaches for plant monitoring and protection.

The ARS subprogram focuses on six major elements: physical protection systems, pebble bed reactor material control and accountability (MC&A), microreactor physical protection systems and MC&A, liquid fueled reactor MC&A, international cooperation, and vendor engagements.

- Physical Protection Systems (PPS) – targets issues such as reducing number of on-site responders and upfront costs and evaluating enhanced safety systems and unique sabotage targets.

- Pebble bed reactor MC&A – focuses on evaluating the regulatory approach and determining the driving requirements, as well as evaluating new monitoring technologies.

- Microreactor PPS and MC&A – works on developing a licensing framework, developing approaches appropriate to the very small scale, and evaluating new monitoring technologies.

- Liquid fueled MC&A – targets evaluating regulatory approach, developing baseline accountancy approaches, and evaluating new measurement and monitoring technologies.

- International Cooperation – focuses on considering and incorporating international safeguards requirements, interfacing with international safeguards and security programs, and supporting the Gen-IV Proliferation Resistance & Physical Protection (PR&PP) Working Group.

- Vendor Engagements – addresses design-specific MC&A and PPS challenges for vendors through direct engagements with DOE national laboratories and generates lessons learned and/or generic deliverables to share information broadly with the advanced reactor community.

The ARS subprogram also coordinates with the Nuclear Regulatory Commission (NRC), the Department of Energy's National Nuclear Security Administration (NNSA), and the nuclear industry to avoid duplication of activity and leverage nationwide expertise. Together, these safeguards and security activities help further advanced reactors development and deployment.

## Advanced Reactor Safeguards

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Change<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Advanced Reactor Safeguards $4,750,000** | **$6,000,000** | **+$1,250,000** |
| • Refined and expanded physical protection design alternatives for a diverse set of advanced reactors, to support cost effective, market competitive designs.<br>• Developed a pebble bed burnup measurement strategy and experimental plan to assist pebble bed reactor vendors to meet key monitoring and accountancy requirements.<br>• Engaged with advanced reactor vendors, in coordination with NNSA, to advance both domestic and international safeguards and security by design. | • Incorporate sabotage scenario analysis into the PPS design for multiple classes of advanced reactors to improve security designs.<br>• Demonstrate burnup measurements on short-cooled TRI-structural ISOtropic particle (TRISO) fuel to advance MC&A technologies and techniques.<br>• Develop recommendations for NE and NNSA on integrated domestic and international safeguards equipment to reduce costs and improve efficiencies.<br>• Expand vendor engagements to examine design-specific MC&A and PPS issues and generate lessons learned for the advanced reactor community. | • The increase reflects additional funds to accelerate advanced reactor PPS and MC&A activities and expand vendor engagements. |

**Construction**

**Description**

Line-item capital projects are sometimes required to maintain the ability to support mission goals. These projects help achieve the Department's and Nuclear Energy (NE)'s strategic objectives by maintaining site services and providing critical information for future decisions. These activities are focused on two primary objectives: (1) identification, planning, and prioritization of projects required to meet NE program objectives, and (2) development and execution of these projects within approved cost and schedule baselines. While the Department's acquisition management process does not guarantee that a project will be completed once the initial information gathering and preliminary design phase are complete, it does provide an important decision-making framework that, when well executed, allows only the most critically necessary, cost-effective projects to proceed to construction.

23-E-200, Laboratory for Operations and Testing in the U.S. (LOTUS)

The LOTUS Project will enable and support the development and deployment of advanced nuclear systems by providing the infrastructure for advanced reactor developers to test and operate experimental reactors that utilize Safeguards Category I materials for operation. First-of-a-kind nuclear technology developers need a location for testing, validating, and maturing new reactor technologies or concepts, and for validating the safety and workability of systems or components individually or as part of the overall reactor system. Advanced reactor developers also need to generate data on key phenomena relevant to the design and safe operation of their designs to aid in future licensing and commercial deployment of these technologies. Although not required for the commercial concepts, some reactor demonstrations and experiments require higher enrichment fuel to keep the size of the reactor small while ensuring that neutronics and thermal hydraulics are representative of commercial designs. The LOTUS Project will ensure safety of initial reactor operations by making available a robust facility that can provide the appropriate containment capabilities and supporting infrastructure.

On March 8, 2022, DOE Order 413.3 B, *Program and Project Management for the Acquisition of Capital Assets*, Critical Decision (CD)-0, Approve Mission Need, was approved for the LOTUS Project, with a current cost range of $28,000,000 to $97,000,000. The approved Mission Need Statement identified the critical need for a test bed capability to conduct reactor experiments requiring appropriate safeguards and security consistent with DOE safety and security requirements. Consistent with Congressional guidance provided in the FY22 Omnibus Appropriation, the Department initiated conceptual design activities in FY 2022.

The FY2024 budget request supports completion of design and initiation of construction activities following CD-1, including construction award and long lead procurement of facility systems such as control room components, electrical and ventilation equipment, and fire suppression systems.

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**Construction**

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Change<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| Construction **$20,000,000** | **$32,000,000** | **+$12,000,000** |
| Laboratory for Operations and Testing in the U.S. (23-E-200)<br>• Initiate preliminary design activities. | Laboratory for Operations and Testing in the U.S. (23-E-200)<br>• Complete preliminary and final design activities and initiate construction related activities. | Laboratory for Operations and Testing in the U.S. (23-E-200)<br>• The increase reflects completion of design and initiation of construction related activities. |

**Advanced Reactor Demonstration Program**
**Construction Projects Summary ($K)**

| | Total | Prior Years | FY 2022 Enacted | FY 2023 Enacted | FY 2024 Request | FY 2024 Request vs FY 2023 Enacted |
|---|---|---|---|---|---|---|
| **23-E-200, LOTUS, INL** | | | | | | |
| Total Estimated Cost (TEC) | 49,000 | 0 | 2,000 | 20,000 | 32,000 | +12,000 |
| Other Project Costs (OPC)[1] | 13,557 | 3,957 | 600 | 1,000 | 8,000 | +7,000 |
| **Total Project Cost (TPC) Project Number 23-E-200** | **62,557** | **3,957** | **2,600** | **21,000** | **40,000** | **+19,000** |
| | | | | | | |
| **Total All Construction Projects** | | | | | | |
| Total Estimated Cost (TEC) | 49,000 | 0 | 2,000 | 20,000 | 32,000 | +12,000 |
| Total Other Project Costs (OPC) | 13,557 | 3,957 | 600 | 1,000 | 8,000 | +7,000 |
| **Total Project Cost (TPC) All Construction Projects** | **62,557** | **3,957** | **2,600** | **21,000** | **40,000** | **+19,000** |

[1] OPC funding for 23-E-200, LOTUS is included within the National Reactor Innovation Center subprogram line.

**23-E-200, Laboratory for Operations and Testing in the United States**
**Idaho National Laboratory**
**Project is for Design and Construction**

## 1. Summary, Significant Changes, and Schedule and Cost History

### Summary

The fiscal year (FY) 2024 Budget Request for the Laboratory for Operations and Testing in the United States (LOTUS) project is $32,000,000. The most recent Department of Energy (DOE) Order 413.3 B Critical Decision (CD)-0, *Approve Mission Need*, was approved on March 8, 2022, with a Total Project Cost (TPC) range of $28,000,000 to $97,000,000. The approved Mission Need Statement identified the critical need for a test bed capability to conduct reactor experiments requiring appropriate safeguards and security consistent with DOE safety and security requirements.

LOTUS is a physical structure in which reactor prototypes can be tested safely and securely. The requested capital funding in FY 2024 supports completion of design and initiation of construction activities following CD-1 including preliminary design, final design, construction award and long lead procurement of facility systems such as control room components, electrical and ventilation equipment, and fire suppression systems. In FY 2023, the project will initiate design activities. Based on Congressional direction to establish test bed capabilities at Idaho National Laboratory (INL) to support advanced reactor demonstration activities, the project's acquisition strategy will utilize a tailored approach per DOE Order 413.3B. The LOTUS project will provide a dynamic test bed to support testing of advanced reactor concepts.

A Level 2 Federal Project Director (FPD) has been assigned to this project.

### Significant Changes

This Construction Project Data Sheet (CPDS) is the first official datasheet for this construction line item. The LOTUS project was initiated in FY 2022 as a non-major acquisition and received its first direct appropriations in FY 2023.

### Critical Milestone History

**(**Fiscal Quarter or Date)

| Fiscal Year | CD-0 | Conceptual Design Complete | CD-1 | Final Design Complete | CD-1/2/3 | D&D Complete | CD-4 |
|---|---|---|---|---|---|---|---|
| FY 2022 | 3/8/2022 | 1/13/2022 | TBD | TBD | TBD | N/A | TBD |
| FY 2023 | 3/8/2022 | 1/13/2022 | TBD | TBD | TBD | N/A | TBD |
| FY 2024 | 3/8/2022 | 1/13/2022 | TBD | TBD | TBD | N/A | TBD |

**CD-0** – Approve Mission Need for a construction project with a conceptual scope and cost range
**Conceptual Design Complete** – Actual date the conceptual design was completed (if applicable)
**CD-1** – Approve Alternative Selection and Cost Range
**Final Design Complete** – Estimated/Actual date the project design will be/was complete(d)
**CD-2/3** – Approve Alternative Selection, Approve Performance Baseline, and Approve Start of Construction
**Construction Complete** – Completion of construction
**CD-4** – Approve Start of Operations or Project Closeout

| Fiscal Year | Performance Baseline Validation | CD-3A | CD-3B |
|---|---|---|---|
| FY 2022 | TBD | TBD | N/A |
| FY 2023 | TBD | TBD | N/A |
| FY 2024 | TBD | TBD | N/A |

**CD-3A** – Approve Long-Lead Procurements, Original Scope
**CD-3B** – Approve Long-Lead Procurements, Revised Scope (as needed)

**Project Cost History**

| Fiscal Year | TEC, Design | TEC, Construction | TEC, Total | OPC, Total | TPC |
|---|---|---|---|---|---|
| FY 2022 | 10,992 | 52,231 | 63,223 | 33,777 | 97,000 |
| FY 2023 | 10,992 | 52,231 | 63,223 | 33,777 | 97,000 |
| FY 2024 | 10,992 | 52,231 | 63,223 | 33,777 | 97,000 |

**2. Project Scope and Justification**

**Scope**

LOTUS will provide a dynamic test bed to support testing of advanced reactor concepts. The test bed will be designed and constructed to meet the following minimum requirements:

- The test bed capability must have the supporting infrastructure to safely test advanced reactor concepts up to 500 kilowatts thermal ($kW_{th}$) and interface, as necessary, with reactor support systems.
- The test bed capability must be able to satisfy Natural Phenomena Hazard (NPH) criteria. As a Hazard Category 2 nuclear facility, the test bed must meet the NPH requirements of DOE Order 420.1C, "Facility Safety," including seismic, wind, flood, and volcanic hazards. Design and construction must ensure that systems, structures, and components will perform safety functions during and after design basis NPH events.
- The test bed capability must be able to provide confinement capability during postulated accident and design basis events. Specifically, it must prevent or control radioactive material release to the environment either in operation or from an accident; and it must ensure air supply and exhaust are controlled, and typically filtered. Confinement may be provided by some combination of leak tightness in the structure and active ventilation to maintain a negative pressure.
- The test bed capability must have the infrastructure (physical and resource) to appropriately control safeguards category I materials.
- The test bed capability must provide the minimum features necessary to conduct an experiment to validate an advanced reactor design starting in FY 2026.
- The test bed capability must be available for advanced reactor testing for a minimum of 20 years from the start of operation.

**Key Performance Parameters (KPPs)**

A KPP is a vital characteristic, function, requirement, or design basis that, if changed, would have a major impact on the facility or system performance, scope, schedule, cost, risk, or the ability of an interfacing project to meet its mission requirements. The preliminary threshold KPPs represent the minimum acceptable scope for successful delivery of the LOTUS project. Achievement of KPPs will be a prerequisite for approval of CD-4. The project anticipates identifying Objective KPPs that will provide expanded capabilities to meet R&D objectives, if needed. If project performance warrants, management reserve and/or contingency funds can be allocated to Objective KPP scope or infrastructure enhancements to improve facility performance. Final KPPs will be established at CD-2/3 when the project's Performance Baseline is established.

**Preliminary Threshold and Objective KPPs**

| Performance Measure | Threshold | Objective* |
|---|---|---|
| Provide the facility infrastructure to support the operation of up to 500 $kW_{th}$ experimental reactors | Establishment of core infrastructure needed to support advanced reactor tests in the test bed, with clearly defined boundaries:<br>• Electrical supply and back-up power (as necessary)<br>• 500 $kW_{th}$ direct reactor cooling system<br>• Ventilation/exhaust for test bed cell<br>• Support systems (e.g., compressed air, argon, fire protection, oxygen monitoring, criticality monitoring)<br>• Establishment of control room area with appropriate data connections | TBD |
| Establish a Hazard Category-2 nuclear facility capable of supporting tests using safeguards category I quantities of material | Establishment of equipment access capability with required confinement and security features<br>Approved Safety Analysis Report addressing test bed capability<br>Completion of DOE Operational Readiness Review for the test bed capability in accordance with DOE Order 425.1D<br>Completion of Vulnerability Assessment demonstrating compliance with applicable security requirements | N/A |

* LOTUS will be baselined to the Threshold Measure. Objective KPPs will be executed if funding is available after Threshold KPPs are achieved.

Completion of operational readiness activities for first reactor tests utilizing LOTUS will not be requisite for determining successful project completion.

As applicable, LOTUS will be constructed using sustainable building considerations per Department of Energy Guide 413.3-6B, dated 4-5-2020, "High Performance Sustainable Buildings." The design will include provisions for meeting the 2016 and 2020 Guiding Principles for Sustainable Federal Buildings, as applicable. Design, construction, and documentation of the Guiding Principles ensure compliance with DOE Order 436.1, Departmental Sustainability.

Funds appropriated under this data sheet may be used to provide independent assessments related to project planning and execution.

**Justification**

Nuclear power remains an important part of our Nation's energy portfolio, as we strive to reduce carbon emissions and address the threat of global climate change. Following the advent of nuclear power generation, the U.S. was an international leader in the development and testing of advanced nuclear reactor technologies. DOE and its predecessor organizations appropriately provided nuclear fuels and materials development capabilities and large-scale demonstration facilities in support of currently deployed nuclear reactor technologies. However, the U.S. has not sufficiently maintained this domestic capability for over two decades. The existing industrial and DOE test bed facilities are not currently capable of supporting fueled advanced reactor tests and international facilities are not an option due to concerns with access, transportation, and technical equivalencies. Lack of domestic advanced reactor test bed capabilities is hampering the U.S. ability to move forward in the development of next generation nuclear reactors and equally impacts the Nation's ability to regain technological leadership in this arena.

Based on the tremendous potential value of improved nuclear energy technology, private-sector investment in nuclear innovation has increased in recent years. Currently there are dozens of U.S. companies pursuing advanced reactor concepts that potentially offer enhanced safety, improved efficiency, and reduced costs. In addition, DOE's national laboratories,

other federal agencies, and universities, are actively pursuing the development of next generation advanced reactor technologies.

The Nuclear Energy Innovation Capabilities Act of 2017 (P.L. 115-248) (NEICA), Section 958, Enabling Nuclear Energy Innovation, authorized the National Reactor Innovation Center (NRIC) as a program to enable the testing and demonstration of reactor concepts to be proposed and funded, in whole or in part, by the private sector. As a result, the DOE Office of Nuclear Energy launched the NRIC in August 2019. NRIC is charged with developing the infrastructure needed for the testing and demonstration of multiple advanced reactor concepts. To fulfill that charge, NRIC has been exploring options to develop test bed capabilities to provide industry partners the infrastructure to startup, test, and operate experimental reactors in a safe and economical manner.

The approved Mission Need Statement for the LOTUS project provides the basis for establishing a safeguards category I advanced reactor test bed capability at INL to support DOE, industry, and other government agency advanced reactor testing needs. Establishment of the LOTUS capability will provide industry with the infrastructure necessary to support development and testing of experimental reactors requiring safeguards category I materials for operation. Testing of these reactor concepts will provide real data that can be used to validate models and support subsequent licensing activities to bring the reactors to market. Advanced reactor communities that are supported by several DOE programs are key to providing a flexible portfolio of energy supply sources. This will ensure national security through energy independence and will re-energize the U.S. nuclear industrial sector for deployment of advanced reactors. This infrastructure will further demonstrate DOE's commitment and support of advanced reactor technologies consistent with NEICA.

Establishment of this test bed is consistent with Congressional direction provided as part of the Consolidated Appropriations Acts of 2021 and 2022.

**3. Financial Schedule**

(Dollars in Thousands)

| | Budget Authority (Appropriations) | Obligations | Costs |
|---|---|---|---|
| **Total Estimated Cost (TEC)** | | | |
| Design | | | |
| FY 2022 | 2,000 | 2,000 | 500 |
| FY 2023 | 8,992 | 8,992 | 9,500 |
| FY 2024 | 0 | 0 | 992 |
| **Total, Design (TEC)** | **10,992** | **10,992** | **10,992** |
| Construction | | | |
| FY 2023 | 11,008 | 11,008 | 1,500 |
| FY 2024 | 32,000 | 32,000 | 20,500 |
| Outyears | 9,223 | 9,223 | 30,231 |
| **Total, Construction (TEC)** | **52,231** | **52,231** | **52,231** |
| Total Estimated Costs (TEC) | | | |
| FY 2022 | 2,000 | 2,000 | 500 |
| FY 2023 | 20,000 | 20,000 | 11,000 |
| FY 2024 | 32,000 | 32,000 | 21,492 |
| Outyears | 9,223 | 9,223 | 30,231 |
| **Total TEC** | 63,223 | 63,223 | 63,223 |
| Other Project Costs | | | |

| | Budget Authority (Appropriations) | Obligations | Costs |
|---|---|---|---|
| FY 2021 | 3,957 | 3,957 | 1,037 |
| FY 2022 | 600 | 600 | 1,973 |
| FY 2023 | 1,000 | 1,000 | 750 |
| FY 2024 | 8,000 | 8,000 | 8,000 |
| Outyears | 20,220 | 20,220 | 22,017 |
| Total OPC | 33,777 | 33,777 | 33,777 |
| **Total Project Costs (TPC)** | | | |
| FY 2021 | 3,957 | 3,957 | 1,037 |
| FY 2022 | 2,600 | 2,600 | 2,473 |
| FY 2023 | 21,000 | 21,000 | 11,750 |
| FY 2024 | 40,000 | 40,000 | 29,492 |
| Outyears | 29,443 | 29,443 | 52,248 |
| **Grand Total** | **97,000** | **97,000** | **97,000** |

**4. Details of Project Cost Estimate**

(Budget Authority in Thousands of Dollars)

| | Current Total Estimate | Previous Total Estimate | Original Validated Baseline |
|---|---|---|---|
| Total Estimated Cost (TEC) | | | |
| Design | | | |
| Design | 6,281 | N/A | TBD |
| Contingency | 4,711 | N/A | TBD |
| Total, Design | 10,992 | N/A | TBD |
| Construction | | | |
| Site Work | 5,272 | N/A | TBD |
| Equipment | 0 | N/A | TBD |
| Construction | 24,577 | N/A | TBD |
| Other, as needed | 0 | N/A | TBD |
| Contingency | 22,382 | N/A | TBD |
| Total, Construction | 52,231 | N/A | TBD |
| Other TEC (if any) | | | |
| Cold Startup | N/A | N/A | -- |
| Contingency | N/A | N/A | N/A |
| Total, Other TEC | N/A | N/A | N/A |
| Total **Estimated Cost** | 63,223 | N/A | N/A |

| | Current Total Estimate | Previous Total Estimate | Original Validated Baseline |
|---|---|---|---|
| *Contingency, TEC* | 27,093 | TBD | TBD |
| Other Project Cost (OPC) | | | |
| OPC except D&D | | | |
| Conceptual Design/Planning | 4,303 | N/A | TBD |
| Other OPC Costs | 15,001 | N/A | TBD |
| Contingency | 14,473 | N/A | TBD |
| **Total, OPC** | 33,777 | N/A | TBD |
| *Contingency, OPC* | 14,473 | N/A | TBD |
| **Total Project Cost** | 97,000 | N/A | TBD |
| ***Total Contingency (TEC+OPC)*** | 41,566 | N/A | TBD |

**5. Schedule of Appropriation Requests**

(Dollars in Thousands)

| Request Year | Type | Prior Years | FY 2021 | FY 2022 | FY 2023 | FY 2024 | Outyears | Total |
|---|---|---|---|---|---|---|---|---|
| FY 2022 | TEC | N/A | 0 | 2,000 | 20,000 | 32,000 | 9,223 | 63,223 |
| | OPC | N/A | 3,957 | 600 | 1,000 | 8,000 | 20,220 | 33,777 |
| | TPC | N/A | 3,957 | 2,600 | 21,000 | 40,000 | 29,443 | 97,000 |
| FY 2023 | TEC | N/A | 0 | 2,000 | 20,000 | 32,000 | 9,223 | 63,223 |
| | OPC | N/A | 3,957 | 600 | 1,000 | 8,000 | 20,220 | 33,777 |
| | TPC | N/A | 3,957 | 2,600 | 21,000 | 40,000 | 29,443 | 97,000 |
| FY 2024 | TEC | N/A | 0 | 2,000 | 20,000 | 32,000 | 9,223 | 63,223 |
| | OPC | N/A | 3,957 | 600 | 1,000 | 8,000 | 20,220 | 33,777 |
| | TPC | N/A | 3,957 | 2,600 | 21,000 | 40,000 | 29,443 | 97,000 |

**6. Related Operations and Maintenance Funding Requirements**

| | |
|---|---|
| Start of Operation or Beneficial Occupancy (fiscal quarter or date) | 4Q FY 2026 |
| Expected Useful Life (number of years) | 20 |
| Expected Future Start of D&D of this capital asset (fiscal quarter) | 1Q FY 2047 |

Related Funding Requirements
(Budget Authority in Thousands of Dollars)

| | Annual Costs | | Life Cycle Costs | |
|---|---|---|---|---|
| | Previous Total Estimate | Current Total Estimate | Previous Total Estimate | Current Total Estimate |
| Operations and Maintenance | N/A | TBD | N/A | TBD |

Development of life-cycle operations and maintenance costs pending selection of a preferred alternative.

**7. D&D Information**

The new area being constructed in this project is modifying an existing facility.

| | Square Feet |
|---|---|
| New area being constructed by this project at INL | TBD |
| Area of D&D in this project at INL | 0 |
| Area at INL to be transferred, sold, and/or D&D outside the project, including area previously "banked" | 0 |
| Area of D&D in this project at other sites | 0 |
| Area at other sites to be transferred, sold, and/or D&D outside the project, including area previously "banked" | 0 |
| Total area eliminated | 0 |

Site location, building name or numbers, and square footages of existing facilities to be replaced: N/A

As an advanced reactor test bed (laboratory facility), the proposed LOTUS is not subject to Freeze the Footprint (>50% lab space).

**8. Acquisition Approach**

Based on Congressional direction to establish test bed capabilities at INL to support advanced reactor demonstration activities, the project's acquisition strategy will utilize a tailored approach under DOE Order 413.3B. This tailoring approach allows for timely movement into capital design activities following selection of a preferred alternative for meeting the identified capability gap.

As a Hazard Category 2 nuclear facility, design, and construction of the LOTUS must be integrated with ongoing nuclear operations activities. Design and construction must also be coordinated/integrated with nuclear research and development programs. A design-bid-build project delivery method managed by the INL management and operating contractor will be used for the design and construction of LOTUS. LOTUS construction subcontract is anticipated to be a firm, fixed-price contract.

# Infrastructure

## Overview

Infrastructure consists of the Idaho National Laboratory (INL) Facilities Operations and Maintenance (IFM) subprogram and Construction subprogram.

The mission of the IFM subprogram is to manage the planning, acquisition, operation, maintenance, and disposition of the multi-program nuclear facilities and capabilities owned by the Office of Nuclear Energy (NE) along with the supporting infrastructure at INL. The IFM subprogram maintains the Department of Energy (DOE) mission-supporting facilities and capabilities at INL in a safe and compliant status (with DOE Orders, federal laws and regulations, and state agreements) to enable technological advancement in the existing nuclear fleet, advanced reactor pipeline, and fuel cycle missions. These key facilities and capabilities support NE research and development (R&D) necessary to revitalize nuclear energy in the U.S. These INL facilities and capabilities also support testing of naval reactor fuels, reactor core components and a diverse range of national security technology programs for the National Nuclear Security Administration (NNSA), isotope production for the Office of Science, and other federal agencies in critical infrastructure protection, nuclear nonproliferation, and incident response. The IFM subprogram integrates and closely coordinates with research programs to ensure proper alignment and prioritization of infrastructure investments, as well as availability of infrastructure for programmatic work.

The Construction subprogram plays a critical role in revitalizing the NE infrastructure. The subprogram focuses on addressing identified gaps created by either deteriorating critical infrastructure or evolving NE missions.

## Highlights of the FY 2024 Budget Request

Oak Ridge National Laboratory (ORNL) Nuclear Facilities are fully funded in the Office of Science FY 2024 Request.

The IFM subprogram maintains focus on the safe and compliant operation of INL nuclear research reactors, non-reactor nuclear facilities, and radiological research facilities while continuing to realize improvements in the condition of aging INL infrastructure. In FY 2024, the IFM subprogram will focus on:

- Funding the established annual increases consistent with negotiated labor wage agreements and reliability improvements to keep facilities at INL operational for NE's research and development missions.
- Continued support of regulatory compliance program to ensure compliance with the State and Federal environmental laws and regulations.
- Continued support of environmental surveillance and monitoring activities including environmental review and data collection activities to support future permits and National Environmental Policy Act (NEPA) documentation.
- Initiating pre-planning for modernizing or replacing end-of-life capabilities.

In FY 2024, there are no new construction line items under the Construction subprogram. The Sample Preparation Laboratory (SPL) project will continue construction activities per the approved project baseline.

**Infrastructure**
**Funding ($K) (Non-Comparable)**

| | FY 2022 Enacted | FY 2023 Enacted | FY 2024 Request | FY 2024 Request vs FY 2023 Enacted ($) | FY 2024 Request vs FY 2023 Enacted (%) |
|---|---|---|---|---|---|
| **Infrastructure** | | | | | |
| INL Facilities Operations and Maintenance[1] | 295,000 | 318,924 | 318,924 | 0 | 0% |
| ORNL Nuclear Facilities O&M | 20,000 | 20,000 | 0 | -20,000 | -100% |
| Research Reactor Infrastructure | 15,000 | 0 | 0 | 0 | 0% |
| Construction: Sample Preparation Laboratory | 41,850 | 7,300 | 0 | -7,300 | -100% |
| **Total, Infrastructure** | **371,850** | **346,224** | **318,924** | **-27,300** | **-7.9%** |

[1] Funding does not reflect the transfer of $92,747,000 in FY 2022 and $99,747,000 in FY 2023 from Naval Reactors for maintenance and operation of the Advanced Test Reactor.

**Infrastructure**
**Explanation of Major Changes ($K)**

| | FY 2024 Request vs FY 2023 Enacted |
|---|---|
| **INL Facilities Operations and Maintenance:** | |
| No Change. | **0** |
| **ORNL Nuclear Facilities O&M:** | |
| No funding requested in FY 2024. ORNL Nuclear Facilities are fully funded within the Office of Science FY 2024 Request. | **-20,000** |
| **Research Reactor Infrastructure:** | |
| No change. Consistent with FY 2023 Enacted, Research Reactor Instructure, also known as "University Fuel Services," is included in the NEUP, SBIR/STTR and TCF program. | **0** |
| **Construction:** | |
| The decrease from $7,300,000 to $0 reflects meeting established baseline funding requirements for the Sample Preparation Laboratory (SPL) project. | **-7,300** |
| **Total, Infrastructure** | **-27,300** |

**INL Facilities Operations and Maintenance**

**Description**

INL Nuclear Research Reactor Operations and Maintenance

This subcategory supports operations and maintenance of the nuclear research reactors at the Advanced Test Reactor (ATR) Complex and the Materials and Fuels Complex (MFC), including the ATR, the ATR Critical Facility (ATRC), the Transient Reactor Test Facility (TREAT), and the Neutron Radiography Reactor (NRAD).

The ATR is the primary research reactor at the Idaho National Laboratory (INL). The ATR supports the majority of the Office of Nuclear Energy (NE) research and development (R&D) programs, as well as the Naval Reactors (NR) Program in support of the U.S. Navy nuclear fleet and National Nuclear Security Administration (NNSA) programs. The ATR is also used by universities, laboratories, and industry and is the primary scientific capability of the Nuclear Science User Facilities (NSUF). R&D demand for thermal neutron irradiation at ATRC and neutron radiography and small component test irradiation at NRAD continues to be significant. The TREAT reactor, an air-cooled thermal spectrum test facility, continues to address technical challenges for reactor fuels related to nuclear fuel performance and qualification. All programmatic work is funded by the sponsoring federal programs. The cost to other users is determined in accordance with Department of Energy (DOE) regulations and depends upon the demands on the reactor and the nature of the user.

To satisfy the irradiation needs of ATR users, efforts will continue in FY 2024 to improve the availability and reliability of the ATR. Continued investments in ATR infrastructure are still needed to sustain the improvements that have been made to date. Funding is identified in FY 2024 to support planning for Long-Term Asset Management requirements including repairs of heat exchanger units and replacement of regulating rod control systems. Additionally, in FY 2024 pre-planning will be initiated for modernizing or replacing end of life capabilities.

Operations at TREAT and NRAD will continue in FY 2024 to support a wide range of customers including NE R&D programs, commercial industry, and other Federal Agencies.

INL Non-Reactor Nuclear Research Facility Operations and Maintenance

This subcategory provides funding for operations, maintenance, and support of non-reactor nuclear and radiological research facilities primarily located at the MFC. Activities within this category sustain unique nuclear and radiological capabilities essential to multiple NE R&D programs. This includes maintaining a safe operating envelope by conducting maintenance (preventative and corrective) and refurbishments to sustain or improve core infrastructure capabilities. The non-reactor nuclear research facilities support core programmatic capabilities for inspecting, fabricating, and processing a myriad radioactive and non-radioactive materials including:

- Post-Irradiation Examination (PIE) and Fresh Fuel Characterization – Receipt of irradiated fuels and materials, non-destructive examinations, destructive examinations and analyses, and mechanical testing of highly radioactive materials.
- Experimental Fuel Fabrication – R&D on fabrication of multiple fuel types at various enrichment levels.
- Advanced Separation and Waste Forms – Separation, pre-treatment technology development, electrochemical separation, and engineering scale waste form development.

To enable R&D activities at the MFC, efforts will continue in FY 2024 to ensure facility availability and equipment reliability is as high as feasible. In FY 2022, the cumulative facility availability for MFC was 94%. In FY 2024, MFC Plant Health investments will continue to focus on improving throughput in MFC mission facilities, such as hot cell window and manipulator refurbishments and replacements at the Hot Fuels Examination Facility (HFEF), Fuel Conditioning Facility (FCF), and Analytical Laboratory (AL); multi-zone system overhaul at AL; MFC plant cooling water system refurbishment; hot cell HEPA replacements at HFEF; and fuel procurement for the NRAD reactor.

This subprogram also provides funding for the management of Nuclear Energy (NE)-owned special nuclear material (SNM), operation and maintenance of the Remote-Handled Low-Level Waste (RHLLW) Disposal Facility and the Radioactive Waste

Scrap Facility (RSWF), support for Nuclear Regulatory Commission cask certifications and Other Project Costs (OPCs) for the Sample Preparation Laboratory (SPL) Project.

INL Engineering and Support Facility Operations and Maintenance

This subcategory provides funds for community and technical support activities including support for the Shoshone-Bannock Tribes, Idaho Department of Environment Quality, and environmental reviews and data collection to support future permits and NEPA reviews. It also supports environmental surveillance and monitoring activities in accordance with State and Federal regulations. This subcategory also funds Payment in Lieu of Taxes (PILT), Institute of Nuclear Power Operations, and other Departmental cross-cutting infrastructure reporting requirements.

Department of Energy (DOE) has had a formal relationship via an Agreement in Principle (AIP) with the Shoshone-Bannock Tribes since 1992 in recognition of the Tribes' connection and vested interest in the land upon which INL is located. Support is provided to the Tribes to participate in the review of Environmental Impact Statement and Environmental Assessments, cultural resource surveys and protection, environmental surveillance, and emergency response and preparedness.

INL Regulatory Compliance

This subcategory supports activities for continual compliance with the State and Federal environmental laws and other regulations applicable to INL. Compliance activities focus on air, soil, and water monitoring and waste disposal consistent with Federal and State permit requirements and agreements such as the INL Site Treatment Plan. Regulatory activities also include efforts that support compliance with the 1995 Settlement Agreement with the State of Idaho, which governs management and disposition of spent nuclear fuel and transuranic wastes at the INL. In November 2019, DOE and the State of Idaho signed a Supplemental Agreement to the 1995 Idaho Settlement Agreement that reaffirms DOE's and Idaho's commitment to remove Cold War legacy waste and special nuclear materials from Idaho. The FY 2024 funds will support material stabilization and legacy material packaging consistent with approved plans.

**INL Facilities Operations and Maintenance**
**Funding ($K)**

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **INL Nuclear Research Reactor Operations and Maintenance $119,362,000** | **$126,070,000** | **+$6,708** |
| • Maintained Advanced Test Reactor (ATR) availability at 60% with 120 irradiation days in the first full year of operations following completion of the Core Internals Change-out (CIC) in FY 2022.<br>• Continued investments to improve ATR availability and reliability through refurbishments and replacements of reactor systems and components such as warm waste pond liner replacement, canal bulkhead replacements, and console display systems.<br>• Initiated planning for major maintenance and repair activities required to sustain ATR operations through 2040 such as replacement of the primary heat exchangers.<br>• Continued transient testing operations at the Transient Reactor Test Facility (TREAT) facility.<br>• Continued operations of the Neutron Radiography Reactor (NRAD). | • Maintains ATR availability at 78% with a target of 154 irradiation days during FY 2024.<br>• Continues investments per the Long-Term Asset Management (LTAM) plan to improve ATR availability and reliability through refurbishments and replacements of reactor systems and components such as, flux wire scanner, and regulating rod control system upgrades.<br>• Initiates preplanning activities for future thermal irradiation capabilities.<br>• Continues transient testing operations at the TREAT facility.<br>• Continues operations of the NRAD. | • The increase supports ATR base operations including labor wage agreements and repairs or replacement of heat exchangers. |
| **INL Non-Reactor Nuclear Research Facility Operations and Maintenance $180,005,000** | **$178,148,000** | **-$1,857,000** |
| • Operated and maintained Materials and Fuels Complex (MFC) infrastructure, facilities, and equipment to support facility operations and programmatic work activities.<br>• Performed maintenance and refurbishment activities within the Materials and Fuels Complex (MFC) nuclear facilities and infrastructure consistent with the approved safety basis.<br>• Performed maintenance and refurbishment on the radiological and balance-of-plant facilities | • Operates and maintains MFC infrastructure, facilities, and equipment to support facility operations and programmatic work activities.<br>• Performs maintenance and refurbishment activities within the MFC nuclear facilities and infrastructure consistent with the approved safety basis.<br>• Performs maintenance and refurbishment on the radiological and balance-of-plant facilities | • The decrease reflects completion of the MFC Analytical Laboratory (AL) HVAC project and in-cell lighting upgrades at Fuel Conditioning Facility (FCF). |

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| necessary to support the Materials and Fuels Complex (MFC) nuclear facilities and core missions.<br>• Continued off-site disposition of surplus Nuclear Energy (NE)-owned special nuclear material (SNM) consistent with programmatic needs and approved nuclear material allotment forecasts.<br>• Operated and maintained the Remote-Handled Low-Level Waste (RHLLW) Disposal Facility to provide legacy and newly - generated waste disposal capability.<br>• Conducted construction oversight activities for the Sample Preparation Laboratory (SPL) Project.<br>• Continued to support activities to maintain Idaho National Laboratory (INL) operations such as Nuclear Regulatory Commission (NRC) certificates for cask.<br>• Continued MFC infrastructure investments to improve reliability and availability of key facilities: Hot Fuels Examination Facility (HFEF), Fuel Conditioning Facility (FCF), Neutron Radiography Reactor (NRAD), and Analytical Laboratory (AL). | necessary to support the MFC nuclear facilities and core missions.<br>• Continues MFC infrastructure investments to improve reliability and availability of key facilities: Hot Fuels Examination Facility (HFEF), Fuel Conditioning Facility (FCF), Neutron Radiography Reactor (NRAD), and Analytical Laboratory (AL).<br>• Initiates pre-planning for future capabilities.<br>• Continues off-site disposition of surplus NE-owned SNM consistent with programmatic needs and approved nuclear material allotment forecasts.<br>• Operates and maintains the RHLLW Disposal Facility to provide legacy and newly - generated waste disposal capability.<br>• Conducts construction oversight activities for the Sample Preparation Laboratory (SPL) Project.<br>• Continues to support activities to maintain INL operations such as NRC certificates for cask. | |
| **INL Engineering and Support Facility Operations and Maintenance $5,743,000** | **$4,500,000** | **-$1,243,000** |
| • Continued to support federally funded activities to maintain operations at the INL such as Payment in Lieu of Taxes (PILT); environmental review and data collection to support future permits/NEPA assessments; and community support activities for local Shoshone- Bannock Tribes including review of Environmental Impact Statement and Environmental Assessments, cultural resource surveys and protection, environmental surveillance, and emergency response and preparedness. | • Continues to support federally funded activities to maintain operations at the INL such as PILT; environmental review and data collection to support future permits/NEPA assessments; and community support activities for local Shoshone-Bannock Tribes including review of Environmental Impact Statement and Environmental Assessments, cultural resource surveys and protection, environmental surveillance, and emergency response and preparedness. | • The decrease reflects anticipated costs to support planned assessments and surveys. |

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **INL Regulatory Compliance $13,814,000** | **$10,206,000** | **– $3,608,000** |
| • Continued regulatory compliance program management.<br>• Met Idaho National Laboratory (INL) Site Treatment Plan milestones for treatment of two cubic meters of mixed low-level waste (MLLW) annually based on a three-year rolling average.<br>• Completed receipt of minimum of 12 transfers of used nuclear fuel from wet storage at Fuel Conditioning Facility (FCF) in accordance with the 1995 Idaho Settlement Agreement and consistent with material requirements for the treatment of Experimental Breeder Reactor (EBR)-II used nuclear fuel.<br>• Completed transfer of Advanced Test Reactor (ATR) spent fuel into dry storage configuration consistent with State agreements.<br>• Processed a minimum of 8 treatment batches of EBR-II fuel through FCF pyro-processing. Beginning in FY24, EBR-II Driver fuel to be treated will be retrieved from Radioactive Waste Scrap Facility (RSWF).<br>• Continued to coordinate activities and operations for the direct shipment of EBR-II fuel from the Idaho Nuclear Technology and Engineering Center to the Materials and Fuels Complex.<br>• Conducted environmental surveillance and monitoring activities. | • Continues regulatory compliance program management.<br>• Meets INL Site Treatment Plan milestones for treatment of two cubic meters of MLLW annually based on a three-year rolling average.<br>• Processes a minimum of 8 treatment batches of EBR-II fuel through FCF pyro-processing. Beginning in FY24, EBR-II Driver fuel to be treated will be retrieved from RSWF.<br>• Continues to coordinate activities and operations for the direct shipment of EBR-II fuel from the Idaho Nuclear Technology and Engineering Center to the Materials and Fuels Complex.<br>• Conducts environmental surveillance and monitoring activities.<br>• Continues shipment of contact handled transuranic waste stored at MFC to WIPP. | • The decrease reflects completion of transfer of used nuclear fuel from wet storage to dry per the Idaho Settlement Agreement. |

## ORNL Nuclear Facilities O&M

**Description**

Consistent with congressional direction, this program provided funds in FY 2023 to support Oak Ridge National Laboratory (ORNL) hot cells, managed by the Office of Science. In FY 2024 full funding for the ORNL Nuclear Facilities is included in the Office of Science Request.

**ORNL Nuclear Facilities O&M**
**Funding ($K)**

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Oak Ridge Nuclear Infrastructure $20,000,000** | **$0** | **-$20,000,000** |
| • Consistent with the FY 2023 Appropriation, the Oak Ridge Nuclear Facilities are managed by the Office of Science. FY 2023 accomplishments are captured in the Office of Science FY 2024 Request. | • No funding is requested. | • No funding is requested in FY 2024 as full funding for the ORNL Nuclear Facilities are included in the Office of Science Request. |

## Construction

**Description**

Line-item capital projects are sometimes required at the Idaho National Laboratory (INL) to maintain its ability to support mission goals. These projects help achieve the Department's and Nuclear Energy (NE)'s strategic objectives by maintaining site services and providing critical information for future decisions. This activity is focused on two primary objectives: (1) identification, planning, and prioritization of projects required to meet NE program objectives, and (2) development and execution of these projects within approved cost and schedule baselines.

**Construction**
**Funding ($K)**

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Construction $7,300,000** | **$0** | **-$7,300,000** |
| *Sample Preparation Laboratory (16-E-200) ($7,300,000)*<br>• Continued Sample Preparation Laboratory (SPL) construction activities consistent with approved baseline including completion of the construction and installation of scientific equipment such as interior of hot cell and experiment spaces, manipulator repair space, glove box and other service areas. | *Sample Preparation Laboratory (16-E-200) ($0)*<br>• No additional funding is required to complete the Sample Preparation Laboratory. | *Sample Preparation Laboratory (16-E-200) (-$7,300,000)*<br>• The decrease reflects meeting established baseline funding requirements. |

**Infrastructure**
**Construction Projects Summary ($K)**

| | Total | Prior Years | FY 2022 Enacted | FY 2022 Actuals | FY 2023 Enacted | FY 2024 Request | FY 2024 Request vs FY 2023 Enacted |
|---|---|---|---|---|---|---|---|
| **16-E-200, Sample Preparation Laboratory, INL** | | | | | | | |
| Total Estimated Cost (TEC) | 144,600 | 95,450 | 41,850 | 41,850 | 7,300 | 0 | -7,300 |
| Other Project Costs (OPC) | 21,400 | 5,147 | 2,500 | 2,500 | 6,903 | 6,000 | -903 |
| **Total Project Cost (TPC) Project Number 16-E-200** | **166,000** | **100,597** | **44,350** | **44,350** | **14,203** | **6,000** | **-8,203** |
| | | | | | | | |
| **Total All Construction Projects** | | | | | | | |
| Total Estimated Cost (TEC) | 144,600 | 95,450 | 41,850 | 41,850 | 7,300 | 0 | -7,300 |
| Total Other Project Costs (OPC) | 21,400 | 5,147 | 2,500 | 2,500 | 6,903 | 6,000 | -903 |
| **Total Project Cost (TPC) All Construction Projects** | **166,000** | **100,597** | **44,350** | **44,350** | **14,203** | **6,000** | **-8,203** |

## Idaho Sitewide Safeguards and Security

**Overview**

The Idaho Sitewide Safeguards and Security (S&S) program supports the Office of Nuclear Energy (NE) assets at the Idaho National Laboratory (INL) and enables NE to conduct research and development (R&D) missions that utilize nuclear materials and protected information.

The FY 2024 Budget Request provides direct funding for the NE's S&S base program. Strategic Partnership Projects (SPP) will continue to fund an allocable share of the S&S base program through full cost recovery. Extraordinary security requirements, such as dedicated security for non-NE infrastructure, special projects or exercises, will be a direct charge to SPP customers. Other DOE programs at the Idaho Site are responsible for directly funding their S&S costs.

**Highlights of the FY 2024 Budget Request**

In FY 2024, the S&S program will sustain program functionality at the level necessary to assure high confidence in the protection of NE-owned INL assets and a high degree of customer service by maintaining effective staffing levels, proactive preventive and corrective maintenance programs, and a robust cybersecurity program. The FY 2024 Budget Request will focus on continued implementation of physical security infrastructure investments, capital improvements, emerging security technology investments, and enhanced cybersecurity program capabilities, including:

- Maintaining protective force staff levels required to ensure an effective S&S program consistent with evolving Departmental requirements;
- Initiating a new general plant project to replace the existing personnel entry building at the Materials and Fuels Complex (MFC) to meet increased operational tempo stemming from growing NE programs focused on fuel and reactor research and development, including expanding the number of entry portals, enhancing personnel screening capabilities, and improving safety by providing internal shelter for personnel waiting to enter MFC;
- Supporting physical security systems life-cycle replacement including preventive and corrective maintenance on critical security systems, subsystems, and components such as lights, sensors, entry/access control devices, locks, and explosives detection equipment;
- Supporting continued implementation of the Design Basis Threat and Departmental Orders; and
- Maintaining an effective cybersecurity program through the addition of lifecycle hardware/software upgrades and replacements including continuous monitoring, maintaining Industrial Control Systems, essential cybersecurity positions, and associated training.

**Idaho Sitewide Safeguards and Security**
**Funding ($K)**

| | FY 2022 Enacted | FY 2023 Enacted | FY 2024 Request | FY 2024 Request vs FY 2023 Enacted($) | FY 2024 Request vs FY 2023 Enacted(%) |
|---|---|---|---|---|---|
| **Idaho Sitewide Safeguards and Security** | | | | | |
| Protective Forces | 85,356 | 88,497 | 92,922 | +4,425 | +5.0% |
| Security Systems | 11,575 | 12,203 | 12,853 | +650 | +5.3% |
| Security Infrastructure | 3,518 | 950 | 18,020 | +17,070 | +1,797% |
| Information Security | 6,174 | 5,016 | 5,748 | +732 | +14.6% |
| Personnel Security | 4,714 | 5,593 | 5,953 | +360 | +6.4% |
| Material Control & Accountability | 6,376 | 5,825 | 6,525 | +700 | +12.0% |
| Program Management | 10,175 | 8,000 | 8,100 | +100 | +1.3% |
| Cybersecurity | 21,912 | 23,916 | 27,612 | +3,696 | +15.5% |
| **Total, Idaho Sitewide Safeguards and Security** | **149,800** | **150,000** | **177,733** | **+27,733** | **+18.5%** |

**Idaho Sitewide Safeguards and Security**
**Explanation of Major Changes ($K)**

| | FY 2024 Request vs FY 2023 Enacted |
|---|---|
| **Protective Forces:** | **+4,425** |
| The increase from $88,497,000 to $92,922,000 reflects costs to train, equip, and maintain the Protective Force personnel staffing levels and associated equipment consistent with Departmental requirements and existing labor wage agreements. | |
| **Security Systems:** | **+650** |
| The increase from $12,203,000 to $12,853,000 supports planned maintenance and end-of-life replacement of security systems and components. | |
| **Security Infrastructure:** | **+17,070** |
| The increase from $950,000 to $18,020,000 provides funds to initiate replacement of the Entrance Control Facility at the Materials and Fuels Complex to provide adequate space and flow to perform personnel inspections consistent with operational tempos. | |
| **Information Security:** | **+732** |
| The increase from $5,016,000 to $5,784,000 supports Controlled Unclassified Information (CUI) program implementation. | |
| **Personnel Security:** | **+360** |
| No significant change. | |
| **Material Control & Accountability:** | **+700** |
| The increase from $5,825,000 to $6,525,000 funds nuclear material tracking activities consistent with operational tempos. | |
| **Program Management:** | |
| No significant change. | **+100** |
| **Cybersecurity:** | **+3,696** |
| The increase from $23,916,000 to $27,612,000 funds computer network tools and associated staff to protect laboratory systems against dynamic cyber security threats and activities to implement Executive Order 14028, *Improving the Nation's Cybersecurity.* | |
| **Total, Idaho Sitewide Safeguards and Security** | **+27,733** |

## Idaho Sitewide Safeguards and Security

**Description**

The Idaho Sitewide Safeguards and Security (S&S) program funds Office of Nuclear Energy (NE) base physical and cybersecurity activities for the Idaho National Laboratory (INL), providing protection of the Department of Energy's (DOE) nuclear materials, classified and unclassified matter, government property, personnel, and other vital assets from theft, diversion, sabotage, espionage, unauthorized access, compromise, and other hostile acts that may cause adverse impacts on our national security; program continuity; or the health and safety of employees, the public, or the environment.

Protective Forces

Protective Forces provides security police officers and other specialized personnel, equipment, training, and management needed during normal and security emergency conditions for the adequate protection of site assets consistent with site security plans. Protective force personnel are deployed 24 hours a day, 7 days a week, across 890 square miles to deter, detect, delay, and respond to adversarial threats.

Security Systems

Physical Security Systems provides preventive and corrective maintenance, performance testing, and replacement of intrusion detection and assessment systems, entry and search control equipment, barriers, secure storage, lighting, sensors, entry/access control devices, locks, explosives detection, and tamper-safe monitoring.

Security Infrastructure

Security Infrastructure provides upgrades, refurbishments, and/or replacements of security facilities, including associated planning and construction activities.

Information Security

Information Security provides for the protection and control of classified and sensitive matter that is generated, received, transmitted, used, stored, reproduced, and/or destroyed. Information Security subprogram also includes the Technical Security Countermeasures and Controlled Unclassified Information programs.

Personnel Security

Personnel Security provides access to classified and sensitive information and assignment of personnel in sensitive positions through the clearance program, adjudication, security awareness and education, U.S. citizen and foreign visitor control, Human Reliability Program, psychological/medical assessments, and administrative review costs.

Material Control and Accountability

Material Control & Accountability (MC&A) provides the personnel, equipment, and services required to account for and control special nuclear materials (SNM) from diversion.

Program Management

Program Management includes policy oversight, development, and update of site security plans, vulnerability assessments, performance testing, investigations into incidents of security concern, and issuance of security infractions. Program management also ensures activities are conducted to analyze and identify the impacts of changes to Departmental policies and requirements on the site-wide safeguards and security program.

Cybersecurity

Cybersecurity maintains the staffing, computing infrastructure, and network security configuration necessary to support classified and unclassified information and electronic operations. Cybersecurity uses a graduated risk approach based on data sensitivity and impact of loss/compromise to ensure that electronic or computer information systems are protected in a manner consistent with upholding key priorities, including importance to national security, support of DOE missions and programs, vulnerability to threats, and the magnitude of harm that would result from an information system and industrial control systems compromise.

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Protective Forces $88,497,000** | **$92,922,000** | **+$4,425,000** |
| • Maintained protective force staff levels, including planned hires for Phase IIB Implementation Plan protective force staffing requirements.<br>• Purchased Protective Force equipment, including ammunition, weapons, protective gear, and maintained security vehicles. | • Maintains protective force staffing levels, consistent with the Site Security Plan and approved site labor wage agreements.<br>• Procures specialized Protective Force equipment such as simulation devices, ammunition, weapons, protective gear, and maintains security vehicles. | • The increase funds training, equipping, and maintaining Protective Force staffing levels consistent with Departmental security requirements. |
| **Security Systems $12,203,000** | **$12,853,000** | **+$650,000** |
| • Planned and conducted preventive and corrective maintenance on physical security systems across multiple Idaho National Laboratory (INL) security areas.<br>• Operated and maintained the INL central alarm stations, including life-cycle replacement of security alarm systems. | • Maintains preventive and corrective maintenance programs for physical security systems across INL multiple security areas.<br>• Operates and maintains INL central alarm stations, including life-cycle replacement of security alarm systems.<br>• Provides funds for security systems to enhance detection capabilities at INL security areas. | • The increase funds planned maintenance and end-of-life replacement of security systems and components. |
| **Security Infrastructure $950,000** | **$18,020,000** | **+$17,070,000** |
| • Initiated preconceptual planning for the Materials and Fuels Complex (MFC) Entry Control Facility Replacement project. | • Initiates design and construction of the MFC Entry Control Facility Replacement project. This project will meet the increased personnel throughput needs due to the expanding mission at MFC while providing modern inspection capabilities. | • The increase provides funds for design and construction activities consistent with Departmental requirements. |
| **Information Security $5,016,000** | **$5,748,000** | **+$732,000** |
| • Operated information security activities to protect classified and sensitive unclassified matter including Classified Matter Protection and Control, Technical Surveillance Countermeasures, Classification/Declassification, and Operations Security programs.<br>• Initiated efforts to establish a Controlled Unclassified Information (CUI) program for INL. | • Conducts information security activities to protect classified and sensitive unclassified matter including Classified Matter Protection and Control, Technical Surveillance Countermeasures, Classification/Declassification, and Operations Security programs.<br>• Continues implementation of CUI program for INL, consistent with EO 13556 and other applicable rules and requirements. | • The increase support CUI implementation activities. |

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Personnel Security $5,593,000** | **$5,953,000** | **+$360,000** |
| • Conducted federal contractor personnel security programs to process clearances; operated Idaho National Laboratory (INL) badging office; processed foreign visits and assignments; and managed human reliability program activities. | • Conducts federal and contractor personnel security programs to process clearances; operating INL badging office; coordinating foreign visits and assignments; and managing human reliability program activities. | • No significant change. |
| **Material Control & Accountability (MC&A)**<br>**$5,825,000** | **$6,525,000** | **+$700,000** |
| • Maintained INL's nuclear material database and tracking systems, coordinated on-and off-site material movements, and conducted accountable special nuclear material inventories. | • Maintains INL's special nuclear material database and tracking systems, manages on-and off-site material movements, and conducts accountable special nuclear material inventories.<br>• Procures and installs equipment to ensure accountability of special nuclear materials. | • The increase funds required nuclear material tracking activities consistent with research and development operational schedules. |
| **Program Management $8,000,000** | **$8,100,000** | **+$100** |
| • Updated INL security plans to meet Design Basis Threat and Departmental security requirement changes. | • Develops and maintains site security documentation, including vulnerability and risk assessments, to ensure alignment to Departmental requirements. | • No significant change. |

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Cybersecurity $23,916,000** | **$27,612,000** | **+$3,696,000** |
| • Provided 24/7 intrusion detection and prevention monitoring to ensure incidents and breaches are discovered and remediated.<br>• Implemented cybersecurity vulnerability management tools to monitor Idaho National Laboratory (INL) network systems.<br>• Completed life-cycle replacement of network boundary protection firewalls. | • Provides 24/7 intrusion detection and prevention monitoring to ensure incidents and breaches are discovered and remediated.<br>• Implements Executive Order (EO) 14028 requirements moving towards Zero Trust principles.<br>• Apply INL's cybersecurity capabilities toward multitude of Industrial Control Systems (ICS), which will enable the ability to identify protect, detect, and respond to malicious cyber-attacks on an array of scientific instruments/capabilities.<br>• Procure a data classification and data loss prevention capabilities to improve protection of data in accordance with the requirements documented in Zero Trust Architecture. | • The increase funds computer network tools and associated staff to protect laboratory systems against dynamic cyber security threats and activities to implement Executive Order 14028, *Improving the Nation's Cybersecurity Activities.* |

**Idaho Sitewide Safeguards and Security**

**Capital Summary ($K)**

| | Total | Prior Years | FY 2022 Enacted | FY 2023 Enacted | FY 2024 Request | FY 2024 Request vs FY 2023 Enacted ($) | FY 2024 Request vs FY 2023 Enacted (%) |
|---|---|---|---|---|---|---|---|
| **Minor Construction Projects** | | | | | | | |
| Materials and Fuels Complex Protective Forces Building | 15,600 | 15,600 | 0 | 0 | 0 | 0 | +0% |
| Consolidated Training Facility at the Central Facilities Area | 12,000 | 12,000 | 0 | 0 | 0 | 0 | +0% |
| Materials and Fuels Complex Entrance Control Facility | 25,000 | 0 | 0 | 950 | 18,020 | +17,070 | +1,797% |
| **Total, Minor Construction Projects** | **52,600** | **27,600** | **3,518** | **950** | **18,020** | **+17,070** | **+1,797%** |
| **Total, Capital Summary** | **52,600** | **27,600** | **3,518** | **950** | **18,020** | **+17,070** | **+1,797%** |

**Idaho Sitewide Safeguard and Security Reimbursable Costs**

The FY 2024 Budget Request provides direct funding for the NE's S&S base program. Strategic Partnership Projects (SPP) will continue to fund an allocable share of the S&S base program through full cost recovery. Extraordinary security requirements, such as dedicated security for non-NE infrastructure, special projects or exercises, will be a direct charge to SPP customers. Other DOE programs at the Idaho Site are responsible for directly funding their S&S costs. Information regarding SPP full cost recovery estimates are provided in the table below.

(Dollars in thousands)

| | FY 2022 Actual | FY2023 Enacted | FY2024 Request | FY2024 Request vs. FY2023 Enacted ($) | FY2024 Request vs. FY2023 Enacted (%) |
|---|---|---|---|---|---|
| Idaho National Laboratory | 9,048 | 9,000 | 10,700 | +1,700 | +18.8% |

## International Nuclear Energy Cooperation

### Overview

The International Nuclear Energy Cooperation (INEC) program leads the Department of Energy's international engagement on civil nuclear energy, including the development, coordination, and implementation of U.S. civil nuclear energy policy integrated with the Office of Nuclear Energy's (NE) technical programs. INEC works with the international community through both bilateral and multilateral fora to ensure U.S. government and industry equities are represented, while advancing nuclear energy as a key part of climate change and energy security strategies. INEC is leading collaborative bilateral and multilateral supply chain mapping efforts to support diversification within the nuclear supply chain. INEC is leveraging technical expertise from DOE's network of national laboratories to assist countries planning for nuclear infrastructure and workforce development, developing creative proposals for financing for nuclear builds, supporting nuclear safety frameworks and regional capacity building, and identifying opportunities for international collaboration to offset gaps in national capabilities. In conducting many of these activities, INEC works to promote U.S. influence in the International Atomic Energy Agency, including its International Project on Innovative Nuclear Reactors and Fuel Cycles, as well as the Organization for Economic Cooperation and Development's Nuclear Energy Agency, and leverages its leadership roles in the International Framework for Nuclear Energy Cooperation, the Nuclear Innovation: Clean Energy (NICE) Future Initiative under the Clean Energy Ministerial, and the Partnership for Transatlantic Energy and Climate Cooperation.

INEC has played a key role in developing strategic partnerships to serve as the foundation for commercial opportunities for U.S. companies. INEC has continually assessed and defined market opportunities and partnered with U.S. industry associations to verify market prioritizations, which help to guide engagement efforts. INEC has created opportunities for U.S. companies to engage with decision makers in central and eastern Europe, Asia, and Africa to promote U.S. technologies. INEC has led U.S. Government engagement on the Romania nuclear power project and provided key advice on the Poland nuclear power project.

In FY 2024, INEC will continue to coordinate its international activities with its partners within the Department and the U.S. interagency, as well as the U.S. nuclear industry to identify opportunities for U.S. nuclear exports, including advanced reactors, to provide solutions to countries seeking to meet economic development, energy security, and climate change goals. In FY 2024, INEC will contribute to Front End Engineering and Design (FEED) studies supporting potential U.S. nuclear builds in partner countries.

INEC will continue to work with partner countries' Clean Energy Training Centers (CETC) to familiarize local academic, government, industry and professional communities with U.S. nuclear technology and nuclear power's role in hybrid energy systems. INEC provides training within each CETC curated to the needs of the region and could offer simulator-assisted training on U.S. reactor designs, online and in-person curricula, and other activities necessary to develop the expert workforce required for a sustainable nuclear energy program. Currently CETCs exist in Poland and Ghana. FY 2024 funding will support the addition of two more CETC partnerships.

In FY 2024, INEC will also continue to support nuclear safety activities in Armenia and Ukraine. INEC will continue its support of Armenia's training pipeline for graduate students and professionals to join the skilled workforce needed to meet Armenia's current and future staffing requirements for its nuclear program. In Ukraine, INEC has amid ongoing hostilities continued to provide training for Ukrainian graduate students and professionals and is also seeking opportunities to procure the materials and supplies necessary for the continued safe operation of Ukraine's nuclear power plants.

### Highlights of the FY 2024 Budget Request

The FY 2024 Request for INEC includes support for the following: Deployment of two additional CETCs to increase awareness of U.S. nuclear technology and best practices; contributing to FEED studies supporting potential U.S. nuclear builds in partner countries; and providing U.S. nuclear expertise to partners in eastern and central Europe, the Baltic States, Southeast Asia, and the Americas to support cooperation in nuclear workforce capacity building, academic and professional training, joint technical studies, and regional technical events. INEC will continue to support nuclear safety activities in Armenia and Ukraine.

**International Nuclear Energy Cooperation**
**Funding ($K)**

| | FY 2022 Enacted | FY 2023 Enacted | FY 2024 Request |
|---|---|---|---|
| **International Nuclear Energy Cooperation** | | | |
| International Nuclear Energy Cooperation | $3,000 | $0 | $13,000 |
| **Total, International Nuclear Energy Cooperation** | **$3,000** | **$0**[1] | **$13,000** |

[1] In FY 2023, INEC was funded at $3 million within the NE Program Direction budget.

**International Nuclear Energy Cooperation**
**Explanation of Major Changes ($K)**

| | FY 2024 Request vs FY 2023 Enacted |
|---|---|
| • $3,000 of the FY 2024 budget funds INEC's continued bilateral and multilateral engagement on the sustainable use of nuclear energy, including cooperative R&D with advanced nuclear programs and broad training for programs in development; establishment of two regional CETCs in priority regions; and continued training for the Armenian nuclear workforce and operator training plus emergency supplies procurement for Ukraine. | **+3,000** |
| • The increase of $10,000 will fund FEED studies for new U.S. advanced reactor builds in partner states, describing reactor and plant design and associated engineering required for the construction and operation of the completed reactors. | **+10,000** |
| **Total, International Nuclear Energy Cooperation** | **+13,000** |

## International Nuclear Energy Cooperation

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **International Nuclear Energy Cooperation**<br>**$0** | **$13,000,000** | **+$13,000,000** |
| • In FY 2023, INEC was funded at $3 million within the NE Program Direction account. Funded activities included the following:<br>• Provides for NE's international engagement activities<br>• Continue support for nuclear safety in Armenia and Ukraine, including emergency support due to the ongoing hostilities in Ukraine.<br>• Continue deployment of CETCs to inform small and emerging nuclear states of U.S. nuclear technology within clean energy systems.<br>• Increase U.S. technical presence through bilateral nuclear cooperation particularly in Eastern Europe, the Baltic States, Southeast Asia, and the Americas, including workforce capacity building, academic and professional training, joint studies, and regional technical events.<br>• Organize a nuclear energy management school.<br>• Continue Fukushima Forensics activities that support improved operation and safety of U.S. domestic nuclear power plants.<br>• Leverage U.S. sponsorship of subject matter experts in international organizations to advance U.S. nuclear equities.<br>• Continue bilateral engagement to build U.S. nuclear cooperation in Baltics, Eastern Europe, Africa and Asia. | • Contribute to FEED studies supporting potential U.S. nuclear builds in partner countries.<br>• Continue support for nuclear safety in Armenia and Ukraine, including emergency support due to the ongoing hostilities in Ukraine.<br>• Continue deployment of CETCs to inform small and emerging nuclear states of U.S. nuclear technology within clean energy systems.<br>• Increase U.S. technical presence through bilateral nuclear cooperation particularly in Eastern Europe, the Baltic States, Southeast Asia, and the Americas, including workforce capacity building, academic and professional training, joint studies, and regional technical events.<br>• Co-sponsor and host an IAEA nuclear energy management school.<br>• Continue Fukushima Forensics activities that support improved operation and safety of U.S. domestic nuclear power plants.<br>• Leverage U.S. sponsorship of subject matter experts in international organizations to advance U.S. nuclear equities.<br>• Continue bilateral engagement to build U.S. nuclear cooperation in Baltics, Eastern Europe, Africa and Asia. | • Contribute to FEED studies supporting potential U.S. nuclear builds in partner countries. |

## Program Direction

### Overview

Program Direction provides the federal staffing resources and associated costs required to support the overall direction and execution of the Office of Nuclear Energy (NE) programs. NE has staff strategically located in multiple locations: Washington, D.C. Headquarters, Nevada Field Office, and the Idaho Operations Office. Activities within the site offices support inherently federal functions that facilitate the efficient execution of Department of Energy (DOE) programs or directly execute DOE mandated safety, security, business functions, and public outreach. In addition to NE federal personnel, Program Direction supports select federal staff and support for the Office of Human Capital Service Center.

The Support Services subprogram allows the Department to cost-effectively hire the best available industry experts to support federal staff in managing the nuclear programs and complex activities. The ability to acquire expertise quickly and on an "as needed basis" provides flexibility in team composition as the needs of NE evolve. Program Direction also includes the Other Related Expenses subprogram, which provides NE's directed funding contribution to the Department's Working Capital Fund (WCF). The WCF supports specific Departmental services and activities that are shared across DOE including: employee health and testing services, and consolidated training and recruitment initiatives; all established in previous fiscal years and supported in FY 2024.

In addition to appropriated funds, NE also manages approximately $200 million annually from other activities including: Strategic Partnerships Program and reimbursable funding from the National Aeronautics and Space Administration (NASA) and the Department of Defense (DOD).

The FY 2024 Request will allow the Office of Nuclear Energy to support its increasing mission and address succession planning for critical technical positions and add diversity. NE has successfully utilized the Department's direct hire authority, outreach through job fairs and social media, and the Oak Ridge Institute for Science and Education (ORISE) fellowships and scholars. The ORISE Fellowships and Scholars are focused on developing the environmental justice and equity strategies to include integrating Energy Justice into program areas, participating in key research and development, as well as collaborating with communities, tribes, and other outside stakeholders. In addition, NE is also utilizing more hiring incentives, such as recruitment bonuses, Advanced-in Hire, creditable leave accrual, student loan repayments, and remote work opportunities for all employees.

### Highlights of the FY 2024 Budget Request

The FY 2024 Program Direction Budget Request includes a transfer of the INEC program within the NE Program Direction Budget Request to a program level activity within the overall NE Congressional Budget Request. NE has been working to rebuild its workforce levels necessary to execute the robust Research and Development, and Infrastructure activities that NE is responsible for overseeing. NE plans on meeting, and then sustaining that level in the FY 2024 Request and beyond.

## Program Direction
## Funding ($K)

| | FY 2022 Enacted | FY 2023 Enacted | FY 2024 Request | FY 2024 Request vs FY 2023 Enacted($) | FY 2024 Request vs FY 2023 Enacted(%) |
|---|---|---|---|---|---|
| **Program Direction** | | | | | |
| Salaries and Benefits | 53,011 | 55,002 | 57,302 | 2,300 | 4% |
| Travel | 1,000 | 1,400 | 1,600 | 200 | 14% |
| Support Services | 12,159 | 12,758 | 13,259 | 501 | 4% |
| Other Related Expenses | 13,830 | 12,840 | 13,339 | 499 | 4% |
| International Nuclear Energy Cooperation | 0 | 3,000 | 0 | -3,000 | -100% |
| **Total, Program Direction** | **80,000** | **85,000** | **85,500** | **500** | **1%** |

## Nuclear Energy FTEs

| | FY 2022 Enacted | FY 2023 Enacted | FY 2024 Request |
|---|---|---|---|
| **Nuclear Energy FTEs** | | | |
| Program Direction | 265 | 294 | 320 |
| Inflation Reduction Act - HALEU | 0 | 6 | 9 |
| Inflation Reduction Act - Infrastructure | 0 | 1 | 2 |
| **Total, Nuclear Energy FTEs** | **265** | **301** | **331** |

**Program Direction**
**Explanation of Major Changes ($K)**

| | FY 2024 Request vs FY 2023 Enacted |
|---|---|
| **Salaries and Benefits:** The increase from $55,002 to $57,302 reflects the funds necessary to achieve and maintain a consistent level of staffing to support Headquarters and Idaho Operations Offices in FY 2024. | **2,300** |
| **Travel:** The increase from $1,200 to $1,600 reflects a return to normal travel spending levels post COVID-19 restrictions as well as funding to support the travel of NE's increasing workforce. | **200** |
| **Support Services:** The increase from $12,758 to $13,259 reflects additional funding allocated for contractual support as needed to aid and support the increased federal workforce responsible for executing NE's requirements. | **501** |
| **Other Related Expenses:** The increase from $12,840 to $13,339 reflects funding to support other expenses related to the increase of NE's workforce that occurred in FY 2023 and will be sustained in FY 2024. | **499** |
| **International Nuclear Energy Cooperation:** The decrease from $3,000 to $0 reflects the International Nuclear Energy Cooperation's transfer from NE Program Direction to a program level activity within the FY 2024 NE Congressional Budget Request. | **-3,000** |
| **Total, Program Direction** | **500** |

## Program Direction
## Funding ($K)

| | FY 2023 Enacted | FY 2024 Request | FY 2024 Request vs FY 2023 Enacted |
|---|---|---|---|
| **Program Direction Summary** | | | |
| **Washington Headquarters** | | | |
| Salaries and Benefits | 27,753 | 29,195 | 1,442 |
| Travel | 1,200 | 1,300 | 100 |
| Support Services | 8,053 | 8,289 | 236 |
| Other Related Expenses | 7,010 | 7,109 | 99 |
| **Total, Washington Headquarters** | **44,016** | **45,893** | **1,877** |
| | | | |
| **Nevada Field Office** | | | |
| Salaries and Benefits | 1,784 | 1,784 | 0 |
| Travel | 0 | 0 | 0 |
| Support Services | 0 | 0 | 0 |
| Other Related Expenses | 115 | 115 | 0 |
| **Total, Nevada Field Office** | **1,899** | **1,899** | **0** |
| | | | |
| **Idaho Operations Office** | | | |
| Salaries and Benefits | 25,465 | 26,323 | 858 |
| Travel | 200 | 300 | 100 |
| Support Services | 4,705 | 4,970 | 265 |
| Other Related Expenses | 5,715 | 6,115 | 400 |
| **Total, Idaho Operations Office** | **36,085** | **37,709** | **1,623** |
| | | | |
| **Total Program Direction** | | | |
| Salaries and Benefits | 55,002 | 57,302 | 2,300 |
| Travel | 1,400 | 1,600 | 200 |
| Support Services | 12,758 | 13,259 | 501 |
| Other Related Expenses | 12,840 | 13,339 | 499 |
| International Nuclear Energy Cooperation | 3,000 | 0 | -3,000 |
| **Total, Program Direction** | **85,000** | **85,500** | **500** |
| **Federal FTEs** | **305** | **320** | **15** |

| | FY 2023 Enacted | FY 2024 Request | FY 2024 Request vs FY 2023 Enacted |
|---|---|---|---|
| **Support Services** | | | |
| Technical Support | | | |
| Mission Related | 830 | 930 | 100 |
| Advisory and Assistance | 2,102 | 2,358 | 256 |
| Total, Technical Support | 2,931 | 3,287 | 356 |
| | | | |
| Management Support | | | |
| Administrative | 2,918 | 3,015 | 97 |
| IT | 6,909 | 6,957 | 48 |
| Total Management Support | 9,827 | 9,972 | 145 |
| **Total, Support Services** | **12,758** | **13,259** | **501** |
| | | | |
| **Other Related Expenses** | | | |
| Working Capital Fund | 5,250 | 5,499 | 249 |
| Training | 100 | 150 | 50 |
| Miscellaneous | 5,453 | 5,653 | 200 |
| Rents and Utilities | 2,037 | 2,037 | 0 |
| **Total, Other Related Expenses** | **12,840** | **13,339** | **499** |

## Program Direction
## Funding

**Activities and Explanation of Changes**

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| **Program Direction $85,000,000** | **$85,500,000** | **$500,000** |
| **Salaries and Benefits $55,001,745** | **$57,301,745** | **$2,300,000** |
| • Provides salaries and benefits for 305 FTEs. | • Provides salaries and benefits for 320 FTEs. | • The increase reflects funding for salaries and benefits of an additional 15 FTE positions. |
| **Travel $1,400,000** | **$1,600,000** | **$200,000** |
| • Provides for travel of the federal staff including any necessary permanent change of duty status costs. | • Provides for travel of the federal staff including any necessary permanent change of duty status costs. | • The increase reflects funding to support travel related expenses due to the increase of NE's workforce. |
| **Support Services $12,758,255** | **$13,259,270** | **$501,015** |
| • Provides for technical and administrative support services for the Nuclear Energy (NE) federal staff. | • Provides for technical and administrative support services for the NE federal staff. | • The increase reflects additional funding allocated for contractual support as needed to aid and support the increased federal workforce responsible for executing NE's requirements. |
| **Other Related Expenses $12,840,000** | **$13,338,985** | **$498,985** |
| • Provides for NE's share of goods and services procured through the Department's Working Capital Fund (WCF); rents and utilities associated with the Idaho Operations Office; federal training expenses; and other miscellaneous expenses. | • Provides for NE's share of goods and services procured through the Department's WCF; rents and utilities associated with the Idaho Operations Office; federal training expenses; and other miscellaneous expenses. | • The increase reflects funding to support other expenses related to the increase of NE's workforce. |
| **International Nuclear Energy Cooperation $3,000,000** | **$0** | **-$3,000,000** |
| • Provides for NE's international engagement activities<br>• Continue support for nuclear safety in Armenia and Ukraine, including emergency support due to the ongoing hostilities in Ukraine.<br>• Continue deployment of CERTCs to inform small and emerging nuclear states of U.S. nuclear technology within clean energy systems. | • This activity will be requested as it's own program within the FY 2024 Congressional Budget Request. | • The decrease reflects INEC's transfer from NE Program Direction to a program level activity within the FY 2024 NE Congressional Budget Request. |

| FY 2023 Enacted | FY 2024 Request | Explanation of Changes<br>FY 2024 Request vs FY 2023 Enacted |
|---|---|---|
| • Increase U.S. technical presence through bilateral nuclear cooperation particularly in Eastern Europe, the Baltic States, Southeast Asia, and the Americas, including workforce capacity building, academic and professional training, joint studies, and regional technical events.<br>• Organize a nuclear energy management school.<br>• Continue Fukushima Forensics activities that support improved operation and safety of U.S. domestic nuclear power plants.<br>• Leverage U.S. sponsorship of subject matter experts in international organizations to advance U.S. nuclear equities.<br>• Continue bilateral engagement to build U.S. nuclear cooperation in Baltics, Eastern Europe, Africa and Asia. | | |

**Nuclear Energy**
**Small Business Innovative Research/Small Business Technology Transfer (SBIR/STTR) ($K)**

| | FY 2022 Enacted | FY 2023 Enacted | FY 2024 Request |
|---|---|---|---|
| NEUP SBIR/STTR and TCF | | | |
| SBIR | 24,997 | 23,385 | 21,314 |
| STTR | 3,515 | 3,288 | 2,997 |
| **Total, SBIR** | **24,997** | **23,385** | **21,314** |
| **Total, STTR** | **3,515** | **3,288** | **2,997** |
| **Total, SBIR/STTR** | **28,512** | **26,673** | **24,311** |

**Nuclear Energy**
**Research and Development ($K)**

| | FY 2022 Enacted | FY 2023 Enacted | FY 2024 Request |
|---|---|---|---|
| Basic | 0 | 0 | 0 |
| Applied | 965,099 | 1,001,402 | 962,535 |
| Development | 309,492 | 336,816 | 327,065 |
| **Subtotal, R&D** | **1,274,591** | **1,338,218** | **1,289,600** |
| Equipment | 0 | 0 | 0 |
| Construction | 41,850 | 7,300 | 0 |
| **Total, R&D** | **1,316,441** | **1,345,518** | **1,289,600** |

**Nuclear Energy**
**Safeguards and Security($K)**

| | FY 2022 Enacted | FY 2023 Enacted | FY 2024 Request |
|---|---|---|---|
| **Idaho Sitewide Safeguards and Security** | | | |
| Protective Forces | 85,356 | 88,497 | 92,922 |
| Security Systems | 11,575 | 12,203 | 12,853 |
| Security Infrastructure | 3,518 | 950 | 18,020 |
| Information Security | 6,174 | 5,016 | 5,748 |
| Personnel Security | 4,714 | 5,593 | 5,953 |
| Material Control & Accountability | 6,376 | 5,825 | 6,525 |
| Program Management | 10,175 | 8,000 | 8,100 |
| Cybersecurity | 21,912 | 23,916 | 27,612 |
| **Total, Idaho Sitewide Safeguards and Security** | **149,800** | **150,000** | **177,733** |

**Nuclear Energy**
**Facilities Maintenance and Repair**

The Department's Facilities Maintenance and Repair activities are tied to its programmatic missions, goals, and objectives. The Facilities Maintenance and Repair activities funded by this budget and displayed below are intended to halt asset condition degradation. This excludes maintenance of excess facilities (including high-risk excess facilities) necessary to minimize the risk posed by those facilities prior to disposition.

**Costs for Direct-Funded Maintenance and Repair (including Deferred Maintenance Reduction) ($K)**

| | FY 2022 Actual Cost | FY 2022 Planned Cost | FY 2023 Planned Cost | FY 2024 Planned Cost |
|---|---|---|---|---|
| Idaho National Laboratory | 59,820 | 32,583 | 33,503 | 34,450 |
| Total, Direct-Funded Maintenance and Repair | 59,820 | 32,583 | 33,503 | 34,450 |

**Costs for Indirect-Funded Maintenance and Repair (including Deferred Maintenance Reduction) ($K)**

| | FY 2022 Actual Cost | FY 2022 Planned Cost | FY 2023 Planned Cost | FY 2024 Planned Cost |
|---|---|---|---|---|
| Idaho National Laboratory | 29,139 | 22,358 | 22,797 | 23,372 |
| Total, Indirect-Funded Maintenance and Repair | 29,139 | 22,358 | 22,797 | 23,372 |

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**Report on FY 2022 Expenditures for Maintenance and Repair**

This report responds to legislative language set forth in Conference Report (H.R. 108-10) accompanying the Consolidated Appropriations Resolution, 2003 (Public Law 108-7) (pages 886-887), which requests the Department of Energy provide an annual year-end report on maintenance expenditures to the Committees on Appropriations. This report compares the actual maintenance expenditures in FY 2022 to the amount planned for FY 2022, including congressionally directed changes.

**Nuclear Energy**
**Total Costs for Maintenance and Repair ($K)**

| | FY 2022 Actual Cost | FY 2022 Planned Cost |
|---|---|---|
| Idaho National Laboratory | 88,959 | 54,941 |
| **Total, Maintenance and Repair** | **88,959** | **54,941** |

Each year, the "Planned Cost" for maintenance and repair is a minimum target amount. The Nuclear Energy (NE) program met its planned minimum target in FY 2022. The NE program exceeded the minimum target amount due to strategic investments at the Advanced Test Reactor and Materials and Fuels Complex at the Idaho National Laboratory.

**Nuclear Energy**
**Excess Facilities**

**Costs for Direct-Funded Excess Facilities ($K)**

| | FY 2022 Actual Cost | FY 2022 Planned Cost | FY 2023 Planned Cost | FY 2024 Planned Cost |
|---|---|---|---|---|
| Idaho National Laboratory | 0 | 0 | 0 | 0 |
| Total, Direct-Funded Excess Facilities | 0 | 0 | 0 | 0 |

**Costs for Indirect-Funded Excess Facilities ($K)**

| | FY 2022 Actual Cost | FY 2022 Planned Cost | FY 2023 Planned Cost | FY 2024 Planned Cost |
|---|---|---|---|---|
| Idaho National Laboratory | 86 | 153 | 65 | 470 |
| Total, Indirect-Funded Excess Facilities | 86 | 153 | 65 | 470 |

In FY 2022, INL:

- Removed the CF-1704 15,000-gallon underground diesel fuel tank.

In FY 2023, INL plans to:

- Remove the CF-1705 15,000-gallon underground diesel fuel tank; and
- Continue legacy underground storage tank (UST) removals and abandoned well closures.

In FY 2024, INL plans to:

- Demolish the CF-638 Dosimetry Lab; and
- Continue legacy UST removals and abandoned well closures.