Office of Science

Science
($K)

FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
$8,240,000	$8,250,000	$7,138,815	-$1,111,185

Note: The FY 2025 Enacted SC total does not include artificial intelligence supplement funding. The FY 2026 Enacted SC total does not include the Infrastructure Investment and Jobs Act supplement funding.

Proposed Appropriation Language
For Department of Energy expenses including the purchase, construction, and acquisition of plant and capital equipment, and other expenses necessary for science activities in carrying out the purposes of the Department of Energy Organization Act (42 U.S.C. 7101 et seq.), including the acquisition or condemnation of any real property or any facility or for plant or facility acquisition, construction, or expansion, and purchase of not more than [35] *35* passenger motor vehicles, [$8,250,000,000] *$7,138,815,000*, to remain available until expended: *Provided*, That of such amount, [$226,831,000] *$206,878,000* shall be available until September 30, [2027] *2028*, for program direction.

Explanation of Change
Proposed appropriation language updates reflect the funding and replacement of passenger motor vehicle levels.

Public Law Authorization
Science:
- Public Law 87-195, "Foreign Assistance Act of 1961"
- Public Law 95-91, "Department of Energy Organization Act", 1977
- Public Law 102-486, "Energy Policy Act of 1992"
- Public Law 108-153, "21st Century Nanotechnology Research and Development Act 2003"
- Public Law 108-423, "Department of Energy High-End Computing Revitalization Act of 2004"
- Public Law 109-58, "Energy Policy Act of 2005"
- Public Law 110-69, "America COMPETES Act of 2007"
- Public Law 111-358, "America COMPETES Reauthorization Act of 2010"
- Public Law 115-246, "American Super Computing Leadership Act of 2017"
- Public Law 115-246, "Department of Energy Research and Innovation Act", 2018
- Public Law 115-368, "National Quantum Initiative Act", 2018
- Public Law 117-167, "CHIPS and Science Act", 2022
- Public Law 117-169, "Inflation Reduction Act of 2022"

Isotope R&D and Production:
- Public Law 101-101, "1990 Energy and Water Development Appropriations Act", establishing the Isotope Production and Distribution Program Fund
- Public Law 103-316, "1995 Energy and Water Development Appropriations Act", amending the Isotope Production and Distribution Program Fund to provide flexibility in pricing without regard to full-cost recovery

Workforce Development for Teachers and Scientists:
- Public Law 101-510, "DOE Science Education Enhancement Act of 1991"
- Public Law 103-382, "The Albert Einstein Distinguished Educator Fellowship Act of 1994"

Mission

The Office of Science's (SC) mission is to deliver scientific discoveries and major scientific tools to transform our understanding of nature and advance the energy, economic, and national security of the United States (U.S.).

Overview

The FY 2027 Request for SC is $7,138.8 million, decrease of $1,101.2 million from the FY 2026 Enacted level. Within this amount, SC prioritizes key Administration and Department priorities, emphasizing transformative advancements in artificial intelligence (AI), quantum information science (QIS), fusion energy, high-performance computing, and critical minerals and materials.

A primary focus for SC is artificial intelligence (AI), particularly through the groundbreaking Genesis Mission. This national initiative led by DOE aims to establish the world's most powerful scientific platform to accelerate discovery, strengthen national security, and drive energy innovation. The Genesis Mission integrates DOE's world-class supercomputing power, unique scientific data, and AI capabilities into a unified system to shrink discovery cycles from years to months. The Genesis Mission will harness scientific datasets to train scientific foundation models and create AI agents for testing hypotheses, automating research workflows, and accelerating scientific breakthroughs. Recent collaborations with industry partners further underscore the commitment to unite government, industry, and academia to redefine American leadership in AI. The FY 2027 Request supports the American Science Cloud, which is the open platform for the Genesis Mission, as well as research on national science and technology challenges through the Transformational AI Models Consortium and program investments. Further investments in AI workforce development will grow the domestic talent to address the Nation's most challenging scientific problems.

The FY 2027 Request includes focused investments in quantum information science (QIS), building on a long history of DOE leadership in quantum science. QIS leverages the principles of quantum mechanics to develop fundamentally new ways of processing information, with the potential to overcome limitations of current technologies and deliver significant scientific and technological breakthroughs. SC supports fundamental QIS research across its programs, including the National Quantum Information Science Research Centers. These centers aim to drive disruptive innovation in quantum computing, sensing, and communication, and to advance the use of quantum technologies for fundamental scientific discovery.

SC continues its support for fusion development, accelerating efforts to close key science and technology gaps in fusion energy. Following the release of U.S. Fusion Science and Technology Roadmap for developing commercial fusion power, DOE is collaborating with the private sector and academic institutions to achieve the true technology breakthrough of delivering fusion power to the grid and winning the fusion commercialization race.

High-performance computing (HPC) is another critical area for SC, serving as a foundational element for advancing both AI and QIS. SC's efforts in HPC and networking facilities involve operating world-class, open-access infrastructure that thousands of researchers rely on to advance their work. The convergence of AI, HPC, and quantum technologies is a strategic investment for DOE, capitalizing on their synergy for unparalleled scientific breakthroughs.

The FY 2027 Request also continues investments in critical minerals and materials (CMM) research. Focus areas include chemical processes and materials to enhance recovery and reuse of critical elements, using synthetic biology approaches to selectively remove or concentrate CMM from source materials and/or dilute solutions, and developing fundamental knowledge of how best to reduce or eliminate the need for critical elements in chemical processes and energy technologies.

These strategic investments are integral to SC's mission to grow the scientific and technical knowledge that spurs discoveries and innovations, explore nature's mysteries from subatomic particles to the building blocks of life, and provide researchers with state-of-the-art scientific user facilities. The Office of Science remains the Nation's largest Federal sponsor of basic research in the physical sciences and a leader in the U.S. scientific discovery and innovation enterprise. Through these efforts, SC continues to build the foundations for new technologies, businesses, and industries, contributing significantly to our nation's economy, national security, and quality of life. Select scientific accomplishments enabled by the SC programs are described in the program budget narratives. Additional descriptions of recent science discoveries can be found at https://www.energy.gov/science/listings/science-highlights.

SC also administers and/or bestows several awards to recognize talented scientists and engineers that advance DOE's missions, including the Presidential Early Career Award for Scientists and Engineers (PECASE), Ernest Orlando Lawrence Award, Enrico Fermi Award, and Distinguished Scientist Fellow opportunity. The Request continues support for these honorary awards.

Science
Funding by Congressional Control

	(dollars in thousands)			
	FY 2025 Enacted	**FY 2026 Enacted**	**FY 2027 Request**	**FY 2027 Request vs FY 2026 Enacted**
Advanced Scientific Computing Research				
ASCR Research	1,036,235	1,116,328	1,104,446	-11,882
Total, Advanced Scientific Computing Research	**1,036,235**	**1,116,328**	**1,104,446**	**-11,882**
Basic Energy Sciences				
BES Research	2,354,785	2,295,643	2,002,337	-293,306
Construction				
24-SC-10 HFIR Pressure Vessel Replacement (PVR), ORNL	6,000	6,000	–	-6,000
24-SC-12 NSLS-II Experimental Tools - III (NEXT-III), BNL	5,500	5,500	–	-5,500
21-SC-10 Cryomodule Repair & Maintenance Facility (CRMF), SLAC	20,000	20,000	7,800	-12,200
19-SC-14 Second Target Station (STS), ORNL	52,000	52,000	80,000	+28,000
18-SC-12 Advanced Light Source Upgrade (ALS-U), LBNL	50,000	50,000	50,000	–
18-SC-13 Linac Coherent Light Source-II-High Energy (LCLS-II-HE), SLAC	100,000	99,343	6,000	-93,343
Total, Construction	**233,500**	**232,843**	**143,800**	**-89,043**
Total, Basic Energy Sciences	**2,588,285**	**2,528,486**	**2,146,137**	**-382,349**
Biological and Environmental Research				
BER Research	851,000	835,000	360,967	-474,033
Construction				
24-SC-31 Microbial Molecular Phenotyping Capability (M2PC), PNNL	19,000	19,000	35,000	+16,000
Total, Construction	**19,000**	**19,000**	**35,000**	**+16,000**
Total, Biological and Environmental Research	**870,000**	**854,000**	**395,967**	**-458,033**
Fusion Energy Sciences				
FES Research	590,000	634,973	677,751	+42,778
Construction				
14-SC-60 US Contributions to ITER	200,000	170,684	77,500	-93,184
Total, Construction	**200,000**	**170,684**	**77,500**	**-93,184**
Total, Fusion Energy Sciences	**790,000**	**805,657**	**755,251**	**-50,406**
High Energy Physics				
HEP Research	848,570	861,156	710,458	-150,698
Construction				
18-SC-42 Proton Improvement Plan II (PIP-II), FNAL	125,000	114,000	105,000	-9,000
11-SC-40 Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment	251,000	260,000	305,000	+45,000
Total, Construction	**376,000**	**374,000**	**410,000**	**+36,000**

(dollars in thousands)

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Total, High Energy Physics	**1,224,570**	**1,235,156**	**1,120,458**	**-114,698**
Nuclear Physics				
NP Operation and Maintenance	715,600	711,141	591,434	-119,707
Construction				
20-SC-52 Electron Ion Collider (EIC), BNL	110,000	155,000	200,000	+45,000
Total, Construction	**110,000**	**155,000**	**200,000**	**+45,000**
Total, Nuclear Physics	**825,600**	**866,141**	**791,434**	**-74,707**
Isotope R&D and Production				
IRP Research	116,736	110,500	114,972	+4,472
Construction				
20-SC-51 U.S. Stable Isotope Production and Research Center (SIPRC), ORNL	45,900	50,000	45,100	-4,900
24-SC-92 Clinical Alpha Radionuclide Producer (CARP), BNL	–	1,000	–	-1,000
24-SC-91 Radioisotope Processing Facility, ORNL	7,000	8,500	8,500	–
Total, Construction	**52,900**	**59,500**	**53,600**	**-5,900**
Total, Isotope R&D and Production	**169,636**	**170,000**	**168,572**	**-1,428**
Accelerator R&D and Production				
ARDAP Research	27,000	–	–	–
Total, Accelerator R&D and Production	**27,000**	**–**	**–**	**–**
Workforce Development for Teachers and Scientists				
WDTS	31,000	32,000	30,000	-2,000
Total, Workforce Development for Teachers and Scientists	**31,000**	**32,000**	**30,000**	**-2,000**
Science Laboratories Infrastructure				
PILT	5,119	5,119	5,000	-119
Oak Ridge Landlord	7,032	7,032	7,500	+468
SLI F&I	42,692	40,000	50,000	+10,000
SLI Laboratory Operations Apprenticeship	3,000	3,000	3,000	–
OR Nuclear Operations	46,000	46,000	46,000	–
Construction				
21-SC-71 Princeton Plasma Innovation Center (PPIC), PPPL	30,000	34,600	–	-34,600
21-SC-72 Critical Infrastructure Recovery & Renewal (CIRR), PPPL	10,000	9,400	12,282	+2,882
20-SC-72 Seismic and Safety Modernization (SSM), LBNL	23,000	–	–	–
20-SC-73 CEBAF Renovation and Expansion (CEBAF), TJNAF	11,000	26,000	–	-26,000
20-SC-77 Argonne Utilities Upgrade (AU2), ANL	3,000	2,250	1,500	-750

	(dollars in thousands)			
	FY 2025 Enacted	**FY 2026 Enacted**	**FY 2027 Request**	**FY 2027 Request vs FY 2026 Enacted**
20-SC-78 Linear Assets Modernization Project (LAMP), LBNL	25,000	19,000	25,000	+6,000
20-SC-79 Critical Utilities Infrastructure Revitalization (CUIR), SLAC	20,000	15,000	18,075	+3,075
20-SC-80 Utilities Infrastructure Project (UIP), FNAL	35,000	18,000	48,815	+30,815
Total, Construction	**157,000**	**124,250**	**105,672**	**-18,578**
Total, Science Laboratories Infrastructure	**260,843**	**225,401**	**217,172**	**-8,229**
Safeguards and Security				
S&S	190,000	190,000	202,500	+12,500
Total, Safeguards and Security	**190,000**	**190,000**	**202,500**	**+12,500**
Program Direction				
PD	226,831	226,831	206,878	-19,953
Total, Program Direction	**226,831**	**226,831**	**206,878**	**-19,953**
Total, Office of Science	**8,240,000**	**8,250,000**	**7,138,815**	**-1,111,185**

Advanced Scientific Computing Research

Overview

The ongoing revolutions in artificial intelligence (AI), quantum computing, and high-performance computing are ushering in a new age of scientific research. The Advanced Scientific Computing Research (ASCR) program is accelerating the dawn of this age by advancing applied mathematics and computer science, including AI and quantum information science (QIS); delivering the most sophisticated computational scientific applications in partnership with disciplinary science; creating first-of-a-kind advanced computing and networking capabilities for the Nation; and developing future generations of computing hardware and software tools for science and engineering in partnership with the research community, including U.S. industry. ASCR's research and facilities investments underpin the Genesis mission by increasing the capability, versatility, impact and efficiency of scientific computing through activities described by four thrusts: *Breakthrough Tools and Technologies*, enhancing software and AI for increasingly complex modeling and simulation, including enabling the convergence of AI with QIS; *Deep Understanding of AI and Physical Models*, advancing knowledge in core mathematical methods and algorithms that underlie all AI, modelling, and simulation; *Enabling High-Precision Research and Development*, concurrently advancing applied mathematics and computer science with disciplinary science in critical areas; and *Hardware Innovation*, increasing the robustness of computing, including underlying communication and energy needs, redefines the art of possible in conventional computing, and leads the development of new emerging technologies.

ASCR is core to the Genesis Mission, driving progress through the development of advanced computing, AI, and QIS technologies and tools. ASCR's research, technology development, and user facilities activities are foundational to the Department's goals to build frontier models for science and energy, QIS algorithms and applications for quantum advantage, and a world-leading, secure platform that integrates DOE computing, data, and networks with U.S. partners for the U.S. research community. The ASCR mission strongly aligns with the Genesis Mission core goal to dramatically increase the nation's scientific output and impact. ASCR will not only play a leading role in the design, delivery, and continuous improvement of the Genesis Mission platform, but will also directly leverage the platform, including frontier AI models and data, to further ASCR research frontiers. Also, ASCR is coordinating closely with AIQ in the development, deployment, and management of the Genesis Mission supercomputing partnerships and quantum investments under AIQ's purview, and ASCR's user facilities, the American Science Cloud, and other ASCR investments are being leveraged by AIQ to deploy and manage Genesis Mission computing resources.

ASCR's program activities steward an innovation pipeline addressing the four thrusts. This pipeline starts with basic research, makes connections to scale-up research and development activities through testbeds and centers, and culminates in world-leading computing, networking, and data infrastructure capabilities:

- ASCR Research's Applied Mathematics and Computer Science activities focus on long-term research to develop innovative algorithms, software, methods, and workflows underpinning current and future HPC, AI, quantum hardware, and science applications. The Computational Partnerships activity catalyzes joint inquiry and effort between mathematics and computer science researchers and domain science researchers to solve interwoven challenges.
- ASCR Advanced Computing Technologies (ACT) anticipates future computing needs and provides testbeds and research centers for the design and development of the newest technologies, including QIS and new microelectronics. ACT focuses on engaging industry and the research community to scale-up research on next-generation technologies for enabling broad research impact, innovation, and initial commercial development.
- ASCR High Performance Computing and Networking Facilities activities conceive, build, and operate world-class, open access HPC, networking, and data infrastructure for scientific research. ASCR facilities partner with industry to create and deploy next generation computing and networking technology. In

addition, ASCR's stewardship of DOE high performance networking connects all DOE national laboratories and major sites to global research networks to advance data-intensive scientific discovery.

The SC crosscutting effort in AI brings together powerful increases in computing power and massive data sets from state-of-the-art facilities to accelerate scientific progress. The effort leverages the American Science Cloud (AmSC) to facilitate and support scientific research, data generation, analysis, and sharing across various disciplines. The effort is also underpinned by the state-of-the-art self-improving AI models developed by the Transformational AI Models Consortium in close collaboration with the leading industry partners. ASCR's request supports leveraging DOE's considerable capabilities to advance scientific AI designed to handle large multi-dimensional data sets and produce the high-precision answers needed for science to meet the Nation's technical challenges. To better couple all elements of the technology innovation chain and combine talents across universities, national labs, and the private sector, ASCR continues its full support for the National QIS Research Centers (NQISRCs) and its partnership with DARPA on industry quantum benchmarking.

Highlights of the FY 2027 Request

The ASCR FY 2027 Request of $1,104.4 million is a decrease of $11.9 million below the FY 2026 Enacted level and is well-aligned with Administration and Department priorities to support the Genesis Mission and advance AI technology and its integration with critical and emerging technologies such as microelectronics and QIS. It also provides support to enhance U.S. competitiveness by developing cutting-edge AI models and applying them to increase the pace of scientific discovery while leveraging AmSC infrastructure, including next-generation HPC, networking, and data processing capabilities.

<u>Research</u>

The Request prioritizes delivering on the promise of the exascale and AI enabled science era while leading innovation in next-generation HPC integrated with QIS and AI. This effort includes funding critical basic research in applied mathematics and computer science to merge the power of AI with exascale computing. These investments also include developing tools that facilitate building foundation models useful for basic and applied science, and partnerships that build and use foundation models for new applications in science, energy, and national security. The Request also emphasizes applied mathematics, computer science, networking, hardware, and microelectronics research to leverage advanced computing including quantum. Increased or shifted efforts in research, advanced computing technologies, and at the facilities will move forward the implementation of the AmSC and its core ASCR infrastructure component, DOE's Integrated Research Infrastructure (IRI), to seamlessly integrate DOE's unique data, user facilities, computing resources, and applications and to accelerate self-improving AI model development. Strategic partnerships, within DOE, at the interagency level, and with industry expand the impact of the exascale capabilities including software and AI and accelerate scientific discovery through advanced computing (SciDAC) and the Transformational AI Models consortium. For example, partnerships will use AI to accelerate the discovery of new quantum algorithms. Underpinning all investments are efforts to grow the necessary competitive workforce through the Computational Sciences Graduate Fellowship (CSGF) and Established Program to Stimulate Competitive Research (EPSCoR).

The Request supports advanced computing technologies innovation through microelectronics, robotics, and quantum information testbeds and centers. Continued support enables the NQISRCs and ASCR's regional quantum testbeds, which will be expanded to derisk larger-scale error-corrected quantum systems, and user programs to provide U.S. researchers with access to unique and commercial quantum computing and networking resources. It also enables basic research in QIS, in coordination with other relevant Departments and Agencies, to cement national leadership in the field. The request will also explore incentive-based competitions to support the demonstration of scientifically relevant quantum computing. Through Research and Evaluation Prototypes (REP), partnerships with industry in collaboration with the research community produce computationally efficient advances for scientific AI, HPC, and QIS. The Request also supports Microelectronics Science Research Centers, a network of multiple multidisciplinary teams comprised of researchers from universities, national laboratories, and industry to develop new materials, chemistries, devices, systems, architectures, algorithms, and software in a co-design innovation ecosystem.

Facility Operations

The FY 2027 Request supports full operations and competitive allocation of the Nation's exascale computing systems for open science, Frontier at the Oak Ridge Leadership Computing Facility (OLCF) and Aurora at the Argonne Leadership Computing Facility (ALCF); full operations of the Perlmutter system at the National Energy Research Scientific Computing Center (NERSC); and full operations of the Energy Sciences Network (ESnet). The Request supports user access to advanced computing and AI testbeds, as well as commercial quantum computers at the facilities through competitive, merit reviewed, open access programs. The Request supports the NERSC-10 and OLCF-6 projects at their CD-2 baseline levels, the ALCF-4 upgrade project, the High Performance Data Facility (HPDF) project, initial planning for the ESnet7, and exploring a quantum computing user facility. The Request builds on the FY 2026 initiation of the AmSC infrastructure platform under the One Big Beautiful Bill's Transformational AI Models provision, advancing the ASCR Facilities as enablers of the AmSC.

Advanced Scientific Computing Research
Funding

	(dollars in thousands)			
	FY 2025 Enacted	**FY 2026 Enacted**	**FY 2027 Request**	**FY 2027 Request vs FY 2026 Enacted**
Advanced Scientific Computing Research				
Applied Mathematics Research	68,182	75,420	58,795	-16,625
Computer Sciences Research	76,718	85,431	50,820	-34,611
Computational Partnerships	56,982	51,151	70,749	+19,598
Advanced Computing Technologies	105,118	120,618	142,236	+21,618
Energy Earthshot Research Centers	3,000	–	–	–
Total, Mathematical, Computational, and Computer Sciences Research	**310,000**	**332,620**	**322,600**	**-10,020**
High Performance Production Computing	154,500	170,328	183,000	+12,672
Leadership Computing Facilities	475,195	513,000	490,000	-23,000
High Performance Network Facilities and Testbeds	93,540	97,261	103,000	+5,739
Integrated Research Infrastructure	3,000	3,119	5,846	+2,727
Total, High Performance Computing and Network Facilities	**726,235**	**783,708**	**781,846**	**-1,862**
Subtotal, Advanced Scientific Computing Research	**1,036,235**	**1,116,328**	**1,104,446**	**-11,882**
Total, Advanced Scientific Computing Research	**1,036,235**	**1,116,328**	**1,104,446**	**-11,882**

Advanced Scientific Computing Research
Explanation of Major Changes

	(dollars in thousands) FY 2027 Request vs FY 2026 Enacted
Mathematical, Computational, and Computer Sciences Research Funding for robust AI research is maintained by the Request, which will develop tools that facilitate building and understanding foundation models useful for basic and applied science, including expanded partnerships with industry, academia, and other agencies, and enable the convergence of AI, HPC, and QIS. DOE will utilize its computing capabilities, AI testbeds, research efforts, and programs like EPSCoR and CSGF to enhance the competitiveness of the U.S. workforce. The ACT activities will increase investments in quantum information sciences research in close coordination with the other SC programs. The decrease represents the transition of some efforts to the Department-wide AI initiative. The consolidation of several core research efforts allow for increased investments in HPC, QIS, and AI.	**-$10,020**
High Performance Computing and Network Facilities The Request provides increased resources for facility operation for ESnet to deliver high performance network access to all DOE national laboratories and dozens of other DOE sites, all of which will support the Genesis mission. Also, the Request supports increase funding for HPDF to advance development of design. Modest reductions to OLCF, ALCF, and NERSC, but will still maintain full operations and competitive allocation of the nation’s first two Exascale computing systems, Frontier and Aurora, and testbed resources focused on novel AI hardware and QIS technologies. The Request supports development of IRI across ASCR facilities.	**-$1,862**
Total, Advanced Scientific Computing Research	**-$11,882**

Basic and Applied R&D Coordination
Coordination across disciplines and programs is a cornerstone of the ASCR program. Partnerships within SC and the National Nuclear Security Administration (NNSA) continue in advanced computing and applications. ASCR also has partnerships in QIS and AI within SC and is collaborating across DOE and with other agencies to expand AI transformational models. Through the Networking and Information Technology R&D Subcommittee, the Subcommittee on MLAI, the Subcommittee on QIS, and the Subcommittee on the Economic and Security Implications of QIS of the National Science and Technology Council (NSTC) Committees on Science, Technology, and Homeland and National Security, ASCR coordinates with programs across the Federal Government. Future advanced computing technologies, scientific data, large scale networking, high end computing, AI, and QIS are coordinated with other agencies through the NSTC. In FY 2027, cross-agency interactions and collaborations continue in coordination with the Office of Science and Technology Policy.

Program Accomplishments
Leveraging AI to Fight Cancer: The Argonne Leadership Computing Facility (ALCF) is at the center of new research to tailor medical decisions, practices, and treatments to individual patients, based on each patient's predicted response. Such "precision medicine" can prevent and detect disease at earlier, more treatable stages, and the ALCF's Aurora exascale AI computer will be crucial to identify the exact pathways to make medicines to inhibit tumor growth. Two huge challenges for using AI to fight cancer are limited data and untested deep learning models. Now, Aurora, one of DOE's most advanced AI supercomputers and the National Cancer Institute (NCI) have teamed up to overcome these limitations through their new "IMPROVE" project (Innovative Methodologies and New Data for Predictive Oncology Model Evaluation). IMPROVE will leverage the Argonne supercomputer to optimize AI that can predict from a patient's biopsy the preferred treatment based on their DNA, and genetic profile, while reducing unwanted side effects such as liver damage or birth defects.

Paving the way for scalable quantum chips: Researchers in the Quantum Systems Accelerator NQISRC have achieved a 100x enhancement over state-of-the-art devices in power efficiency of a computer chip that can be used to control quantum systems. The chip, manufactured in the Sandia lab's volume foundry uses their innovative device which is just 2mm long (about as big as a grain of rice) to enable large-scale control of quantum chips. This class of devices enables highly-scalable control of "trapped ion" chips, allowing them to utilize increasingly high numbers of qubits, and therefore achieve quantum computing advantages. The innovative device helps overcome a major obstacle faced by quantum computers of the future: how to match the miniaturization and integration achieved by classical electronics. The team used advanced nanophotonics with a clever design to couple piezoelectric transducers and optical guides aimed at controlling neutral atoms and trapped ions in quantum processing units.

Simulating hypersonic flight conditions. Hypersonic flight promises to slash flight times and energy costs with vehicles soaring at thousands of miles per hour, but the extreme speeds generate massive shock waves and scorching temperatures. Now, researchers are tapping into the ALCF's supercomputing power to simulate the behavior of billions of oxygen molecules and temperatures as they flow around a prototype design. Accurately predicting heat loads on a hypersonic vehicle's surface is paramount for devising effective thermal protection strategies, directly impacting mission safety and success. The exciting new work was published in Science Advances and is funded by SC's Innovative and Novel Computational Impact on Theory and Experiment (INCITE) Program. The study's large-scale simulations offer new insights into how shockwaves interact and the molecular-level mechanisms that drive hypersonic flows. The findings could directly contribute to the development of hypersonic rocket cargo vehicles, such as those being developed by SpaceX and the U.S. Air Force.

Leak proof fusion brings abundant low-cost energy closer to reality. A key challenge for fusion reactors is to contain leakage of high-energy particles causing loss of critical plasma conditions needed to sustain nuclear fusion. Using the advanced mathematical methods developed via support from ASCR, the scientists have made a key breakthrough that will enable engineers to design leak-proof magnetic confinement systems ten times faster than current methods without losing accuracy. For decades, engineers have wrestled with the challenge of magnetic confinement, essential for harnessing fusion energy, often battling troublesome gaps in complex magnetic fields within the stellarator, the leading candidate for commercial fusion. Now, in a leap forward, scientists and their industry partner Type One Energy have deployed a machine learning model, trained on real-world data, that significantly outperforms current standards in this nearly 70-year-old quest. This breakthrough accelerates the production of low-cost nuclear fusion energy.

DOE's new wireless transmission capability connects geothermal scientists to supercomputers. Utilizing wavelengths as short as one millimeter, ESnet is connecting field sites to the high-performance science network DOE supercomputers and is now empowering geothermal energy researchers collecting seismic data. By overcoming the limitations of Wi-Fi and cellular service at remote energy field sites, researchers can now perform vital real-time analysis of massive datasets, enabling them to better locate, monitor, and map geothermal energy sources for efficient exploitation. A novel, highly mobile millimeter wave (mmWave) data transmission prototype, invented and developed by DOE ESnet engineers, successfully passed its field testing in Utah and Nevada, offering easy transport in a pickup truck and flexible battery operation. By combining this wireless transmission with ESnet's blazing fast fiber optics, scientists can achieve real-time interpretation of seismic data, potentially enabling the induction of controlled seismic events for geothermal power production.

Exascale simulations underpin quake-resistant infrastructure designs. Researchers at Berkeley National Laboratory used the Frontier supercomputer at Oak Ridge National Laboratory to develop the most advanced simulations to date for studying earthquake dynamics. The simulations reveal in stunning new detail how geological conditions influence earthquake intensity — and, in turn, how those complex ground motions directly impact buildings and infrastructure. The data is already being shared with the broader earthquake science and engineering communities to deepen understanding of seismic behavior and to guide the designs of earthquake-resistant infrastructure and improved emergency response.

Partnership on muon catalyzed fusion increases industry investment. Muon-catalyzed fusion (MCF), a promising approach for clean, abundant energy uses heavier muon particles to bring nuclei together at lower temperatures than traditional fusion. ASCR partnered with ARPA-E to use leading-edge computational tools to explore an advanced concept for producing muons at 1/10th the normal cost. The project demonstrated strong results to suggest the feasibility of cost-competitive power plants based on MCF. This validated a potential experimental pathway for this promising technology to leapfrog to a higher TRL than today’s leading fusion technologies and led to over $20 million in private investment.

Description

The Mathematical, Computational, and Computer Sciences Research subprogram supports research activities to effectively meet the SC AI, QIS, HPC, and computational science mission needs, including both data and computationally intensive science. These sciences coupled with AI are central to progress at the frontiers of science and our most challenging engineering problems, including for next-generation microelectronics and systems exploring the convergence of HPC, AI, and QIS. The Computer Science and Applied Mathematics activities in ASCR provide the foundation for increasing the capability of the national HPC ecosystem and scientific data infrastructure. This goal is accomplished through long-term research focused on developing intelligent software, algorithms, and methods that anticipate future hardware challenges and opportunities, and address evolving science needs. ASCR's partnerships with disciplinary science and industry deliver some of the most advanced scientific computing applications in areas of strategic importance to the Nation and help realize the promise of the exascale and AI-enabled science era. Research efforts anticipate changes in hardware and rapidly developing capabilities such as AI and QIS, as well as mission needs over the long term. ASCR's partnerships with industry, including vendors and users, and discipline sciences are essential to these efforts. The Request supports research and partnerships addressing challenges under the Transformational AI Models Consortium and The American Science Cloud (AmSC), which were launched under the Working Families Tax Cuts Act (Pub. L. 119-21) and the activities supporting the Genesis Mission Executive Order (EO 14363).

Applied Mathematics Research

The FY 2027 Request for the Applied Mathematics activity supports basic research leading to fundamental mathematical advances and computational breakthroughs across DOE and SC missions. Basic research in scalable algorithms and libraries, multiscale and multi-physics modeling, methods that facilitate building and understanding foundational models for leading AI capabilities, and efficient data analysis underpin all of DOE's computational and data-intensive science efforts. More broadly, the Request supports foundational research in problem formulation, multiscale modeling and coupling, mesh discretization, time integration, advanced solvers for large-scale linear and nonlinear systems of equations, methods that use asynchrony or randomness, uncertainty quantification, and optimization. Historically, advances in these methods have contributed as much, if not more, to gains in computational science than hardware improvements alone. The forward-looking efforts of these activities anticipate DOE mission needs from the closer coupling and integration of advanced computing with scientific modeling, AI, and QIS. The results enable greater capabilities for scientific discovery, design, and decision-support in complex systems and new algorithms to support data analysis at the edge of experiments and instruments; and protect the privacy of sensitive datasets. Industry often uses software developed with Applied Mathematics investments and integrates it with their own software.

Computer Science Research

The FY 2027 Request for the Computer Science activity supports long-term, basic research on the software infrastructure that is essential for the effective use of the most powerful HPC and networking systems in the Nation; the tools and data infrastructure to enable the incorporation of AI techniques and real-time exploration and the understanding of extreme scale; and complex data from both simulations and experiments. Additionally, Computer Science efforts play a key role in understanding gaps and future opportunities for the design of future computing systems, ensuring that the U.S. maintains leadership in high-performance and data-intensive computing, and integrating them with AI and QIS technologies. To advance these goals, this activity includes support for foundational research in data analysis and visualization, data management and storage, distributed systems and resource management, programming models and tools enabling high performance and portability, program verification and testing, operating and runtime systems, advanced networking, hardware/software co-design, computer-science fundamentals, and HPC cybersecurity. Hardware and software vendors often use software developed with ASCR Computer Science investments and integrate it with their own software. In addition, partnerships between mathematicians and computer scientists, jointly supported by this activity and Applied Mathematics, develop computationally efficient algorithms and methods that scale from intelligent sensors to HPC and advance the Department's energy goals.

Computational Partnerships

The FY 2027 Request for the Computational Partnerships activity supports the Scientific Discovery through Advanced Computing, or SciDAC, program, for the effective use of HPC for scientific discovery. Established in 2001, SciDAC involves ASCR partnerships with the other SC programs, other DOE program offices, and other federal agencies in strategic areas with a goal to dramatically accelerate progress in scientific computing, including AI, through deep collaborations between discipline scientists, applied mathematicians, and computer scientists. SciDAC accomplishes this by providing the intellectual resources in applied mathematics and computer science, expertise in algorithms and methods, and scientific software tools to advance scientific discovery through modeling, simulation, large-scale data analysis, and scientific AI in areas of strategic importance to SC, DOE, and the Nation. These efforts include partnerships with industry, academia, and other agencies to utilize DOE's advanced computing capabilities and AI testbeds to build foundation models that support new applications in science and energy. The FY 2027 Request supports building SciDAC partnerships focused on AI for science with other SC and DOE programs.

Advanced Computing Technologies

The FY 2027 Request for the Advanced Computing Technologies (ACT) activity supports research focused on the development of emerging computing technologies through REP and center investments, in partnership with the other SC and DOE program offices. These technologies include QIS, neuromorphic computing, robotics, automated systems for scientific discovery, and other advanced microelectronics technologies. ACT also strengthens the competitiveness of the U.S. scientific computing workforce through CSGF.

REP has a long history of partnering with U.S. vendors to develop the next generation of computing technologies that advance the state-of-the-art enabling DOE researchers to better understand the challenges and capabilities of emerging technologies. REP partnerships with industry and in collaboration with the research community focused on computationally efficient, leap-ahead technologies for scientific AI, HPC, and robotics will accelerate the development of scalable qubit architectures, first-of-a-kind neuromorphic devices for AI applications, and novel AI training methods for robotics. The activity will support testbeds for emerging neuromorphic and robotics hardware that enable edge and embodied AI applications for science.

In close coordination with IRI and American Science Cloud activities, the Request will support the development of critical components of a high-level programming interface that supports and facilitates integrated AI-enabled scientific workflows for all major DOE science instruments and user facilities with ASCR HPC and external compute resources, including cloud computing. The efforts foster a DOE national laboratory ecosystem of automated labs, edge sensors, data resources, and access to commercial cloud capabilities to radically accelerate the pace of innovation and discovery.

This activity also supports ASCR's investments in the NQISRCs and quantum technologies, including quantum hardware performance verification and validation, quantum error corrected architectures, algorithms, and software research and development, as well as testbeds to derisk the scaling of fault tolerant quantum computing and supporting quantum networking technologies. These investments focus on building game-changing quantum-computing systems that will provide the U.S. scientific community with transformative capabilities to simulate physical systems at scales and levels of fidelity out of reach of classical techniques. To accelerate scientific discovery, AI and HPC will be leveraged to optimize and explore new system designs, and combined with quantum computing systems, to enable algorithmic and architectural innovations.

Success in fostering and stewarding a highly skilled and competitive workforce is fundamental to SC's mission and key to also sustaining U.S. leadership in HPC and computational science. The high demand across DOE missions and the unique challenges of high-performance computational science and engineering led to the establishment of the CSGF in 1991. With increasing demand for these highly skilled scientists and engineers, ASCR continues to partner with the NNSA to support the CSGF to increase the availability and breadth of a trained workforce for exascale computing, AI, and QIS.

Additionally, the Request supports ASCR's contribution to the SC Microelectronics Science Research Centers formed as networks of individual projects, aggregated into three centers, that each address a common challenge. These Centers include researchers from universities, national laboratories, and industry that develop materials, chemistries, devices, systems, architectures, algorithms, and software.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Mathematical, Computational, and Computer Sciences Research $332,620	**$322,600**	**-$10,020**
Applied Mathematics Research $75,420	$58,795	-$16,625
Funding focuses on core foundational research efforts in algorithms, libraries, and methods that underpin high-end scientific simulations, scientific AI techniques, building and understanding foundation models, and methods that help scientists extract insights from massive scientific datasets with an emphasis on capabilities for making data AI-ready. Funding continues partnerships between mathematicians and computer scientists to develop computationally efficient algorithms and methods for hybrid architectures including HPC, quantum, and AI, and in physics-informed, multiscale algorithms.	The Request will focus on core foundational research efforts in algorithms, libraries, and methods that underpin high-end scientific simulations, scientific AI techniques, building and understanding foundation models, and methods that help scientists extract insights from massive scientific datasets with an emphasis on capabilities for making data AI-ready. The Request will continue partnerships between mathematicians and computer scientists to develop computationally efficient algorithms and methods for hybrid architectures including HPC, quantum, and AI, and in physics-informed, multiscale algorithms.	The Request will support the consolidation of several efforts to focus on the most promising future directions for increasingly hybrid architectures that integrate HPC, QIS, and AI and the transition of some efforts to the Department-wide AI initiative.
Computer Science Research $85,431	$50,820	-$34,611
Funding focuses on foundational research efforts in software that improves the utility of HPC and advanced networks for science. This includes AI techniques, workflows, tools, data management, analytics and visualizations with strategic	The Request will focus on foundational research efforts in software that improves the utility of HPC and advanced networks for science. This includes AI techniques, workflows, tools, data management, analytics and visualizations with strategic	The Request will support the consolidation of several efforts to focus on the most promising future directions for increasingly hybrid architectures that integrate HPC, QIS, and AI and the transition of some efforts to the Department-wide AI initiative.

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
increases focused on critical tools to facilitate building and understanding foundation models and making massive data sets AI-ready. Funding for this activity continues long-term basic research efforts that explore and prepare for emerging technologies and the integration of HPC, QIS, and AI. Small investments in cybersecurity continues. In addition, funding supports partnerships between mathematicians and computer scientists to develop computationally efficient scalable algorithms and methods.		increases focused on critical tools to facilitate building and understanding foundation models and making massive data sets AI-ready. Funding for this activity will also continue long-term basic research efforts that explore and prepare for emerging technologies and the integration of HPC, QIS, and AI. Small investments in cybersecurity will continue. In addition, funding will support partnerships between mathematicians and computer scientists to develop computationally efficient scalable algorithms and methods.	
Computational Partnerships	$51,151	$70,749	+$19,598
Funding continues support for the SciDAC partnerships with other SC and DOE programs to enable AI-driven, high precision science R&D and realize the promise of exascale computing. Support for Advanced Computing continues.		The Request will continue support for the SciDAC partnerships with other SC and DOE programs to enable AI-driven, high-precision science R&D and scientific automation and realize the promise of exascale computing.	The Request will focus on increased investments in AI and QIS research and technology in support of the Genesis Mission. Lower priority research is decreased as the program focuses on the transition of some research reaching testbed readiness, including that focused on AI memory technologies, to Advanced Computing Technologies, other minor adjustments, and the transition of some efforts to the Department-wide AI initiative.
Advanced Computing Technologies	$120,618	$142,236	+$21,618
Funding supports quantum computing testbed efforts, and regional quantum networking testbeds. Funding allows REP to increase strategic investments in hardware, and research that		The Request will continue to support quantum , AI, neuromorphic, and robotics technology testbed efforts. The Request allows REP to increase strategic investments in	The Request will prioritize AI, HPC, and QIS-focused applications and hardware investments. New partnerships with industry in collaboration with the research community will

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
supports the integration of HPC, QIS, and AI, as well as continued support for hardening of critical software developed under ECP to enable science in the exascale era. Funding continues support for the CSGF fellowship, in partnership with NNSA. Also, funding supports the NQISRCs, as authorized in the National Quantum Initiative Act. Additionally, funding continues support for research awards that contribute to the Microelectronics Science Research Centers.	hardware, and research that supports the integration of HPC, QIS, and AI, as well as continued support for hardening of critical software developed under ECP to enable science in the exascale era. The Request will continue support for the CSGF fellowship, in partnership with NNSA. The Request will continue support for the NQISRCs and the Microelectronics Science Research Centers. The request will explore incentive-based competitions to support the demonstration of scientifically relevant quantum computing.	be leveraged to develop computationally efficient, leap-ahead technologies for scientific AI, HPC, and QIS.

Description

The High Performance Computing (HPC) and Network Facilities subprogram supports the construction and operations of forefront research computing, networking, and data user facilities to meet critical mission needs and advance American dominance of HPC, Artificial Intelligence (AI), and Quantum Information Science (QIS). The ASCR Facilities will continue to play a central role in developing and deploying infrastructure powering the Genesis Mission. The HPC activity supports the National Energy Research Scientific Computing Center (NERSC) at Lawrence Berkeley National Laboratory (LBNL), which provides HPC resources and large-scale storage to a broad range of SC researchers, and the High Performance Data Facility (HPDF) that will provide a managed computational and data resource to attack fundamental problems in science and engineering. The Request advances the HPDF to CD-2/3, preserving options for phased installation to meet the urgency of the Department's mission needs in data-intensive research and AI. The Leadership Computing activity supports the two Leadership Computing Facilities (LCFs) at Oak Ridge National Laboratory (ORNL) and Argonne National Laboratory (ANL), which provide leading-edge HPC capabilities to the U.S. research and industrial communities. The High Performance Network Facilities and Testbeds activity supports the high-performance network user facility, ESnet, which connects all DOE national laboratories and many other sites to global research networks and delivers highly reliable data transport capabilities optimized for the requirements of large-scale science. Within the subprogram, facility operations include investments in upgrade projects, software innovation, and testbeds. The core strength of the facilities is the dedicated staff who work to maximize user productivity and science impact and efficiently operate and maintain world-leading research computing, networking, and data infrastructure, while simultaneously executing major upgrade projects and exploring advanced applications of AI and commercial quantum computing technologies.

The HPC and Network Facilities subprogram investments are informed through formal collection of strategic user requirements for research computing and data management from stakeholders across SC and DOE, including the other SC research programs, SC scientific user facilities, DOE national laboratories, U.S. industry, and other stakeholders. ASCR continues to observe an accelerating pace of innovation in computing technology through and beyond the exascale era. Allocation of HPC resources to users follows the merit review public-access model used by all SC scientific user facilities. The Innovative and Novel Computational Impact on Theory and Experiment (INCITE) allocation program provides access to the LCFs; the ASCR Leadership Computing Challenge (ALCC) allocation program provides a path for critical DOE mission applications to access the LCFs and NERSC, and a mechanism to address urgent national emergencies and priorities.

The FY 2027 Request builds on the FY 2026 initiation of the American Science Cloud (AmSC) infrastructure platform under the Working Families Tax Cut Act (Pub. L. 119-21) and supports the Genesis Mission's creation of an integrated AI platform. The ASCR Facilities and HPDF will be core enablers of the AmSC and, in turn, the Integrated Research Infrastructure (IRI) activity supports the core governance and services spanning across all ASCR Facilities to meet the Department's AI research requirements and uplift the AmSC for the Genesis Mission. IRI activities focus on unlocking the ASCR Facilities computing, data, and networking services for users to run seamless automated computational and experiments workflows across DOE's world class user facilities and research infrastructure. ASCR is coordinating closely with AIQ in the development, deployment, and management of the Genesis Mission supercomputing partnerships and quantum investments under AIQ's purview, and ASCR's user facilities, the American Science Cloud, and other ASCR investments are being leveraged by AIQ to deploy and manage Genesis Mission computing resources. The FY 2027 request will also support the exploration of a quantum computing user facility.

High Performance Production Computing

The FY 2027 Request for this activity will continue to support the NERSC user facility at LBNL to deliver high-end production computing resources and data services for the SC research community. NERSC users come from nearly every state in the U.S., with about half based in universities, approximately one-third in DOE laboratories, and other users from government laboratories, non-profits, small businesses, and industry. NERSC aids users entering the HPC arena for the first time, as well as those preparing leading-edge codes that harness the full potential of ASCR's exascale resources.

The FY 2027 Request will continue to support NERSC operation of the 125 pf HPE/AMD/NVIDIA NERSC-9 system (Perlmutter), an AI-enabled GPU-CPU system, which came online in FY 2021. NERSC is consistently oversubscribed, with user requests exceeding capacity by a factor of 3–10 each year. In addition, the variety of data- and compute-intensive research workflows is expanding rapidly. The FY 2027 Request supports NERSC operations and the NERSC-10 upgrade project to build and commission the Dell/NVIDIA Doudna system, a flexible HPC platform to serve an even wider range of NERSC users, workflows, and applications. The Request also supports NERSC's exploratory efforts in AI and access to commercial quantum computing technologies to benefit the NERSC user community.

The FY 2027 OMB Request provides funding to advance the HPDF to CD-2/3 as the data services foundational infrastructure for the AmSC with options for phased installation in the future, preserving options to meet the urgency of the Department's mission needs in data-intensive research and AI.

Leadership Computing Facilities

The LCFs are national resources featuring first-of-a-kind supercomputing systems that drive innovation in HPC to enable open scientific computational applications, including industry applications, that harness the full potential of extreme-scale leadership computing to accelerate discovery. The success of this effort is built on the gains made in the ECP, REP, and ASCR research efforts. The LCFs foster partnerships between domain scientists and computational science experts that extend the power of exascale computing to the Nation's most pressing research challenges. Industrial users of LCFs often prompt their companies to invest in their own HPC resources, which benefit from ASCR's investments that reduce risk for vendors and enable pioneering product lines for larger markets. The LCFs' experienced staff deploy cutting edge technologies and conduct scaling tests, while providing direct support to users, early science application teams, and HPC software innovators.

The FY 2027 Request for this activity supports operation and competitive allocation of the OLCF at ORNL, including the Nation's first exascale computing system, an HPE-Cray/AMD exascale system (Frontier), deployed in 2021. The Request also supports the Quantum Computing User Program, IRI efforts for the AmSC, advanced testbeds, and supporting resources.

The FY 2027 Request for this activity supports operation and competitive allocation of the ALCF at ANL, including the Nation's second exascale and DOE's most AI capable system, an Intel/HPE-Cray system (Aurora) deployed in 2023, and the 44 PF HPE/AMD/NVIDIA testbed (Polaris), the AI testbed, IRI efforts for the AmSC, and supporting resources.

The ALCF and OLCF systems are architecturally distinct, consistent with DOE's strategy to manage enterprise risk, provide the Nation's HPC user community with the most effective resources, explore diverse advanced computing, AI, and QIS technologies, and expand U.S. competitiveness. The demand for 2025 INCITE allocations at the LCFs outpaced the available resources by a factor of three, the 2025–2026 ALCC demand outpaced resources by a factor of five, and demand continues to increase as industry and interagency partners adopt exascale technologies and as users leverage the LCFs for a wide range of AI applications. The FY 2027 Request for the LCFs will continue implementation of the OLCF-6 and ALCF-4 upgrade projects, cultivate vendor partnerships to spur innovation of strategic value and to drive U.S. competitiveness, expand access to cutting edge AI and quantum hardware, and develop new services essential to the Genesis Mission.

High Performance Network Facilities and Testbeds

The FY 2027 Request for this activity supports ESnet, SC's high performance network user facility, providing world-leading wide-area network access for all of DOE. ESnet is widely recognized as a global leader in the research and education network community, with a multi-decade track record of developing innovative network architectures and services, regularly achieving lossless high-volume low-latency data transmission designed for 99.9 percent uptime for connected sites. The ESnet backbone network spans the continental U.S. and the Atlantic Ocean, connecting all 17 DOE National Laboratories and dozens of DOE sites to 200+ research and commercial networks around the world, enabling many tens of thousands of scientists across the country to access data and research resources. ESnet supports the data transport needs of all SC user facilities. The expert staff at ESnet operate the current generation network, ESnet6, leveraging its unique data transport orchestration, automation, and programmability features to advance the American Science Cloud for the Genesis Mission, and DOE's data-intensive science goals. The FY 2027 Request for ESnet will continue to invest in site resiliency improvements across the DOE complex and will leverage ESnet6 to develop advanced services to support DOE priority R&D thrusts, and will also support initial planning for the ESnet7 upgrade project.

Integrated Research Infrastructure (IRI)

The FY 2027 Request for IRI Operations will support the core governance and services spanning across all ASCR Facilities and the HPDF project to meet the Department's AI research requirements and uplift the AmSC. IRI activities will translate Genesis Mission architecture and security requirements, such as interface standards, user vetting, and workflow authentication and authorization, into coherent practice across the ASCR Facilities to continually improve frictionless interoperability for the broader AmSC effort integrating SC's experimental and observational scientific user facilities, data assets, and AI tools. IRI supports DOE's Genesis Mission vision for researchers to effortlessly combine these tools in novel ways to radically increase scientific productivity for competitive advantage.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
High Performance Computing and Network Facilities	**$783,708**	**$781,846**	**-$1,862**
High Performance Production Computing	$170,328	$183,000	+$12,672
Funding supports operations at the NERSC user facility, including user support, power, space, system leases, staff, and the NERSC-10 upgrade project at the CD-2 baseline level. Funding sustains support for implementation of IRI and ECP software and technologies critical to HPC operations and users.		The Request will support operations at the NERSC user facility, including user support, power, space, system leases, staff, and the NERSC-10 upgrade project at the CD-2 baseline level. The Request will sustain support for ECP software and technologies critical to HPC operations and users and NERSC's integration with the AmSC.	The funding will support the Genesis Mission NERSC operations and the NERSC-10 upgrade project at the CD-2 baseline level as the project enters the Doudna system delivery phase.
National Energy Research Scientific Computing Center (NERSC)	*$154,328*	*$151,000*	*-$3,328*
Funding continues support for operations at the NERSC user facility, including user support, power, space, system leases, and staff. Funding also supports the NERSC-10 upgrade project at the CD-2 baseline level, and full operations and allocation of the NERSC-9 Perlmutter system. In addition, funding supports implementation of IRI and ECP software and technologies critical to HPC operations and users. Funding continues support for exploratory efforts in AI and quantum computing to benefit the NERSC user community.		The Request will support operations at the NERSC user facility, including user support, power, space, system leases, and staff. The Request will also support the NERSC-10 upgrade project at the CD-2 baseline level, and full operations and allocation of the NERSC-9 Perlmutter system. In addition, funding will support ECP software and technologies critical to HPC operations and users and NERSC's integration with the AmSC. The Request continues support for exploratory efforts in AI and quantum computing to benefit the NERSC user community and advance DOE priorities.	The funding will support NERSC operations, and the NERSC-10 upgrade project at the CD-2 baseline level as the project enters the Doudna system delivery phase.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
High Performance Data Facility, OPC *$16,000*	*$32,000*	*+$16,000*
Funding provides support to complete the design of HPDF with options for phased installation in the future.	The Request provides funding to pursue CD-2/3 approval for HPDF.	The Request provides funding to pursue CD-2/3 approval for HPDF, preserving options to meet the urgency of the Department's mission needs in data-intensive research and AI.
Leadership Computing Facilities $513,000	$490,000	-$23,000
Funding continues support for operations at LCF facilities at ANL and ORNL, including user support, power, space, system leases, early access systems and testbeds, and staff. Funding also supports operations and allocation of exascale systems at OLCF and ALCF. Funding supports implementation of major upgrade projects; AI testbeds; user access to commercial quantum systems; vendor partnerships; and IRI. The LCFs continues support for ECP software and technologies critical to HPC operations and users.	The Request will support operations at LCF facilities at ANL and ORNL, including user support, power, space, system leases, early access systems and testbeds, and staff. The Request will support operations and allocation of exascale systems at OLCF and ALCF. The Request will grow support implementation of major upgrade projects; novel AI computing platforms for the AmSC; AI testbeds; user access to commercial quantum systems; and vendor partnerships. The LCFs will continue support for ECP software and technologies critical to HPC operations and users.	The funding will support the Genesis Mission, LCF operations, the OLCF-6 project at the target baseline as the project enters the Discovery system delivery phase, and implementation of the ALCF-4 project.
Leadership Computing Facility at ANL *$238,000*	*$225,000*	*-$13,000*
Funding supports operations and competitive allocation of the Aurora exascale system and the AI Testbed. Funding supports implementation of the ALCF-4 upgrade project. Funding continues to support implementation of IRI. ALCF continues to deploy and maintain ECP software and technologies critical to HPC operations and users.	The Request will support operations and competitive allocation of the Aurora exascale system and the AI Testbed. The Request will support implementation of the ALCF-4 upgrade project and novel AI computing platforms for the AmSC. ALCF will continue to deploy and maintain ECP software and technologies critical to HPC operations and users.	The funding will support ALCF operations and implementation of the ALCF-4 upgrade project and novel AI computing platforms for the AmSC.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Leadership Computing Facility at ORNL *$275,000*	*$265,000*	*-$10,000*
Funding supports operations at the OLCF facility, including user support, power, space, maintenance, and staff. Funding supports the OLCF-6 upgrade project at the target baseline. Funding supports operation and competitive allocation of the Frontier exascale system and the user access program for commercial quantum computing platforms. The Request also will support implementation of IRI. OLCF continues to deploy and maintain ECP software and technologies critical to HPC operations and users.	The Request will support operations at the OLCF facility, including user support, power, space, maintenance, and staff. The Request will support the OLCF-6 upgrade project at the target baseline. The Request will also support operation and competitive allocation of the Frontier exascale system, access to novel quantum hardware, and the user access program for commercial quantum computing platforms. OLCF will continue to deploy and maintain ECP software and technologies critical to HPC operations and users.	The funding will support OLCF operations and the OLCF-6 upgrade project at the target baseline as the project enters the Discovery system delivery phase.
High Performance Network Facilities and Testbeds $97,261	$103,000	+$5,739
Funding supports operations of ESnet at 99.9 percent reliability, including user support, operations and maintenance of equipment, fiber leases, R&D testbed, and staff. Funding also supports site resiliency investments and implementation of IRI.	The Request will support operations of ESnet at 99.9 percent reliability, including user support, operations and maintenance of equipment, fiber leases, R&D testbed, and staff. Funding also supports site resiliency investments, and the networking requirements for AI efforts and the AmSC. Planning efforts begin for the ESnet7 upgrade project.	The funding will support the Genesis Mission, ESnet operations, implementation of site resiliency improvements, networking requirements for AI efforts and the AmSC. Planning efforts begin for the ESnet7 upgrade project.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Integrated Research Infrastructure $3,119	$5,846	+$2,727
Funding supports continuation of IRI community governance activities and software engineering for core IRI operations services.	The Request will support continuation of IRI community governance activities and software engineering for core IRI operations services that are instrumental to the AmSC.	The funding will support limited expansion of software engineering efforts that are instrumental to the AmSC and the Genesis Mission.

Advanced Scientific Computing Research
Capital Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Capital Operating Expenses						
Capital Equipment	N/A	N/A	5,000	5,000	5,000	–
Total, Capital Operating Expenses	**N/A**	**N/A**	**5,000**	**5,000**	**5,000**	**–**

Capital Equipment

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Capital Equipment						
Major Items of Equipment						
Total, MIEs	N/A	N/A	–	–	–	–
Total, Non-MIE Capital Equipment	N/A	N/A	5,000	5,000	5,000	–
Total, Capital Equipment	**N/A**	**N/A**	**5,000**	**5,000**	**5,000**	**–**

Note:
- *The Capital Equipment table includes MIEs with a Total Estimated Cost (TEC) > $10M.*

Scientific User Facility Operations

The treatment of user facilities is distinguished between two types: TYPE A facilities that offer users resources dependent on a single, large-scale machine; TYPE B facilities that offer users a suite of resources that is not dependent on a single, large-scale machine.

(dollars in thousands)

	FY 2025 Enacted	FY 2025 Current	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Scientific User Facilities - Type A					
National Energy Research Scientific Computing Center	**146,500**	**146,800**	**154,328**	**151,000**	**-3,328**
Number of Users	10,750	11,719	11,000	11,000	–
Planned Operating Hours	8,585	8,585	8,585	8,585	–
Argonne Leadership Computing Facility	**215,195**	**215,195**	**238,000**	**225,000**	**-13,000**
Number of Users	1,700	2,103	1,800	1,800	–
Planned Operating Hours	7,008	7,008	7,008	7,008	–
Oak Ridge Leadership Computing Facility	**260,000**	**260,000**	**275,000**	**265,000**	**-10,000**
Number of Users	1,800	1,738	1,900	1,900	–
Planned Operating Hours	7,008	7,008	7,008	7,008	–
Energy Sciences Network	**93,540**	**93,540**	**97,261**	**103,000**	**+5,739**
Number of Users	–	169	–	–	–
Planned Operating Hours	8,760	8,760	8,760	8,760	–
Total, Facilities	**715,235**	**715,535**	**764,589**	**744,000**	**-20,589**
Number of Users	14,250	15,729	14,700	14,700	–
Planned Operating Hours	31,361	31,361	31,361	31,361	–

Note:
- *Achieved Operating Hours and Unscheduled Downtime Hours will only be reflected in the Congressional budget cycle which provides actuals.*
- *Percent optimal operations defines what is achieved at this funding level. This includes staffing, up-to-date equipment and software, operations and maintenance, and appropriate investments to maintain world leadership.*

Advanced Scientific Computing Research
Scientific Employment

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Number of Permanent Ph.Ds (FTEs)	811	850	850	–
Number of Postdoctoral Associates (FTEs)	341	386	386	–
Number of Graduate Students (FTEs)	510	542	542	–
Number of Other Scientific Employment (FTEs)	219	217	217	–
Total Scientific Employment (FTEs)	**1,881**	**1,995**	**1,995**	**–**

Note:

- *Other Scientific Employment (FTEs) includes technicians, engineers, computer professionals and other support staff.*

Basic Energy Sciences

Overview
Accelerating progress in critical and emerging technologies requires the discovery, design, and control of materials and chemical systems across wide scales of time and space. Such R&D drives innovation—in next-generation microelectronics and qubit platforms; in fusion, advanced nuclear fission, and enhanced geothermal energy; and in the critical minerals and materials needed for these technologies. The Basic Energy Sciences (BES) program addresses these needs through a broad portfolio of fundamental research and enabling capabilities that provide the discoveries needed to invent, develop, and deploy next-generation technologies. Through partnership with industry and other DOE programs, BES enables critical R&D to advance the promising nearer-term technologies.

The Department's Genesis Mission seeks to build the world's most powerful discovery platform by connecting the Nation's scientific infrastructure with purpose-built AI models and comprehensive datasets. The BES program provides an unmatched source of AI-ready data, as well as development of physics-informed AI-models that will leverage these data. Further, the scientific discoveries from BES-supported research and scientific user facilities are a primary source of new knowledge needed for the discovery platforms of the future.

Maintaining U.S. leadership requires fundamental research and next-generation tools to generate the knowledge needed for technology development critical to economic and national security. The BES mission is to support fundamental research to understand, predict, and control matter and energy at the electronic, atomic, and molecular levels. This research forms the basis for innovations in energy generation, conversion, transmission, and storage, as well as technologies for quantum information science, microelectronics, and critical minerals and materials. BES achieves this through sustained investment in leading-edge scientific research and stewardship of twelve world-class scientific user facilities.

The research disciplines that BES supports, touches virtually every aspect of energy resource production, conversion, transmission, and storage, providing a knowledge base for a secure, abundant, and affordable energy future. BES research similarly provides discoveries that advance innovation in microelectronics, QIS, and AI, and create the foundation of new knowledge required to invent the technologies of the future. This sustained mission-relevance of BES research is due to a long-standing, community-driven strategic planning process, resulting in a portfolio of investments balanced between discovery-oriented transformational basic research and use-inspired basic research.

BES scientific user facilities consist of complementary x-ray and neutron sources, and centers for nanoscale science. BES facilities probe systems at ultrahigh spatial, temporal, and energy resolution to investigate the critical functions of matter that provide answers to challenging science questions and insights on the scientific basis for new technologies. These facilities provide an unmatched source of data for AI model training under the Genesis Mission. Further, ongoing facility upgrades will dramatically increase data volumes and rates, and generate data that is currently inaccessible. BES has a long history of delivering major construction projects on time and on budget, and of providing reliable availability and support to users,[a] including rigorous community engagement in planning and performance assessment.

Exploiting scientific discoveries for future energy systems requires creation of new materials and chemistries using innovative synthesis and processing techniques to precisely define atomic arrangements, and discovery and design of chemical processes. These innovations, based on principles revealed by fundamental science and using experimental tools integrated with advanced computational, AI, and data science, enable better control of physical and chemical transformations and conversions of energy from one form to another. This generates

[a] https://www.gao.gov/assets/gao-08-641.pdf

knowledge for the development and improvement of energy-relevant technologies and industrial processes. BES research is further informed by practical technology challenges with findings disseminated to the community to translate federal investments to industrial impact and economic prosperity.

The grand challenge and use-inspired scientific research that is necessary to address National priorities requires a sustained and integrated ecosystem of scientists, engineers, and enabling capabilities. BES research and facilities provide a significant strategic advantage for the Nation to advance scientific frontiers while laying the foundation for future innovations that will sustain American scientific, technological, and energy dominance.

Highlights of the FY 2027 Request

The BES FY 2027 Request of $2,146.1 million is a decrease of $382.3 million below the FY 2026 Enacted level.

<u>Research</u>

Guided by strategic planning and current Departmental priorities, including the Genesis Mission, the Request underscores continued support for Energy Frontier Research Centers (EFRCs), National Quantum Information Science Research Centers (NQISRCs), and BES core scientific research programs. Continued funding for the Established Program to Stimulate Competitive Research (EPSCoR) will maintain support of institutions in U.S. states and territories that do not historically have large federally supported academic research programs, thereby enhancing research and user communities from across the Nation to ensure a strong scientific foundation in the BES ecosystem. The FY 2027 Request:

- Increases funding for artificial intelligence and machine learning (AI/ML) research in support of the Genesis Mission, accelerating fundamental discoveries, enhancing user facility operations, and advancing interpretation of massive data sets. As part of this portfolio, BES will emphasize efforts focused on AI/ML for science within the Theoretical Condensed Matter Physics and Computational and Theoretical Chemistry programs.
- Increases funding for QIS research, which includes a robust core research portfolio and contributions from selected EFRCs to complement the NQISRCs.
- Continues funding for critical minerals and materials (CMM) research to expand understanding of the role of rare earth elements, platinum-group elements, and other critical elements in determining the functional properties of materials and catalysts across different length scales, discover chemical processes and materials that can enhance recovery and reuse of critical elements, and develop fundamental knowledge of how best to reduce or eliminate the need for critical elements in chemical processes and energy technologies.
- Continues funding for the energy innovation hub program addressing basic scientific challenges in both the batteries and energy storage and fuels from sunlight areas. The hub program focuses on collaborative research to overcome key scientific barriers for major energy challenges that require large, multidisciplinary teams to provide the required science foundations and innovations.
- Continues funding for multi-disciplinary microelectronics research in which materials, chemistries, devices, systems, architectures, algorithms, and software are developed in a closely integrated, co-design approach. As part of this portfolio, the Microelectronics Science Research Centers (MSRCs) comprise a network of multiple team awards, with individual awards focused on a dimension related to a common research topic for each center. The multidisciplinary teams include researchers from national laboratories, universities, and industry. The Request will enable support for BES research awards that contribute to these cross-SC Research Centers.
- Continues funding for the highest priority research that provides foundational knowledge for the development of next-generation energy technologies.

Facility Operations

The Request balances support for user access with the need to ensure safe operations of five BES-supported x-ray light sources, two neutron sources, and five Nanoscale Science Research Centers (NSRCs). In support of the Genesis Mission, the Request provides continued support for development and implementation of novel AI-based approaches to facility operation and data analysis that enhances efficiency across the facility and within the user community. Preconceptual planning continues for beamline MIE projects.

Projects

Support continues for the Linac Coherent Light Source-II High Energy (LCLS-II-HE), Second Target Station (STS), and Cryomodule Repair and Maintenance Facility (CRMF) line-item projects. Funding is requested for the Advanced Light Source Upgrade (ALS-U) line-item project consistent with a new project baseline budget to be established in FY 2026. Funding for the NSLS-II Experimental Tools (NEXT)–III and High Flux Isotope Reactor (HFIR) Pressure Vessel Replacement (PVR) projects is deferred.

Basic Energy Sciences
Funding

(dollars in thousands)

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Basic Energy Sciences				
Scattering and Instrumentation Sciences Research	81,396	68,324	16,772	-51,552
Condensed Matter and Materials Physics Research	205,714	198,896	128,354	-70,542
Materials Discovery, Design, and Synthesis Research	87,297	78,587	35,093	-43,494
Established Program To Stimulate Competitive Research EPSCoR	25,000	25,000	25,000	–
Energy Frontier Research Centers - Materials	65,000	65,000	58,419	-6,581
Energy Earthshot Research Centers - Materials	3,500	–	–	–
Energy Innovation Hubs - Materials	25,913	25,913	25,913	–
Computational Materials Sciences	13,492	4,000	3,683	-317
Total, Materials Sciences and Engineering	**507,312**	**465,720**	**293,234**	**-172,486**
Fundamental Interactions Research	140,593	140,599	90,723	-49,876
Chemical Transformations Research	114,658	100,861	42,577	-58,284
Photochemistry and Biochemistry Research	99,710	86,009	30,848	-55,161
Energy Frontier Research Centers - Chemical	65,000	65,000	60,151	-4,849
Energy Earthshot Research Centers - Chemical	3,500	–	–	–
Energy Innovation Hubs - Chemical	20,758	20,758	20,758	–
General Plant Projects - Chemical	1,000	1,000	1,000	–
Computational Chemical Sciences	13,492	4,000	3,683	-317
Total, Chemical Sciences, Geosciences, and Biosciences	**458,711**	**418,227**	**249,740**	**-168,487**
X-Ray Light Sources	778,865	867,675	868,226	+551
High-Flux Neutron Sources	373,367	297,993	380,026	+82,033
Nanoscale Science Research Centers	159,230	177,304	175,570	-1,734
Other Project Costs	9,500	23,100	5,000	-18,100
Scientific User Facilities, Research	67,800	45,624	30,541	-15,083
Total, Scientific User Facilities (SUF)	**1,388,762**	**1,411,696**	**1,459,363**	**+47,667**
Subtotal, Basic Energy Sciences	**2,354,785**	**2,295,643**	**2,002,337**	**-293,306**
Construction				
24-SC-10 HFIR Pressure Vessel Replacement (PVR), ORNL	6,000	6,000	–	-6,000
24-SC-12 NSLS-II Experimental Tools - III (NEXT-III), BNL	5,500	5,500	–	-5,500

	(dollars in thousands)			
	FY 2025 Enacted	**FY 2026 Enacted**	**FY 2027 Request**	**FY 2027 Request vs FY 2026 Enacted**
21-SC-10 Cryomodule Repair & Maintenance Facility (CRMF), SLAC	20,000	20,000	7,800	-12,200
19-SC-14 Second Target Station (STS), ORNL	52,000	52,000	80,000	+28,000
18-SC-12 Advanced Light Source Upgrade (ALS-U), LBNL	50,000	50,000	50,000	–
18-SC-13 Linac Coherent Light Source-II-High Energy (LCLS-II-HE), SLAC	100,000	99,343	6,000	-93,343
Subtotal, Construction	**233,500**	**232,843**	**143,800**	**-89,043**
Total, Basic Energy Sciences	**2,588,285**	**2,528,486**	**2,146,137**	**-382,349**

Basic Energy Sciences
Explanation of Major Changes

	(dollars in thousands) FY 2027 Request vs FY 2026 Enacted
Materials Sciences and Engineering Research will continue to support fundamental scientific opportunities for materials innovations. Research priorities include energy technologies (e.g., nuclear fission, fusion, energy storage, and grid), microelectronics research (including the MSRCs), AI/ML, CMM, and QIS. The Request also includes funding for continued support of the EFRCs, the Batteries and Energy Storage Energy Innovation Hub, the NQISRCs, and EPSCoR.	**-$172,486**
Chemical Sciences, Geosciences, and Biosciences Research will continue to support fundamental scientific opportunities for innovations in chemistry, geosciences, and biosciences. Research priorities include energy (e.g., geothermal, fuels and high commodity chemicals), AI/ML, QIS, microelectronics (including the MSRCs), and CMM. The Request also includes funding for continued support of the EFRCs, the NQISRCs, and the Energy Innovation Hub.	**-$168,487**
Scientific User Facilities (SUF) The 12 BES user facilities will be supported in a manner balancing safe operation and user access. Continued facilities research priorities include accelerator and detector R&D and AI/ML. The Request also provides Other Project Costs (OPC) to support the STS project.	**+$47,667**
Construction The Request provides continuing support for the LCLS-II-HE, STS, CRMF, and ALS-U projects.	**-$89,043**
Total, Basic Energy Sciences	**-$382,349**

Basic and Applied R&D Coordination
As a program that supports fundamental scientific research relevant to many DOE mission areas, BES strives to build and maintain close connections with other DOE program offices. BES coordinates with DOE R&D programs through a variety of Departmental activities, including workshops, strategic planning activities, solicitation development, and program review, as elaborated below. BES also works closely with representatives from technology offices and the National Nuclear Security Administration on shared priorities established under the Department's Genesis Mission.

BES has robust interactions with DOE technology offices through formal and informal coordination activities. Historically, co-siting of research by BES and other DOE programs at the same institutions has facilitated close integration of basic and applied research. The DOE national laboratory system plays a crucial role in achieving this integration of basic and applied research.

BES program managers also participate in intra-DOE information exchange and coordination on solicitations and in program reviews and project selections. These activities facilitate cooperation and coordination between BES and other parts of DOE, notably the energy technology offices.

Program Accomplishments

- The Linac Coherent Light Source at SLAC National Accelerator Laboratory successfully deployed a new machine learning-based (ML-based) algorithm for automated emittance tuning of both the normal conducting and superconducting linacs. Facility operators were able to achieve a 2x improvement in beam emittance automatically with a 10x speed up in time relative to manual tuning (15-20 minutes vs. hours). The success of this ML-based approach will provide uses with improved signal quality in less experimental time, and will open the door to further operational improvements previously seen as inaccessible to facility operators.
- A team of university and DOE National Laboratory researchers discovered new fundamental physics in a class of materials called rare earth-based pyrochlores that offers exciting new opportunities for the development of quantum technologies. The team made two significant discoveries. First, they measured a rare phenomenon known as "electronic anisotropy" at the interface of two pyrochlores, presenting new opportunities to develop exquisitely sensitive quantum sensors. Second, they directly observed persistent, gapped magnon modes above the temperature at which long-range magnetic ordering is lost, challenging previous assumptions and offering new pathways to study spin liquids that hold promise for fault tolerant quantum computing.
- Researchers from a DOE National Laboratory and U.S. company made a breakthrough in the development of compact free electron lasers (FELs). The team demonstrated the ability to reliably and stably produce high energy, high brightness electron beams from a plasma and pass them through an undulator to produce a nearly 1000x exponential gain in FEL light. Realizing compact FEL systems based on plasma acceleration offers significant opportunity to expand the utilization of FELs for scientific discovery, as well as for industrial applications, including microelectronics fabrication.
- Researchers from a DOE National Laboratory and U.S. university discovered an unexpected "quantum echo" in superconducting niobium materials using advanced Terahertz (THz) spectroscopy techniques. Further, such THz radiation pulses could be used to encode, store, and retrieve quantum information within such superconducting niobium materials, offering new pathways to realize practical quantum information storage and processing.
- Researchers from a DOE National Laboratory-led Energy Frontier Research Center, have discovered a new, lower-cost solution to separating lithium from other elements in seawater and underground saltwater

reserves. The team's new membrane is based on a widely available, low-cost clay called vermiculate. Using their new process, the team separated the clay into ultra-thin layers and reassembled them into stacks supported by aluminum oxide pillars, helping the materials to avoid degradation in water. Lithium ion selectivity was enabled through introduction of sodium cations in the membrane, allowing for discrimination of other ions by both size and charge. Further development of this approach may enable recovery of other critical elements.

- The Advanced Photon Source (APS) at Argonne National Laboratory (ANL) measured a horizontal emittance of 33 picometers-radians, the lowest ever emittance measured at such a facility and approximately three times better than the previous record held by China's High Energy Photon Source. The measurements cemented the facility as the most advanced synchrotron X-ray light source in the world and underscored the success of the APS Upgrade project. The benefits of lower beam emittance, including improved signal-to-noise ratios, increased efficiency of beamtime, and expanded science opportunities, will yield new scientific discoveries across a broad range of areas critical to the nation, including microelectronics, quantum materials, energy storage, and medicine.
- Researchers from a DOE National Laboratory discovered "berkelocene," the first demonstration that the heavy element berkelium can be bonded with carbon. Electronic calculations of the highly symmetrical sandwich structure indicated that the berkelium atom at its center behaved in an unexpected manner, showing that actinides cannot be treated like lanthanides and providing new insights for the separation of complicated radioactive mixtures.
- A team of researchers from DOE National Laboratories and a large public company built novel tools for molecular screening. The collaboration leveraged software developed at one of the DOE laboratories to predict the 3D structure of metal complexes. The metal complexes represent an important class of chemistry explored in the dataset that is relevant to many fields in energy, biology, and materials science. The immense data generated can be used to train machine learning models at a fraction of time and cost. This work is potentially transformative for scientific discovery as these tools are open to the public and available to researchers who can use the data and models relevant to their own research.
- Researchers from a U.S. university discovered a new state of matter in rhombohedral graphene. At low temperatures, this material behaves as both a superconductor and a magnet. The material was found to host two superconducting states that can be switched using an applied magnetic field, which is only possible if the superconducting material has intrinsic orbital magnetism. The result strongly suggests a type of exotic superconductivity called chiral that has been hypothesized in a few complex materials but never observed in a naturally occurring material. This result increases the likelihood of achieving understanding and control of highly sought topological superconductivity, which could be revolutionary for error resistant quantum computing.

Description

Materials are critical to nearly every aspect of energy generation, storage, transmission, and end-use, as well as numerous other critical technologies, including in the areas of quantum information science (QIS) and microelectronics. Materials limitations are often a significant barrier to longer lifetimes of infrastructure and devices, the introduction of new energy technologies, or improved energy efficiencies. The Materials Sciences and Engineering (MSE) subprogram supports research to provide the fundamental understanding and control of materials synthesis, properties, and functionality that will enable solutions to challenges in energy generation, storage, and use. The research explores the origin of macroscopic material behaviors; their fundamental connections to atomic, molecular, and electronic structures; and their evolution as materials move from nanoscale building blocks to mesoscale systems. At the core of the subprogram is experimental, theoretical, computational, and instrumentation research that will enable the predictive discovery, design, and characterization of new materials with novel structures, properties, and functions. To accomplish these goals, the portfolio includes three integrated research activities:

- Scattering and Instrumentation Sciences Research
- Condensed Matter and Materials Physics Research
- Materials Discovery, Design, and Synthesis Research

The Request continues the highest-priority fundamental research that supports the DOE mission, including the Genesis Mission, and establishes the foundational knowledge necessary to accelerate innovation to advance energy technologies, critical emerging technologies, and other national priorities. The portfolio emphasizes understanding of how to direct and control energy flow in materials systems over multiple time and length scales, and translation of this understanding to prediction of material behavior, transformations, and processes in challenging real-world systems. This will establish a foundational knowledge base for future advanced energy and information technologies, as well as industrial processes. The research supported explores a broad spectrum of materials science, including new frontiers of emergent materials behavior; utilization of nanoscale control; and metastable or far from equilibrium materials systems that enable novel materials design and advanced manufacturing.

Research activities in quantum materials emphasize the development of systems that realize unique properties required for QIS technologies. Materials science for microelectronics provides the advances needed for future computing, sensors, detectors, and communication critical for energy and for leadership in advanced research. An increasingly important aspect of materials research is the development and use of artificial intelligence/machine learning (AI/ML) and data science techniques to enhance the utility of both theoretical and experimental data for predictive design and discovery of materials. The MSE subprogram supports the development of advanced characterization tools, instruments, and techniques that can access a wide range of space and time scales, especially in combination and under operando conditions to analyze non-equilibrium materials, conditions, and excited-state phenomena. In addition to a multifaceted portfolio of single-investigator and small-group research projects, the MSE subprogram supports multi-investigator, multi-disciplinary team-science research modalities, including Energy Frontier and Microelectronics Science Research Centers, Energy Innovation Hubs, Computational Materials Sciences, and the National QIS Research Centers (NQISRCs). This subprogram also includes the DOE Established Program to Stimulate Competitive Research (EPSCoR) program to broaden investments in foundational science and early-stage energy research for U.S. states and territories that do not historically have large federally supported academic research programs.

Scattering and Instrumentation Sciences Research

This activity supports innovative techniques and instrumentation development for advanced materials science research with scattering, spectroscopy, and imaging using electrons, neutrons, and x-rays, including development of science to understand ultrafast dynamics. These techniques provide precise and complementary information about the relationship among structure, dynamics, and properties, and are critical in advancing understanding and discovery of novel quantum materials, including materials for next-generation systems to advance microelectronics and QIS. The tools and capabilities developed in this activity are broadly applicable to other fields, including chemistry, biology, and geoscience. The unique interactions of electrons, neutrons, and x-rays with matter enable a range of complementary tools with different sensitivities and resolution for the characterization of systems at length- and time-scales spanning many orders of magnitude. Included is the use of cryogenic environments to evaluate properties only occurring at low temperatures and to learn about processes and interfaces in materials damaged by the probes used to characterize them. In parallel with the development of advanced instrumentation, application of novel data science approaches, including those leveraging AI/ML, to improve the collection, processing, and analysis of very large data sets is critical to ensuring optimal use of such instruments in support of the Genesis Mission.

Condensed Matter and Materials Physics Research

This activity supports fundamental experimental and theoretical research to discover, understand, and control novel phenomena in solid materials. These electronic, magnetic, optical, thermal, and structural materials make up the infrastructure for innovative energy advances, accelerator and detector technologies for SC facilities, and microelectronics and QIS. This activity supports research to understand the role of critical materials in determining material properties and functionality, so that they can be reduced or eliminated from key energy technology supply chains.

Experimental research in this activity emphasizes discovery and characterization of materials' properties that have the potential to be exploited for new technological functionalities. Complementary theoretical research aims to explain such properties across a broad range of length- and time-scales. Theoretical research also includes development and integration of predictive theory and modeling for the discovery of materials with targeted properties. Advanced computational and data science techniques, including AI/ML, are enabling knowledge to be extracted from large materials databases of theoretical calculations and experimental measurements. This activity supports the development of such databases, the computational tools that can take advantage of them, and innovative physics-guided AI approaches to accelerate discovery in support of the Genesis Mission. This activity continues to emphasize understanding and control of quantum materials. The research advances the fundamental understanding of electronic, magnetic, thermal, and optical properties relevant to energy-efficient microelectronics and QIS. Specifically, the MSE subprogram's dedicated QIS portfolio supports fundamental research with potentially transformative impact on the development and characterization of qubit platforms for future quantum computing, sensing, and communication systems. Activities also emphasize research to understand how materials respond to temperature, light, radiation, corrosive chemicals, and other environmental conditions.

In FY 2027, BES will continue to partner with other SC programs in the NQISRC program. NQISRC research supported by the MSE subprogram includes theory of materials for quantum applications in computing, communication, and sensing; device science for next-generation QIS systems; and synthesis, fabrication, and characterization of quantum materials. BES will also continue to partner with other SC programs on activities to support multi-disciplinary basic research to accelerate the advancement of microelectronic technologies in a co-design innovation ecosystem, where the design of materials, devices, architectures, and algorithms are integrated as part of a single R&D pipeline.[b] BES contributes to the SC Microelectronics Science Research Centers (MSRCs) program, a portfolio of awards that support research in energy efficiency for microelectronics

[b] https://science.osti.gov/-/media/bes/pdf/reports/2019/BRN_Microelectronics_rpt.pdf

or their operation in extreme environments. Materials, chemistries, devices, systems, architectures, algorithms, and software are being developed in tandem.

Materials Discovery, Design, and Synthesis Research

This activity supports the predictive design, discovery, and development of new materials with desired properties, which is the engine that drives science frontiers and technology innovations. It aims to grow and maintain U.S. leadership in materials discovery by investing in advanced synthesis capabilities and by coupling these with state-of-the-art user facilities and advanced computational capabilities at DOE laboratories, generating scientific knowledge that is foundational to the BES mission.

The FY 2027 Request continues support of materials discovery and synthesis research to understand the unique properties of critical materials, with the goal of reducing their use. Understanding the science of synthesis will enable the design of new systems that are easier to efficiently convert into similar products with comparable or enhanced complexity, functionality, and value. The activity also supports fundamental research in solid-state chemistry to enable discovery of new functional materials and the development of new crystal growth methods and thin film deposition techniques to create complex materials with targeted structure and properties. In addition to research on chemical and physical synthesis processes, the portfolio includes research to understand how to use bio-mimetic and biology-inspired approaches to design and synthesize novel materials with some of the unique properties found in nature. The activity supports the development of new AI/ML-based approaches aimed at accelerating materials discovery and enabling scalable, automated synthesis with real-time adaptive control in support of the Genesis Mission.

Established Program to Stimulate Competitive Research (EPSCoR)

The DOE EPSCoR program funds fundamental and early-stage research that supports DOE's science and energy mission in states and territories with historically lower levels of federal academic research funding. The program emphasizes research that will improve the capability of designated states and territories to conduct nationally competitive fundamental and early-stage energy-related research; jumpstart research capabilities through workforce development in energy-related areas; and build beneficial relationships between scientists and engineers in the designated jurisdictions and DOE laboratories. Managed by BES, funding for the EPSCoR program is distributed among the six major research programs within SC.[c] Annual EPSCoR funding opportunities alternate between research performed in collaboration with the DOE laboratories and larger-team implementation awards. The FY 2027 program is planned to emphasize Implementation awards to establish larger, multi-investigator teams that will develop research capabilities, including investment in instrumentation, in EPSCoR jurisdictions. The technical scope will focus on the research topics supported by SC program offices and early-stage energy research broadly. The program will continue to support other SC programs, including the Early Career Research Program.

Energy Frontier Research Centers

The EFRC research modality brings together the skills and talents of teams of investigators to combine discovery science and energy-relevant basic research whose scope and complexity is beyond what is possible from single-investigator or small-group awards. These multi-investigator, multi-disciplinary centers aim to accelerate basic research to enable transformative scientific advances and uncover new and innovative solutions to the most difficult problems in materials sciences. EFRCs supported in this subprogram focus on the design, discovery, synthesis, characterization, and understanding of novel, solid-state materials that generate and convert energy; the understanding of materials and processes foundational for electrical energy storage; quantum materials and QIS; microelectronics; and materials for future nuclear energy. The development and application of novel AI/ML-based tools and techniques for scientific discovery throughout the EFRC portfolio

[c] Per direction in the explanatory statement accompanying the FY 2023 Consolidated Appropriations Act

contributes to the Department's Genesis Mission. The FY 2027 Request continues support for EFRC awards made in prior fiscal years.

Energy Innovation Hubs

The Batteries and Energy Storage Energy Innovation Hub program will continue to tackle forefront, basic scientific challenges for next-generation electrochemical energy storage. Hubs focus on collaborative research to overcome key scientific barriers for major energy challenges that require large, multidisciplinary teams to provide the required science foundations and innovations. The Request will continue to support the Batteries and Energy Storage Energy Innovation Hub.

Computational Materials Sciences

This program has focused on research leading to computational codes and associated experimental/computational databases for the design of materials with advanced functionalities. This included development of new ab initio theory, contributing the generated data to databases; advanced characterization and controlled synthesis to provide the data to validate computational predictions; and design of computational codes to take advantage of DOE's world-leading exascale high-performance computers.

In FY 2027, the program will continue to focus on the development of novel AI/ML-based tools and techniques for accelerated scientific discovery in support of the Genesis Mission. Support for the maintenance and further development of high value, widely used software previously developed under the program may be considered based on program priorities.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Materials Sciences and Engineering $465,720	**$293,234**	**-$172,486**
Scattering and Instrumentation Sciences Research $68,324	$16,772	-$51,552
Funding continues to focus on the development and use of advanced characterization tools to extract information on multiple length and time scales. Advanced instrumentation research is applied to a breadth of national priorities, including QIS, microelectronics, critical minerals, energy science, and advanced industrial processes.	The Request will continue to focus on the development and use of advanced characterization tools to extract information on multiple length and time scales. Advanced instrumentation research will be applied to a breadth of national priorities, including QIS, microelectronics, critical minerals, energy science, and advanced industrial processes.	Reductions will be based on programmatic priorities.
Condensed Matter and Materials Physics Research $198,896	$128,354	-$70,542
Funding continues to emphasize the understanding and control of the fundamental properties of materials that are central to their functionality in a wide range of clean energy-relevant technologies. Exploration of quantum materials remains a high priority, specifically the role they play in microelectronics, accelerators, and QIS. The program continues to partner with other SC program offices in the NQISRCs and the MSRCs. Additional investments expand support for research to leverage AI/ML to accelerate materials discovery and characterization in support of the Genesis Mission.	The Request will continue to emphasize the understanding and control of the fundamental properties of materials that are central to their functionality in a wide range of energy-relevant technologies. Exploration of quantum materials remains a high priority, specifically the role they play in microelectronics, accelerators, and QIS. The program will partner with other SC program offices in the NQISRCs and the MSRCs. Investments will continue support for research to develop and leverage AI/ML to accelerate materials discovery and characterization in support of the Genesis Mission.	Reductions will be based on programmatic priorities.

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Materials Discovery, Design, and Synthesis Research	$78,587	$35,093	-$43,494
Funding continues support for the design, discovery, and synthesis of novel forms of matter with desired properties and functionalities with an emphasis on advancing the fundamental science relevant to future industrial processes and energy technologies, as well as developing and implementing novel AI-based techniques to accelerate synthesis and characterization in support of the Genesis Mission. Research on bio-mimetic and biology-inspired materials is relevant to energy technologies as well as other national priorities such as critical minerals and materials.		The Request will continue support for the design, discovery, and synthesis of novel forms of matter with desired properties and functionalities with an emphasis on advancing the fundamental science relevant to future industrial processes and energy technologies, as well as developing and implementing novel AI-based techniques to accelerate synthesis and characterization in support of the Genesis Mission. Research on bio-mimetic and biology-inspired materials is relevant to energy technologies as well as other national priorities such as critical minerals and materials.	Reductions will be based on programmatic priorities.
Established Program to Stimulate Competitive Research (EPSCoR)	$25,000	$25,000	$ —
Funding continues to support fundamental science and early-stage R&D, including research that underpins DOE energy technology programs. FY 2026 funding supports State-National Laboratory Partnership awards. Investment continues in early career research faculty from EPSCoR-designated jurisdictions and in co-investment with other initiatives.		The Request will continue to support fundamental science and early-stage R&D, including research that underpins DOE energy technology programs. FY 2027 will emphasize Implementation awards to establish larger, multi-investigator teams that develop research capabilities, including investment in instrumentation, in EPSCoR jurisdictions. Investment will continue in early career research faculty from EPSCoR-designated jurisdictions and in co-investment with other initiatives.	Funding will focus on Implementation awards, with the aim to improve the capability of designated states and territories to conduct sustainable and nationally competitive fundamental and early-stage energy-related research.

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Energy Frontier Research Centers	$65,000	$58,419	-$6,581
Funding provides the third year of support for four-year EFRC awards that were made in FY 2024. In addition, BES will recompete awards made in FY 2022, with emphasis on a broad range of topics relevant to energy and other national priorities.		The Request will provide the final year of support for four-year EFRC awards that were made in FY 2024 and the second year of support for four-year awards made in FY 2026.	Technical emphasis for the EFRC program will continue to include new research directions that cut across BES programmatic efforts, as well as those identified in recent strategic planning activities related to energy, QIS, microelectronics, and other national priorities.
Energy Innovation Hubs	$25,913	$25,913	$ —
Funding supports the fourth year of funding for Batteries and Energy Storage Hub award initiated in prior years through an open competition.		The Request will support the Batteries and Energy Storage Hub award initiated in prior years.	No change.
Computational Materials Sciences	$4,000	$3,683	-$317
The CMS activity supports the development of AI-based tools and techniques for materials discovery and characterization in support of the Genesis Mission. Support for the maintenance and further development of high value, widely used software previously developed under the program may be considered based on program priorities.		The CMS activity will continue to develop AI-based tools and techniques for materials discovery and characterization in support of the Genesis Mission. Support for the maintenance and further development of high value, widely used software previously developed under the program may be considered based on program priorities.	Fundamental research will target AI for accelerated scientific discovery to support the goals of the Genesis Mission.

Description

Development of innovative energy technologies relies on understanding and ultimately controlling transformations of energy among forms and conversions of matter across multiple scales starting at the atomic level. The Chemical Sciences, Geosciences, and Biosciences (CSGB) subprogram supports research to discover fundamental knowledge of chemical reactivity and energy conversion foundational to energy-relevant chemical processes, such as catalysis, synthesis, separations, and light-driven chemical transformations. The research addresses how physical and chemical phenomena at the scales of electrons, atoms, and molecules—including quantum phenomena—control complex and collective behavior of macroscopic-scale energy and matter conversion systems. Fundamental knowledge developed through this subprogram can enable science to tailor chemical transformations with atomic and molecular precision and achieve predictive understanding of complex chemical, geochemical, and biochemical systems.

To address these challenges, the portfolio includes coordinated research activities in three areas:

- Fundamental Interactions Research
- Chemical Transformations Research
- Photochemistry and Biochemistry Research.

The Request continues the highest-priority fundamental research that supports the DOE mission, including the Genesis Mission, and provides foundational knowledge that can advance affordable, reliable, and secure energy technologies. Research will discover and develop chemical processes that are energy and atom efficient and increase understanding of the phenomena relevant to QIS. This fundamental science can lead to new approaches for industrial processes, innovations in microelectronics, and reduced dependence on critical materials and minerals. Fundamental biochemistry will discover principles that could enable biomimetic and biohybrid energy systems and guide development of new biotechnologies. Integration of artificial intelligence/machine learning (AI/ML), data science, and computational chemistry will provide tools and infrastructure needed for shared data repositories and accelerated discovery and characterization of complex chemical systems.

The CSGB subprogram supports a multifaceted portfolio of single-investigator and small-group research projects as well as multi-investigator, multi-disciplinary team-science research including Energy Frontier and Microelectronics Science Research Centers, Energy Innovation Hubs, Computational Chemical Sciences, and the National QIS Research Centers (NQISRCs).

Fundamental Interactions Research

This activity emphasizes structural and dynamical studies of atoms, molecules, and nanostructures to understand their interactions in full quantum detail. Research is conducted at the boundary of chemistry and physics to understand reactive chemistry in the gas phase, in condensed phases, and at interfaces. This activity provides leadership for ultrafast chemistry and advances ultrafast tools and approaches to probe and control chemical processes. It supports theory and computation for accurate descriptions of molecular reactions and chemical dynamics, optimal use of exascale computing facilities, and potential application of future quantum computers to computational quantum chemistry. In support of the Genesis Mission, this activity supports AI/ML efforts that can advance use of exascale or quantum computing hardware to simulate chemical systems and processes for fundamental discovery as well as methods to accelerate the analysis of complex experimental data. It also supports a program of QIS research at the intersection of chemistry, quantum physics, and information theories that can advance foundational understanding of quantum information control in complex molecular systems. This fundamental research can lay the foundation for the chemical design principles needed to realize next-generation quantum technologies in computing, sensing, and communication.

In FY 2027, BES will continue as a partner in the NQISRC program. The research in this portfolio will advance state-of-the-art science and technology to realize the full potential of quantum-based applications and pave the path to quantum computing in the longer term. BES will also continue to partner on microelectronics research to unravel complex mechanisms of chemical reactions at interfaces to inform design and synthesis of new materials and chemical processes.[d] As part of this portfolio, the Microelectronics Science Research Centers (MSRCs) comprise a network of multiple team awards, with individual awards focused on a dimension related to one of two common research topics for each Center—energy efficiency or extreme environments. The multidisciplinary teams include researchers from universities, national laboratories, and industry and are developing chemistries, materials, devices, systems, architectures, algorithms, and software in a co-design innovation ecosystem.

Chemical Transformations Research

This activity seeks fundamental knowledge of chemical reactivity, matter and charge transport, and chemical separation and stabilization processes foundational to development of affordable and reliable energy technologies. Fundamental research in this activity spans catalysis science, separation science, heavy element chemistry, and geosciences to advance mechanistic understanding of charge transport and reactivity, catalytic efficiency and selectivity, critical materials recovery, conversion of energy resources, and chemistry in subsurface and aqueous systems important in chemical processes.

In the FY 2027 Request, this activity will continue to investigate transformative approaches for energy. Research will focus on discovery and design of catalytic and separation processes and provide fundamental knowledge of subsurface processes such as mineralization, crack propagation, and rock fracture to foster innovation in the use of the subsurface for energy generation and storage. Research will also address critical minerals and materials with a focus on approaches for resource identification and extraction, selective separation, and substitution of critical elements. Research will also examine quantum phenomena enabled by rare earth elements and actinides. AI/ML approaches will be emphasized to accelerate the generation of scientific knowledge foundational to the BES mission and its role in realizing the goals of the Genesis Mission.

Photochemistry and Biochemistry Research

This activity supports fundamental research on the molecular mechanisms of capture and conversion of light energy into chemical energy in both natural and man-made systems, providing a model system for studies of energy conversion and quantum phenomena relevant to critical materials and radiation chemistry. It integrates research at the interface of chemistry, physics, and biology and plays a leadership role for basic research on natural photosynthesis and photochemistry. Such research can inspire new strategies for energy conversions and inform development of innovative energy technologies, including how elements in critical materials can be reduced or even eliminated without negatively affecting energy conversion efficiency. To understand energy conversion across spatial and temporal scales, research explores charge transport and redox interconversion of atoms and small molecules important in production of commodity and specialty chemicals and fuels. Research also examines ionizing radiation effects and radiation chemistry which can provide insights for nuclear reactor design, remediation, and fuel-cycle separation as well as other chemical transformations.

In the FY 2027 Request, the activity will continue to focus on molecular-level understanding of biochemical, biophysical, and photochemical processes to enhance energy conversions. Research will aim to discover and design chemical processes, complex structures, and bio-inspired and biohybrid systems and approaches to advance affordable energy technologies, including microelectronics. Studies will continue on reducing use of critical and rare earth elements in catalysts and light absorbers and on radiation chemistry, including growing the scientific workforce. This activity will also continue research to understand quantum phenomena such as

[d] https://science.osti.gov/-/media/bes/pdf/reports/2019/BRN_Microelectronics_rpt.pdf

coherence in natural and artificial systems, providing insights for enhancing energy conversion and potentially inspiring materials development for QIS. AI/ML-based methods will be supported to accelerate discovery of chemistries and new materials for energy conversion and to identify and characterize biochemical and biophysical processes based on large, complex datasets in support of the Genesis Mission.

Energy Frontier Research Centers

The EFRC research modality brings together the skills and talents of teams of investigators to combine discovery science and energy-relevant, basic research whose scope and complexity are beyond what is possible from single-investigator or small-group awards. These multi-investigator, multi-disciplinary centers aim to accelerate basic research to enable transformative scientific advances and uncover new and innovative solutions to the most difficult problems in chemical sciences, geosciences, and biosciences. EFRCs supported in this subprogram focus on the design, discovery, characterization, and control of chemical, biochemical, and geological processes for improved electrochemical conversion; the understanding of catalytic chemistry and biochemistry that is foundational for production of fuels and chemicals and for separations; QIS; nuclear energy and the chemistry of waste processing; and the advanced characterization of the Earth's subsurface. The development and application of novel AI/ML-based tools and techniques for scientific discovery throughout the EFRC portfolio contributes to the Department's Genesis Mission. The FY 2027 Request continues support for EFRC awards made in prior fiscal years.

Energy Innovation Hubs

Energy Innovation Hubs focus on collaborative research to overcome key scientific barriers for major energy challenges that require large, multidisciplinary efforts. The Fuels from Sunlight Hub program addresses both new directions and long-standing fundamental science challenges in fuels generation identified in the report from the Liquid Solar Fuels Roundtable.[e] The Request will continue support for the two Hub projects recommended for renewal following external peer review of renewal proposals in FY 2025.

The two Fuels from Sunlight Hub awards will continue to conduct fundamental research on key scientific challenges for fuels production that uses light energy, water, and carbon dioxide as the only inputs to reduce or replace critical and rare earth elements. AI/ML methods and laboratory automation will continue to be developed and used for discovery of materials for energy conversion and in support of the Genesis Mission.

Computational Chemical Sciences

This program has supported basic research to develop validated, open-source codes and associated experimental/ computational databases for modeling and simulation of complex chemical processes and phenomena that can take advantage of today's exascale high-performance computers. Research has supported establishment of a publicly accessible website[f] of open source, robust, validated, user-friendly software that captures the essential physics and chemistry of relevant chemical systems. The broader research community and industry are using these codes/data to accelerate U.S. chemical research.

In FY 2027, the program will continue to focus on development of novel AI/ML-based tools and techniques for accelerated scientific discovery and in support of the Genesis Mission. Support for the maintenance and further development of high value, widely used software previously developed under the program may be considered based on program priorities.

General Plant Projects

General Plant Projects funding provides for minor new construction, other capital alterations and additions, and improvements to land, buildings, and utility systems to maintain the productivity and usefulness of DOE-owned facilities and to meet requirements for safe and reliable facilities operation.

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[e] https://science.osti.gov/-/media/bes/pdf/reports/2020/Liquid_Solar_Fuels_Report.pdf
[f] https://ccs-psi.org/

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Chemical Sciences, Geosciences, and Biosciences	**$418,227**	**$249,740**	**-$168,487**
Fundamental Interactions Research	$140,599	$90,723	-$49,876
Funding continues to develop innovative ultrafast approaches, with emphasis on use of x-ray free electron lasers; determine how reactive intermediates affect reaction pathways; and characterize quantum phenomena underlying QIS. Research funding is targeting the understanding and control of interfacial chemical conversion mechanisms and quantum phenomena to advance novel energy technologies for improved energy capture and conversion and microelectronics. The program continues to partner with other SC program offices for the NQISRCs and the MSRCs. Additional investments expand support for research to leverage AI/ML to accelerate discovery and characterization in support of the Genesis Mission.		The Request will continue to develop innovative ultrafast approaches, with emphasis on the use of x-ray free electron lasers; determine how reactive intermediates affect reaction pathways; and characterize quantum phenomena underlying QIS. Research will also target the understanding and control of interfacial chemical conversion mechanisms and quantum phenomena to advance novel energy technologies for improved energy capture and conversion and microelectronics. The program will partner with other SC program offices for the NQISRCs and the MSRCs. Investments will continue support for research to develop and leverage AI/ML to accelerate discovery and characterization in support of the Genesis Mission.	Reductions will be based on programmatic priorities.
Chemical Transformations Research	$100,861	$42,577	-$58,284
Funding continues fundamental research to understand catalytic mechanisms for thermo- and electro-chemical conversions and to develop atomically precise synthesis of catalysts important for affordable and reliable energy. Research in separation science		The Request will continue fundamental research to understand catalytic mechanisms for thermo- and electro-chemical conversions and to develop atomically precise synthesis of catalysts important for affordable and reliable energy. Research in separation science will	Reductions will be based on programmatic priorities.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
continues to focus on innovative mechanisms for high-efficiency chemical separations and processes. Heavy element research continues to advance understanding of actinide speciation and reactivity and f-electron systems. Geosciences research continues to reveal subsurface phenomena that can be foundational to new energy technologies. Research continues to advance the separations and extraction of rare earth elements from complex and dilute mixtures and the development of alternative approaches to reduce use of critical elements. AI/ML and data science approaches will be leveraged across the activity to accelerate discovery and characterization in support of the Genesis Mission.	continue to focus on innovative mechanisms for high-efficiency chemical separations and processes. Heavy element research will continue to advance understanding of actinide speciation and reactivity and f-electron systems. Geosciences research will continue to reveal subsurface phenomena that can be foundational to new energy technologies. Research will continue to advance the separations and extraction of rare earth elements from complex and dilute mixtures and the development of alternative approaches to reduce the use of critical elements. AI/ML and data science approaches will be developed and leveraged across the activity to accelerate discovery and characterization in support of the Genesis Mission.	
Photochemistry and Biochemistry Research $86,009	$30,848	-$55,161
Funding supports research on physical, chemical, biophysical, and biochemical processes of light energy capture and conversion which could inspire technology innovations for affordable and reliable energy. Biological and chemical studies examines the role of quantum phenomena in energy conversion. Biochemical studies can provide insights for bio-inspired and biohybrid systems with desired functions and properties and new strategies for artificial photosynthesis, energy conversions, and biotechnology. Solar fuels research continues to address molecular mechanisms of photon capture, charge transport, product selectivity, and reduced critical element use in	The Request will continue research on physical, chemical, biophysical, and biochemical processes of light energy capture and conversion which could inspire technology innovations for affordable and reliable energy. Biological and chemical studies will examine the role of quantum phenomena in energy conversion. Biochemical studies will provide insights for bio-inspired and biohybrid systems with desired functions and properties and new strategies for artificial photosynthesis, energy conversions, and biotechnology. Solar fuels research will address molecular mechanisms of photon capture, charge transport, product selectivity, and reduced critical element use in catalysts. AI/ML	Reductions will be based on programmatic priorities.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
photoabsorbers and catalysts. AI/ML and data science methods continue to be integrated across the activity to accelerate discovery and characterization in support of the Genesis Mission.	and data science methods will continue to be developed and integrated across the activity to accelerate discovery and characterization in support of the Genesis Mission.	
Energy Frontier Research Centers $65,000	$60,151	-$4,849
Funding provides the third year of support for the four-year EFRC awards that were made in FY 2024. In addition, BES will recompete awards made in FY 2022, with emphasis on a broad range of topics relevant to energy and other national priorities.	The Request will provide the final year of support for the four-year EFRC awards that were made in FY 2024 and the second year of support for the four-year awards made in FY 2026.	Technical emphasis for the EFRC program will continue to include new research directions that cut across BES programmatic efforts, as well as those identified in recent strategic planning activities related to energy, QIS, microelectronics, and other national priorities.
Energy Innovation Hubs $20,758	$20,758	$ —
Funding continues support for the Hub awards made in FY 2025 to further advance research efforts on solar fuels generation for affordable and secure energy.	The Request will continue support for the Hub awards renewed in FY 2025 to further advance research efforts on fuels generation for affordable and secure energy.	Fundamental research will continue to target innovative artificial photosynthesis approaches for fuels generation to reduce or replace critical materials used in catalysts.
Computational Chemical Sciences $4,000	$3,683	-$317
The CCS activity supports the development of AI-based tools and techniques for discovery and characterization in the chemical sciences in support of the Genesis Mission. Support for the maintenance and further development of high value, widely used software previously developed under the program may be considered based on program priorities.	The CCS activity will continue support to develop AI-based tools and techniques for discovery and characterization in the chemical sciences in support of the Genesis Mission. Support for the maintenance and further development of high value, widely used software previously developed under the program may be considered based on program priorities.	Fundamental research will target AI for accelerated scientific discovery to support the goals of the Genesis Mission.

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
General Plant Projects	$1,000	$1,000	$ —
Funding supports minor facility improvements at Ames National Laboratory.		The Request will support minor facility improvements at Ames National Laboratory.	No change.

Basic Energy Sciences
Scientific User Facilities (SUF)

Description

The Scientific User Facilities subprogram supports the operation of a geographically and technically diverse suite of major research facilities that provide unique tools to thousands of researchers from universities, industry, and government laboratories to advance a broad range of scientific domains and technology areas that are critical to DOE's mission and to many other National priorities. The BES user facilities portfolio consists of a complementary set of intense x-ray sources, neutron scattering facilities, and research centers for nanoscale science. These facilities allow researchers to probe materials in space, time, and energy with the resolution to interrogate the inner workings of matter to help understand the fundamental aspects of the natural world. Operated on an open access, competitive, merit review basis, scientists from every state can utilize the facilities' capabilities and sophisticated instrumentation. The 12 BES scientific user facilities collectively contribute to important scientific results across basic and applied research in chemistry, physics, geology, materials science, environmental science, biology, and biomedical science that can lead to the discovery and design of advanced materials and novel chemical processes with broad societal impacts. In FY 2024, more than 13,000 scientists and engineers in many fields of science and technology used BES scientific facilities.

The Department's Genesis Mission aims to build the world's most powerful scientific platform for discovery by connecting the Nation's scientific infrastructure with purpose-built AI models and comprehensive data sets. The 12 BES-stewarded user facilities are an unmatched source of the AI-ready data necessary to realize this vision, conducting hundreds of experiments simultaneously around the clock. These experiments are generating vast quantities of raw experimental data that must be stored and analyzed to translate the data into information to yield answers to important scientific questions. The data challenges continue to grow as new capabilities and advanced detector technologies come online. Data science and AI/ML methods coupled with advanced computing hardware are required to address these challenges and get the highest value data from user experiments. There are also AI/ML opportunities to improve the efficiency and reliability of accelerator and instrument operations. The Request continues support for the research needed to realize these opportunities in AI/ML, in alignment with the goals of the Genesis Mission.

Maintaining world-leading capabilities is crucial for international competitiveness as advances in tools and instruments often drive scientific discovery. Major upgrades to BES facilities are supported through line-item construction and Major Items of Equipment (MIEs), including support for new and upgraded x-ray and neutron experimental stations and forefront nanoscience instrumentation. The subprogram also supports research in accelerator and detector development to explore technology options for the next generations of x-ray and neutron sources that will keep BES accelerator-based facilities at the forefront.

The FY 2027 Request supports user facilities' operational budget requirements determined by the user facilities. Base requirements for operations continue to increase due to the steady rise in the cost of staff, utilities, maintenance, and materials; evolution of remote use; increased data and computational costs; and the transition of new capabilities from facility upgrades to operations. Funding will require a careful balance to meet costs to ensure safe operations and user access.

X-Ray Light Sources
X-rays are an essential tool for studying the structure of matter and have long been used to see things that visible light cannot resolve. X-rays are critical tools for assessing dynamics as materials, chemistries, and biological systems evolve. Large-scale light source facilities have vastly enhanced the utility of existing x-ray techniques and have given rise to entirely new ways to do experiments that are not otherwise feasible with conventional x-ray machines. Owing to their broadly tunable wavelengths, coherence, ultrafast pulses, and polarization control, light source facilities are incisive probes for advanced research.

BES operates five light sources, including a free electron laser, the Linac Coherent Light Source (LCLS) at SLAC, and four storage ring-based sources—the Advanced Light Source (ALS) at LBNL, the Advanced Photon Source (APS) at ANL, the Stanford Synchrotron Radiation Light Source (SSRL) at SLAC, and the National Synchrotron Light Source (NSLS)-II at BNL. BES provides funding to support facility operations, technical support, computational tools for data analysis, and user program administration, which are made available to all researchers with access determined via peer review of user proposals. All facilities are multidisciplinary and have extensive outreach efforts to ensure that researchers have fair and equitable access regardless of their research focus, geographical location, or institutional size. In support of the Genesis Mission, all light source facilities are actively developing AI/ML tools to both optimize facility operations and provide enhanced scientific capabilities to users. Upgrade projects are underway for the APS, ALS, and LCLS to ensure ongoing world leadership for these facilities. The initial suite of seven beamlines at NSLS-II in FY 2015 has expanded to 29 beamlines with three under construction and room for about 30 more. To adopt the most up-to-date technologies and provide the most advanced capabilities, BES has a phased approach to new beamlines at NSLS-II, as was done for other BES facilities. The NSLS-II Experimental Tools-II (NEXT-II) MIE project, started in FY 2020, provides three best-in-class beamlines to support the needs of the U.S. research community. In FY 2024, planning and conceptual design funds were provided for NEXT-III, a line-item construction project to deliver the next cadre of beamlines. The Request supports continued preliminary planning for future beamline MIEs.

High-Flux Neutron Sources
BES supports two neutron sources at ORNL, the High Flux Isotope Reactor (HFIR) and the Spallation Neutron Source (SNS). Neutron sources are used to understand the factors that determine the properties and functions of matter and provide foundational insights for development of new materials and molecules with desired functionality. Thermal and cold neutrons are unique tools for the study of atomic-scale structure and dynamics. The wavelength and energy of neutrons are similar to interatomic distances and elementary excitations in materials, allowing atomic-resolution studies of structure and an investigation of material dynamics. As they carry no charge, neutrons can assess bulk properties. Critically, neutrons can discriminate different isotopes of the same element, making them a unique probe to resolve, for example, the location of hydrogen atoms in organic and biological materials via isotope substitution of deuterium for hydrogen. In addition, their magnetic moments allow investigation of magnetism, important for electronic technologies and systems.

HFIR generates neutrons via fission. It operates at 85 megawatts and provides state-of-the-art facilities for neutron scattering, isotope production, materials irradiation, and neutron activation analysis. It is the world's leading production source of elements heavier than plutonium for medical, industrial, and research applications. There are 12 neutron scattering beamlines in the user program at HFIR, which include state-of-the-art instruments for spectroscopy, diffraction, imaging, and small angle scattering. Operations funding in the FY 2027 Request will continue to support efforts to replace the beryllium reflector at HFIR.

SNS produces neutron beams using an accelerator to generate proton pulses that strike a mercury target. As a result of impacts, cascades of neutrons are produced in a process known as spallation. It is the world's brightest pulsed neutron facility and presently offers 19 beamlines. This is a world-leading suite of instruments for very high-resolution spectroscopy and diffraction, reflectometry, spin echo, and small angle spectrometers. Demand is strong for SNS instruments (3.6x oversubscribed) across a very broad range of scientific disciplines and technology areas. Current construction projects at SNS focus on maintaining world-leadership for neutron scattering.

At both HFIR and SNS, investments will advance data science, AI/ML, and computing hardware to support experiment planning, data analysis, and operational efficiency of the accelerator, reactor, and beamlines, in support of the Genesis Mission.

Nanoscale Science Research Centers

Developments at the nanoscale are foundational for delivery of remarkable scientific discoveries that transform our understanding of energy and matter. The Nanoscale Science Research Centers (NSRCs) provide the tools and capabilities for experimental and computational research that lead to technological innovations, new experimental tools, and new computational and modelling capabilities. NSRCs comprise a suite of unique tools and platforms, as well as expert scientific staff that enable and advance probing, manipulating, and assembling single atoms, clusters of atoms, and molecular structures for transformative science providing the foundation for the development of next-generation technologies.

The five NSRCs are the Center for Nanoscale Materials (CNM) at ANL, the Center for Functional Nanomaterials (CFN) at BNL, the Molecular Foundry (MF) at LBNL, the Center for Nanophase Materials Sciences (CNMS) at ORNL, and the Center for Integrated Nanotechnologies (CINT) at SNL and LANL. Each center has complementary expertise and capabilities for synthesis and assembly; theory, modeling, and simulation; imaging and spectroscopy; and nanostructure fabrication and integration. Selected thematic areas include quantum materials, next generation semiconductors, nanoscale photonics, catalysis, and soft/biological materials. These facilities include clean rooms, nanofabrication resources, one-of-a-kind signature tools, custom advanced instrumentation laboratories, and unique AI/ML and data science analytical capabilities, in support of the Genesis Mission. Each NSRC is co-located with other scientific user facilities and/or complementary capabilities, enabling users to more easily take advantage of these additional world-leading experimental and computational resources. Operating funds ensure cutting-edge research capabilities, technical support, and administration of the user program, which serves academic, government, and industry researchers.

Going forward, the NSRCs will continue to spearhead the development of flexible infrastructure and enabling capabilities for materials synthesis, device fabrication, metrology, modeling, and simulation. Investments will focus on evolving these capabilities to address the most pressing national needs, including QIS and next-generation microelectronics. Coordination across the NSRCs will grow to support development of cross-cutting, mutually beneficial techniques and facilitate access to complementary instrumentation.

Other Project Costs

Total project cost (TPC) is comprised of total estimated cost (TEC) and other projects costs (OPC). TEC includes post-Critical Decision (CD)-1 costs for engineering; the acquisition of equipment; and construction/fabrication. OPC represents all other costs incurred during the initiation and definition phase for planning, conceptual design, conceptual design, research, and development, and during the execution phase for startup and commissioning. OPC is always funded via operating funds.

Major Items of Equipment

BES supports MIE projects to ensure continual development and upgrade of scientific facility capabilities, by fabricating upgraded and new stand-alone instruments and capabilities at X-Ray Light Sources, High-Flux Neutron Sources, and NSRCs.

Research

This activity supports research from conceptual studies of accelerator physics and instrumentation to their translation into components or techniques that improve BES user facilities and maintain international competitiveness. Production of beams with increased average flux/brightness and detection tools responsive to high beam intensities are required components for the advancement of light and neutron sources. Research on superconducting undulators will focus on increasing magnetic fields and eliminating liquid helium use. Higher beam availability is needed to respond to the increasing number of facility users, requiring research on techniques to support multiple beamlines simultaneously. Detectors require higher computational capabilities per pixel, improved readout rates, radiation hardness, and better energy and temporal resolutions. Higher neutron-flux capabilities at the SNS demand tight control of beam losses and detectors designed for advanced neutron imaging. BES coordinates with the SC Offices of High Energy Physics and Nuclear Physics on crosscutting accelerator research and technology areas. BES accelerator R&D research is informed by recent workshops.[g] Investments will continue to support development of data science methods and AI/ML-enabled tools to address data and information challenges in support of the Genesis Mission.

[g] https://science.osti.gov/-/media/bes/pdf/brochures/2024/24-G00737-BRN-ABI-brochure-Final.pdf

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Scientific User Facilities (SUF)	**$1,411,696**	**$1,459,363**	**+$47,667**
X-Ray Light Sources	$867,675	$868,226	+$551
Funding supports operations at five BES light sources (LCLS, APS, ALS, NSLS-II, and SSRL). Development of AI/ML-enabled capabilities for computational techniques, and data analysis methods continues.		The Request will support operations at five BES light sources (LCLS, APS, ALS, NSLS-II, and SSRL). Development of AI/ML-enabled capabilities for computational techniques, and data analysis methods will continue.	Funding will support LCLS, APS, ALS, NSLS-II and SSRL operations, accounting for inflation, supply chain costs, staffing support, remote operations, and costs for operation of new/upgraded capabilities.
High-Flux Neutron Sources	$297,993	$380,026	+$82,033
Funding supports operations at SNS and HFIR (including ongoing funding for maintenance of HFIR with the beryllium reflector replacement). Development of AI/ML-enabled capabilities for computational techniques, and data analysis methods continues.		The Request will support operations at SNS and HFIR (including ongoing funding for maintenance of HFIR with the beryllium reflector replacement). Development of AI/ML-enabled capabilities for computational techniques, and data analysis methods will continue.	Funding will support operations for SNS and HFIR, accounting for inflation, supply chain costs, staffing support, remote operations, and costs for operation of new/upgraded SNS capabilities.
Nanoscale Science Research Centers	$177,304	$175,570	-$1,734
Funding provides funding for five NSRCs (CFN, CNM, CNMS, MF, and CINT). The NSRCs continue to develop infrastructure and capabilities to maintain world-leading synthesis, device fabrication, characterization, modeling, and simulation.		The Request will provide funding for five NSRCs (CFN, CNM, CNMS, MF, and CINT). The NSRCs will continue to develop infrastructure and capabilities to maintain world-leading synthesis, device fabrication, characterization, modeling, and simulation.	Funding will support operations for the five NSRCs, accounting for inflation, supply chain costs, staffing support, remote operations, and other costs.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Other Project Costs $23,100	$5,000	-$18,100
Funding supports OPC for the LCLS-II-HE project at SLAC, the HFIR PVR project at ORNL, and the NEXT-III project at BNL.	The Request will support OPC for the STS project at ORNL.	OPC will support conceptual design and planning for the STS project at ORNL.
Research $45,624	$30,541	-$15,083
Funding supports high-priority research activities for accelerators, detectors, and applications of AI/ML and other data science techniques to accelerator optimization, control, prognostics, and data analysis to help advance the goals of the Genesis Mission. Research emphasizes transformative advances in accelerator science and technology that lead to significant improvements in very high brightness and high current electron sources and in high intensity proton sources.	The Request will support high-priority research activities for accelerators, detectors, and development and application of AI/ML and other data science techniques to accelerator optimization, control, prognostics, and data analysis to help advance the goals of the Genesis Mission. Research will emphasize transformative advances in accelerator science and technology that lead to significant improvements in very high brightness and high current electron sources and in high intensity proton sources.	Funding will support investment in future accelerator and detector technologies to continue to provide the world's most comprehensive and advanced accelerator-based facilities for scientific research. Funding will continue investments in data science and AI/ML methods and tools to address data and information challenges at the BES user facilities, including accelerator control and experiment automation with real time data analysis.

Note:

- *As part of the FY 2026 Appropriation, the High-Flux Neutron Sources received $150,000,000 in prior year funds not included in the FY 2026 Enacted table above.*

Description

Accelerator-based x-ray light sources, accelerator-based pulsed neutron sources, reactor-based neutron sources, and nanoscale science research centers are essential user facilities that enable critical DOE mission-driven science, including research in support of next-generation energy technologies and other critical and emerging technologies (e.g., in quantum information science, microelectronics, and critical minerals) vital to U.S. economic and national security. These user facilities provide the academic, laboratory, and industrial research communities with the tools to fabricate, characterize, and develop new materials and chemical processes to advance basic and applied research across multiple scientific disciplines. Funding for the construction of new user facilities and upgrades to existing user facilities are essential to maintaining U.S. scientific leadership.

21-SC-10, Cryomodule Repair & Maintenance Facility (CRMF), SLAC

The CRMF project will provide a much-needed capability to maintain, repair, and test superconducting radiofrequency (SRF) accelerator components. These components include but are not limited to superconducting RF cavities and cryomodules that make up the new superconducting accelerator being constructed by the now complete LCLS-II project and ongoing LCLS-II-HE project, high brightness electron injectors, and superconducting undulators. The facility will provide for the full disassembly and repair of the SRF cryomodule; the ability to disassemble, clean, and reassemble the SRF cavities and cavity string; testing capabilities for the full cryomodule; and separate testing capabilities for individual SRF cavities. To accomplish this, the project requires a building of up to 21,000 gross square feet to contain the necessary equipment, tools, and fixtures, as well as a control room, clean rooms, and liquid helium distribution system. The project received CD-1, Approve Alternative Selection and Cost Range, on October 11, 2023, with a current TPC range of $70,000,000–$98,000,000, but is actively being re-evaluated due to current construction market conditions. A CD-3A, Approve Long Lead Procurements, is expected in 3Q FY 2026.

19-SC-14, Second Target Station (STS), ORNL

The STS project will expand SNS capabilities for neutron scattering research by exploiting 0.7 MW of the 2.8 MW SNS accelerator proton beam power enabled by the Proton Power Upgrade (PPU) project. The STS will provide high brightness, cold neutrons complementary to the first target station (FTS). Instruments will feature advanced neutron optics, optimized geometry, and high resolution, advanced detectors, enabling new research opportunities in quantum materials, materials science and engineering, chemistry and catalysis, soft matter and polymers, and biological systems. The project received CD-1, Approve Alternative Selection and Cost Range, on November 23, 2020, establishing the approved TPC range of $1,800,000,000–$3,000,000,000. A combined CD-2/3, Approve Performance Baseline and Approve Start of Construction, is expected in 4Q FY 2026.

18-SC-13, Linac Coherent Light Source-II-High Energy (LCLS-II-HE), SLAC

The LCLS-II-HE project will expand the capabilities of the LCLS to maintain U.S. leadership in ultrafast and ultrabright x-ray science. The project will increase the energy of the superconducting linac from 4 GeV to 8 GeV and thereby expand the high repetition rate operation (1 million pulses per second) into the hard x-ray regime (5-12 keV). This will transform the community's ability to interrogate and advance understanding of complex matter at the atomic scale on ultrafast time scales with elemental specificity relevant to real world systems, including quantum materials, functional materials, catalysts, and biological molecules. The project received a combined CD-2/3, Approve Performance Baseline and Approve Start of Construction, on September 19, 2024, establishing a TPC of $716,000,000. CD-4, Approve Start of Operations, is expected 2Q FY 2028.

18-SC-12, Advanced Light Source Upgrade ALS-U, LBNL

The ALS-U project will upgrade the existing ALS facility by replacing the existing electron storage ring with a new electron storage ring based on a multi-bend achromat lattice design, which will provide a soft x-ray source that is up to 1,000 times brighter and with a significantly higher coherent flux fraction. ALS-U will leverage two decades of investments in scientific tools at the ALS by making use of the existing beamlines and infrastructure. ALS-U will ensure that the ALS facility remains a world leader in soft x-ray science. The project received CD-3, Approve Start of Construction, on November 10, 2022, with an original Total Project Cost (TPC) of $590,000,000. The ALS-U project is currently working towards rebaselining, which will establish a new TPC and schedule no later than 3Q FY 2026. CD-4, Approve Project Completion, is currently expected 4Q of FY 2030.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Construction	**$232,843**	**$143,800**	**-$89,043**
21-SC-10, Cryomodule Repair & Maintenance Facility (CRMF), SLAC	$20,000	$7,800	-$12,200
Funding supports the continuation of activities required to secure a combined CD-3A approval and initiation of Long-lead Procurements (LLPs), expected in 3Q FY 2026.		The Request will support ongoing construction of the building and conventional facilities and initiate procurement of key technical systems and facilitate procurement activities for the cryogenic system.	Final funding for this project is requested in FY 2027.
19-SC-14, Second Target Station (STS), ORNL	$52,000	$80,000	+$28,000
Funding continues the activities, focusing on the highest priority accelerator and target designs in parallel with advancing long lead procurement activity for civil construction site preparation upon associated CD approvals.		The Request will support planning, R&D, design, engineering, prototyping, fabrication, procurement, and testing to advance the highest priority activities with emphasis on the target monolith, bunker, and associated controls system designs.	Funding will advance progress on the STS project.
18-SC-13, Linac Coherent Light Source-II-High Energy (LCLS-II-HE), SLAC	$99,343	$6,000	-$93,343
Funding continues the construction and installation contracts, complete the pre-staging activities, and start installation activities during the year-long LCLS Dark Time in FY 2026.		The Request will continue planning, R&D, design, engineering, prototyping, and testing, procurement, and construction to advance the highest priority activities with the emphasis on continuing the construction and installation contracts, including the infrastructure systems for cryogenic transfer lines, cryomodules, safety systems, and the experimental hutch.	Final funding for this project is requested in FY 2027.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
18-SC-12, Advanced Light Source Upgrade ALS-U, LBNL $50,000	$50,000	$ —
Funding advances installation of the Accumulator ring in the tunnel and the beamline front end engineering and system engineering as well as begin preparation activities for the dark time Storage Ring installation.	The Request will enable continued planning, design, engineering, prototyping, and testing to advance the highest priority activities with emphasis on Accumulator Ring commissioning, production of the Storage Ring rafts, completing the beamline front-end engineering, and advancing beamline systems engineering.	Funding will advance progress on the ALS-U project.

Basic Energy Sciences
Capital Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Capital Operating Expenses						
Capital Equipment	N/A	N/A	29,590	47,693	79,783	+32,090
Minor Construction Activities						
General Plant Projects	N/A	N/A	10,900	46,361	33,039	-13,322
Accelerator Improvement Projects	N/A	N/A	19,605	60,427	88,562	+28,135
Total, Capital Operating Expenses	**N/A**	**N/A**	**60,095**	**154,481**	**201,384**	**+46,903**

Capital Equipment

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Capital Equipment						
Major Items of Equipment						
Total, MIEs	N/A	N/A	–	–	–	–
Total, Non-MIE Capital Equipment	N/A	N/A	29,590	47,693	79,783	+32,090
Total, Capital Equipment	**N/A**	**N/A**	**29,590**	**47,693**	**79,783**	**+32,090**

Note:
- *The Capital Equipment table includes MIEs with a Total Estimated Cost (TEC) > $10M.*

Minor Construction Activities

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
General Plant Projects (GPP)						
GPPs (greater than $5M and $34M or less)						
Technical and Storage Space	9,528	–	–	9,528	–	-9,528
SLAC, SSRL, B120 Expansion for Beamline Upgrade	27,700	–	–	1,700	26,000	+24,300
SLAC, LCLS, Far Experimental Hall	25,000	–	–	25,000	–	-25,000
Spallation Neutron Source Sample Environmental Building	8,594	–	–	8,594	–	-8,594
HFIR Helium Recovery System	539	–	–	539	–	-539
Total GPPs (greater than $5M and $34M or less)	71,361	N/A	–	45,361	26,000	-19,361
Total GPPs $5M or less	N/A	N/A	10,900	1,000	7,039	+6,039
Total, General Plant Projects (GPP)	**N/A**	**N/A**	**10,900**	**46,361**	**33,039**	**-13,322**
Accelerator Improvement Projects (AIP)						
AIPs (greater than $5M and $34M or less)						
DISCOVER, Spallation Neutron Source	5,000	–	–	–	5,000	+5,000
3rd Harmonic Cavity, National Synchrotron Light Source-II	10,600	–	–	5,300	5,300	–
New SAX/WAX Beamline, LBNL	9,390	1,890	–	7,500	–	-7,500
ALS Beamline Readiness	6,000	–	–	6,000	–	-6,000
ALS Front End Readiness	6,000	–	–	6,000	–	-6,000
HFIR HBRR MANTA	8,525	–	–	753	7,772	+7,019
HFIR HBRR MARS	14,855	–	–	1,282	13,573	+12,291
LOB 742 #1 National Synchrotron Light Source II at BNL	21,158	–	–	–	21,158	+21,158
Total AIPs (greater than $5M and $34M or less)	81,528	1,890	–	26,835	52,803	+25,968
Total AIPs $5M or less	N/A	N/A	19,605	33,592	35,759	+2,167
Total, Accelerator Improvement Projects (AIP)	**N/A**	**N/A**	**19,605**	**60,427**	**88,562**	**+28,135**
Total, Minor Construction Activities	**N/A**	**N/A**	**30,505**	**106,788**	**121,601**	**+14,813**

Notes:

- *GPP activities $5M and less include design and construction for additions and/or improvements to land, buildings, replacements or addition to roads, and general area improvements. AIP activities $5M and less include minor construction at an existing accelerator facility.*
- *The Total funding for the 3rd Harmonic Cavity (AIP) project is $5,300,000. This project, originally requested in FY 2024, has been deferred until FY 2027.*

- *The Total funding for the SAX/WAX Beamline (AIP) project is $9,000,000. This project, originally requested in FY 2024, has been deferred with revised scope until FY 2026.*
- *The Total funding for the NSLS-II Technical and Storage Space (GPP) project is $9,528,000. This project, originally requested in FY 2025, has been deferred until FY 2026.*
- *The SLAC B120 Expansion for Beamline Upgrade (GPP) project originally requested in FY 2025 has been delayed. Design efforts are requested in FY 2026.*
- *The Total funding for the Far Experimental Hall (GPP) project is $28,400,000. This project, originally requested in FY 2025, has been deferred until FY 2026.*
- *The Total funding for the HFIR Helium Recovery System (GPP) project is $7,440,000. Design efforts are requested in FY 2026.*
- *The Total funding for the ALS Beamline Readiness (AIP) project is $7,500,000. Design efforts will be fully funded in FY 2025 and the remaining funds are requested in FY 2026.*
- *The Total funding for the ALS Front End Readiness (AIP) project is $7,500,000. Design efforts will be fully funded in FY 2025 and the remaining funds are requested in FY 2026.*
- *The Total funding for the HFIR HBRR MANTA (AIP) project is $8,525,000. Design efforts are requested in FY 2026 and the remaining funds are requested in FY 2027.*
- *The Total funding for the HFIR HBRR MARS (AIP) project is $14,855,000. Design efforts are requested in FY 2026 and the remaining funds are requested in FY 2027.*

Basic Energy Sciences
Construction Projects Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
24-SC-10, HFIR Pressure Vessel Replacement (PVR), ORNL						
Total Estimated Cost (TEC)	16,000	4,000	6,000	6,000	-	-6,000
Other Project Cost (OPC)	27,000	12,000	5,000	10,000	-	-10,000
Total Project Cost (TPC)	**43,000**	**16,000**	**11,000**	**16,000**	**-**	**-16,000**
24-SC-12, NSLS-II Experimental Tools - III (NEXT-III), BNL						
Total Estimated Cost (TEC)	13,556	2,556	5,500	5,500	-	-5,500
Other Project Cost (OPC)	18,100	5,500	4,500	8,100	-	-8,100
Total Project Cost (TPC)	**31,656**	**8,056**	**10,000**	**13,600**	**-**	**-13,600**
21-SC-10, Cryomodule Repair & Maintenance Facility (CRMF), SLAC						
Total Estimated Cost (TEC)	88,800	41,000	20,000	20,000	7,800	-12,200
Other Project Cost (OPC)	5,700	5,700	-	-	-	-
Total Project Cost (TPC)	**94,500**	**46,700**	**20,000**	**20,000**	**7,800**	**-12,200**
19-SC-14, Second Target Station (STS), ORNL						
Total Estimated Cost (TEC)	1,930,727	208,700	52,000	52,000	80,000	+28,000
Other Project Cost (OPC)	69,273	52,845	-	-	5,000	+5,000
Total Project Cost (TPC)	**2,000,000**	**261,545**	**52,000**	**52,000**	**85,000**	**+33,000**
18-SC-12, Advanced Light Source Upgrade (ALS-U), LBNL						
Total Estimated Cost (TEC)	TBD	562,000	50,000	50,000	50,000	-
Other Project Cost (OPC)	TBD	28,000	-	-	-	-
Total Project Cost (TPC)	**TBD**	**590,000**	**50,000**	**50,000**	**50,000**	**-**
18-SC-13, Linac Coherent Light Source-II-High Energy (LCLS-II-HE), SLAC						
Total Estimated Cost (TEC)	684,000	478,657	100,000	99,343	6,000	-93,343
Other Project Cost (OPC)	32,000	27,000	-	5,000	-	-5,000
Total Project Cost (TPC)	**716,000**	**505,657**	**100,000**	**104,343**	**6,000**	**-98,343**
Total, Construction						
Total Estimated Cost (TEC)	**N/A**	**N/A**	**233,500**	**232,843**	**143,800**	**-89,043**
Other Project Cost (OPC)	**N/A**	**N/A**	**9,500**	**23,100**	**5,000**	**-18,100**
Total Project Cost (TPC)	**N/A**	**N/A**	**243,000**	**255,943**	**148,800**	**-107,143**

Note:
- *The project is currently working on a new cost and schedule analysis that will inform a new baseline TPC in FY 2026.*

Basic Energy Sciences
Scientific User Facility Operations

The treatment of user facilities is distinguished between two types: TYPE A facilities that offer users resources dependent on a single, large-scale machine; TYPE B facilities that offer users a suite of resources that is not dependent on a single, large-scale machine.

(dollars in thousands)

	FY 2025 Enacted	FY 2025 Current	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Scientific User Facilities - Type A					
Advanced Light Source	**118,439**	**119,665**	**133,698**	**126,617**	**-7,081**
Number of Users	1,550	1,609	776	820	+44
Achieved Operating Hours	–	2,583	–	–	–
Planned Operating Hours	2,768	2,768	1,850	1,515	-335
Advanced Photon Source	**201,758**	**201,758**	**224,442**	**213,956**	**-10,486**
Number of Users	2,736	2,140	4,400	3,280	-1,120
Achieved Operating Hours	–	4,809	–	–	–
Planned Operating Hours	4,774	4,774	4,000	4,100	+100
National Synchrotron Light Source II	**158,134**	**158,134**	**189,038**	**191,730**	**+2,692**
Number of Users	2,500	2,330	1,840	1,968	+128
Achieved Operating Hours	–	4,783	–	–	–
Planned Operating Hours	4,900	4,900	4,000	4,100	+100
Stanford Synchrotron Radiation Light Source	**69,000**	**69,000**	**86,120**	**92,465**	**+6,345**
Number of Users	1,900	1,529	14,520	1,558	-12,962
Achieved Operating Hours	–	5,106	–	–	–
Planned Operating Hours	5,116	5,116	4,080	4,100	+20
Linac Coherent Light Source	**231,534**	**235,534**	**234,377**	**243,458**	**+9,081**
Number of Users	1,000	1,092	800	820	+20
Achieved Operating Hours	–	7,053	–	–	–
Planned Operating Hours	7,500	7,500	4,360	4,510	+150
Spallation Neutron Source	**230,741**	**225,741**	**153,213**	**211,163**	**+57,950**
Number of Users	1,082	1,059	743	1,701	+958
Achieved Operating Hours	–	4,364	–	–	–
Planned Operating Hours	4,329	4,329	3,956	4,100	+144
High Flux Isotope Reactor	**142,626**	**147,626**	**144,780**	**168,863**	**+24,083**
Number of Users	403	399	442	882	+440
Achieved Operating Hours	–	1,383	–	–	–
Planned Operating Hours	2,250	2,250	2,924	2,296	-628
Scientific User Facilities - Type B					

(dollars in thousands)

	FY 2025 Enacted	FY 2025 Current	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Center for Nanoscale Materials	**32,445**	**32,445**	**36,367**	**35,765**	**-602**
Number of Users	885	1,001	830	820	-10
Center for Functional Nanomaterials	**27,663**	**27,663**	**30,130**	**30,161**	**+31**
Number of Users	750	739	701	693	-8
Molecular Foundry	**39,273**	**39,273**	**46,529**	**46,253**	**-276**
Number of Users	1,150	1,135	1,132	1,118	-14
Center for Nanophase Materials Sciences	**30,743**	**30,743**	**34,013**	**33,820**	**-193**
Number of Users	850	957	689	681	-8
Center for Integrated Nanotechnologies	**29,106**	**29,106**	**30,265**	**29,571**	**-694**
Number of Users	1,100	949	913	902	-11
Total, Facilities	**1,311,462**	**1,316,688**	**1,342,972**	**1,423,822**	**+80,850**
Number of Users	15,906	14,939	27,786	15,243	-12,543
Achieved Operating Hours	–	30,081	–	–	–
Planned Operating Hours	31,637	31,637	25,170	24,721	-449

Note:

- *Percent optimal operations defines what is achieved at this funding level. This includes staffing, up-to-date equipment and software, operations and maintenance, and appropriate investments to maintain world leadership.*

Scientific Employment

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Number of Permanent Ph.Ds (FTEs)	5,530	4,930	3,890	-1,040
Number of Postdoctoral Associates (FTEs)	1,510	1,290	880	-410
Number of Graduate Students (FTEs)	2,340	1,990	1,320	-670
Number of Other Scientific Employment (FTEs)	3,520	3,250	2,850	-400
Total Scientific Employment (FTEs)	**12,900**	**11,460**	**8,940**	**-2,520**

Note:
- *Other Scientific Employment (FTEs) includes technicians, engineers, computer professionals and other support staff.*

21-SC-10, Cryomodule Repair & Maintenance Facility (CRMF), SLAC
SLAC National Accelerator Laboratory, SLAC
Project is for Design and Construction

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

Summary

The Cryomodule Repair and Maintenance Facility (CRMF) project will provide a much-needed capability to maintain, repair, and test superconducting radiofrequency (SRF) accelerator components. The FY 2027 Request for the CRMF project at SLAC National Accelerator Laboratory is $7,800,000 of Total Estimated Cost (TEC) funding. This project has a preliminary Total Project Cost (TPC) range of $70,000,000 to $98,000,000. This cost range encompasses the most feasible preliminary alternatives as of CD-1 approval in FY 2024. As the design of this project has matured, the current preliminary TPC estimate for this project of $94,500,000 is being evaluated considering current construction market conditions.

Significant Changes

CRMF was initiated in FY 2021. The most recent DOE Order 413.3B approved Critical Decision (CD) is CD-1, Approve Alternative Selection and Cost Range, which was approved on October 11, 2023. On March 27, 2025, the Secretary of Energy issued a memorandum amending the project TPC thresholds in DOE Order 413.3B, resulting in the delegation of the CRMF project to the SLAC laboratory director. As the design has matured and cost estimates have grown, consistent with materials and labor inflation in the region, the $94,500,000 TPC estimate may not contain sufficient contingency for covering the remaining risks.

FY 2025 funding supported the completion of design work for the construction scope, including the building and conventional facilities, while advancing the designs and specifications for the technical systems including the superconducting radiofrequency (SRF) equipment, controls, and cryogenics capabilities. The FY 2026 Enacted supports the next building construction phase including the issuing of the Request for Proposals (RFP) and initiation of the construction contract. CD-3A will be requested in FY 2026 for Long-lead Procurement (LLP) of cryogenic, safety, and radio frequency equipment and systems. The FY 2027 Request will support ongoing construction of the building and conventional facilities and continue planning, design, engineering, prototyping, testing, fabrication, and installation to advance the highest priority activities with emphasis on initiating procurement of key technical systems and facilitating procurement activities for the cryogenic system.

A Federal Project Director, certified to Level II, has been assigned to this project.

Critical Milestone History

Fiscal Year	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
FY 2027	12/6/19	8/24/23	10/11/23	1Q FY 2027	4Q FY 2026	1Q FY 2027	3Q FY 2030

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; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

Fiscal Year	Performance Baseline Validation	CD-3A
FY 2027	1Q FY 2027	3Q FY 2026

CD-3A – Approve Long-lead Procurement (LLP) of cryogenic, safety, and radio frequency equipment and systems

Project Cost History

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	20,700	68,100	88,800	5,700	5,700	94,500
FY 2027	21,100	67,700	88,800	5,700	5,700	94,500

Note:
- *This project has not received CD-2 approval; therefore, funding estimates are preliminary.*

2. Project Scope and Justification

Scope

The preliminary scope of the CRMF project is to construct a building equipped with clean rooms, high pressure rinsing capabilities, handling tools, and fixtures to support the repair, maintenance, and testing of SRF linear accelerator (linac) components. These components may include, but are not limited to, SRF cavities and cryomodules, future capabilities for high brightness electron injectors, and superconducting undulators. The requirements will be further refined as the project matures.

Justification

Through two BES construction projects at SLAC, LCLS-II (completed) and LCLS-II-HE (well underway), SC is making over $1,800,000,000 of capital investment in those projects with improved SRF linac performance to support researchers advancing the scientific discovery and technology development missions of DOE. The LCLS-II project provided a 4 GeV SRF-based linear accelerator containing 35 SRF cryomodules (CMs) to accelerate the electrons. The LCLS-II-HE project will increase the energy of the superconducting linac to 8 GeV by providing an additional 23 SRF CMs of a similar design to those installed by the LCLS-II project but operating at a higher accelerating gradient. SLAC has partnered with Fermi National Accelerator Laboratory (FNAL) and the Thomas Jefferson National Accelerator Facility (TJNAF) to provide the accelerating CMs. The specialized CM fabrication, assembly, and test capabilities are currently available at FNAL and TJNAF, but not at SLAC. Therefore, to make any repairs, SLAC must send the CMs cross country back to either FNAL or TJNAF at an increased risk of damage, cost, and schedule delays. This situation also requires that either FNAL or TJNAF have the maintenance facility capacity and trained personnel available when needed. Historically, these facilities are actively working on CMs for other SC projects, and maintenance or repairs typically require scheduling 6 to 12 months in advance.

The CRMF is designed to meet these challenges by providing SLAC with the capability to repair, maintain, and test the cryomodules and components that make up the upgraded LCLS superconducting linac.

The project is delegated to the SLAC laboratory director to manage and will be executed using a tailored approach defined in the preliminary project execution plan (PPEP) while maintaining best practices and principles in DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*.

Key Performance Parameters (KPPs)
The KPPs are preliminary and may change as the project continues towards CD-2. At CD-2 approval, the KPPs will be part of the approved performance baseline. The Threshold KPPs represent the minimum acceptable performance that the project must achieve. The Objective KPPs represent the desired project performance. Achievement of the Threshold KPPs will be a prerequisite for approval of CD-4, Project Completion.

Capability	Threshold	Objective
Disassembly, repair, and re-assembly of a 1.3 gigahertz (GHz) cryomodule	Install CM assembly tooling and ISO 4 Cleanroom	Same as threshold
1.3 GHz cavity qualification tests in CM	One 7 kilowatt (kW) Solid State Amplifier (SSA) installed with controls and safety systems operational	Eight 7kW SSA installed
High-pressure-rinsing (HPR) of 1.3 GHz cavity	Space for High-Pressure Rinse (HPR)	Installation of HPR and ultrapure water systems
Cryogenic cooling	Delivery of sufficient 4.5 kelvin (K) liquid Helium (LHe) to sustain 100W of heat load at 2 K for 8 hours	Delivery of sufficient 4.5 Kelvin LHe to sustain 250W of heat load at 2 K for 8 hours
Infrastructure	18,000 GSF building	21,000 GSF building
Infrastructure for testing of 1.3 GHz cavity & cryomodule	Shielded enclosure and 880 GSF dedicated area for vertical test stand equipment and construction of two vertical pits	Same as threshold
Area for SRF-related equipment	Space for ISO 4 cleanroom and CM assembly workstations	Additional space for future SRF shielded enclosure

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Estimated Cost (TEC)				
Design (TEC)				
Prior Years	2,540	2,540	—	—
Prior Years - IRA Supp.	18,560	18,560	—	5,954
FY 2025	—	—	—	7,398
FY 2026	—	—	2,540	5,208
Total, Design (TEC)	**21,100**	**21,100**	**2,540**	**18,560**
Construction (TEC)				
Prior Years	18,460	18,460	—	—

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Estimated Cost (TEC)				
Prior Years - IRA Supp.	1,440	1,440	—	—
FY 2025	20,000	20,000	—	—
FY 2026	20,000	20,000	25,388	1,440
FY 2027	7,800	7,800	36,533	—
Outyears	—	—	4,339	—
Total, Construction (TEC)	**67,700**	**67,700**	**66,260**	**1,440**
Total Estimated Cost (TEC)				
Prior Years	21,000	21,000	—	—
Prior Years - IRA Supp.	20,000	20,000	—	5,954
FY 2025	20,000	20,000	—	7,398
FY 2026	20,000	20,000	27,928	6,648
FY 2027	7,800	7,800	36,533	—
Outyears	—	—	4,339	—
Total, Total Estimated Cost (TEC)	**88,800**	**88,800**	**68,800**	**20,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Other Project Cost (OPC)				
Prior Years	5,000	5,000	3,089	–
Prior Years - IRA Supp.	700	700	–	700
FY 2025	–	–	8	–
FY 2027	–	–	6	–
Outyears	–	–	1,897	–
Total, Other Project Cost (OPC)	**5,700**	**5,700**	**5,000**	**700**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Project Cost (TPC)				
Prior Years	26,000	26,000	3,089	–
Prior Years - IRA Supp.	20,700	20,700	–	6,654
FY 2025	20,000	20,000	8	7,398
FY 2026	20,000	20,000	27,928	6,648
FY 2027	7,800	7,800	36,539	–
Outyears	–	–	6,236	–

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Project Cost (TPC)				
Total, TPC	**94,500**	**94,500**	**73,800**	**20,700**

4. **Details of Project Cost Estimate**

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design	20,100	17,000	**N/A**
Design - Contingency	1,000	3,700	**N/A**
Total, Design (TEC)	**21,100**	**20,700**	**N/A**
Construction_No_Detail	38,900	31,700	**N/A**
Equipment	27,000	22,600	**N/A**
Construction Contingency	1,800	13,800	**N/A**
Total, Construction (TEC)	**67,700**	**68,100**	**N/A**
Total, TEC	**88,800**	**88,800**	**N/A**
Contingency, TEC	*2,800*	*17,500*	***N/A***
Other Project Cost (OPC)			
OPC, Except D&D	740	N/A	**N/A**
Conceptual Planning	500	500	**N/A**
Conceptual Design	2,805	2,800	**N/A**
Start-up	500	1,200	**N/A**
OPC - Contingency	1,155	1,200	**N/A**
Total, Except D&D (OPC)	**5,700**	**5,700**	**N/A**
Total, OPC	**5,700**	**5,700**	**N/A**
Contingency, OPC	*1,155*	*1,200*	***N/A***
Total, TPC	**94,500**	**94,500**	**N/A**
Total, Contingency (TEC+OPC)	***3,955***	***18,700***	***N/A***

5. **Schedule of Appropriations Requests**

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	41,000	20,000	20,000	—	7,800	88,800
	OPC	5,700	—	—	—	—	5,700
	TPC	46,700	20,000	20,000	—	7,800	94,500
FY 2027	TEC	41,000	20,000	20,000	7,800	—	88,800
	OPC	5,700	—	—	—	—	5,700
	TPC	46,700	20,000	20,000	7,800	—	94,500

Note:
- *This project has not received CD-2 approval; therefore, funding estimates are preliminary.*

6. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy	3Q FY 2030
Expected Useful Life	25 years
Expected Future Start of D&D of this capital asset	3Q FY 2055

Related Funding Requirements
(dollars in thousands)

	Annual Costs		Life Cycle Costs	
	Previous Total Estimate	**Current Total Estimate**	**Previous Total Estimate**	**Current Total Estimate**
Operations, Maintenance and Repair	5,500	5,500	137,500	137,500

7. D&D Information

At this stage of project planning and development, SC is planning to construct a new building up to 21,000 gross square feet as part of this project.

	Square Feet
New area being constructed by this project at SLAC	21,000
Area of D&D in this project at SLAC	—
Area at SLAC to be transferred, sold, and/or D&D outside the project, including area previously "banked"	21,000
Area of D&D in this project at other sites	—
Area at other sites to be transferred, sold, and/or D&D outside the project, including area previously "banked"	—
Total area eliminated	—

8. Acquisition Approach

The CRMF Project will be sited at SLAC and is being acquired under the existing DOE M&O contract with Stanford University. SLAC has delivered several large construction projects and research facilities and has the requisite expertise to successfully deliver CRMF. SLAC, with support from partner laboratory expert staff, will complete the design of the technical systems. The acquisition of the CRMF building will be based on the design-bid-build methodology. Selected subcontracted vendors, pre-qualified with the necessary capabilities, will fabricate the technical equipment. SLAC will competitively bid and award all contracts based on best value to the government.

SC and the M&O will draw from the lessons learned from other SC projects and other similar facilities in planning and executing the CRMF project. SC will evaluate the M&O contractor's performance through the annual laboratory performance appraisal process.

19-SC-14, Second Target Station (STS), ORNL
Oak Ridge National Laboratory, ORNL
Project is for Design and Construction

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

Summary

The STS project will design and build a new, very high brightness cold[h] neutron scattering capability to maintain U.S. competitiveness in providing world-leading neutron scattering user facilities. STS will offer unique beamlines to advance our understanding of the fundamental aspects of the natural world. The FY 2027 Request for the STS project is $80,000,000 of Total Estimated Cost (TEC) funding. This project has a preliminary Total Project Cost (TPC) range of $1,800,000,000 to $3,000,000,000. This cost range encompasses the most feasible preliminary alternatives. The current preliminary TPC estimate is $2,000,000,000 based on the most current revised scope, notional funding profile, and schedule.

Significant Changes

STS was initiated in FY 2019. The most recent DOE Order 413.3B approved Critical Decision (CD) is CD-3A, Approve Long Lead Procurements (LLPs), which was approved on June 24, 2025. The project continues to face schedule and cost challenges due to increasing construction costs in the local market and has worked with the program on the Key Performance Parameter (KPP) and scope refinements to keep within the $2,000,000,000 preliminary TPC point estimate. The preliminary TPC is subject to change with adjustments in the annual funding levels.

FY 2025 funding continued planning, R&D, design, engineering, prototyping, and testing to advance the highest priority activities with emphasis on key project scope for the accelerator, bunker, target assembly, shielding, moderator reflector assembly, and conventional facilities, including initiating site preparation for the conventional facilities. The FY 2026 Enacted supports continuation of FY 2025 activities to further advance the final designs in readiness for CD-2, *Approve Performance Baseline* and CD-3 *Approve Start of Construction* for the conventional civil construction and all the technical systems except for the beamline scope. The STS science advisory board will provide recommendations on the highest priority instrument concepts for inclusion in the project for further development. The FY 2027 Request will support planning, R&D, design, engineering, prototyping, fabrication, procurement, and testing to advance the highest priority activities with emphasis on the target monolith, bunker, and associated controls system designs. Site preparation, completed in FY 2027, will enable construction of the proton transport tunnel and the target and instrument building. Procurements, including the accelerator magnets, will be evaluated based on sufficient funding beyond what is needed for construction.

A Federal Project Director, certified to level III, has been assigned to this project.

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[h] Neutrons can be described based on their wavelength and energy. Cold neutrons have lower energy (below 25 meV) and longer wavelengths (>0.2 nm) than thermal neutrons. Cold neutrons are best for characterizing materials with large atomic/molecular structures, such as polymers, biological materials, and magnetic materials. The wavelength of cold neutrons is similar to the activation energies for many solid-state excitations, molecular relaxations, and dynamic processes.

Critical Milestone History

Fiscal Year	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
FY 2027	1/7/09	4/30/21	11/23/20	4Q FY 2026	1Q FY 2032	4Q FY 2026	3Q FY 2040

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; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

Fiscal Year	Performance Baseline Validation	CD-3A
FY 2027	4Q FY 2026	06/24/25

CD-3A – Approve Long-Lead Procurements for the Construction Management/General Contractor (CM/GC) to perform site preparation for conventional civil construction.

Project Cost History

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	263,520	1,660,400	1,923,920	76,080	76,080	2,000,000
FY 2027	285,222	1,645,505	1,930,727	69,273	69,273	2,000,000

Note:
- *This project has not received CD-2 approval; therefore, funding estimates are preliminary.*

2. Project Scope and Justification

Scope

The STS project will design and build the new cold neutron scattering facility that comprises four primary elements: the neutron target and moderators; the accelerator systems; the instruments; and the conventional facilities. Costs for acceptance testing, integrated testing, and initial commissioning to demonstrate achievement of the KPPs are included in the STS scope. STS will be located in unoccupied space east of the existing SNS First Target Station (FTS). The project requires approximately 230,000 square feet of new buildings, making conventional facility construction a major contributor to project costs. The conventional facilities have been consolidated and the footprint reduced to lower the construction cost and shorten the schedule.

Justification

BES supports two world-class neutron scattering facilities, the HFIR and the SNS, with the SNS FTS among the world's brightest pulsed neutron scattering facilities providing thermal neutron capability.[i] Currently, the U.S. lacks domestic capacity for research with lower energy, longer wavelength cold neutrons. Filling this gap is critical to maintaining U.S. competitiveness in world-leading neutron scattering research. The STS project will design and build a new world-leading, peak brightness, cold neutron source. The STS will provide an initial set of unique, world-class instruments that will address major scientific challenges that are currently difficult or impossible to conduct at existing facilities. This includes unlocking breakthroughs in quantum materials, biomaterials, soft matter and polymers, materials under extreme conditions and in non-equilibrium environments, enhancing advanced manufacturing, and improving efficiency of catalytic transformations within chemical manufacturing, all of which are enabling for U.S. energy dominance.

The STS will use the high-power proton beam from the SNS proton linac to strike a solid tungsten target to produce neutrons that illuminate geometrically optimized compact moderators, yielding cold neutron beams with unparalleled peak brightness for instruments. The STS project will use 0.7 MW of the 2.8 MW accelerator proton beam power enabled by the PPU project. STS is designed to operate at 15 pulses/second simultaneously with FTS by using one out of every four proton pulses to produce cold neutron beams. FTS will operate at 45 pulses/second. An initial set of world-class instruments to support the refined science case will enable new research opportunities and unprecedented levels of performance. STS will fill the capability gap that is emerging with upgrades and construction of new facilities worldwide.

The closest operational competitor facility is J-PARC in Japan, which became the brightest pulsed cold neutron source with a recent power upgrade. The CSNS in China has lower peak and average brightness but offers resolution flexibility with its optimized pulse length. The European Spallation Source (ESS), a long-pulse facility under construction in Sweden, is expected to provide neutrons by 2027 with an initial ramp-up to a proton beam power of 2 MW at 14 pulses/second by ~2028. With a designed power of 5 MW, ESS will not achieve the anticipated STS world-leading peak brightness. However, it will be highly competitive with its unique, bi-spectral capability that allows instruments to simultaneously use neutrons from both cold and thermal moderators, world-leading average brightness, and ultimate resolution flexibility. Therefore, STS, with its unmatched capabilities, would fill a capability gap in the context of other facilities worldwide.

The project is being conducted in accordance with the project management requirements in DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*.

Key Performance Parameters (KPPs)

The KPPs are preliminary and may change as the project continues towards CD-2. At CD-2 approval, the KPPs will be baselined. The Threshold KPPs represent the minimum acceptable performance that the project must achieve. The Objective KPPs represent the desired project performance. Achievement of the Threshold KPPs will be a prerequisite for approval of CD-4, Project Completion.

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[i] Thermal neutrons have higher energy (at and above 25 meV) and shorter wavelengths (<0.2 nm) than cold neutrons. The wavelength of thermal neutrons is similar to the interatomic distances in materials, making them ideal for engineering materials, imaging, and determination of crystal structures.

Performance Measure	Threshold	Objective
Demonstrate independent control of the proton beam on the two target stations	Operate beam to FTS at 45 pulses/s, with no beam to STS. Operate beam to STS at 15 pulses/s, with no beam to FTS. Operate with beam to both target stations 45 pulses/s at FTS and 15 pulses/s at STS.	Same as threshold.
Demonstrate proton beam power on STS at 15 Hz with FTS at 2MW at 45 pulses/s	100 kW beam power	700 kW beam power
Demonstrate STS neutron brightness	Peak brightness of 2 x 10^{13}n/cm^2/sr/Å/s at 5 Å	Peak brightness of 2 x 10^{14}n/cm^2/sr/Å/s at 5 Å
Beamlines transitioned to operations	3 beamlines successfully passed the integrated functional testing per the transition to operations parameters acceptance criteria.	≥ 3 beamlines successfully passed the integrated functional testing per the transition to operations parameters acceptance criteria.

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Estimated Cost (TEC)				
Design (TEC)				
Prior Years	151,000	151,000	84,474	—
Prior Years - IRA Supp.	42,700	42,700	—	42,700
FY 2025	17,000	17,000	43,226	—
FY 2026	24,452	24,452	35,989	—
FY 2027	—	—	21,000	—
Outyears	50,070	50,070	57,833	—
Total, Design (TEC)	**285,222**	**285,222**	**242,522**	**42,700**
Construction (TEC)				
Prior Years	15,000	15,000	—	—
FY 2025	35,000	35,000	5,303	—
FY 2026	27,548	27,548	29,635	—
FY 2027	80,000	80,000	73,000	—
Outyears	1,487,957	1,487,957	1,537,567	—
Total, Construction (TEC)	**1,645,505**	**1,645,505**	**1,645,505**	**—**
Total Estimated Cost (TEC)				
Prior Years	166,000	166,000	84,474	—
Prior Years - IRA Supp.	42,700	42,700	—	42,700

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Estimated Cost (TEC)				
FY 2025	52,000	52,000	48,529	—
FY 2026	52,000	52,000	65,624	—
FY 2027	80,000	80,000	94,000	—
Outyears	1,538,027	1,538,027	1,595,400	—
Total, Total Estimated Cost (TEC)	**1,930,727**	**1,930,727**	**1,888,027**	**42,700**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Other Project Cost (OPC)				
Prior Years	52,845	52,845	40,180	–
FY 2025	–	–	4,540	–
FY 2026	–	–	3,832	–
FY 2027	5,000	5,000	498	–
Outyears	11,428	11,428	20,223	–
Total, Other Project Cost (OPC)	**69,273**	**69,273**	**69,273**	**–**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Project Cost (TPC)				
Prior Years	218,845	218,845	124,654	–
Prior Years - IRA Supp.	42,700	42,700	–	42,700
FY 2025	52,000	52,000	53,069	–
FY 2026	52,000	52,000	69,456	–
FY 2027	85,000	85,000	94,498	–
Outyears	1,549,455	1,549,455	1,615,623	–
Total, TPC	**2,000,000**	**2,000,000**	**1,957,300**	**42,700**

4. Details of Project Cost Estimate

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design	253,902	248,220	**N/A**
Design - Contingency	31,320	28,300	**N/A**
Total, Design (TEC)	**285,222**	**276,520**	**N/A**
Construction_No_Detail	1,198,600	1,128,120	**N/A**
Construction Contingency	446,905	519,280	**N/A**
Total, Construction (TEC)	**1,645,505**	**1,647,400**	**N/A**
Total, TEC	**1,930,727**	**1,923,920**	**N/A**
Contingency, TEC	*478,225*	*547,580*	***N/A***
Other Project Cost (OPC)			
R&D	19,743	5,632	**N/A**
Conceptual Design	29,142	36,644	**N/A**
Start-up	14,313	18,588	**N/A**
OPC - Contingency	6,075	15,216	**N/A**
Total, Except D&D (OPC)	**69,273**	**76,080**	**N/A**
Total, OPC	**69,273**	**76,080**	**N/A**
Contingency, OPC	*6,075*	*15,216*	***N/A***
Total, TPC	**2,000,000**	**2,000,000**	**N/A**
Total, Contingency (TEC+OPC)	***484,300***	***562,796***	***N/A***

5. Schedule of Appropriations Requests

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	208,700	52,000	52,000	—	1,611,220	1,923,920
	OPC	52,845	—	—	—	23,235	76,080
	TPC	261,545	52,000	52,000	—	1,634,455	2,000,000
FY 2027	TEC	208,700	52,000	52,000	80,000	1,538,027	1,930,727
	OPC	52,845	—	—	5,000	11,428	69,273
	TPC	261,545	52,000	52,000	85,000	1,549,455	2,000,000

Note:
- *This project has not received CD-2 approval; therefore, funding estimates are preliminary.*

6. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy	3Q FY 2040
Expected Useful Life	25 years
Expected Future Start of D&D of this capital asset	3Q FY 2065

Related Funding Requirements
(dollars in thousands)

	Annual Costs		Life Cycle Costs	
	Previous Total Estimate	**Current Total Estimate**	**Previous Total Estimate**	**Current Total Estimate**
Operations, Maintenance and Repair	59,000	59,000	1,475,000	1,475,000

The numbers presented are the incremental operations and maintenance costs above the existing SNS facility without escalation. The estimate will be updated and additional details will be provided after CD-2, Approve Performance Baseline.

7. D&D Information

The new area being constructed in this project will not replace existing facilities.

	Square Feet
New area being constructed by this project at ORNL	~230,000
Area of D&D in this project at ORNL	—
Area at ORNL to be transferred, sold, and/or D&D outside the project, including area previously "banked"	~230,000
Area of D&D in this project at other sites	—
Area at other sites to be transferred, sold, and/or D&D outside the project, including area previously "banked"	—
Total area eliminated	—

8. Acquisition Approach

Based on the DOE determination at CD-1, ORNL is acquiring the STS project under the existing DOE M&O contract.

The M&O contractor prepared a Conceptual Design Report for the STS project and identified key design activities, requirements, and high-risk subsystem components to reduce cost and schedule risk to the project and expedite the startup. The necessary project management systems are fully up to date, operating, and are maintained as an ORNL-wide resource.

ORNL will design and procure the key technical subsystem components. Some technical system designs will require research and development activities. Preliminary cost estimates for most of these systems are based on SNS operating experience and vendor estimates, while some first-of-a-kind systems are based on expert judgement. Vendors and/or partner labs with the necessary capabilities will fabricate the technical equipment. ORNL will competitively bid and award all subcontracts based on best value to the government. SC will evaluate the M&O contractor's performance through the annual laboratory performance appraisal process.

SC and the M&O will draw from lessons learned from other SC projects and other similar facilities in planning and executing the STS project.

18-SC-12, Advanced Light Source Upgrade (ALS-U), LBNL
Lawrence Berkeley National Laboratory, LBNL
Project is for Design and Construction

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

Summary

The FY 2027 Request for the ALS-U project is $50,000,000 of Total Estimated Cost (TEC) funding. The project has a baselined Total Project Cost (TPC) of $590,000,000. Since the TPC was established at CD-2, Approve Performance Baseline, on April 2, 2021, the project has experienced significant cost and schedule escalation because of factors both external and internal to the project. As a result, the Department is preparing for a rebaseline of the project, which is currently planned for no later than 3Q FY 2026.

Significant Changes

The ALS-U was initiated in FY 2018. The most recent DOE Order 413.3B approved Critical Decision (CD) is CD-3, Approve Start of Construction, approved on November 10, 2022. This Construction Project Data Sheet (CPDS) is an update of the FY 2026 CPDS and does not include a new start for FY 2027.

Independent project reviews (IPR) carried out by the DOE Office of Project Assessment in November 2023 and May 2024 identified significant challenges impacting project performance. Following an internal laboratory assessment and subsequent external Director's review in November 2024, the lab concluded that the project was on a trajectory to exceed its current baseline. The analysis identified multiple issues that have been validated by a root cause analysis. A revised bottom-up cost and schedule baseline will be assessed and validated with independent project reviews occurring in early calendar year 2026 to inform, with confidence, the rebaseline evaluation and decision in 3Q FY 2026.

The FY 2025 funding supported advancing the remaining Accumulator Ring procurements and the Storage Ring final designs. The first article raft and sector mockup will advance as necessary precursors for pre-staging and assembly of the Storage Ring rafts. The FY 2026 funding advances key activities, such as the first article raft and sector mockup, necessary precursors for pre-staging and assembly of the Storage Ring raft assemblies, cable plant installation, Accumulator Ring electrical installation, and beamline front end and system engineering. Vacuum system components will be procured, in preparation for the dark time Storage Ring installation. The FY 2027 Request will enable continued planning, design, engineering, prototyping, installation, and testing to advance the highest priority activities with emphasis on Accumulator Ring commissioning, production of the Storage Ring rafts, completing the beamline front-end engineering, and advancing beamline systems engineering as the project continues progressing toward completion.

A FPD certified to Level III has been assigned to this project, with Level IV certification in progress.

Critical Milestone History

Fiscal Year	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
FY 2027	9/27/16	4/30/18	9/21/18	4/2/21	1Q FY 2027	11/10/22	4Q FY 2030

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; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

Fiscal Year	Performance Baseline Validation	CD-3A
FY 2027	4/2/21	12/19/19

CD-3A – Approve Long-Lead Procurements includes Accumulator Ring equipment on the critical path necessary for installation.

Note:

- *The ALS-U project is currently working towards a rebaseline in FY 2026 that will establish a new cost and schedule estimate. The current cost and schedule estimates shown are those established at CD-2.*

Project Cost History

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	134,340	427,660	562,000	28,000	28,000	590,000
FY 2027	TBD	TBD	TBD	TBD	TBD	TBD

Note:

- *The ALS-U project is currently working towards a rebaseline in FY 2026 that will establish a new cost and schedule estimate. The current cost and schedule estimates shown are those established at CD-2.*

2. Project Scope and Justification

Scope

The ALS-U project will upgrade the existing ALS facility by replacing the existing electron storage ring with a new electron storage ring based on a multi-bend achromat (MBA) lattice design to provide a soft x-ray source that is an increase in brightness of up to 100 times over the current ALS—and to provide a significantly higher fraction of coherent light in the soft x-ray region (approximately 50-2,000 electronvolts [eV]) than is currently available at ALS. The project will replace the existing triple-bend achromat storage ring with a new, high-performance storage ring based on a nine-bend achromat design. In addition, the project will add a low-emittance, full-energy accumulator ring to the existing tunnel inner shield wall to enable on- and off-axis, swap-out injection and extraction into and from the new storage ring using fast kicker magnets. The new source will require upgrading x-ray optics on existing beamlines with some beamlines being realigned or relocated. The project adds two new undulator beamlines that are optimized for the novel science made possible by the beam's new high coherent flux. The project intends to reuse the existing building, utilities, electron gun, linac, and booster synchrotron equipment currently at ALS. Prior to CD-2, the scope was increased to include radiation shielding and safety-mandated seismic structural upgrades to the ALS facility. With an aggressive accelerator design, ALS-U will provide the highest coherent flux covering the entire soft x-ray regime (up to a photon energy range of about 3.5 keV) of any existing or planned storage ring facility worldwide.

Justification

At this time, our ability to observe and understand materials and material phenomena in real-time as they emerge and evolve is limited. Soft x-rays (approximately 50 to 2,000 eV) are ideally suited for revealing the chemical, electronic, and magnetic properties of materials, as well as the chemical reactions that underpin these properties. This knowledge is crucial for the design and control of new advanced materials that address the challenges of new energy technologies.

Existing storage ring light sources lack a key attribute that would revolutionize x-ray science: stable, nearly continuous soft x-rays with high brightness and high coherent flux—that is, smooth, well organized soft x-ray wave fronts. Such a source would enable 3D imaging with nanometer resolution and the measurement of spontaneous nanoscale motion with nanosecond resolution—all with electronic structure sensitivity.

Currently, BES operates advanced ring-based light sources that produce soft x-rays. The NSLS-II, commissioned in 2015, is the brightest soft x-ray source in the U.S. The ALS, completed in 1993, is competitive with NSLS-II for x-rays below 200 eV but not above that. NSLS-II is somewhat lower in brightness than the Swedish light source, MAX-IV, which began user operations in 2017 and represented the first use of a Multi-Bend-Achromat (MBA) magnet lattice design to dramatically increase the brightness in a light source facility. Neither NSLS-II nor ALS make use of the newer MBA lattice design. Switzerland's SLS-2 (an MBA-based design that began user operations in late 2025) will be a brighter soft x-ray light source than both NSLS-II and MAX-IV. These international light sources, and those that follow present a significant challenge to the U.S. light source community to provide competitive x-ray sources to domestic users until the ALS upgrade is complete.

Neither the NSLS-II nor ALS soft x-ray light sources possess sufficient brightness or coherent flux to provide the capability to meet the mission need in their current configurations.

The existing ALS is a 1.9 GeV storage ring operating at 500 milliamps (mA) of beam current. It is optimized to produce intense beams of soft x-rays, which offer spectroscopic contrast, nanometer-scale resolution, and broad temporal sensitivity. The ALS facility includes an accelerator complex and photon delivery system that can provide the foundations for an upgrade that will achieve world-leading soft x-ray coherent flux. The existing ALS provides a ready-made foundation, including conventional facilities, a $500,000,000 scientific infrastructure investment and a vibrant user community of over 2,500 users per year already attuned to the potential scientific opportunities an upgrade offers. The facility also includes extensive (up to 40) simultaneously operating beamlines and instrumentation, an experimental hall, computing resources, ancillary laboratories, offices, and related infrastructure that will be heavily utilized in an upgrade scenario. Furthermore, the upgrade leverages the ALS staff, who are experts in the scientific and technical aspects of the proposed upgrade.

In summary, the capabilities at our existing x-ray light source facilities are insufficient to develop the next generation of tools that combine high resolution spatial imaging together with precise energy resolving spectroscopic techniques in the soft x-ray range. To enable these cutting-edge experimental techniques, ALS-U is designed and being constructed to be a world-leading facility in soft x-ray science by delivering ultra-bright source of light in the soft x-ray regime with the high coherent x-ray flux required to resolve nanometer-scale features and interactions, and to allow the real-time observation and understanding of materials and phenomena as they emerge and evolve. Developing such a light source will ensure the U.S. has the tools to maintain its leadership in soft x-ray science and will significantly accelerate the advancement of the fundamental sciences that underlie a broad range of emerging and future energy applications.

The project is being conducted in accordance with the project management requirements in DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets.*

Key Performance Parameters (KPPs)
The Threshold KPPs approved at CD-2 represent the minimum acceptable performance that the project must achieve. The Objective KPPs represent the desired project performance. Achievement of the Threshold KPPs will be a prerequisite for approval of CD-4, Project Completion.

Performance Measure	Threshold	Objective
Storage Ring Energy	≥ 1.9 GeV	2.0 GeV
Beam Current	> 25 mA	500 mA
Horizontal Emittance	< 150 pm-rad	< 85 pm-rad
Brightness @ 1 keV[a]	> 2 x 10^{19}	≥ 2 x 10^{21}
New MBA Beamlines	2	≥ 2

[a] Units = photons/sec/0.1% BW/mm2/mrad2

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Estimated Cost (TEC)				
Design (TEC)				
Prior Years	134,340	134,340	130,975	—
FY 2025	—	—	3,365	—
Total, Design (TEC)	**134,340**	**134,340**	**134,340**	**—**
Construction (TEC)				
Prior Years	331,060	331,060	164,336	—
Prior Years - IRA Supp.	96,600	96,600	—	95,034
FY 2025	50,000	50,000	57,183	1,566
FY 2026	50,000	TBD	TBD	—
FY 2027	TBD	TBD	TBD	TBD
Outyears	TBD	TBD	TBD	TBD
Total, Construction (TEC)	**TBD**	**TBD**	**TBD**	**TBD**
Total Estimated Cost (TEC)				
Prior Years	465,400	465,400	295,311	—
Prior Years - IRA Supp.	96,600	96,600	—	95,034
FY 2025	50,000	50,000	60,548	1,566
FY 2026	50,000	TBD	TBD	—

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Estimated Cost (TEC)				
FY 2027	TBD	TBD	TBD	TBD
Outyears	TBD	TBD	TBD	TBD
Total, Total Estimated Cost (TEC)	**TBD**	**TBD**	**TBD**	**TBD**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Other Project Cost (OPC)				
Prior Years	28,000	28,000	23,560	–
FY 2026	–	–	4,440	–
Total, Other Project Cost (OPC)	**28,000**	**28,000**	**28,000**	**–**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Project Cost (TPC)				
Prior Years	493,400	493,400	318,871	–
Prior Years - IRA Supp.	96,600	96,600	–	95,034
FY 2025	50,000	50,000	60,548	1,566
FY 2026	50,000	TBD	TBD	–
FY 2027	TBD	TBD	TBD	TBD
Outyears	TBD	TBD	TBD	TBD
Total, TPC	**TBD**	**TBD**	**593,400**	**96,600**

Note:

- *The ALS-U project is currently working towards a rebaseline in FY 2026 that will establish a new cost and schedule estimate. The current cost and schedule estimates shown are those established at CD-2.*
- *The FY 2027 Request includes $50M for the ALS-U project. This funding will not be reflected in the table until a new CD-2 baseline is approved.*

4. Details of Project Cost Estimate

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design	117,778	117,778	92,967
Design - Contingency	16,562	16,562	38,778
Total, Design (TEC)	**134,340**	**134,340**	**131,745**
Construction_No_Detail	159,338	159,338	142,165
Equipment	172,938	172,938	161,449
Construction Contingency	95,384	95,384	126,641
Total, Construction (TEC)	**427,660**	**427,660**	**430,255**
Total, TEC	**562,000**	**562,000**	**562,000**
Contingency, TEC	*111,946*	*111,946*	*165,419*
Other Project Cost (OPC)			
R&D	N/A	N/A	8,241
Conceptual Planning	10,261	10,261	2,000
Conceptual Design	14,100	14,100	12,100
Start-up	1,000	1,000	2,000
OPC - Contingency	2,639	2,639	3,659
Total, Except D&D (OPC)	**28,000**	**28,000**	**28,000**
Total, OPC	**28,000**	**28,000**	**28,000**
Contingency, OPC	*2,639*	*2,639*	*3,659*
Total, TPC	**590,000**	**590,000**	**590,000**
Total, Contingency (TEC+OPC)	***114,585***	***114,585***	***169,078***

Note:

- *The ALS-U project is currently working towards a rebaseline in FY 2026 that will establish a new cost and schedule estimate. The current cost and schedule estimates shown are those established at CD-2.*

5. Schedule of Appropriations Requests

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	562,000	50,000	50,000	TBD	TBD	TBD
	OPC	28,000	—	—	TBD	TBD	TBD
	TPC	590,000	50,000	50,000	TBD	TBD	TBD
FY 2027	TEC	562,000	50,000	50,000	TBD	TBD	TBD
	OPC	28,000	—	—	TBD	TBD	TBD
	TPC	590,000	50,000	50,000	TBD	TBD	TBD

Note:

- *The ALS-U project is currently working towards a rebaseline in FY 2026 that will establish a new cost and schedule estimate. The current cost and schedule estimates shown are those established at CD-2.*
- *The FY 2027 Request includes $50M for the ALS-U project. This funding will not be reflected in the table until a new CD-2 baseline is approved.*

6. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy	4Q FY 2030
Expected Useful Life	25 years
Expected Future Start of D&D of this capital asset	4Q FY 2055

Related Funding Requirements
(dollars in thousands)

	Annual Costs		**Life Cycle Costs**	
	Previous Total Estimate	**Current Total Estimate**	**Previous Total Estimate**	**Current Total Estimate**
Operations, Maintenance and Repair	71,500	71,500	2,597,500	2,597,500

7. D&D Information

At this stage of project planning and development, SC anticipates that there will be no new area being constructed in the construction project.

8. Acquisition Approach

Based on the DOE determination at CD-1, LBNL is acquiring the ALS-U project under the existing DOE Management and Operations (M&O) contract.

The ALS-U project identified key design activities, requirements, and high-risk subsystem components to reduce cost and schedule risk to the project and expedite the startup. The necessary project management systems are fully up-to-date, operating, and are maintained as a LBNL-wide resource.

LBNL has partnered with BNL for design and procurement of all required power supplies. Technical system designs required research and development and prototyping activities that are now near completion. Cost estimates for the remaining work have been updated by acquiring recent vendor quotes as part of CD-3 approval. All subcontracts are being competitively bid and awarded based on best value to the government. The M&O contractor's performance is being evaluated through the annual laboratory performance appraisal process.

Lessons learned from other SC projects and other similar facilities are being exploited fully in planning and executing ALS-U.

18-SC-13, Linac Coherent Light Source-II-High Energy (LCLS-II-HE), SLAC
SLAC National Accelerator Laboratory, SLAC
Project is for Design and Construction

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

Summary
The LCLS-II-HE project will expand the capabilities of the LCLS to maintain U.S. leadership in ultrafast and ultrabright x-ray science. The project will increase the energy of the superconducting linac from 4 GeV to 8 GeV and thereby expand the high repetition rate operation (one million pulses per second) into the hard x-ray regime (5-12 keV). The FY 2027 Request for the LCLS-II-HE project is $6,000,000 of Total Estimated Cost (TEC) funding. The Total Project Cost established at the combined CD-2/3 is $716,000,000.

Significant Changes
The LCLS-II-HE project was initiated in FY 2019. The most recent DOE Order 413.3B approved Critical Decision (CD) is a combined CD-2/3, Approve Performance Baseline/Approve Start of Construction, which was approved on September 19, 2024. The phased long-lead procurements were enabled by the investment of the Inflation Reduction Act (IRA) funds. CD-4 is projected for 2Q FY 2028.

FY 2025 funding supported continued engineering, R&D, and injector gun prototyping; and initiated CD-3C, Approve Long-lead Procurements of cryogenic system components and early construction of vertical transfer line penetration through the linac structure for delivery of cryogens, and cryogenic distribution system and controls instruments required for installation during the year-long down time. The FY 2026 Enacted will continue engineering, R&D, and prototyping for the superconducting radiofrequency electron gun; cryomodule and solid state amplifier production and delivery; continued CD-3C procurements advancing the cryogenic distribution systems; and initiating the low-emittance injector tunnel infrastructure; and initiating construction/installation contracts. The FY 2027 Request will enable continuation of the planning, R&D, design, engineering, prototyping, testing, procurement, and construction to advance the highest priority activities with the emphasis on continuing the construction and installation contracts, including the infrastructure systems for cryogenic transfer lines, cryomodules, safety systems, and the experimental hutch. Installation activities continue during the year-long LCLS downtime and commissioning the new beamline.

A Federal Project Director, certified to Level IV, has been assigned to this project.

Critical Milestone History

Fiscal Year	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
FY 2027	12/15/16	3/23/18	9/21/18	09/19/24	3Q FY 2026	09/19/24	2Q FY 2028

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; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

Fiscal Year	Performance Baseline Validation	CD-3A	CD-3B	CD-3C
FY 2027	09/19/24	5/12/20	1/27/23	7/2/24

CD-3A – Approve Long-Lead Procurements for cryomodule associated parts and equipment.
CD-3B – Approve Long-Lead Procurements for SRF Injector cryogenic systems, Cryo Distribution Box, Optics for Experimental Systems, Controls Systems.
CD-3C – Approve Long-Lead Procurements of cryogenic system distribution and controls, beamline optics, and Early Limited Construction including drilling vertical penetration into the accelerator housing for delivery of cryogens into the tunnel.

Project Cost History

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	68,000	616,000	684,000	32,000	32,000	716,000
FY 2027	67,300	616,700	684,000	32,000	32,000	716,000

2. Project Scope and Justification

Scope
The LCLS-II-HE project's scope increases the superconducting linac energy from 4 GeV to 8 GeV by installing additional cryomodules in the first kilometer of the existing linac tunnel. The electron beam, generated by a superconducting electron source, will be transported to the existing undulator hall to extend the x-ray energy to 12 keV and beyond. The project will also modify or upgrade existing infrastructure (process cooling water, power, electrical) in the last sector of the linac tunnel and the x-ray transport, optics, and diagnostic and safety systems. It will provide new or upgraded instrumentation to augment existing and planned capabilities.

Justification
International developments in X-ray facilities will challenge LCLS's world leadership position. The Shanghai Advanced Research Institute XFEL in Shanghai, China, called SHINE, will match the high pulse rate for continuous operation and have double the electron energy enabled by the LCLS-II project, which allows production of shorter (i.e., harder) x-ray wavelength pulses compared to LCLS. The European X-ray Free Electron Laser (XFEL) at DESY in Hamburg, Germany has a higher electron energy than LCLS, and recent plans could extend the European XFEL from a pulsed operation mode to continuous operation. The continuous operation improves the stability of the electron beam and provides uniformly spaced pulses of x-rays or, if desired, the ability to customize the sequence of x-ray pulses provided to experiments to optimize the measurements being made. The European XFEL began operations in 2017, and SHINE is estimated to begin user operations in 2027. Both facilities will create a profound capability gap compared to LCLS.

In the face of this challenge to U.S. scientific leadership, extending the energy reach of x-rays beyond the upper limit of the current LCLS superconducting linac (5 keV) is a high priority. This expanded range to 12 keV will allow U.S. researchers to access x-ray wavelengths as short as one Ångstrom and probe earth-abundant elements for novel catalysts used for electricity, fuel, and chemical production. It also allows the study of strong spin-orbit coupling that underpins many aspects of quantum materials, and it reaches the biologically important selenium k-edge, used for protein crystallography.

The ability to observe and understand the structural dynamics of complex matter at the atomic scale, at ultrafast time scales, and in operational environments is critical to the nation's R&D enterprise and its ability to develop advanced materials for new energy technologies. To achieve this objective, DOE needs a hard x-ray source capable of producing high energy ultrafast bursts with full spatial and temporal coherence at high repetition rates. This capability cannot be provided by any existing or planned light source.

The LCLS-II project was completed successfully in October 2023 and LCLS began operation in November 2023. The LCLS-II project was the first step in addressing the capability gap described above. With this upgrade, LCLS is currently the premier XFEL facility in the world at photon energies ranging from 200 eV up to approximately 5 keV. The cryomodule technology is a major advancement from prior designs that will allow continuous operation up to 1 MHz.

The LCLS-II cryomodules have consistently performed beyond expectations, providing the technical basis to double the electron beam energy. The LCLS-II-HE project adds the additional acceleration capacity necessary to double the electron beam energy of the superconducting linear accelerator (linac) from 4 GeV to 8 GeV. The LCLS-II-HE upgrade will meet the mission need by providing world leading experimental capabilities for the U.S. research community by extending the energy into the hard x-ray regime (from 5 keV to 12 keV and beyond).

The project is being conducted in accordance with the project management requirements in DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*.

Key Performance Parameters (KPPs)
The threshold KPPs approved at CD-2 represent the minimum acceptable performance that the project must achieve. The Objective KPPs represent the desired project performance. Achievement of the Threshold KPPs will be a prerequisite for approval of CD-4, Project Completion.

Performance Measure	Threshold	Objective
Superconducting linac electron beam energy	7 GeV	$\geq$ 8 GeV
Electron bunch repetition rate	93 kHz	929 kHz
Superconducting linac charge per bunch	0.02 nC	0.1 nC
Photon beam energy range	250 to 8,000 eV	250 to 12,800 eV
High repetition rate capable, hard X-ray end stations	$\geq$ 1	$\geq$ 2
FEL photon quantity (10^{-3} BW)	5×10^{8} @ 8 keV (10x spontaneous)	10^{10} @ 12.8 keV (20 mJ)

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Estimated Cost (TEC)				
Design (TEC)				
Prior Years	67,300	67,300	52,081	—

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Estimated Cost (TEC)				
FY 2025	—	—	12,176	—
FY 2026	—	—	3,043	—
Total, Design (TEC)	**67,300**	**67,300**	**67,300**	**—**
Construction (TEC)				
Prior Years	321,357	321,357	200,706	—
Prior Years - IRA Supp.	90,000	90,000	—	52,735
FY 2025	100,000	100,000	97,061	30,609
FY 2026	99,343	99,343	181,607	6,656
FY 2027	6,000	6,000	46,658	—
Outyears	—	—	668	—
Total, Construction (TEC)	**616,700**	**616,700**	**526,700**	**90,000**
Total Estimated Cost (TEC)				
Prior Years	388,657	388,657	252,787	—
Prior Years - IRA Supp.	90,000	90,000	—	52,735
FY 2025	100,000	100,000	109,237	30,609
FY 2026	99,343	99,343	184,650	6,656
FY 2027	6,000	6,000	46,658	—
Outyears	—	—	668	—
Total, Total Estimated Cost (TEC)	**684,000**	**684,000**	**594,000**	**90,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Other Project Cost (OPC)				
Prior Years	27,000	27,000	13,456	–
FY 2025	–	–	–	6,000
FY 2026	5,000	5,000	3,216	–
FY 2027	–	–	8,736	–
Outyears	–	–	592	–
Total, Other Project Cost (OPC)	**32,000**	**32,000**	**26,000**	**6,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Project Cost (TPC)				
Prior Years	415,657	415,657	266,243	–
Prior Years - IRA Supp.	90,000	90,000	–	52,735
FY 2025	100,000	100,000	109,237	36,609
FY 2026	104,343	104,343	187,866	6,656
FY 2027	6,000	6,000	55,394	–
Outyears	–	–	1,260	–
Total, TPC	**716,000**	**716,000**	**620,000**	**96,000**

Note:

– *In FY 2021, the Office of Science reprogrammed $19,343,211.24 of prior year funds from this project to support the LCLS-II project at SLAC. The Prior Year Budget Authority in the table above reflects this reprogramming. Also in FY 2021, a total of $10,000,000 in current year and prior year funding was reprogrammed to the LCLS-II-HE project and additional funds were included in the outyears to maintain the project profile.*

4. Details of Project Cost Estimate

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design	66,539	65,000	65,000
Design - Contingency	761	3,000	3,000
Total, Design (TEC)	**67,300**	**68,000**	**68,000**
Construction_No_Detail	281,000	268,000	506,000
Site Preparation	20,000	2,000	**N/A**
Equipment	262,460	236,000	**N/A**
Construction Contingency	53,240	110,000	110,000
Total, Construction (TEC)	**616,700**	**616,000**	**616,000**
Total, TEC	**684,000**	**684,000**	**684,000**
Contingency, TEC	*54,001*	*113,000*	*113,000*
Other Project Cost (OPC)			
R&D	5,000	5,000	**N/A**
Conceptual Planning	N/A	1,000	6,000
Conceptual Design	14,600	12,000	12,000
Start-up	9,200	8,000	8,000
OPC - Contingency	3,200	6,000	6,000
Total, Except D&D (OPC)	**32,000**	**32,000**	**32,000**
Total, OPC	**32,000**	**32,000**	**32,000**
Contingency, OPC	*3,200*	*6,000*	*6,000*
Total, TPC	**716,000**	**716,000**	**716,000**

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total, Contingency (TEC+OPC)	***57,201***	***119,000***	***119,000***

5. Schedule of Appropriations Requests

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	478,657	100,000	99,343	—	6,000	684,000
	OPC	27,000	—	5,000	—	—	32,000
	TPC	505,657	100,000	104,343	—	6,000	716,000
FY 2027	TEC	478,657	100,000	99,343	6,000	—	684,000
	OPC	27,000	—	5,000	—	—	32,000
	TPC	505,657	100,000	104,343	6,000	—	716,000

Note:

- *In FY 2021, the Office of Science reprogrammed $19,343,211.24 of prior year funds from this project to support the LCLS-II project at SLAC. The Prior Year Budget Authority in the table above reflects this reprogramming. Also in FY 2021, a total of $10,000,000 in current year and prior year funding was reprogrammed to the LCLS-II-HE project and additional funds were included in the outyears to maintain the project profile.*

6. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy	2Q FY 2028
Expected Useful Life	25 years
Expected Future Start of D&D of this capital asset	2Q FY 2053

Related Funding Requirements
(dollars in thousands)

	Annual Costs		Life Cycle Costs	
	Previous Total Estimate	**Current Total Estimate**	**Previous Total Estimate**	**Current Total Estimate**
Operations, Maintenance and Repair	21,500	21,500	537,500	537,500

The numbers presented are the incremental operations and maintenance costs above the LCLS-II facility without escalation. The estimate will be updated and additional details will be provided after CD-2, Approve Project Performance Baseline.

7. D&D Information

At this stage of project planning and development, SC anticipates no new area will be constructed for this project.

8. Acquisition Approach

Based on the DOE determination at CD-1, SLAC is acquiring the LCLS-II-HE project under the existing DOE M&O contract.

SLAC has completed the requirements for baselining the project and LCLS-II-HE has received CD-2/3 approval. The necessary project management systems are fully operating and are maintained as a SLAC-wide resource.

SLAC is partnering with other laboratories for design and procurement of key technical subsystem components. Technical system designs require research and development activities. Preliminary cost estimates for these systems are based on actual costs from the LCLS-II project and other similar facilities, to the extent practicable. The M&O contractor is fully exploiting recent cost data in planning and budgeting for the project. SLAC or partner laboratory staff will complete the design of the technical systems. SLAC or subcontracted vendors with the necessary capabilities will fabricate the technical equipment. All subcontracts will be competitively bid and awarded based on best value to the government. SC will evaluate the M&O contractor's performance through the annual laboratory performance appraisal process.

SC and the M&O will draw from lessons learned from the LCLS-II project and other similar facilities in planning and executing the LCLS-II-HE project.

Biological and Environmental Research

Overview

The Biological and Environmental Research (BER) program's basic research portfolio is poised for rapid advancement and leadership in key scientific innovations vital to America's energy expansion and economic prosperity, fully aligned with Departmental and Administration priorities for Artificial Intelligence (AI), Quantum Information Science (QIS) and securing Critical Minerals and Materials (CMM) for the Nation. The Genesis Mission goal is to double the productivity and impact of American research within a decade, which includes pursuing pathbreaking advances in BER's science. In partnership with industry, BER will target the challenges most vital to ensure that America leads the global race in AI-enabled biotechnology. BER's earth-energy-biological systems models are becoming faster, more precise, and purpose-driven through AI methodologies. BER data systems are open, curated, and increasingly integrated and AI ready in support of the Genesis Mission. AI together with targeted laboratory and modeling research innovate new approaches to securing CMM. BER's QIS research is developing revolutionary methods to image and sense biological and material properties at unprecedented resolution and with reduced damage opening new technological advances.

BER's mission is to support transformative science and scientific user facilities to achieve a predictive understanding of complex biological and earth systems, supporting DOE's vision to advance innovative solutions for the Nation's energy, economic and national security challenges. BER's fundamental research, conducted at DOE national laboratories, research institutions and in partnership with industry, plays a unique role in ensuring national leadership in biotechnology innovation and in the ability to understand and predict the interdependencies involving energy and the environment over a wide range of conditions. Biology remains a vast, largely untapped resource of genomic potential and BER science unlocks the fundamental drivers of processes within microorganisms, plants, and microbiomes. AI assists researchers to harness the power of biology and discover, understand, design, and build new biosystems. BER is pioneering self-reinforcing AI capabilities integrated with automated experimental systems and trained on world-class datasets to dramatically accelerate biotechnology innovation. The experimental data feeds back into AI systems to progressively train the models, with the potential to gain unprecedented insight into biological function and design across species. Advanced AI methods include developing techniques to synthesize new experimental data in the context of previously published information in order pose new hypotheses for additional research. Through AI, DOE is poised to vastly expand biotechnology's potential for the Nation, including designs of novel proteins, cells, microbes, plants and microbiomes for next generation fuels, chemicals, and materials, the efficient recovery of CMM, enhancement of soils, and design of robust plants.

Earth and environmental research leverages AI and computationally advanced modeling to enhance predictability of integrated energy, biological, and earth systems. DOE's Energy Exascale Earth System Model (E3SM) is supplemented with detailed atmospheric and terrestrial observations and curated data for initialization, parameterization, and validation. AI methods enable modeling of finer spatial scales, enhance accuracy, increase simulation speeds and allow for integration of earth and energy sector models. The predictive models are increasingly skillful to provide energy stakeholders with key information to ensure resiliency to power grid vulnerabilities and to expand U.S. energy dominance.

Over the past three decades, BER's scientific impact has been transformative and world leading, beginning with the DNA sequencing revolution that evolved from the Human Genome Project in the 1990's to more recent developments in genome editing technology (CRISPR) and AI breakthroughs in computational protein design. Focused on non-biomedical microorganisms, plants, and ecosystems, BER science fills a unique niche among federal basic science agencies by addressing the most pressing energy and national security challenges. BER has also been a critical contributor to fundamental earth science, tackling grand challenges in atmospheric and terrestrial science and developing DOE's flagship E3SM with careful coupling to energy system models targeting the needs of the energy sector.

BER's Scientific Joint Genome Institute (JGI) and the Environmental Molecular Science Laboratory (EMSL) user facilities, data, and experimental capabilities are advancing through AI innovation, using novel approaches to autonomous experimentation for genomic and molecular sciences and for rapid processing and analysis of data streams. BER supports the Genesis Mission by building an open, accessible, curated, federated AI Biodata Network vital for biotechnology advances. BER's bioimaging and quantum-science efforts in imaging and sensing, data analytics, and computational modeling are using AI to rapidly provide visual and calculated validation to experimental results. These advances may unlock the ability to not only understand but rapidly re-design biological systems. Biodesign innovations in biotechnology, biofuels, biochemicals, and bioproducts are pursued in the Bioenergy Research Centers (BRCs), expanding options for plant biomass.

Highlights of the FY 2027 Request

The BER FY 2027 Request of $396.0 million is a decrease of $458.0 million below the FY 2026 Enacted level. Aligned with the Genesis Mission, BER is integrating AI across its research portfolio and user facilities to accelerate biotechnology innovation. BER is developing AI automated experimental workflows, an AI Biodata Network, data analytics, and foundation modeling for genomics, microbial and plant biotechnology integrated with the SC-wide American Science Cloud and Modeling Consortium activities. A new Plant Transformation Capability (PTC) project starts at Lawrence Berkeley National Laboratory's (LBNL) JGI that will support the Genesis Mission as it leverages AI to rapidly automate plant gene editing. A complementary new grand challenge biotechnology initiative seeks to efficiently design and incorporate large DNA sequences into plants spurring game changing innovation and supporting America's global leadership in biotechnology. BER will prioritize efforts in QIS for bioimaging and sensing applications. BER continues biosystems design research for CMM extraction, recovery, and design of alternative forms of minerals and materials, using AI to accelerate this vital research to mitigate domestic supply chain constraints.

Research

- Genomic Sciences continues foundational research on microbial, plant, and microbiome systems. Reductions to the portfolio focus efforts on Administration priorities. The BRCs will focus research both individually and through shared themes, underpinning energy and biotechnology innovations and biological production of fuels, chemicals, and other products.
- Computational Biosciences efforts are consolidated as BER shifts to include a more AI -centric approach to genomic science and to develop integrated approaches to analyzing genomic and ecosystem data across platforms and user facilities. As a critical component of the Genesis Mission, and in partnership with industry, AI for biotechnology is developing the AI Biodata Network interconnected with automated laboratories together with foundation models for rapid discovery and design for proteins, microbial, and plant systems.
- Research in Biomolecular Characterization and Imaging Science will focus on QIS-enabled techniques to visualize and develop new sensing capabilities to understand biological processes while minimizing damage to samples.
- Bio-inspired CMM research will continue to support fundamental research to augment or enhance microbes and plants, using synthetic biology approaches to selectively remove or concentrate CMM from source materials and/or dilute solutions. CMM will also explore the biosynthesis of new minerals and materials capable of replacing existing CMMs to provide sustainable, lower-energy manufacturing options.
- Earth and environmental modeling is focused on developing an AI-driven hyper-resolution predictive system for integrated energy and earth systems, including the AI-enhanced E3SM model, to address key uncertainties affecting the ability to predict seasonal (weeks) and near-term (years) water availability for

energy needs. These models continue to benefit from new software and computational advances, atmospheric and terrestrial process research, curated and open data, and field work with a particular focus on regional case studies that target science, energy, or national security challenges.

Facility Operations

- JGI continues to transition towards a more AI-centric user facility by reorganizing its data resources into an AI Biodata Network, thereby facilitating AI analysis while continuing to deliver high-quality genome sequencing and innovative analysis techniques for complex plant and microbiome samples. Consolidating data analytics while integrating and standardizing data workflows will enable seamless aggregation and harmonization of genomic data, ensuring that users benefit from cutting-edge AI-powered insights and streamlined access to comprehensive analytical capabilities.
- EMSL develops integrated analyses across multiple analytical capabilities to advance biological and environmental science to uncover the biochemical pathways connecting gene functions to complex biological responses and develop predictive understanding of the mechanistic interplay of physical, environmental and biological processes. EMSL supports the Genesis Mission through use of AI workflows, data analytics, visualization, computational modeling, and AI techniques applied to phenotyping anaerobic microbes in field sites distributed across the U.S.
- The Atmospheric Radiation Measurement (ARM) user facility completes all campaigns and is closed.

Projects

- The FY 2027 Request includes $35.0 million to continue the Microbial Molecular Phenotyping Capability (M2PC) project at the Pacific Northwest National Laboratory (PNNL).

Biological and Environmental Research
Funding

(dollars in thousands)

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Biological and Environmental Research				
Genomic Science	340,900	260,404	136,142	-124,262
Biomolecular Characterization and Imaging Science	45,750	47,000	33,487	-13,513
Biological Systems Facilities & Infrastructure	95,127	97,596	101,900	+4,304
Total, Biological Systems Science	**481,777**	**405,000**	**271,529**	**-133,471**
Atmospheric System Research	28,656	39,500	–	-39,500
Environmental System Sciences	82,800	96,000	–	-96,000
Earth and Environmental Systems Modeling	109,281	118,500	28,968	-89,532
Earth and Environmental Systems Sciences Facilities and Infrastructure	148,486	176,000	60,470	-115,530
Total, Earth and Environmental Systems Sciences	**369,223**	**430,000**	**89,438**	**-340,562**
Subtotal, Biological and Environmental Research	**851,000**	**835,000**	**360,967**	**-474,033**
Construction				
24-SC-31 Microbial Molecular Phenotyping Capability (M2PC), PNNL	19,000	19,000	35,000	+16,000
Subtotal, Construction	**19,000**	**19,000**	**35,000**	**+16,000**
Total, Biological and Environmental Research	**870,000**	**854,000**	**395,967**	**-458,033**

Biological and Environmental Research
Explanation of Major Changes

	(dollars in thousands)
	FY 2027 Request vs FY 2026 Enacted
Biological Systems Science Within Genomic Sciences, the Request reduces lower priority efforts while focusing support on the Genesis Mission and integrating AI to accelerate biotechnology innovation and CMM recovery and supporting key quantum science research for imaging and sensing to align with Administration priorities. Foundational genomics will reduce and focus the portfolio on core elements of basic microbial and plant biosystems design research to underpin and accelerate biotechnology development. CMM will focus on key biodesign efforts to enhance microbial and plant abilities to recover, separate, and concentrate on critical elements from the environment. The BRCs focus on resolving remaining fundamental research challenges to producing fuels, chemicals, and other products from plant biomass. A new biotechnology initiative will advance the ability to design large sequences of DNA to be incorporated into plants to spur plant biotechnology for bioenergy and a broader bioeconomy. Computational Bioscience continues to integrate AI techniques across the research portfolio, within open-access AI Biodata Network and computational platforms for genomic analyses, and among BER user facilities. Environmental Genomics will reduce and prioritize plant and microbiome biotechnology. Biomolecular Characterization and Imaging Science research will reduce characterization and structural biology capabilities, de-emphasize multimodal classical bioimaging science, and focus on quantum-science enabled imaging and sensing concepts. JGI will prioritize user-initiated genome sequence production support and data infrastructure reorganization for AI. Other project costs are requested for a new PTC project at LBNL.	**-$133,471**
Earth and Environmental Systems Sciences All BER programmatic activities involving earth and environmental systems sciences are funded under earth system modeling. The consolidation includes the environmental system sciences, atmospheric system research, earth system modeling, and data management. The Atmospheric Radiation Measurement (ARM) User Facility completes all campaigns and will close. Earth system modeling will focus on harnessing AI to accelerate, enhance and couple BER's suite of exascale class and multi-sector dynamics models and integrate atmospheric and environmental field observations to enhance weeks to years predictive skill for energy expansion. This integrated system will be applied to specific target regions where energy expansion is envisioned and are particularly sensitive to variable environmental conditions such as water availability, ice storms and within the Arctic.	**-$340,562**

	(dollars in thousands)
	FY 2027 Request vs FY 2026 Enacted
The EMSL User Facility will focus on biological and environmental molecular science, including further preparation of new AI-driven automated technologies for microbial molecular phenotyping. EMSL's experimental and analytic efforts support BER priorities in biotechnology and critical mineral extraction with biology, using AI analytics and laboratory automation to advance biosystems discovery.	
Construction	**+$16,000**
Construction of the facility and procurement of the high-throughput phenotyping equipment will continue for the M2PC at PNNL.	
Total, Biological and Environmental Research	**-$458,033**

Basic and Applied R&D Coordination

BER research underpins the needs of DOE's energy and environmental missions and is coordinated through internal DOE mechanisms, and more broadly through the National Science and Technology Council (NSTC) and other committees of the Office of Science and Technology Policy (OSTP). BER research includes biological and environmental systems investments in theoretical, experimental, predictive modeling research, and science supporting energy expansion. Basic research on genomics, microbes and plants provides fundamental knowledge that can be used to develop new biotechnology innovations in bioenergy and bioproduct production processes that enhance the economy. Coordination with other federal agencies on priority biotechnology science occurs through the Biomass Research and Development Board, a Congressionally mandated interagency group created by the Biomass Research and Development Act of 2000, as amended by the Energy Policy Act of 2005 and the Agricultural Act of 2014. BER coordinates with DOE's applied energy offices through regular joint DOE working groups, program manager meetings, the Critical Minerals Collaborative (CMC), and by participating in internal program reviews and in joint principal investigator meetings and technical workshops.

BER supports interagency projects to manage databases (such as the Protein Data Bank) through interagency awards and funding for complementary community resources (such as beamlines and cryo-electron microscopy), particularly with NIH and NSF. BER is a member of the advisory committee for DoW's BioMADE project researching synthetic biology applications. BER seeks to partner across agencies to build federated biological databases vital to Genesis and U.S. leadership in biotechnology.

Program Accomplishments

- *Dataset helps decode fungal genomes.* Researchers at the JGI have assembled a massive dataset on the diversity and functional potential of over 2000 fungi gleaned from over 200 publications. Fungi harbor unique metabolic capabilities with numerous applications in bioenergy and biomanufacturing and the new dataset will serve as a resource for deep machine learning and AI algorithms to decipher fungal genomes. The work dovetails with ongoing efforts to assemble broader AI-ready datasets at the JGI.
- *Accelerated enzyme engineering.* Using an AI-enabled approach to help guide enzyme engineering, researchers at Northwestern University combined cell-free gene expression, DNA assembly, and functional assays to design optimized enzymes for distinct chemical reactions. The new AI technique tracks changes in protein sequence that link to function to converge on an optimized enzyme activity opening design pathways to explore new-to-nature enzymes, a key focus of a rapidly expanding biotechnology sector.
- *Progress towards whole cell mechanistic models.* A major drawback to simulating metabolic processes in cells is the sparse availability of kinetic data on which to describe biochemical reactions. The Center for Bioenergy Innovation (CBI) developed a new deep learning method (CatPred) that uses protein language models and three-dimensional protein structures to predict enzyme kinetics. The new AI-based method assigns functions and kinetic parameters to genes of unknown function, a key step towards a mechanistic understanding of biology from genome principles.
- *New plant transformation method.* Plant species harbor some of the largest genomes and are a significant source of untapped genomic potential for economically important products, fuels, chemicals, and materials. Bottlenecks in plant biotechnology are a lack of efficient, cheap, and broadly applicable methods to edit the genomes. Researchers at UC Los Angeles, UC Berkeley, and LBNL overcame barriers by developing a method using a plant virus to deliver CRISPR gene editing components into the plant genome.

- *Improved predictions of elemental cycling across complex soil types.* Using data from EMSL's Molecular Observing Network (MONet), scientists applied an AI algorithm based on molecular composition of soil organic matter, resulting in dramatically improved predictions of elemental cycling in U.S. soil systems. The new science informs the dynamics and biogeochemistry governing the fate and transport of trace compounds and legacy waste.
- *Causal understanding of thunderstorm dynamics.* Using multi-year multi-instrument observational datasets, researchers applied causal discovery models to reveal how different atmospheric conditions affect the height at which storm clouds stop rising and begin to spread out. Explicitly describing the causal pathways instead of using correlation-based approaches paves the way to dramatically improved representations of processes in earth system models and next-generation machine learning frameworks.
- *Revolutionary insights into coastal atmospheric processes with AI.* The DOE TRACER experiment and coordinated campaigns (2021-2022) in southeastern Texas created an unprecedented dataset on aerosol, cloud, convection, and surface gradient interactions in a populated energy-intensive coastal environment. Outcomes included AI-driven insights into convective updrafts, identification of distinct aerosol composition regimes and frequent new and unexpected particle formation, quantification of sea breeze impacts on convection, and testing aerosol-convection invigoration theories. Results led to significantly improved predictions of environmental impacts on energy infrastructure in populated coastal regions.
- *Incorporating AI in high resolution Earth system and energy predictions.* Scientists developing DOE's Energy Exascale Earth System Model achieved a breakthrough with the release of an AI emulator that operates at 100X the speed of previous capabilities. Model simulations were conducted at the DOE NERSC computing facility to enable scientific discoveries to inform the design and deployment of the suite of emerging energy infrastructures.

Description

The Biological Systems Science subprogram supports the DOE Genesis Mission through integration of AI capabilities with advanced genomics research and user facility capabilities to greatly accelerate the ability to understand the largely undiscovered complexity and potential of biology. Science focuses on plant, microbial and microbiome systems and includes assembly of increasingly vast genomic datasets driven by increasingly capable AI capabilities to accelerate the understanding and design of biology. The activity also targets breakthrough discoveries in critical mineral and material (CMM) extraction and in quantum sensing and imaging as part of BER's Quantum Information Science (QIS) efforts. These investments focus on advancing U.S. leadership in biotechnology innovation relevant to DOE missions in energy, biomanufacturing and biosecurity.

<u>Genomic Science</u>

The Genomic Science activity supports basic research in Foundational Genomics, Bioenergy, Environmental Genomics, Computational Bioscience and includes CMM research and development of new AI capabilities for genomic science. This activity addresses the grand challenges necessary to efficiently design new biosystems and advance biotechnology.

Foundational Genomics supports basic research to understand the organization, regulation and expression of genes in plants and microorganisms to enable the design of biological processes tailored to specific DOE mission applications. Efforts support the Genesis Mission through development of self-reinforcing AI systems coupled to automated experimental labs to accelerate the ability to design biomolecules, metabolic pathways, cells, microbiomes and plants from genome-based, first principles. This leads to the understanding, prediction and design of biological processes to produce a range of bioproducts and bioprocesses. A new initiative supports the Genesis Mission, as it seeks efficient design of synthetic plant chromosomes, a crucial breakthrough that if realized would transform plant biotechnology. Efforts continue to design microbes and plants with enhanced capabilities to scavenge and sequester key CMMs, such as rare earth elements.

The DOE Bioenergy Research Centers (BRCs) address basic science bottlenecks impeding the ability to convert inedible lignocellulosic biomass grown on underutilized lands to biofuels, chemicals, materials, and other bioproducts. These multi-disciplinary, multi-institutional centers accelerate the scientific groundwork necessary for biomanufacturing and biotechnology innovation to ensure domestic supply chains of critical commodity products that can be produced from plant-based resources. The BRCs partner with and spawn new start-up efforts to move basic research concepts to industry.

Environmental Genomics supports research to understand functional genomics in plants and microbial communities. The research seeks to understand plant and microbial processes in the lab and the environment as a foundation on which to learn how to engineer microbial communities and plant-microbe interactions for specific industrial and/or environmental purposes relevant to bioenergy and bioproduct development.

Computational Biosciences supports on-line, open access bioinformatics and modeling capabilities within the DOE Systems Biology Knowledgebase (KBase) and the National Microbiome Data Collaborative (NMDC). These integrated resources together with new AI capabilities, support large-scale collaborative genomic science investigations of plant and microbial systems to reveal insights into biological processes and new biosystems designs. Efforts continue to integrate these data resources together with the Joint Genome Institute (JGI), the Environmental Molecular Sciences Laboratory (EMSL) and other DOE Laboratory data into an open-access, curated AI-Biodata Network to create the high-quality datasets needed to train AI models. Efforts continue on new AI-driven automated laboratory systems to accelerate the design of biomolecules, microbes and plants. These activities directly support the Genesis Mission, including DOE's American Science Cloud (AmSc) and Model Consortium (ModCon), leading to accelerated discovery and biosystems design.

Biomolecular Characterization and Imaging Science

Biomolecular characterization and imaging science supports integrative approaches, including QIS-enabled efforts, to detect, visualize, and measure biological processes *in-situ* and gain a predictive understanding of cellular function, critical for advanced genomics research and biotechnology development. This activity will emphasize innovative QIS-enabled research on sensors and sensing capabilities that are key to observing biological systems with minimal damage.

Biological Systems Facilities and Infrastructure

The DOE JGI user facility is the only federally funded major genome sequencing center focused on genome discovery and analysis in plants and microbes for energy, biotechnology, and environmental research. This scientific user facility provides high-throughput DNA sequencing and analysis capabilities for plants, microorganisms, and microbial communities from samples obtained within the U.S. (including from Federal lands) and worldwide as a foundational source of genomic data for BER's genomic science research efforts. JGI will continue efforts coordinated with KBase, NMDC, and EMSL to organize its vast genomic data resources into an open access AI Biodata Network suitable to facilitate broader integration of AI into genomic research in support of the Genesis Mission. The new data and burgeoning AI capability will efficiently provide the vast high-quality datasets needed to train advanced AI capabilities to accelerate an unprecedented understanding of biological complexity across species with game changing implications for DOE efforts in energy, economy, and national security with far-reaching implications for health and agriculture as well. A new Plant Transformation Capability (PTC) project starts at LBNL.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Biological Systems Science	**$405,000**	**$271,529**	**-$133,471**
Genomic Science	$260,404	$136,142	-$124,262
Funding supports Foundational Genomics priorities in fundamental systems biology research on plants and microorganisms. Funding continues to support biotechnology innovation and accelerate biosystems design efforts. Additionally, efforts in CMM research narrow focus on key synthetic biology objectives to explore designing plants and microorganisms for extraction and recovery of critical elements.		The Request for Foundational Genomics will prioritize AI-enabled fundamental systems biology research on plants and microorganisms supporting biotechnology innovation and accelerating biosystems design efforts. Efforts in CMM research will focus on key synthetic biology designs for plants and microorganisms to extract and recover critical elements. Efforts will be initiated to explore how to construct a synthetic plant chromosome to advance plant biotechnology.	The funding will support Foundational Genomics efforts at the DOE National Laboratories and within academia to focus on the Genesis Mission including AI-enabled biosystems design and biotechnology innovation. Plant and microbial research key to the Genesis Mission and biotechnology will continue, while a new effort to explore building a synthetic plant chromosome will be initiated. Biosystem design research for CMM extraction, recovery, and synthesis efforts will continue.
Funding supports Environmental Genomics priorities in plant functional genomics and environmental microbiome science to enable efforts in plant biotechnology and engineered microbial communities.		The Request for Environmental Genomics will prioritize plant functional genomics and environmental microbiome design science to enable plant biotechnology and engineered microbial communities tailored for biotechnology applications.	The funding will support and prioritize research projects in AI-enabled biotechnology development efforts within plants and microbiomes.
BRaVE efforts are complete. Funding supports Low dose radiation research prioritizes research on experimental dataset generation to serve as training sets for AI modeling of low dose radiation effects.		The Request will prioritize AI modeling of low dose radiation effects.	The funding will support the focus on the potential to extrapolate key AI modeling outputs from available datasets to understand potential health effects of low dose radiation.
Funding supports Computational Bioscience for Genomic Science by providing bioinformatics, simulation, and modeling capabilities. Efforts		The Request will support Computational Bioscience for Genomic Science by developing a cyberinfrastructure data and AI	The funding will support Computational Biosciences research focused on developing a more comprehensive, holistic

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
expand to integrate AI/ML infrastructure and capabilities across BER User Facilities and KBase.	framework to support an AI Biodata Network, including NMDC, BER user facilities, and other National Laboratories. These efforts will support the Genesis Mission and will develop AI capabilities to accelerate Administration priorities to advance AI more broadly into basic research.	approach that integrates AI across BER's research portfolio, computational platforms, and user facilities, building upon the advanced and federated AI Biodata Network supports the Genesis Mission, AmSC, genomic science and biotechnology innovation.
Funding supports the BRCs by sharpening their focus on critical basic science needs to accelerate plant and microbial biotechnology innovation including prioritizing the integration of AI/ML techniques into their research plans and shared research objectives.	The Request will support BRCs to focus on critical basic science needs to accelerate plant and microbial biotechnology innovation including integrating AI/ML techniques into their research plans while the teams participate in a re-competition of the BRC program.	The funding will support AI-enabled capabilities with emphasis on activities to accelerate leading edge design of plants and microorganisms to bolster U.S. biotechnology leadership for producing a range of products from plant biomass.
Funding supports EPSCoR-State/National Laboratory Partnerships.	The Request will support EPSCoR Implementation Grants.	The funding will continue to support research in EPSCoR jurisdictions.
Biomolecular Characterization and Imaging Science $47,000	$33,487	-$13,513
Funding supports imaging and characterization technologies with an emphasis on quantum-science enabled imaging and sensor development tailored to plants and microorganisms, while maintaining capabilities for structural biology.	The Request will support imaging technology prioritizing QIS-enabled imaging and sensor development tailored to plants and microorganisms.	The funding will support priority efforts in QIS related research, particularly the development of novel quantum science-informed sensor technologies, characterization techniques, and structural biology capabilities at the DOE light sources.
Biological Systems Facilities & Infrastructure $97,596	$101,900	+$4,304
Funding supports JGI sequence production capacity to meet the needs of scientific users. JGI provides users with high quality genome sequences and new analysis techniques for complex plant and microbiome	The Request will support JGI to continue to provide genome sequence production capabilities to meet the needs of scientific users. JGI will provide users with high quality genome	Funding will focus on supporting the Genesis Mission. Funding will accelerate development of the AI Biodata Network, integrating JGI's data with other BER biological data and making this enhanced data

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
samples. Integrative activities with KBase continuing to provide new cross-platform capabilities for users. Progress on reorganizing JGI's data infrastructure environment continues as the facility prepares to become a more AI-centric facility for genomic science.	sequences and analysis techniques for complex plant and microbiome samples. Integrative activities with KBase and NMDC will continue to provide new cross-platform capabilities for users. The development of a federated AI Biodata Network will be prioritized as the facility transitions to a more AI-centric facility for genomic science.	resource available to the research community. These efforts will contribute towards JGI becoming a more AI-centric facility for AI-enabled genomic science and biotechnology innovation. Planning will begin with other project costs for a Plant Transformation Capability to rapidly automate plant gene editing.

Description

The Earth and Environmental Systems Sciences (EESS) subprogram supports fundamental research and scientific user facilities that enable enhanced predictability of dynamically variable environmental and earth systems, in support of DOE's mission involving transformative science for energy dominance and national security. Research includes radically improving predictability of variable environmental conditions that inform the design, optimization, and deployment of next generation energy technologies and infrastructures, based on experimental and modeling research on earth and energy systems. This work includes modeling, analysis, and uncertainty quantification of the interdependent atmospheric terrestrial, marine, coastal, and cryospheric systems, with energy technologies and infrastructures embedded in the earth system. This integrated portfolio extends from molecular to regional and global scales and time scales from sub-seasonal (weeks) to decadal (years) as appropriate for energy strategic planning horizons. The research uses the DOE Office of Science (SC) Environmental Molecular Sciences Laboratory (EMSL) user facility to advance basic science through its world-class, multi-modal instrumentation and scientific leadership that equips researchers to achieve a predictive understanding of complex interdependent biological and environmental systems. Modeling and facility activities leverage DOE's exascale leadership computing user facilities and harness artificial intelligence (AI) to accelerate speed and precision of models and science providing unique successes to the Genesis Mission.

Earth and Environmental Systems Modeling

EESM develops the physical, biogeochemical, and dynamical science and software capabilities underpinning the design and use of fully coupled earth system models, focusing on the most challenging predictive timescales of weeks to years that are most vital for energy expansion. DOE's flagship Energy Exascale Earth System Model (E3SM) as well as more regional and multi-sector dynamics models are continually upgraded with state-of-the-art AI tools and use of DOE's exascale computers to achieve unprecedented capabilities and accuracy. EESM brings unique modeling, simulation, and prediction capabilities in support of the Genesis Mission, with more efficient AI methodologies as part of surrogate components, multi-model optimization strategies, huge ensembles to enhance predictive skill, and new data initialization methods. EESM relies on critical observations drawn from BER's open-access, curated field research, crowd-sourced information, and AI-generated synthetic data to accelerate progress towards new predictive understanding in complex geographic domains relevant to DOE's science, energy, and national security missions.

Earth and Environmental Systems Sciences Facilities and Infrastructure

The EMSL user facility provides a unique resource to discover the basic principles of how gene and microbial processes interplay with biochemical pathways and physical conditions. EMSL is a prime contributor to the Genesis Mission by developing AI-driven laboratory automation and workflows to process, analyze, visualize, and model the data from its distributed networks of soil, microbiome, and biogeochemical field and experimental systems. EMSL's Microbial Molecular Phenotyping Capability (M2PC) project fully embraces state-of-the art AI capabilities as part of the Genesis Mission to accelerate progress in achieving a comprehensive understanding of the drivers and potential design of microbial systems. EMSL contributes to BER's AI Biodata Network together with the Joint Genome Institute and other BER data systems, providing the scientific community with curated open-access data as well as scientific expertise to facilitate cutting edge research and predictive modeling capabilities across molecular science disciplines. This information is also vital to multiple DOE challenges involving critical minerals and materials (CMM) and other energy-relevant needs involving subsurface science. The ARM User Facility will be closed in FY 2027.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Earth and Environmental Systems Sciences	**$430,000**	**$89,438**	**-$340,562**
Atmospheric System Research	$39,500	$ —	-$39,500
Atmospheric System Research (ASR) completes and closes out most research on clouds, aerosols, and thermodynamic processes, including those with a focus on data from the Atmospheric Radiation Measurement (ARM) facility long-term sites as well as data from the completed Cape-K (Cloud and Precipitation Experiment at Kennaook) in Tasmania and CoURAGE (Coast-Urban-Rural Atmospheric Gradient Experiment) in Baltimore, Maryland.		Most ASR research on clouds, aerosols, and thermodynamic processes, analyzing observational datasets is completed except those supporting the modeling activities aligned with administration priorities.	ASR funding will be consolidated under Earth and Environmental Systems Modeling to support the administration's highest priority research.
Environmental System Sciences	$96,000	$ —	-$96,000
Environmental System Sciences (ESS) completes most research on permafrost, boreal ecology, and modeling hydrobiogeochemistry of watersheds and terrestrial-aquatic interfaces, with a focus on urban systems and on the coastal zones encompassed by the Delaware and Susquehanna watersheds and the Great Lakes, and Puget Sound.		Most ESS research on hydro-biogeochemical processes in terrestrial watershed, coastal systems and urban systems is completed except those supporting the modeling activities aligned with administration priorities.	ESS funding will be consolidated under Earth and Environmental Systems Modeling to support the administration's highest priority research.

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Earth and Environmental Systems Modeling	$118,500	$28,968	-$89,532
Funding supports EESM to focus investments towards regionally refined modeling of earth-energy system interactions using the E3SM and other models on exascale computers, achieving hyper-resolution scales and incorporating state-of-the-art AI in support of the Genesis Mission. New science was derived from data and new process representations provided from ASR research on cloud-aerosol-precipitation interactions as well as advanced biogeochemical, watershed, and coastal research derived from ESS.		The Request for EESM expands engagement with the Genesis Mission with focused investments on foundational hybrid modeling of detailed earth-energy interactions on hyper-resolution scales, sophisticated AI methodologies and best-in-class exascale computer architectures. Science will emphasize a select set of regionally refined modeling domains, including the Arctic, that utilize critical observations to develop, test, and validate new near-term prediction capabilities.	The funding will support the integration of new observations from watershed and atmospheric field campaigns into the model development research.
Earth and Environmental Systems Sciences Facilities and Infrastructure	$176,000	$60,470	-$115,530
Funding supports EMSL to proceeded with MONet solicitations for proposals from the scientific community, expanded the DigiPhen effort to derive data from fungal proteins from U.S. sites, initiated new science on phenotyping anerobic microorganisms using a test automation platform, and contributed to the Genesis Mission with new AI driven science.		The Request will allow EMSL to continue to accelerate science outputs by placing greater emphasis on the use of AI methodologies in support of the Genesis Mission applied to multi-disciplinary scientific projects that use combinations of EMSL's advanced instrumentation, data analytics, and modeling and simulation capabilities through a variety of workflows. EMSL continues to leverage a network of geographically distinct field sites to achieve a comprehensive understanding of molecular processes.	The funding will support EMSL's emphasis on AI-driven laboratory automation and other AI efforts enhances the Genesis Mission. EMSL will operate a platform that uses AI analysis and workflow techniques to phenotype anaerobic microbes and will expand the scope of solicitations for user research in alignment with its campaigns toward a U.S.-based network of molecular observations in order to develop a digital phenome and integrate modeling and data agents.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
The Atmospheric Radiation Measurement (ARM) SC user facility completes ARM mobile facility campaigns in Tasmania, Baltimore, and Phoenix and completes activities at fixed sites in Alaska, Oklahoma, and the Eastern North Atlantic site. ARM conducts remediation of sites and deployments.	ARM campaigns will be completed, and the facility is closed.	ARM campaigns will be completed.
The Earth and Environmental Sciences Data Management activity completes activities to support and maintain existing and new software and data archives for experimental and modeling research. Essential data archiving and storing protocols, capacity, and provenance are completed. Advanced analytical methodologies such as AI and Machine Learning were enhanced and used to improve predictability more rapidly using the combination of field observations with Earth system models.	Most Earth and Environmental Sciences Data Management activities are completed except those supporting the modeling activities aligned with administration priorities.	Earth and Environmental Sciences Data Management funding will be consolidated under Earth and Environmental Systems Modeling to support the highest priority research proposals.

Description

This subprogram supports line-item construction for the BER program. All Total Estimated Costs (TEC) are funded in this subprogram, including engineering, design, and construction. The FY 2027 Request continues the Microbial Molecular Phenotyping Capability project.

<u>24-SC-31, Microbial Molecular Phenotyping Capability (M2PC), PNNL</u>

The M2PC will be the world's first fully connected end to end phenotyping platform from genetic diversity creation, to culturing, functional testing, and deep analyses of produced proteins and metabolites allowing for autonomous biological experimentation when combined with AI approaches. The M2PC project will design and construct a new capability that will provide a range of 24,500–50,000 gross square feet (GSF) of instrumentation and support spaces conducive for highly autonomous operations, with a target of greater than 30,000 GSF. In addition, the M2PC design will include acquisition of analytical instrumentation and microbial culturing and characterization capabilities that will be modular and expandable, self-contained, and operate in an automated pod configuration. Capabilities will include a suite of 5 to 10 microbial culturing pods, 3 to 5 biological and functional assay pods, and 4 to 5 analytical phenotyping workflow pods. This new capability will position BER to take a global lead in answering the most pressing challenge in biology—generating molecular phenotypic data at a pace that matches the rapid developments in high throughput genome sequencing and synthesis. Applicability of this capability to BER interests in bioproducts, critical elements, nutrient cycling, and other DOE-relevant bioeconomy applications, will create a knowledge ecosystem that would provide data to amplify BER's genome engineering and biosystems design efforts, as well as mechanistic hydro-biogeochemistry modeling capabilities. In the FY 2027 Request, the TEC funding of $35,000,000 will be used to continue construction of the conventional facility, and procurement of the high throughput phenotyping equipment.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Construction	**$19,000**	**$35,000**	**+$16,000**
24-SC-31, Microbial Molecular Phenotyping Capability (M2PC), PNNL	$19,000	$35,000	+$16,000
Funding supports initial construction boreholes for the Facility and achievement of the final designs for both the Facility and the High-throughput Automated Phenotyping Platform (HTP-APP).		Funding will support contract awards to cover the first two years of construction of the Facility, and assembly of instrumentation for the HTP-APP.	Funding will increase to transition from 100% designs to actual construction of the Facility and assembly of HTP-APP.

Biological and Environmental Research
Capital Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Capital Operating Expenses						
Capital Equipment	N/A	N/A	3,000	14,071	2,071	-12,000
Total, Capital Operating Expenses	**N/A**	**N/A**	**3,000**	**14,071**	**2,071**	**-12,000**

Capital Equipment

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Capital Equipment						
Major Items of Equipment						
Total, MIEs	N/A	N/A	–	–	–	–
Total, Non-MIE Capital Equipment	N/A	N/A	3,000	14,071	2,071	-12,000
Total, Capital Equipment	**N/A**	**N/A**	**3,000**	**14,071**	**2,071**	**-12,000**

Note:
- *The Capital Equipment table includes MIEs with a Total Estimated Cost (TEC) > $10M.*

Biological and Environmental Research
Construction Projects Summary

	(dollars in thousands)					
	Total	**Prior Years**	**FY 2025 Enacted**	**FY 2026 Enacted**	**FY 2027 Request**	**FY 2027 Request vs FY 2026 Enacted**
27-SC-33, Plant Transformation Capability, LBNL						
Total Estimated Cost (TEC)	112,920	-	-	-	-	-
Other Project Cost (OPC)	8,120	-	-	-	4,000	+4,000
Total Project Cost (TPC)	**121,040**	**-**	**-**	**-**	**4,000**	**+4,000**
24-SC-31, Microbial Molecular Phenotyping Capability (M2PC), PNNL						
Total Estimated Cost (TEC)	117,000	10,000	19,000	19,000	35,000	+16,000
Other Project Cost (OPC)	5,000	1,200	-	-	-	-
Total Project Cost (TPC)	**122,000**	**11,200**	**19,000**	**19,000**	**35,000**	**+16,000**
Total, Construction						
Total Estimated Cost (TEC)	**229,920**	**10,000**	**19,000**	**19,000**	**35,000**	**+16,000**
Other Project Cost (OPC)	**13,120**	**1,200**	**-**	**-**	**4,000**	**+4,000**
Total Project Cost (TPC)	**243,040**	**11,200**	**19,000**	**19,000**	**39,000**	**+20,000**

Biological and Environmental Research
Scientific User Facility Operations

The treatment of user facilities is distinguished between two types: TYPE A facilities that offer users resources dependent on a single, large-scale machine; TYPE B facilities that offer users a suite of resources that is not dependent on a single, large-scale machine.

(dollars in thousands)

	FY 2025 Enacted	FY 2025 Current	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Scientific User Facilities - Type B					
Environmental Molecular Sciences Laboratory	**57,729**	**60,411**	**70,000**	**60,470**	**-9,530**
Number of Users	753	599	859	780	-79
Joint Genome Institute	**95,127**	**96,281**	**97,596**	**97,900**	**+304**
Number of Users	2,491	2,627	2,571	2,645	+74
Atmospheric Radiation Measurement User Facility	**83,757**	**83,365**	**96,000**	**–**	**-96,000**
Number of Users	1,073	1,116	1,215	–	-1,215
Total, Facilities	**236,613**	**240,057**	**263,596**	**158,370**	**-105,226**
Number of Users	4,317	4,342	4,645	3,425	-1,220

Note:

- *Percent optimal operations defines what is achieved at this funding level. This includes staffing, up-to-date equipment and software, operations and maintenance, and appropriate investments to maintain world leadership.*

Biological and Environmental Research
Scientific Employment

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Number of Permanent Ph.Ds (FTEs)	1,740	1,708	795	-913
Number of Postdoctoral Associates (FTEs)	405	400	200	-200
Number of Graduate Students (FTEs)	630	619	305	-314
Number of Other Scientific Employment (FTEs)	405	395	205	-190
Total Scientific Employment (FTEs)	**3,180**	**3,122**	**1,505**	**-1,617**

Note:
- *Other Scientific Employment (FTEs) includes technicians, engineers, computer professionals, and other support staff.*

24-SC-31, Microbial Molecular Phenotyping Capability (M2PC), PNNL
Pacific Northwest National Laboratory, PNNL
Project is for Design and Construction

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

Summary

The FY 2027 Request for the Microbial Molecular Phenotyping Capability (M2PC) project is $35,000,000 of Total Estimated Cost (TEC) funding. The project will design and construct a new research capability that will be broadly available to the scientific community as part of an Office of Science User Facility. The PNNL Director, designated as the M2PC Project Management Executive (PME), approved Critical Decision (CD)-2/3 on September 2, 2025. The Total Project Cost (TPC) is set at $122,000,000 with project completion (CD-4) in 1Q FY 2032.

Significant Changes

In accordance with the DOE Memo to National Laboratory Directors regarding 413.3 Capital Asset Projects less than $300,000,000, authority for the M2PC project has been delegated to the PNNL Director. An independent review committee evaluated the project documentation and artifacts required by DOE 413.3B and recommended the approval of CD-2/3 for the M2PC project. An Independent Cost Estimate (ICE) team reviewed the documentation and performed an ICE and an independent risk analysis. The PNNL Director, designated as the M2PC PME, approved Critical Decision (CD)-2/3 on September 2, 2025. Upon receiving DOE consent to award, both the High Throughput Automated Phenotyping Platform (HTP-APP) solution and the facility construction subcontracts were awarded in October. The Total Project Cost (TPC) is set at $122,000,000, which is within the cost range approved at CD-1 ($100,000,000 to $167,000,000).

FY 2025 funding was used to prepare documentation, including preliminary designs for both the Facility and the HTP-APP, for the Independent Cost Estimate (ICE) review, and for the CD-2/3 approval meeting, with CD-2/3 approved in early September 2025. FY 2026 funding supports initial construction boreholes for the Facility and achievement of final designs for both the Facility and the HTP/APP. The FY 2027 Request will support contract awards that cover the first two years of construction of the Facility, and assembly of instrumentation for the HTP/APP. Design-Build activities for the facility construction will commence and procurement and fabrication of the initial HTP phenotyping equipment components will begin.

Critical Milestone History

Fiscal Year	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
FY 2027	4/28/21	6/30/22	2/15/24	9/2/2025	4Q FY 2026	9/2/2025	1Q FY 2032

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; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

Project Cost History

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	29,000	88,000	117,000	5,000	5,000	122,000
FY 2027	29,000	88,000	117,000	5,000	5,000	122,000

2. Project Scope and Justification

Scope

The scope of this project includes the acquisition of a fully functional HTP-APP to increase data throughput, content, quality, and reproducibility of experimental analysis to meet the Mission Need. It also includes construction of a facility that is greater than 30,000 gross square feet to house, and provide support laboratories and spaces to effectively operate, the HTP-APP. M2PC will be attached to the North side of the Environmental Molecular Sciences Laboratory (EMSL) user facility at PNNL to leverage existing related adjacent research and facility systems.

Justification

Within the Biological and Environmental Research (BER) program, basic research to gain a predictive understanding of biological systems provides the foundation for harnessing and integrating the latest biosystems design techniques with data science and multi-scale modeling approaches. This effort will advance a burgeoning bioeconomy and provide transformative science and technology solutions to enable DOE to meet its energy and environmental challenges. Toward systems-level understanding, BER-supported research has increasingly embraced the integration of multi-omics analyses together with phenotypic characterization of microbial isolates and communities to determine the function of expressed genes and pathways.

While the number of microbial isolates and chassis microbes interrogated is expanding rapidly along with advances in next generation genome sequencing and synthesis, incomplete and constrained genome annotation limits the ability to understand and model the range of activities and functions of individual microbes, engineered microbial consortia with bio-industrial potential or ecological relevance, and microbial communities from natural soil environments. Specifically, there is a significant gap in the ability of the scientific community to identify proteins and biochemical pathways of unknown function in microbes at the single-cell to microbial-community scales, in part because the phenotypes of microbes change rapidly due to environmental factors and perturbations. To address this gap, BER proposes a research capability for a M2PC that would be broadly available to the scientific community as part of a DOE Office of Science User Facility.

An emphasis on coupled high-throughput autonomous experimental and multimodal analytical capabilities would be the primary components of the instrumentation part of the M2PC. These capabilities would be integrated with, and amplify, existing BER data platforms within the DOE JGI, the NMDC, and the KBase to speed the discovery of new protein functions and metabolic pathways in microbial systems, including fungi, algae, bacteria, protists, archaea, and viruses.

This new capability will position BER to take a global lead in answering the most pressing challenge in biology—generating molecular phenotypic data at a pace that matches the rapid developments in high throughput genome sequencing and synthesis, and it will advance the DOE mission to ensure America's security and prosperity by addressing energy and environmental challenges through transformative science and technology solutions. Applicability of this capability to BER interests in bioproducts, critical elements, nutrient cycling, and other DOE-relevant bioeconomy applications, will create a knowledge ecosystem that will provide data to amplify BER's genome engineering and biosystems design efforts, as well as to mechanistic hydro-biogeochemistry modeling capabilities.

The project is being conducted in alignment with DOE's project management requirements.

Key Performance Parameters (KPPs)
The Threshold KPPs represent the minimum acceptable performance that the project must achieve. The achievement of the Threshold KPPs will be a prerequisite for approval of CD-4, Project Completion. The Objective KPPs represent the desired project performance.

Performance Measure	Threshold	Objective
Demonstrate high-throughput (HTP) Culturing	Capacity to operate with 500 Experiments/Week	Capacity to operate with 2,000 Experiments/Week
Demonstrate HTP Microbiome Culturing	Capacity to operate with 100 Microbiome Experiments/Week*	Capacity to operate with 500 Microbiome Experiments/Week*
Demonstrate HTP Assaying and Phenotyping	Capacity to obtain 1,000,000 Multi-Modal Analytical Measurements/Month	Capacity to obtain 3,000,000 Multi-Modal Analytical Measurements/Month
Remote Capability to Access Operations	Demonstrate that remote users can run pre-defined EMSL protocols to be executed autonomously within M2PC across culturing, assaying, and analyses**	Demonstrate remote users can perform dynamic experimental intervention with help from EMSL staff by modifying an executed protocol during the experimental timeframe**
Total Building Size (GSF)	24,500 sq. ft.	50,000 sq. ft.
*A microbiome start is an experiment consisting of a mix of 2-8 microbial species cultured under a defined set of conditions. **Protocol settings will have built-in acceptable safe operating ranges for selection within established instrument specifications from vendors, EMSL protocol best-practices, and PNNL EH&S safe research operating windows.		

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Estimated Cost (TEC)			
Design (TEC)			
Prior Years	10,000	10,000	10,000
FY 2025	19,000	19,000	19,000
Total, Design (TEC)	**29,000**	**29,000**	**29,000**
Construction (TEC)			
FY 2026	19,000	19,000	19,000
FY 2027	35,000	35,000	35,000

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Estimated Cost (TEC)			
Outyears	34,000	34,000	34,000
Total, Construction (TEC)	**88,000**	**88,000**	**88,000**
Total Estimated Cost (TEC)			
Prior Years	10,000	10,000	10,000
FY 2025	19,000	19,000	19,000
FY 2026	19,000	19,000	19,000
FY 2027	35,000	35,000	35,000
Outyears	34,000	34,000	34,000
Total, Total Estimated Cost (TEC)	**117,000**	**117,000**	**117,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Other Project Cost (OPC)			
Prior Years	1,200	1,200	1,200
Outyears	3,800	3,800	3,800
Total, Other Project Cost (OPC)	**5,000**	**5,000**	**5,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Project Cost (TPC)			
Prior Years	11,200	11,200	11,200
FY 2025	19,000	19,000	19,000
FY 2026	19,000	19,000	19,000
FY 2027	35,000	35,000	35,000
Outyears	37,800	37,800	37,800
Total, TPC	**122,000**	**122,000**	**122,000**

4. Details of Project Cost Estimate

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Design	20,500	N/A	20,500
Design - Contingency	8,500	N/A	8,500
Total, Design (TEC)	**29,000**	**N/A**	**29,000**
Construction_No_Detail	10,000	N/A	10,000
Total, Construction (TEC)	**10,000**	**N/A**	**10,000**
Total, TEC_No_Detail	**78,000**	**N/A**	78,000
Total, TEC	**117,000**	**N/A**	**117,000**
Contingency, TEC	*8,500*	***N/A***	*8,500*
Other Project Cost (OPC)			
OPC, Except D&D	5,000	N/A	5,000
Total, Except D&D (OPC)	**5,000**	**N/A**	**5,000**
Total, OPC	**5,000**	**N/A**	**5,000**
Contingency, OPC	***N/A***	*N/A*	***N/A***
Total, TPC	**122,000**	**N/A**	**122,000**
Total, Contingency (TEC+OPC)	***8,500***	***N/A***	***8,500***

5. Schedule of Appropriations Requests

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	10,000	19,000	10,000	—	78,000	117,000
	OPC	1,200	—	—	—	3,800	5,000
	TPC	11,200	19,000	10,000	—	81,800	122,000
FY 2027	TEC	10,000	19,000	19,000	35,000	34,000	117,000
	OPC	1,200	—	—	—	3,800	5,000
	TPC	11,200	19,000	19,000	35,000	37,800	122,000

6. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy	1Q FY 2032
Expected Useful Life	50 years
Expected Future Start of D&D of this capital asset	1Q FY 2082

Related Funding Requirements
(dollars in thousands)

	Annual Costs		Life Cycle Costs	
	Previous Total Estimate	**Current Total Estimate**	**Previous Total Estimate**	**Current Total Estimate**
Operations	N/A	223	N/A	11,150
Utilities	N/A	145	N/A	7,250
Maintenance and Repair	N/A	331	N/A	16,550
Total, Operations and Maintenance	N/A	699	N/A	34,950

7. D&D Information

The new area being constructed is part of this project and will not be replacing any existing facilities.

	Square Feet
New area being constructed by this project at PNNL	34,500
Area of D&D in this project at PNNL	—
Area at PNNL to be transferred, sold, and/or D&D outside the project, including area previously "banked"	—
Area of D&D in this project at other sites	—
Area at other sites to be transferred, sold, and/or D&D outside the project, including area previously "banked"	—
Total area eliminated	—

8. Acquisition Approach

The two largest procurements, the HTP-APP and the facility, have been awarded and Notice to Proceed with design has been established for both contractors. The contractors are coordinating design efforts and multiple partnering meetings have been held, which include M2PC project team, the facility team, and the HTP-APP team. As of December, the project is preparing for the first on-site construction activities: scanning and bore hole drilling. SC will evaluate the M&O contractor's performance through the annual laboratory performance appraisal process.

SC and the M&O will draw from lessons learned from other SC projects and other similar facilities in planning and executing the M2PC project.

Fusion Energy Sciences

Overview

The Fusion Energy Sciences (FES) program is advancing in alignment with a set of national priorities that emphasize energy security, economic competitiveness, and U.S. technological leadership in accordance with the goals of the Department of Energy (DOE) Genesis Mission to integrate artificial intelligence (AI), high-performance computing, experimental facilities, and data infrastructure into a national discovery platform. The U.S. Fusion Science & Technology Roadmap (Roadmap) establishes a national strategy to close scientific and technological (S&T) gaps on the critical path toward fusion energy, supporting a new era of U.S. fusion energy leadership. In alignment with the DOE Genesis Mission Lighthouse Challenges, the AI-Fusion Digital Convergence Platform (DCP) will accelerate sustaining burning plasmas and materials discovery to harness fusion power using the most sophisticated AI models ever developed. Targeted Quantum Information Science (QIS) investments leverage transformative tools for plasma science, materials research, and diagnostics in extreme environments.

The FES mission is to drive the S&T foundation for a fusion energy source and support the development of a competitive U.S. fusion energy industry. The Roadmap is DOE's strategy to "Build", "Innovate", and "Grow" a leading, robust American fusion energy industry, and ensures that FES core research aligns with closing gaps along the critical path to fusion energy. It's six Core Challenge Areas are strongly aligned to the 2020 Fusion Energy Sciences Advisory Committee (FESAC) Long-Range Plan (LRP): structural materials, plasma-facing components and plasma-material interactions, confinement approaches, the fuel cycle, blankets, and fusion plant engineering and system integration.

FES supports advancing multiple confinement concepts. The Sustain a Burning Plasma element includes research and development (R&D) on U.S. world-leading short-pulse toroidal facilities (e.g., DIII-D and National Spherical Torus Experiment-Upgrade [NSTX-U]) that support AI-fusion convergence, optimize magnetic confinement regimes and test prototypic fusion technology, while also enabling international collaborations on long pulse facilities abroad. Inertial Fusion Energy (IFE) hubs support rapid growth of IFE approaches. U.S. participation in ITER provides U.S. scientists access to an industrial scale burning plasma experimental facility and helps build the American fusion energy supply chain. Fusion Innovation Research Engine (FIRE) Collaboratives bridge basic science with the needs of the growing fusion industry, to address S&T gaps informed by the private sector. Complementing FIRE is a suite of public-private partnership (PPP) programs. The Milestone-Based Fusion Energy Development Program supports fusion development companies to establish viable fusion pilot plant (FPP) designs. The Innovation Network for Fusion Energy (INFUSE) provides vouchers to fusion startups to access expertise and capabilities at national labs and universities. The Private Facility Research (PFR) program leverages private capital investment by supporting research on private facilities to advance S&T for public benefit. The Public Private Consortium Framework (PPCF) supports Fusion Bringing Regional Investments to Develop & Grow fusion Engines (Fusion BRIDGE) to cost-share small and medium-scale test stands to de-risk critical fusion materials and technologies.

Fusion Materials and Internal Components address the development of novel materials and technologies that can withstand enormous heat and neutron exposure. The Material Plasma Exposure eXperiment (MPEX) facility will address knowledge gaps in plasma-material interactions, and a new design activity to evaluate a mission need for a Fusion Prototypical Neutron Source (FPNS) to address the highest priority facility need identified by the FESAC LRP. Closing the Fusion Cycle develops the breeding and processing technology for fusion fuels that ensure fusion is a self-sustaining energy source. This includes a strategy to develop test stands and components along a path to developing integrated blanket and fuel cycle testing capabilities.

FES supports fusion theory and simulation to enable prediction and interpretation of complex plasma phenomena and fusion technology, and to provide validated high-fidelity physical models for plant design. To steward advanced computation for fusion energy, FES supports Scientific Discovery through Advanced

Computing (SciDAC) portfolio, in partnership with the Advanced Scientific Computing Research (ASCR) program.

FES supports plasma science and technology research areas such as plasma astrophysics, space plasmas, plasma propulsion, high-energy-density laboratory plasmas (HEDLP), and low-temperature plasmas. Practical societal applications of plasmas are found in plasma processing of advanced materials, plasma-enabled chemical processing, and plasma medicine.

Within SC, FES invests in several cross-cutting initiatives such as AI and machine learning (AI/ML), QIS, and microelectronics. With continued funding for the Established Program to Stimulate Competitive Research (EPSCoR), FES builds strategic programs to enhance SC-sponsored fusion-relevant research in key states and territories.

Highlights of the FY 2027 Request

The FES FY 2027 Request of $755.3 million is a decrease of $50.406 million below FY 2026 Enacted, with reduced funding for core research to offset increases for high priority research activities and facility operations. The Request is aligned to support the overall U.S. fusion strategy and the Roadmap, including reviewing partnerships and investment approaches to quickly advance fusion energy. The Request aligns with recommendations in the FESAC LRP. The FY 2027 Request includes:

<u>Research</u>

- DIII-D research: Exploit novel heating and current drive systems to test, integrate, and demonstrate advanced operation of these systems in support of the global supply chain for plasma actuators. Support publicly and privately funded facility users to close high priority gaps for pulsed and steady-state tokamak operational scenarios.
- NSTX-U research: Begin NSTX-U plasma experiments. Support collaborative research related to the optimization of tokamak aspect ratio and high field conventional tokamak studies in support of FPP development.
- Partnerships with the private sector: For the Milestone-Based Fusion Development Program, support subsequent phases of research and commercialization activities of the teams that successfully met their initial milestones; continue the INFUSE program; and support the PFR program, where private fusion companies offer their facilities at no cost to public sector sponsored researchers to perform mutually beneficial, open research. In addition, Fusion BRIDGE explores modalities that support PPPs and regional consortia aimed at developing and building small, medium, and large-scale capabilities, including test stands. These efforts are targeted toward closing critical Fusion Materials and Technology (FM&T) gaps defined by both the public and private sectors.
- IFE: Expand research activities, including the IFE Science & Technology Accelerated Research (STAR) hubs and the IFE ecosystem stewardship. Additionally, initiate advanced modeling, simulation, and AI/ML capabilities to bridge S&T gaps and accelerate the development of an IFE FPP.
- FIRE Collaboratives: Strengthen support for the multi-institutional, multi-disciplinary R&D efforts to address critical S&T gaps outlined in the FESAC LRP and support public and private FPP efforts. The Request supports multiple collaboratives in four technical areas: advanced simulation, materials, blanket/fuel cycle, and enabling technologies.
- Fusion Materials and Internal Components: Initiate evaluation of a mission need for a FPNS facility. FPNS was the highest priority new facility in the FESAC LRP. The FPNS facility would enable investigation of the effects of fusion-relevant irradiation on material properties degradation in this harsh burning plasma environment. This capability will provide a better understanding of materials performance and lifetime limits from an engineering science perspective as well as supporting the development of structural and plasma facing materials for use in a next-step fusion device.
- Closing the Fusion Cycle: Initiate design of an Integrated Blanket and Fuel Cycle Test Facility (IB-FCTF), consistent with recent FESAC reports and following design and cost estimate work in FY 2026. The

approach to delivering an IB-FCTF will be a phased approach that delivers component capabilities integrated over time, to support closing the critical S&T gaps identified in the Roadmap blanket and fuel cycle core challenges in both the areas of tritium breeding capabilities of various blanket concepts and the development of the fuel processing technology to separate and process the tritium to make fusion an inexhaustible energy resource for the future.

- International Collaborations: Continue to exploit international, long-pulse facilities by multi-institutional teams, and complete fabrication and installation of advanced diagnostic systems on new world-leading facilities. Expand strategic international partnerships on FM&T facilities and partner to build new large-scale facilities and test stands with Fusion BRIDGE in the U.S. fusion ecosystem.
- Discovery Plasma Science and Technology: Continue support for basic plasma and plasma astrophysics research including multi-island magnetic reconnection and coronal heating, collaborative research facilities including the Facility for Laboratory Reconnection Experiment (FLARE), HEDLP research including utilizing the Matter in Extreme Conditions (MEC) instrument at the SLAC Linac Coherent Light Source (LCLS), and LaserNetUS facilities, microelectronics research and centers, plasma-based technology research, and QIS research.
- Theory and Simulation: Continue aligning foundational theory and computational simulation efforts with FES priorities in the realms of plasma confinement, digital engineering, and development of FPPs.
- AI/ML: Increase support for multi-disciplinary teams applying AI/ML for science discovery through foundational models, model extraction through surrogates of high-fidelity simulations, data-enhanced prediction and autonomous plasma control, facility operations, and modeling of manufacturing and supply chain logistics. Advance the AI-Fusion DCP as called for in the Roadmap, in support of the Genesis Mission.
- EPSCoR: Strengthen fusion-relevant research capacity and capabilities in key states and territories.

Facility Operations

- DIII-D operations: Support 16 weeks of facility operations with a new divertor allowing higher plasma performance, and complete ongoing infrastructure improvements including electron cyclotron heating enhancements.
- NSTX-U recovery and operations: Complete the recovery and repair activities including machine assembly. Commission all systems and begin experimental plasma operations.
- Material Plasma Exposure eXperiment (MPEX): After completion of the MPEX project, initiate preparation for operation of this facility.

Projects

- U.S. hardware development and delivery to ITER: Support the continued design and fabrication of multiple in-kind hardware with no cash contribution. Realign project with reassessment of how ITER fits in the overall U.S. fusion strategy, including reviewing partnerships and investment approaches to quickly advance fusion energy.

Other

- General Plant Projects/General Purpose Equipment (GPP/GPE): Support infrastructure improvements and repairs at the Princeton Plasma Physics Laboratory (PPPL) and other DOE laboratories.

Fusion Energy Sciences
Funding

(dollars in thousands)

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Fusion Energy Sciences				
Theory and Simulation	64,000	65,776	72,540	+6,764
Fusion Materials and Internal Components	85,000	76,411	68,000	-8,411
Sustain a Burning Plasma	123,000	141,661	140,000	-1,661
Closing the Fusion Cycle	69,000	56,238	89,000	+32,762
Discovery Plasma Science and Technology	48,000	65,000	55,900	-9,100
Public-Private Partnerships	71,200	100,000	135,000	+35,000
FES Established Program to Stimulate Competitive Research (EPSCoR)	2,000	2,000	2,000	–
Other Research	3,890	3,687	6,311	+2,624
Total, AT80 - Fusion and Plasma Research	**466,090**	**510,773**	**568,751**	**+57,978**
DIII-D Operations	71,600	74,000	61,000	-13,000
National Spherical Torus Experiment-Upgrade (NSTX-U) Operations	52,310	50,200	47,000	-3,200
MPEX Operations	–	–	1,000	+1,000
Total, AT81 - Fusion Facility Operations	**123,910**	**124,200**	**109,000**	**-15,200**
Subtotal, Fusion Energy Sciences	**590,000**	**634,973**	**677,751**	**+42,778**
Construction				
14-SC-60 US Contributions to ITER	200,000	170,684	77,500	-93,184
Subtotal, Construction	**200,000**	**170,684**	**77,500**	**-93,184**
Total, Fusion Energy Sciences	**790,000**	**805,657**	**755,251**	**-50,406**

Fusion Energy Sciences
Explanation of Major Changes

	(dollars in thousands) FY 2027 Request vs FY 2026 Enacted
Fusion and Plasma Research	**+$57,978**

Funding for DIII-D Research will continue to focus efforts on developing the scientific foundation and operating scenarios for a burning plasma. Funding for NSTX-U Research will maintain collaborative research at other facilities, begin preparations for utilizing NSTX-U as it moves closer to startup of plasma operations, and establish new strategic FM&T initiatives. Both domestic assets provide a platform for convergence of AI and fusion energy development. The Request enhances support for the Milestone-Based Fusion Development Program, continues support for Materials and increases support for Closing the Fusion Cycle consistent with the FESAC LRP goals with a focus on delivering small to medium scale experimental capabilities aligned with the Roadmap using multiple modalities, tools, and approaches. Initiate design of an IB-FCTF that will help close the S&T gaps in the blanket and fuel cycle areas. In addition, the Request continues the FIRE Collaboratives on Structural/Plasma Facing Materials, Blanket/Fuel Cycle, Enabling Technologies, and Advanced Simulation for Design and Optimization to address the Roadmap Core Challenge Areas. The Request increases support for IFE S&T in IFE STAR hubs, increases support for Measurement Innovation, and increases support for AI/ML research in areas such as control theory, materials design, and disruption mitigation research. The Request continues the PFR program for fusion community to perform research on private fusion and plasma science facilities. It also enhances support for the Fusion BRIDGE activity, to explore models that support PPPs towards developing innovative partnerships and regional consortia to building small, medium, and large-scale capabilities, including test stands targeted toward closing key FM&T gaps identified in the Roadmap. The Request continues support for high-priority international collaboration activities and establish new ones, for both tokamaks and stellarators that support burning plasma studies for U.S. scientists. The Request also supports Future Facilities Studies program focusing on new strategic experimental facilities addressing S&T gaps identified in the FESAC LRP and the Roadmap.

For General Plasma Science and Technology, the Request emphasizes user research on collaborative research facilities at universities and national laboratories including the FLARE at PPPL and work in emerging plasma technology topics. For HEDLP, the Request continues support for research utilizing the MEC instrument and the ten LaserNetUS networked facilities. Support for SC-wide Microelectronics Science Research Centers will emphasize convergence of plasma technology and advanced microelectronic materials. The Request maintains support for QIS, which supports the

	(dollars in thousands)
	FY 2027 Request vs FY 2026 Enacted
Fusion and Plasma Research core research portfolio stewarded by FES and the National QIS Research Centers. Support continues for EPSCoR.	**+$57,978**
Fusion Facility Operations The Request will support NSTX-U Recovery completion involving final stages of machine assembly, system commissioning, and start of plasma operations. Funding for DIII-D operations will support 16 weeks of facility operations, operate with a new divertor allowing higher plasma performance, and complete ongoing machine and infrastructure improvements. Oak Ridge National Laboratory (ORNL) will initiate preparation for the startup of operation of the MPEX device.	**-$15,200**
Construction The U.S. Contributions to ITER project will continue design, fabrication, and delivery of the highest priority hardware contributions while a reassessment of the project in the U.S. fusion strategy is underway.	**-$93,184**
Total, Fusion Energy Sciences	**-$50,406**

Basic and Applied R&D Coordination
FES participates in coordinated intra- and inter-agency initiatives within DOE and with other federal agencies on science and technology issues related to fusion and plasma science. Within SC, FES operates the MEC instrument at the SLAC LCLS user facility operated by the Basic Energy Sciences (BES) program, supports high-performance computing research with ASCR, uses the BES-supported High Flux Isotope Reactor (HFIR) facility at ORNL for fusion materials irradiation research, and supports the construction of a high field magnet vertical test facility at the Fermi National Accelerator Laboratory with the High Energy Physics (HEP) program. Within DOE, FES manages a joint program with NNSA in HEDLP science and continues to coordinate research activities with the Advanced Research Projects Agency-Energy (ARPA-E).

Program Accomplishments
SciDAC Advances in Fusion Simulation
Through the SciDAC program, researchers are transforming how fusion reactors are modeled and designed. A partnership led by the University of California at San Diego has developed AI-driven reduced models that can rapidly predict transport in tokamaks by combining experimental datasets with the power of high-performance computing (HPC). In parallel, a team led by ORNL has achieved a breakthrough by integrating high-fidelity plasma simulation codes with commercial engineering tools from Ansys, enabling streamlined calculations of plasma instabilities and their impact on liquid metal blankets and structural components. Together, these advances mark a new era where AI, HPC, and engineering-grade simulation converge to accelerate the path to practical fusion energy.

Artificial Intelligence in Fusion Energy
AI is rapidly reshaping the frontier of fusion research. At ORNL, scientists have created a powerful AI toolkit that leverages vast experimental datasets to accurately predict fusion experiment pulses, giving researchers a new edge in planning and control. At PPPL, teams are constructing a fusion-dedicated, AI-optimized supercomputing cluster equipped with cutting-edge graphics processing units (GPUs), designed to accelerate predictive simulations and strengthen collaboration with private fusion companies on FPP design. Meanwhile, researchers at the University of Texas at Austin have harnessed AI/ML alongside analytic theory and simulation to resolve a decades-old challenge in high-energy particle confinement—a landmark advance that pushes theory into the era of AI-enabled discovery. Together, these breakthroughs signal a decisive shift toward an AI-powered fusion ecosystem capable of speeding progress from experiment to deployment.

Morphology of Copper Nanofoams for Inertial Fusion Energy
Scientists at Los Alamos National Laboratory (LANL), SLAC National Accelerator Laboratory, Brigham Young University, and Lawrence Livermore National Laboratory (LLNL) have utilized a powerful technique called 3D Ptychotomography at an X-ray Free Electron Laser (XFEL) to investigate the nanostructure of copper foams for fusion applications. Their groundbreaking research, published in Nano Letters, reveals unexpected morphological complexities, such as distorted, merged, or open shells, and a mass density lower than targeted. This unprecedented nanoscale information is critical for improving foam modeling and fabrication methods, paving the way for tailored materials that can significantly enhance the performance of IFE and related experiments.

Correlated x-ray pairs generated at an XFEL for the first time
A SLAC-led collaboration has achieved the first observation of correlated X-ray pairs generated at an XFEL, consistent with quantum entanglement, by utilizing parametric down-conversion at a Japanese XFEL facility. This breakthrough, which validates the production of X-ray pairs even with XFEL's ultrashort pulses, paves the way for quantum-enhanced X-ray imaging with reduced dose and noise, and advancements in QIS.

Simulating Plasma Wave Propagation on a Superconducting Quantum Chip

Researchers from Rigetti Computing, LLNL, and the University of Colorado at Boulder have achieved the first quantum simulation of plasma waves. They used Rigetti's Ankaa-3 superconducting quantum computer to model plasma wave propagation and scattering in a non-uniform medium, identifying a quantum model of magnetism that mimics plasma behavior. This approach offers computational advantages over classical methods, particularly for simulating nonlinear quantum effects in high-energy, high-density plasmas. The project, which also involved developing a regression technique for error mitigation, marks a significant step toward using quantum computing for complex multiscale, multi-physics problems in fusion energy, nuclear science, chemistry, and materials science.

Surprising energy cascade transfer pathways in solar wind plasmas
Researchers from LANL and the University of Delaware have employed a new scale decomposition method to investigate turbulence in wavenumber-frequency space. This has enabled, for the first time, the investigation of the turbulent energy transfer in spatial and temporal domains. In contrast, most of the previous methods have focused only on the spatial transfer. One new result from this investigation is that magnetic fluctuations with timescales longer than the nonlinear timescale exhibit an inverse cascade toward smaller frequencies. Higher frequency magnetic modes, on the other hand, undergo a forward cascade. Detailed analysis suggests that the low frequency solar wind fluctuations may have originated locally through turbulence inverse cascade. Turbulence is ubiquitous in astrophysical and laboratory plasmas including fusion, with its hallmark characteristic of cascading the injected energy to small spatial scales.

A three-theory problem for the observed temperatures inside a spherical tokamak
Using sophisticated simulations of small fluctuations within previous NSTX test results, researchers identified a third possible explanation for the observed temperature profiles. Specifically, the simulation results show that internal turbulence driven by high internal pressures can exhibit the observed electron temperature profile behavior during strong external heating. Initial theoretical work identified instabilities caused by fast injected particles as a possible cause. More recently, global instabilities showed promise. Once operational, experimentation on NSTX-U will provide definitive evidence to determine which of the three theories is correct.

Description

This subprogram advances our scientific understanding of how to control and sustain a burning plasma, a critical step along the path to fusion power plants, utilizing both simulation and experimental results from domestic and international devices. The subprogram supports closing critical science, materials and technology gaps that must be closed for fusion energy development, such as the breeding and handling of fusion fuels, the development of the required materials, and breeding blanket and fusion fuel-cycle technology that can withstand the harsh fusion environment and harness fusion power. Innovation in this subprogram establishes the foundation of a competitive fusion power industry in the U.S. through partnerships with the private sector and allied nations on fusion technology development projects and capabilities. In addition, it supports research that explores the fundamental properties and complex behavior of matter in the plasma state, making plasma science and technology fully available to support the U.S. economic growth and safeguard national security. The FIRE Collaboratives provide coordination among program elements to address critical scientific and technology gaps in fusion energy. The Fusion BRIDGE supports development of regional consortia and new public-private partnership modalities to deliver small-to-medium test stands aligned with the Fusion S&T Roadmap core challenge areas, and to, in part, help support R&D in FIRE Collaboratives.

Theory and Simulation

The Theory and Simulation activity supports research on foundational theory to advance the scientific understanding of the behavior of fusion plasmas, and multi-institutional interdisciplinary efforts under the SciDAC program, in partnership with the Advanced Scientific Computing Research (ASCR) program, to accelerate scientific discovery in fusion plasma S&T. This activity also includes support for advancing the AI-Digital Convergence Platform as part of the Genesis Mission, and the FIRE Collaboratives for advanced simulations for design and optimization, which addresses critical scientific gaps for FPP concepts in coordination with the other FIRE Collaboratives. This program supports the application of AI/ML techniques encompassing multiple FES areas including digital engineering in partnership with data and computational scientists through collaborations.

Fusion Materials and Internal Components

Developing materials that can meet the needs of a fusion power plant is a grand challenge in the field of Materials Science and Engineering. Every component, from the innermost chamber walls to the outer power-plant structure, requires materials that can withstand a broad range of conditions, including extremes of heat and particle exposure, especially high energy neutron fluxes. This program aims to advance the understanding of material properties to support predictions of evolving material properties in prototypic fusion power plant environments with the aim to maximize material lifetime and performance. This activity includes FIRE Collaboratives and research capabilities to address many of the difficult and unique fusion materials challenges. The MPEX Major Item of Equipment (MIE) project, which is a new U.S. materials experimental capability initiated in FY 2019 with expected operation in late FY 2027/early FY 2028 time-frame, will enable researchers to find solutions for the challenges associated with plasma-facing materials, including exposing irradiated samples, and understanding materials degradation in the fusion nuclear environment. In addition, a new design activity will be initiated on a FPNS which was considered by the FESAC LRP to be the highest priority new FES facility.

Sustain a Burning Plasma

The Sustain a Burning Plasma (SBP) activity supports a diversity of approaches to confinement of plasmas in fusion energy systems. This program includes traditional toroidal confinement approaches such as advanced tokamaks (ATs), spherical tokamaks (STs), high magnetic field tokamaks, and stellarators. As these approaches address physics and technology gaps and outcomes are translated to development programs, novel approaches, such as linear plasma concepts (field-reverse configuration, axisymmetric mirrors, and plasma pinches), are nurtured and expanded. This program also includes innovative Inertial Fusion Energy (IFE) approaches.

The Toroidal Long Pulse (TLP) area advances steady-state fusion energy approaches by leveraging a coordinated network of tokamaks and stellarators in the U.S. and internationally, with the dual aims of sustaining U.S. scientific leadership and preparing the foundation for an FPP. Built around long-pulse, burning plasma relevant conditions, the program integrates experiments, advanced diagnostics, theory, and simulation to close critical gaps in the physics basis for burning plasmas. Its scope spans five major research divisions (sustaining burning plasma, handling power and particle exhaust, advancing plasma–material interactions, controlling damaging transients, and validating theory and modeling) supported by crosscutting activities in magnetic confinement technology, engineering, and operations. The Theory and Model Validation topic encompasses AI/ML applications, integrated control, and model verification efforts that tie experiments to predictive capabilities developed in the Theory and Simulation program areas. Research is carried out across U.S. facilities like the DIII-D National Fusion Facility (an Office of Science (SC) user facility) and the Helically Symmetric Experiment (HSX) as well as through strong collaborations on leading international superconducting tokamaks and stellarators such as the JT-60SA in Japan, and the Wendelstein 7-X (W7-X) in Germany, ensuring broad engagement of national laboratories, universities, and industry. Together, the TLP Program provides the scientific knowledge, technology pathways, and coordinated structure necessary to accelerate the nation's progress toward practical fusion energy.

The Compact Toroidal Concepts (CTC) area supports research necessary to develop a compact toroidal configuration. Two promising concepts addressed in CTC are the ST, such as the NSTX-U, and conventional aspect ratio tokamaks operated at high magnetic fields, exemplified by Commonwealth Fusion Systems' SPARC tokamak. These devices offer complementary strategies for improving confinement and achieving compactness: STs leverage enhanced plasma physics properties while high-field conventional tokamaks rely on high-field magnet technology. Regardless of the approach, enabling technologies are essential for delivering these compact designs, including high-temperature superconducting magnets, and liquid metal plasma-facing components. With several private sector stakeholders pushing the frontiers, the CTC program naturally incorporates the fusion energy industry and fosters strong connections to foundational S&T research.

The IFE area supports the scientific foundations and enabling technologies critical to advancing IFE. Priority research areas include improving target physics, developing high repetition rate drivers, reducing laser-plasma instabilities, developing scalable methods for target fabrication, and creating advanced, radiation-hardened diagnostics capable of operating at high repetition rates. These efforts are supported by the IFE Science & Technology Accelerated Research (IFE-STAR) hubs. The program also emphasizes ecosystem stewardship by fostering collaboration among national laboratories, academic institutions, and the private sector.

The Measurement Innovation area supports the development of world-leading transformative and innovative diagnostic techniques, focused on delivering novel systems for measurements in an FPP.

The Future Facilities Studies area supports studies and research for required facilities that "best serve fusion" and facilitate the development of fusion energy while addressing needs of both the public and private sectors aligned with the FESAC LRP in 2020 and the FESAC Facilities Construction Projects Subcommittee Draft Report in 2024.

Closing the Fusion Cycle

Within a fusion energy system, subsystems sustain plasma conditions, extract energy, fuel the plasma, and manage waste. This research area aims to build the capabilities to design and mature each system while simultaneously integrating them efficiently to realize practical fusion power. This includes developing the next generation of real-time systems for plasma control, qualifying blankets that breed fusion fuel, and prototyping fuel-processing technologies that can optimize and sustain the fusion reaction. This area supports enabling R&D, fusion nuclear science, FIRE Collaboratives, and research capabilities to advance the readiness of these critical capabilities. Research areas include initiating the design of an integrated blanket/fuel cycle facility as a MIE project that will support addressing a number of these critical scientific challenges. In addition, a new research effort will be initiated to evaluate various possible options for a neutron source that could enable testing of both structural/plasma facing materials and blanket concepts in a fusion-relevant environment.

Discovery Plasma Science and Technology

Discovery Plasma Science and Technology (DPST) research supports activities in HEDLP, foundational plasma science research, transformational plasma S&T, innovation in advanced microelectronics, and efforts in the convergence of plasmas and QIS.

Research in HEDLP explores the behavior of plasmas at extreme conditions of temperature, density, and pressure. This activity also includes LaserNetUS, a geographically distributed network of ten high-intensity laser facilities that provide students and scientists with broad access to unique facilities and enabling technologies and advances the frontiers of HED and laser science research.

General Plasma Science and Technology (GPST) research in foundational plasma S&T aims to increase our understanding of the complex behavior of the plasma state, ranging from astrophysical plasma to low-temperature plasma. GPST supports collaborative research facilities, enabling experiments in new regimes to enhance our understanding of plasma phenomena in nature and in the laboratory. Transformational plasma S&T includes frontier research in low-temperature plasmas, microelectronics, and plasma-based technologies with applications in medicine, space plasmas, plasma-enabled chemical reactions, environmental remediation, and agriculture.

The Advanced Microelectronics area supports discovery plasma research in a multi-disciplinary, co-design framework to accelerate plasma-based microelectronics fabrication and advance the development of microelectronic technologies. This activity also supports the DOE Microelectronics Science Research Centers.

Quantum Information Science (QIS) area supports basic research in QIS that can have a transformative impact on FES mission areas as well as research that takes advantage of unique FES-enabled capabilities to advance QIS development. This activity also supports the portfolio of DOE National QIS Research Centers.

Public-Private Partnerships

Resilient Public-Private Partnerships (PPPs) will foster bridges between the public and private sectors to address foundational gaps and accelerate fusion toward commercial viability.

Within this PPP framework, the INFUSE program provides private-sector fusion companies with access to world-class expertise and capabilities at DOE's national laboratories and U.S. universities to overcome critical scientific and technological hurdles in a manner that maintains control over proprietary information.

The Fusion Development Milestone Program aims to accelerate progress toward the development of commercial fusion energy through PPPs, with near-term goals of delivering preconceptual designs and technology roadmaps for an FPP and enabling significant performance improvements of FPP concepts. In fiscal year 2024, the Fusion Development Milestone Program established eight public-private partnerships, and multiple milestones have been met by the teams to date. The current awardees are working toward presenting pre-conceptual designs and technology roadmaps of their FPP concepts within the first 18 months of the Milestone program. If they successfully meet these milestones, they will proceed into the next phase of the Milestone Program, where the awardees are planning to build and operate integrated experiments and/or demonstrate some of the critical underlying technologies for their FPPs. Since selection, four teams have collectively raised over $386 million of new private funding, compared to the $46 million of federal funding initially committed. Continued progress in the Milestone program is contingent on Congressional appropriations, successful negotiation of future milestones, and successful progress in the program including awardees success in securing the required non-Federal funding to complete their milestones.

The Public Private Consortium Framework (PPCF) supports modalities such as Fusion BRIDGE which seeks to develop a network of regional activities to accelerate cost-sharing to deliver and operate small and medium-scale test stands to de-risk most common and critical Fusion Materials and Technology (FM&T) gaps. Fusion BRIDGE supports regional consortia efforts with seed funding meant to catalyze cost share and regional investments in projects, to build industry-led development of test stands in a network of economic regional hubs aligning advanced manufacturing, digital engineering, and infrastructure to support a U.S.-based fusion innovation supply chain.

The Private Facilities Research (PFR) Program offers researchers from DOE national laboratories and U.S. universities the opportunity to conduct non-proprietary open scientific studies on privately constructed facilities for the mutual benefit of all parties. All funding is directed to the public sector. Private companies offer the public sector experimental access to their facilities at no cost, allowing the public sector to leverage billions of dollars in private investment. The private sector benefits as researchers maximize their device performance toward realizing investor goals, and the public benefits by open publishing of research results.

Established Program to Stimulate Competitive Research (EPSCoR)

The Established Program to Stimulate Competitive Research (EPSCoR) provides opportunities to U.S. regions with potential to build critical expertise and capacity.

Other Research

This area supports the Postdoctoral Research Program, fusion and plasma science outreach programs, critical general infrastructure, and environmental monitoring at the Princeton Plasma Physics Laboratory (PPPL) and other DOE laboratories, and other programmatic activities.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Fusion and Plasma Research	**$510,773**	**$568,751**	**+$57,978**
Theory and Simulation	$65,776	$72,540	+$6,764
Funding supports efforts focused on the fundamental theory of fusion plasmas, the fourth and final year of the SciDAC portfolio, the development of advanced simulation tools for the FIRE Collaborative and AI/ML research in cross-cutting interdisciplinary fusion energy and plasma science research.		The Request will continue to support efforts focused on the fundamental theory of fusion plasmas, high-fidelity simulations of plasmas and their associated facilities, a new round of FES/ASCR SciDAC Partnerships, the development of advanced simulation tools for the FIRE Collaboratives and AI/ML research in cross-cutting interdisciplinary fusion energy, plasma science, and digital engineering research supporting AI-Fusion Digital Convergence Platform within the Genesis Mission.	Prioritization with theory and SciDAC will align this research with LRP priorities. Funding will continue to support FIRE Collaboratives. Funding for AI/ML research will align with Genesis Mission and FPP design efforts.
Fusion Materials and Internal Components	$76,411	$68,000	-$8,411
Funding enables growth in the key area of materials which is critical in de-risking gaps for fusion energy. Funding continues to support the FIRE Collaboratives for structural and plasma facing materials. Funding also continues to support the MPEX MIE project, consistent with the approved baseline for the project.		The Request will continue to support the FIRE Collaboratives for structural and plasma-facing materials and the growth of small-to-medium scale testing capabilities necessary for the development and evaluation of fusion materials. The Request will continue to support both the MPEX MIE project and research activities. The Request includes funding to support design and mission need activities for a FPNS.	Funding will continue to support the highest priority research activities on structural and plasma-facing materials to address the scientific/technical gaps outlined in the FS&T Roadmap. The decrease in funding reflects the expectation that the MPEX MIE project will be completed in late FY 2027 to early FY 2028-time frame.

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Sustain a Burning Plasma $141,661	$140,000	-$1,661
Funding supports research efforts at DIII-D and lays the groundwork for the initiation of NSTX-U research activities. Funding supports small-scale U.S. experimental facilities to help close scientific gaps, supports research on international facilities for both tokamak and stellarator concepts, and supports the priority research opportunities identified in the IFE BRN Workshop. The development of innovative and transformative diagnostics and studies to help define requirements for future facilities are continued.	The Request will continue support for research at DIII-D and continued NSTX-U research. The Request supports small-scale U.S. experimental facilities to help close scientific gaps, supports research on international facilities for both tokamak and stellarator concepts, and supports priority R&D in breakthrough technologies in IFE and Measurement Innovation defined by the FS&T Roadmap.	Funding will support DIII-D and NSTX-U platforms aligned with priorities in FESAC LRP and support for Genesis Mission data mining. IFE and Measurement Innovation R&D will continue to be aligned with priorities in IFE development and critical diagnostic tools for FPPs.
Closing the Fusion Cycle $56,238	$89,000	+$32,762
Funding supports the key areas of fusion nuclear science and enabling R&D, including the FIRE Collaboratives for blanket/fuel cycle, and enabling technologies, which are critical in developing the scientific foundation and technology development for fusion energy.	The Request will support the key areas of fusion nuclear science and enabling R&D, including the FIRE Collaboratives for blanket/fuel cycle, and enabling technologies, which are critical in developing the scientific foundation and technology development for fusion energy. The Request will also include an initial investment in a blanket/fuel cycle test facility and neutron source infrastructure.	Funding increase will support new fusion technology capabilities necessary to close key gaps in blanket and fusion fuel cycle including initiating design activities for a future blanket/fuel cycle test facility as a Major Item of Equipment project consistent with the FS&T Roadmap.
Discovery Plasma Science and Technology $65,000	$55,900	-$9,100
Funding continues to support basic and translational science and MEC and LaserNetUS operations in HEDLP. In GPST, funding continues to support basic and low temperature plasma science as well as operations of research facilities. For Advanced Microelectronics, funding continues to support the centers selected in FY 2025 and the priority research opportunities identified in the recent workshop. For QIS, funding continues	The Request, in HEDLP, will continue to support basic and translational science and MEC and LaserNetUS operations. In GPST, it will continue to support basic and low temperature plasma science as well as operations of research facilities. For Advanced Microelectronics, it will continue to support the centers selected in FY 2025 and the priority research opportunities identified in the recent	Funding will support the highest-priority activities including QIS, plasma technology, and the PPPL Facility for Laboratory Reconnection Experiments (FLARE).

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
to support the research awards as well as the National QIS Research Centers.	workshop. For QIS, it will continue to support the research awards as well as the National QIS Research Centers.	
Public-Private Partnerships $100,000	$135,000	+$35,000
Funding supports PPPs through the Fusion Development Milestone Program, the INFUSE program, and the PFR program which started as a pilot program in FY 2025. Funding is also allocated to Fusion BRIDGE to support PPPs towards developing and building small-to-midscale capabilities.	The Request will support PPPs through the Fusion Development Milestone Program, the INFUSE program, and the PFR program which started as a pilot program in FY 2025. The Request will also allocate funding to the PPCF to support PPPs through Fusion BRIDGE towards developing and building small-to-midscale capabilities.	Funding increase will support subsequent phases of the Fusion Development Milestone Program, the PFR program, and the new Fusion BRIDGE initiative, a new modality under the PPCF.
Established Program to Stimulate Competitive Research (EPSCoR) $2,000	$2,000	$ —
Funding continues to support EPSCoR State-National Laboratory Partnership awards and early career awards.	The Request will continue to support EPSCoR Implementation awards and early career awards.	No change.
Other Research $3,687	$6,311	+$2,624
Funding continues to support programmatic activities and infrastructure improvements.	The Request will continue to support programmatic activities and infrastructure improvements.	Funding will support the highest priority activities aligned with FESAC LRP.

Description

The DIII-D National Fusion Facility and the NSTX-U facility are world-leading SC user facilities for experimental research used by scientists from national laboratories, universities, and private industry research groups to optimize magnetic confinement regimes and test prototype fusion technology in an integrated environment. The operation of these facilities addresses the FESAC Long-Range Plan Fusion Science & Technology (FS&T) recommendation to "utilize research operations on DIII-D and NSTX-U, and collaborate with other world-leading facilities, to ensure that FPP design gaps are addressed in a timely manner." Gaps that can be addressed by the operation of the FES user facilities include novel heating and current drive technology, low aspect ratio physics, disruption avoidance and mitigation, plasma control, core-edge integration, steady state burning plasma scenario development, and plasma facing component integration, including assessment of liquid metal approaches. These user facilities provide a valuable resource to the private fusion energy sector to resolve S&T challenges associated with their confinement concepts. In addition, they play a key role in the convergence of AI and fusion energy and have a significant role in training the next generation of fusion scientists and permitting the U.S. research community to take full advantage of operations on international facilities. The MPEX, which is being built at Oak Ridge National Laboratory (ORNL), will be able to address critical fusion materials science questions on the path toward proving the scientific viability of fusion power. MPEX will allow for dedicated studies of reactor-relevant heat and particle loads on neutron-irradiated materials. The overall motivation is to enter into a new class of fusion materials science wherein the combined effects of fusion-relevant heat, particle, and neutron fluxes can be studied for the first time anywhere in the world. It will provide a world-leading, highly cost-effective experimental device with superior capability, high throughput, and versatility. With the FY 2027 Request, MPEX will begin preparations for its initial operation.

DIII-D Operations

The DIII-D scientific user facility at General Atomics is the most adaptable and best-diagnosed magnetic confinement facility in the U.S. Its advanced diagnostics, evolving heating and current drive systems, and broad research team make it ideal for closing critical science and technology gaps pursued by the TLP program and enabling extrapolation to burning plasma conditions. In FY 2025, DIII-D operated and upgraded the facility while supporting 833 users from 128 institutions across 21 countries, including 40 faculty and 204 students—one of the largest U.S. fusion workforce contributions.

National Spherical Torus Experiment-Upgrade (NSTX-U) Operations

The NSTX-U scientific user facility at Princeton Plasma Physics Laboratory (PPPL) is used to close remaining and critical S&T gaps of the ST magnetically confined plasma configuration. The ST has a toroidal magnetic field shaped like a cored apple and low values (<2) of aspect ratio, the ratio of the major to minor radius of the torus. Previous experiments and high-fidelity simulations indicate that STs may offer improved energy confinement and greater stability at high pressure relative to larger (>3) aspect ratio tokamaks. The NSTX-U program aims to show that the ST may enable higher fusion power density (reduced device size) and reduced recirculating power (improved economics) leading to affordable and compact fusion power plant option on a path to fusion energy commercialization. NSTX-U is the world's most powerful ST, with external heating of approximately 19 megawatts, toroidal magnetic fields as high as one Tesla, and plasma currents as high as two megaamperes. Combining an upgraded neutral beam heating system with unique ST plasma properties, NSTX-U is also an ideal test bed for studying interactions between plasma waves and fast fuel ions in ways that are relevant to burning plasma science. NSTX-U also provides a unique exhaust environment for testing emerging plasma-facing component systems.

MPEX Operations

MPEX, at ORNL, will be a world-leading experimental capability to explore solutions to the plasma materials interactions challenge. When fully operational, this facility will enable dedicated studies of reactor-relevant plasma-material interactions at a scale not previously accessible to any fusion research program. The key research objective is to create a new class of fusion materials science enabling the study of the combined effects of fusion-relevant heat, particles, and neutron fluxes for the first time anywhere in the world.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Fusion Facility Operations	**$124,200**	**$109,000**	**-$15,200**
DIII-D Operations	$74,000	$61,000	-$13,000
Funding supports 16 weeks of operations at the DIII-D facility, including exploitation of the high-field-side lower hybrid current drive system installed in FY 2025. Support continues for enhancements to the DIII-D electron heating system, up to ten gyrotrons providing 7 MW of injected power.		The Request will support 16 weeks of operations at the DIII-D facility, including exploitation of increased plasma heating and current drive capabilities and further studies aimed at exploring novel strategies for handling heat and particle fluxes in the tokamak divertor including negative triangularity shaped plasmas.	Funding will support the highest priority work elements of plasma heating and divertor systems. Facility operating time is prioritized.
National Spherical Torus Experiment-Upgrade (NSTX-U) Operations	$50,200	$47,000	-$3,200
Funding supports NSTX-U Recovery fabrication and machine reassembly activities.		The Request will support NSTX-U Recovery completion involving final stages of machine assembly, system commissioning, and start of plasma operations.	Funding will support the highest priority work elements of the NSTX-U Recovery effort and start of operations.
MPEX Operations	$ —	$1,000	+$1,000
		The Request will support MPEX start-up operations including hiring and training of operators and diagnosticians, support for MPEX staff, purchase of consumable supplies, equipment maintenance, and exploitation of the surface analysis station.	Funding will support getting this new facility ready for operations.

Fusion Energy Sciences
Construction

Description

This subprogram supports all line-item construction projects. All Total Estimated Costs (TEC) are funded in this subprogram.

14-SC-60 US Contributions to ITER

The ITER facility, currently under construction in Saint Paul-lez-Durance, France, is designed to provide fusion power output approaching reactor levels of hundreds of megawatts, sustained as a burning plasma for hundreds of seconds. ITER provides an experimental industrial-scale platform supporting the development of energy pilot plants in the private sector and enabling U.S. supply chains helping to keep the U.S. competitive internationally. Construction of ITER is governed under an international agreement (the "ITER Joint Implementing Agreement"). As a co-owner and Member of ITER, the U.S. contributes in-kind hardware components and financial contributions for the ITER Organization (IO) management and overhead (e.g., design integration, nuclear licensing, quality control, safety, overall project management, and installation and assembly of the components provided by the U.S. and other Members). The IO also employs over 30 U.S. nationals who work on site.

An independent review of Critical Decision-2 (CD-2), "Approve Performance Baseline," for the U.S. Contributions to ITER—First Plasma subproject (SP-1) was completed in November 2016 and then subsequently approved by the Project Management Executive on January 13, 2017, with a total project cost (TPC) of $2,500,000,000. Responding to Congressional direction in the FY 2021 Appropriations Act, the entire project was baselined in December 2023 and achieved CD-2/3B, which includes a rebaseline of SP-1 scope, baseline of Post-First Plasma (SP-2) scope, and financial contributions for the project to CD-4, "Approve Project Completion". U.S. Contributions to ITER will include the delivery of the completed Central Solenoid Magnet System, Steady-State Electrical Network, Disruption Mitigations System, Tritium Exhaust Processing System, Ion Cyclotron Heating and Electron Cyclotron Heating Systems, Diagnostics, and Roughing Pumps. U.S. investment in ITER has advanced the nation's industrial capabilities supporting a U.S. fusion power industry and resulted in over $1.4B awarded to American companies through 2024 in 46 states. U.S. companies, DOE labs and U.S. universities contribute to the design, fabrication, and delivery of in-kind hardware for ITER.

The FY 2027 Request of $77,500,000 will support the continued systems design, fabrication, and delivery of in-kind hardware with no cash contribution. The revised baseline is $6,500,000,000, which includes all U.S. in-kind hardware and financial construction contributions through the completion of the ITER project. The IO provided an updated baseline at the June 2024 ITER Council meeting. U.S. Contributions to ITER are estimated to remain within the TPC of $6,500,000,000.

The U.S. in-kind contribution represents 9.09 percent (1/11th) of the overall ITER project but will provide U.S. researchers and industry access to 100 percent of the science and engineering associated with what will be the largest magnetically confined burning plasma experiment ever created. The U.S. involvement in ITER is consistent with the recommendations of the FESAC LRP, and it was ranked as a top priority by the FESAC *Facilities Construction Projects*[a] assessment. ITER also contributes to FES PPPs through the sharing of design information as well as lessons learned in the design, fabrication, and installation of hardware to sustain ITER operating conditions. The Request is aligned with a reassessment of how ITER fits in the overall U.S. fusion strategy, including reviewing partnerships and investment approaches to quickly advance fusion energy.

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[a] https://science.osti.gov/-/media/fes/fesac/pdf/2024/FCPREPORT--final-submittedapproved0424.pdf

Fusion Energy Sciences
Construction

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Major Changes FY 2027 Request vs FY 2026 Enacted
Construction	**$170,684**	**$77,500**	**-$93,184**
14-SC-60 U.S. Contributions to ITER U.S. ITER	$170,684	$77,500	-$93,184
Funding supports continued design and fabrication of in-kind hardware systems.		The Request will support continued design and fabrication of in-kind hardware systems.	Funding will support design and fabrication of the highest priority in-kind hardware contributions.

Fusion Energy Sciences
Capital Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Capital Operating Expenses						
Capital Equipment	N/A	N/A	46,400	49,380	31,200	-18,180
Minor Construction Activities						
General Plant Projects	N/A	N/A	–	–	2,000	+2,000
Total, Capital Operating Expenses	**N/A**	**N/A**	**46,400**	**49,380**	**33,200**	**-16,180**

Capital Equipment

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Capital Equipment						
Major Items of Equipment						
Fusion and Plasma Research						
Material Plasma Exposure eXperiment (MPEX)	194,036	139,656	22,200	25,180	7,000	-18,180
Total, MIEs	194,036	139,656	22,200	25,180	7,000	-18,180
Total, Non-MIE Capital Equipment	N/A	N/A	24,200	24,200	24,200	–
Total, Capital Equipment	**N/A**	**N/A**	**46,400**	**49,380**	**31,200**	**-18,180**

Note:
- The Capital Equipment table includes MIEs with a Total Estimated Cost (TEC) > $10M.

Fusion Energy Sciences
Major Items of Equipment Description(s)

<u>Fusion Materials and Internal Components MIEs:</u>

Material Plasma Exposure eXperiment (MPEX)

FES is developing a first-of-a-kind, world-leading experimental capability to explore solutions to the plasma-materials interactions challenge. This device, known as MPEX, will be located at ORNL and will enable dedicated studies of reactor-relevant plasma-material interactions at a scale not previously accessible to the fusion program. The overall goal of this project is to create a new class of fusion materials science enabling the study of the combined effects of fusion-relevant heat, particle, and neutron fluxes for the first time anywhere in the world. The project received CD-2/3 "Approve Performance Baseline/Start of Construction" on August 22, 2022, with a TPC of $201,000,000. The last year of funding for the MPEX project was expected to be in the FY 2026 Request. However, due to the increase in costs of the project, it will need additional resources above the current TPC in FY 2027. The CD-4 "Project Completion" date is still January 2028 which includes several months of schedule contingency. MPEX scope includes the design, fabrication, installation, and commissioning of the MPEX linear plasma device, as well as associated facility and infrastructure modifications and reconfiguration. In the FY 2027 Request, there is funding to initiate the required preparations to begin operations. This activity is in the Facility Operations part (MPEX Operations) of the FY 2027 Request.

<u>Closing the Fusion Cycle</u>

Integrated Blanket and Fuel Cycle Test Facility (IB-FCTF)

While previous public sector investments have provided a strong basis in the areas of plasma confinement and plasma enabling technologies, large gaps remain in the areas of power generation and sustainable closure of the fuel cycle, both of which strongly influence the economic, safety, and environmental attractiveness of fusion systems. Addressing the challenges of closing these technology gaps from a relatively low level of maturity to the level needed to design, build and operate a fusion pilot plant (FPP) requires an integrated testing capability. The IB-FCTF would be a world-leading facility that would provide the FES program with the capability needed to sufficiently retire the risks associated with moving forward with immature and incomplete blanket and fuel cycle systems. In the FY 2027 Request, there is a funding request of $8,000,000 for OPC to continue design activities to evaluate fully the possible options to build such a facility.

Fusion Energy Sciences
Construction Projects Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
14-SC-60, U.S. Contributions to ITER						
Total Estimated Cost (TEC)	6,429,698	2,835,617	200,000	170,684	77,500	-93,184
Other Project Cost (OPC)	70,302	70,302	-	-	-	-
Total Project Cost (TPC)	**6,500,000**	**2,905,919**	**200,000**	**170,684**	**77,500**	**-93,184**
Total, Construction						
Total Estimated Cost (TEC)	**N/A**	**N/A**	**200,000**	**170,684**	**77,500**	**-93,184**
Other Project Cost (OPC)	**N/A**	**N/A**	**-**	**-**	**-**	**-**
Total Project Cost (TPC)	**N/A**	**N/A**	**200,000**	**170,684**	**77,500**	**-93,184**

Fusion Energy Sciences
Scientific User Facility Operations

The treatment of user facilities is distinguished between two types: TYPE A facilities that offer users resources dependent on a single, large-scale machine; TYPE B facilities that offer users a suite of resources that is not dependent on a single, large-scale machine.

(dollars in thousands)

	FY 2025 Enacted	FY 2025 Current	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Scientific User Facilities - Type A					
DIII-D National Fusion Facility	**114,600**	**118,254**	**96,668**	**95,000**	**-1,668**
Number of Users	550	833	550	500	-50
Achieved Operating Hours	–	716	–	–	–
Planned Operating Hours	640	640	640	640	–
Unscheduled Down Time Hours	–	125	–	–	–
National Spherical Torus Experiment-Upgrade	**82,310**	**87,123**	**68,852**	**72,000**	**+3,148**
Number of Users	380	347	380	350	-30
Total, Facilities	**196,910**	**205,377**	**165,520**	**167,000**	**+1,480**
Number of Users	930	1,180	930	850	-80
Achieved Operating Hours	–	716	–	–	–
Planned Operating Hours	640	640	640	640	–
Unscheduled Down Time Hours	–	125	–	–	–

Notes:

- *Percent optimal operations defines what is achieved at this funding level. This includes staffing, up-to-date equipment and software, operations and maintenance, and appropriate investments to maintain world leadership.*
- *MPEX operations funding will cover start-up operations, including staffing (hiring, training, and support), consumable supplies, equipment maintenance, and surface analysis station exploitation.*

Fusion Energy Sciences
Scientific Employment

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Number of Permanent Ph.Ds (FTEs)	1,141	1,145	1,065	-80
Number of Postdoctoral Associates (FTEs)	141	145	118	-27
Number of Graduate Students (FTEs)	380	384	349	-35
Number of Other Scientific Employment (FTEs)	1,703	1,715	1,560	-155
Total Scientific Employment (FTEs)	**3,365**	**3,389**	**3,092**	**-297**

Note:
- *Other Scientific Employment (FTEs) includes technicians, engineers, computer professionals, and other support staff.*

14-SC-60 US Contributions to ITER
Project is for Design and Construction

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

Summary

The FY 2027 Request for the U.S. Contributions to ITER (U.S. ITER) project is $77,500,000 of Total Estimated Cost (TEC) funding. The Total Project Cost (TPC) for the project is $6,500,000,000 with an expected CD-4 in 1Q 2040. In FY 2023, the entire U.S. ITER project was baselined, with a TPC of $6,500,000,000 which included all the Subproject-1 (SP-1) and Subproject-2 (SP-2) scope, as well as the total construction cash contributions to the ITER Organization (IO). The U.S. involvement in ITER is consistent with the recommendations of the FESAC LRP, and it was designated as a facility that "best serves" the FES mission by the FESAC *Facilities Construction Projects*[b] assessment. U.S. Contributions to ITER also supports a U.S. fusion supply chain that supports the growing fusion power industry. ITER also contributes to FES public-private partnerships through the sharing of design information as well as lessons learned in the design, fabrication, and installation of hardware to sustain ITER operating conditions. Sections of this Construction Project Data Sheet (CPDS) have been tailored to reflect the unique nature of the U.S. ITER project. The Request is aligned with a reassessment of how ITER fits in the overall U.S. fusion strategy, including reviewing partnerships and investment approaches to quickly advance fusion energy.

Significant Changes

The U.S. ITER project was initiated in FY 2006. The most recent DOE Order 413.3B approved Critical Decision (CD) is CD-3C, Approve Long Lead Procurements, which was approved on December 16, 2024.

On January 13, 2017, U.S. ITER SP-1 achieved CD-2, Approve Performance Baseline, and CD-3, Approve Start of Construction. CD-4, Project Completion, for SP-1 was planned for December 2028. The full requirement to complete the U.S. Contributions to ITER project was baselined in December 2023. The U.S. baselined the entire U.S. Contributions to ITER project, including re-baselining SP-1 and the baselining of SP-2 as a result of the IO re-baselining for the overall project due to COVID and first-of-a-kind component delivery delays, material specification and fabrication issues, as well as quality challenges. The IO submitted an updated cost and schedule to the ITER Council at the June 2024 meeting which delays machine startup. This submittal was assessed by a U.S.-led Independent Assessment (IA) team consisting of several ITER members and its conclusions presented to the ITER IO in Fall of 2024. The IA report, along with other input, is currently supporting a reassessment of ITER and how it fits the overall U.S. strategy on fusion energy.

In FY 2025, one Central Solenoid Module (CSM) was delivered to the IO, bringing the total to five of seven that make up the Central Solenoid Magnet (including one spare). In FY 2026, the final two CSMs are scheduled to arrive at the IO. In FY 2025, the delivery of central solenoid pre-compression and support structures to the IO were completed; the largest procurement for the Electron Cyclotron Heating (ECH) system, waveguides, was awarded; and the Tokamak Exhaust Processing final design review was completed. The FY 2026 funding supports the completion of the Vacuum Auxiliary System and Roughing Pump System design and the delivery of the ECH miter bends to the IO. The FY 2027 Request will support the continued design and fabrication of multiple in-kind hardware with no cash contribution.

[b] https://science.osti.gov/-/media/fes/fesac/pdf/2024/FCPREPORT--final-submittedapproved0424.pdf

Critical Milestone History

Fiscal Year	CD-0	Conceptual Design Complete	CD-1	CD-2	CD-3	CD-4
FY 2027	7/5/05	–	1/25/08	12/12/2023	12/12/2023	1Q FY 2040

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; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

Fiscal Year	Performance Baseline Validation	CD-1 Cost Range Update	CD-1R	CD-3A	CD-3B	CD-3C	CD-4
FY 2027	1/13/17	1/13/17	1/13/17	1/13/17	12/12/23	12/16/24	1Q FY 2040

CD-1R – Approve Alternative Selection and Cost Range, Revised; **CD-3A** – Approval of the project starting construction of original 2017 approved baseline; **CD-3B -** Approval of the project starting construction under the 2023 approved baseline; **CD-3C** – Approval of additional Long-Lead In-Kind Hardware Procurements in the following areas: Electron Cyclotron Heating, Tokamak Cooling Water System, Roughing Pump and Vacuum Auxiliary Systems; **CD-4 -** Completion of In-kind Hardware Scope.

Project Cost History

At the time of CD-1 approval in January 2008, the preliminary cost range was $1,450,000,000 to $2,200,000,000. Until 2016, however, it was not possible to confidently baseline the project due to delays early in the international ITER construction schedule. Various factors (e.g., schedule delays, design and scope changes, funding constraints, regulatory requirements, risk mitigation, and inadequate project management and leadership issues in the IO at that time) affected the project cost and schedule. Shortly after the arrival of the new Director General in March 2015, the overall ITER Project was baselined for cost and schedule.

In response to a 2013 Congressional request, a DOE SC Independent Project Review (IPR) Committee assessed the project and determined that the existing cost range estimate of $4,000,000,000 to $6,500,000,000 would likely encompass the final TPC (includes SP-1, SP-2, and Cash Contributions). In preparation for baselining SP-1, based on the results of an Independent Project Review, the acting Director for the Office of Science updated the lower end of this range to reflect updated cost estimates, resulting in the current approved CD-1 Revised (CD-1R) range of $4,700,000,000 to $6,500,000,000.

FY 2023 reflects only SP-1 and associated cash contributions. Beginning in FY 2024, the entire U.S. ITER Project was baselined. The TPC for the entire project is projected to be $6,500,000,000.

U.S. Contributions to ITER In-kind Hardware and Construction Cash Contributions

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Cash Contributions	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	439,243	4,677,455	1,313,000	6,429,698	70,302	70,302	6,500,000
FY 2027	439,243	4,677,455	1,313,000	6,429,698	70,302	70,302	6,500,000

2. Project Scope and Justification

ITER, currently one of the largest science experiments in the world, is a major fusion research facility under construction in St. Paul-lez-Durance, France by an international partnership of seven Members or domestic agencies, specifically, the U.S., China, the European Union, India, Korea, Japan, and the Russian Federation. ITER is co-owned and co-governed by the seven Members. The Energy Policy Act of 2005 (EPAct 2005), Section 972(c)(5)(C) authorized U.S. participation in ITER. The Agreement on the Establishment of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project (Joint Implementation Agreement or JIA), signed on November 21, 2006, provides the legal framework for the four phases of the program: construction, operation, deactivation, and decommissioning. The JIA is a Congressional-Executive Hybrid Agreement. The other six Members entered the project by treaty. The IO is a designated international legal entity located in France.

Scope

U.S. Contributions to ITER – Construction Project Scope

The overall U.S. ITER project includes three major elements:

- In-kind Hardware systems (13 in total), built under the responsibility of the U.S., and then shipped to the ITER site for IO assembly, installation, and operation. Included in this element is cash provided in-lieu of U.S. in-kind component contributions to adjust for certain reallocations of hardware contributions between the U.S. and the IO.
- Funding to the IO to support common expenses, including ITER research and development (R&D), design and construction integration, overall project management, nuclear licensing, IO staff and infrastructure, IO-provided hardware, on-site assembly/installation/testing of all ITER components, installation, safety, quality control, and operation.
- Other Project Costs (OPC), including R&D (other than mentioned above) and conceptual design-related activities.

Justification

The purpose of ITER is to investigate and conduct research in the "burning plasma" regime—a performance region that exists beyond the current experimental state of the art. Creating a self-sustaining burning plasma will provide essential scientific knowledge necessary for practical fusion power. There are two planned experimental outcomes expected from ITER. The first is to investigate the fusion process in the form of a "burning plasma," in which the heat generated by the fusion process exceeds that supplied from external sources (i.e., self-heating). The second is to sustain the burning plasma for a long duration (e.g., several hundred to a few thousand seconds), during which time equilibrium conditions can be achieved within the plasma and adjacent structures. ITER will provide a sustained burning plasma for long-term experimentation which is a necessary step toward developing a fusion pilot plant.

Although not classified as a Capital Asset, the U.S. ITER project is being conducted following project management principles of DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets,* to the greatest extent possible.

Key Performance Parameters (KPPs)

The U.S. Contributions to ITER Project will not deliver an integrated operating facility, but rather in-kind hardware contributions, which represent a portion of the international ITER facility. The U.S. ITER project defines project completion as delivery and IO acceptance of the U.S. in-kind hardware.

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Estimated Cost (TEC)				
Design (TEC)				
Prior Years	439,243	439,243	439,243	—
Total, Design (TEC)	**439,243**	**439,243**	**439,243**	**—**
Construction (TEC)				
Prior Years	1,652,377	1,652,377	1,139,517	—
Prior Years - IRA Supp.	190,000	190,000	—	185,029
FY 2025	144,000	144,000	183,356	4,971
FY 2026	170,684	170,684	170,684	—
FY 2027	77,500	77,500	77,500	—
Outyears	2,442,894	2,442,894	2,916,398	—
Total, Construction (TEC)	**4,677,455**	**4,677,455**	**4,487,455**	**190,000**
Cash Contributions (TEC)				
Prior Years	487,997	487,997	485,761	—
Prior Years - IRA Supp.	66,000	66,000	—	66,000
FY 2025	56,000	56,000	56,347	—
FY 2026	—	—	1,889	—
Outyears	703,003	703,003	703,003	—
Total, Cash Contributions (TEC)	**1,313,000**	**1,313,000**	**1,247,000**	**66,000**
Total Estimated Cost (TEC)				
Prior Years	2,579,617	2,579,617	2,064,521	—
Prior Years - IRA Supp.	256,000	256,000	—	251,029
FY 2025	200,000	200,000	239,703	4,971
FY 2026	170,684	170,684	172,573	—
FY 2027	77,500	77,500	77,500	—
Outyears	3,145,897	3,145,897	3,619,401	—
Total, Total Estimated Cost (TEC)	**6,429,698**	**6,429,698**	**6,173,698**	**256,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Other Project Cost (OPC)				
Prior Years	70,302	70,302	70,302	–
Total, Other Project Cost (OPC)	**70,302**	**70,302**	**70,302**	**–**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Project Cost (TPC)				
Prior Years	2,649,919	2,649,919	2,134,823	–
Prior Years - IRA Supp.	256,000	256,000	–	251,029
FY 2025	200,000	200,000	239,703	4,971
FY 2026	170,684	170,684	172,573	–
FY 2027	77,500	77,500	77,500	–
Outyears	3,145,897	3,145,897	3,619,401	–
Total, TPC	**6,500,000**	**6,500,000**	**6,244,000**	**256,000**

Notes:
- *The entire project was baselined in December 2023 with a TPC of $6,500,000,000.*
- *All Appropriations to date for the U.S. Contributions to ITER project include both funding for SP-1 and funding for Cash Contributions, as well as for work associated with the new overall In-kind Hardware baseline.*
- *Obligations and costs through FY 2024 reflect actuals; obligations and costs for FY 2025 and the outyears are estimates.*

4. Details of Project Cost Estimate

The overall U.S. Contributions to ITER project has an approved revised CD-1R. Cost Range (CD-1R). In 2016, DOE chose to divide the project hardware scope into two distinct subprojects (First Plasma or SP-1, and Post-First Plasma or SP-2) so that an initial portion of the project that was mature enough to baseline could be accomplished. The baseline for SP-1 In-kind Hardware ($2,500,000,000) was approved in January 2017. In December 2023, the entire project was baselined with a total project cost of $6,500,000,000 and achieved CD-2/3B.

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design	439,243	439,243	573,660
Design - Contingency	N/A	N/A	122,365
Total, Design (TEC)	**439,243**	**439,243**	**696,025**
Construction_No_Detail	3,317,455	3,317,455	**N/A**
Equipment	N/A	N/A	1,362,521
Construction Contingency	1,360,000	1,360,000	371,152
Total, Construction (TEC)	**4,677,455**	**4,677,455**	**1,733,673**
Cash Contributions	1,313,000	1,313,000	**N/A**
Total, Cash Contributions (TEC)	**1,313,000**	**1,313,000**	**N/A**
Total, TEC	**6,429,698**	**6,429,698**	**2,429,698**
Contingency, TEC	*1,360,000*	*1,360,000*	*493,517*
Other Project Cost (OPC)			
OPC, Except D&D	70,302	70,302	70,302

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total, Except D&D (OPC)	**70,302**	**70,302**	**70,302**
Total, OPC	**70,302**	**70,302**	**70,302**
Contingency, OPC	*N/A*	*N/A*	*N/A*
Total, TPC	**6,500,000**	**6,500,000**	**2,500,000**
Total, Contingency (TEC+OPC)	***1,360,000***	***1,360,000***	***493,517***

Notes:
- *In the table above, the previous total estimate includes cash contributions estimate to align with the TPC budget request. The "Original Validated Baseline" reflects SP-1 only.*
- *Current total estimated design reflects work done prior to CD-2/3. SP-2 design work is accounted for in TEC Construction as part of SP-1 scope approved at CD-2/3.*

5. Schedule of Appropriations Requests

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	2,835,617	200,000	77,500	—	3,316,581	6,429,698
	OPC	70,302	—	—	—	—	70,302
	TPC	2,905,919	200,000	77,500	—	3,316,581	6,500,000
FY 2027	TEC	2,835,617	200,000	170,684	77,500	3,145,897	6,429,698
	OPC	70,302	—	—	—	—	70,302
	TPC	2,905,919	200,000	170,684	77,500	3,145,897	6,500,000

6. Related Operations and Maintenance Funding Requirements

The U.S. Contributions to ITER operations phase is to begin with initial integrated commissioning activities with an assumed useful life of 30 to 35 years. The fiscal year in which commissioning activities begin depends on the international ITER project schedule. As a result of COVID-19 and other known delays, the IO has submitted an overall ITER project updated cost and schedule to the ITER Council at the June 2024 meeting. This update indicates the start of commissioning activities after 2033.

Start of Operation or Beneficial Occupancy	1Q FY 2040
Expected Useful Life	35 years
Expected Future Start of D&D of this capital asset	1Q FY 2075

7. D&D Information

Since ITER is being constructed in France by a coalition of countries and will not be a DOE asset, the "one-for-one" requirement is not applicable to this project.

The U.S. Contributions to ITER decommissioning phase is assumed to begin no earlier than 30 years after the start of operations. The deactivation phase is also assumed to begin no earlier than 30 years after operations begin and will continue for a period of five years. The U.S. is responsible for 13 percent of the total decommissioning and deactivation cost; this requirement will be collected and escrowed out of Research Operations funding.

8. Acquisition Approach

The U.S. ITER Project Office (USIPO) at Oak Ridge National Laboratory, with its two partner laboratories (Princeton Plasma Physics Laboratory and Savannah River National Laboratory), will procure and deliver in-kind hardware in accordance with the Procurement Arrangements established with the IO. The USIPO will subcontract with a variety of research and industry sources for design and fabrication of its ITER components, ensuring that designs are developed that permit fabrication, to the maximum extent possible, to use fixed-price subcontracts (or fixed-price arrangement documents with the IO) based on performance specifications, or more rarely, on build-to-print designs. USIPO will use cost-reimbursement type subcontracts only when the work scope precludes accurate and reasonable cost contingencies being gauged and established beforehand. USIPO will use best value, competitive source-selection procedures to the maximum extent possible, including foreign firms on the tender/bid list when necessary. Such procedures shall allow for cost and technical trade-offs during source selection. For the large-dollar-value subcontracts (and critical path subcontracts as appropriate), USIPO will utilize unique subcontract provisions to incentivize cost control and schedule performance. In addition, where it is cost effective and it reduces risk, the USIPO will participate in common procurements led by the IO or request the IO to perform activities that are the responsibility of the U.S. SC will evaluate the Management and Operation (M&O) contractor's performance through the annual laboratory performance appraisal process.

SC and the M&O will draw from lessons learned from other SC projects and other similar facilities in planning and executing the project.

High Energy Physics

Overview

The High Energy Physics (HEP) program supports research which brings unique expertise to the Genesis Mission, Quantum Information Science (QIS), and microelectronics and harnesses these tools to understand the fundamental constituents of the universe pursuing the discovery science mission laid out in the 2023 P5 report. HEP uniquely integrates new technologies into larger collaborative research efforts, meeting real-world challenges on the road to widespread deployment scales. As part of the Genesis Mission Platform, HEP hosts exabytes of calibrated scientific datasets collected and curated over decades on computing systems that serve the needs of widely-distributed thousand person collaborations. As early adopters and developers of Artificial Intelligence (AI) methods, HEP scientists employ unique datasets to understand and push the limits of fundamental AI techniques. HEP is pushing QIS to achieve unprecedented precision by measuring rare and weak signals from our universe and integrating these new capabilities into pathfinder experiments across our frontiers. In QIS and Genesis Mission, HEP scientists work to identify the next phase of development and ensure that the United States hosts the foremost sites of international excellence in these fields such as the National QIS Research Centers and Microelectronics Science Research Centers.

The HEP program is dedicated to unraveling the mysteries of the universe by exploring the fundamental building blocks of matter and energy. Through groundbreaking scientific discoveries in particle physics and the management of top-tier scientific facilities, HEP plays a crucial role in advancing research and technology development. By ensuring the timely completion of significant projects and maintaining state-of-the-art facilities, HEP contributes to positioning the U.S. as a leader in global particle physics research and collaboration.

Our current understanding of the elementary constituents of matter and energy, as well as the forces that govern them, is encapsulated in the Standard Model of particle physics. However, experimental measurements indicate that the Standard Model is incomplete, hinting at the possibility of uncovering new physics through future experiments. In December 2022, the Department of Energy (DOE) and National Science Foundation (NSF) charged the High Energy Physics Advisory Panel (HEPAP) to assemble a new Particle Physics Project Prioritization Panel (P5) subpanel to formulate a ten-year plan for the field. At the December 2023 HEPAP meeting, the subpanel presented the new 2023 P5 report, "Exploring the Quantum Universe: Pathways to Innovation and Discovery in Particle Physics,"[a] which HEPAP unanimously approved. The report emphasized finishing ongoing major HEP projects. The 2023 P5 report outlines six core science drivers that offer promising pathways towards unraveling the mysteries beyond the Standard Model.

- Reveal the secrets of the Higgs boson,
- Elucidate the mysteries of neutrinos,
- Search for direct evidence of new particles,
- Pursue quantum imprints of new phenomena,
- Determine the nature of dark matter,
- Understand what drives cosmic evolution.

Highlights of the FY 2027 Request

The HEP FY 2027 Request of $1,120.5 million is a decrease of $114.7 million below the FY 2026 Enacted level. This funding will prioritize fundamental research, operation and maintenance of scientific user facilities, facility upgrades, and projects outlined in the 2023 P5 report.

[a] https://science.osti.gov/-/media/hep/hepap/pdf/Reports/2024/2023_P5_Report_Single_Pages.pdf

Research

The Request will provide continued support for HEP core competencies in theoretical and experimental activities and world-leading advanced technology research and development (R&D) in pursuit of discovery science. Funding will also enable key advances in SC cross-cutting initiatives including:

- AI/ML: Contribute to making the Genesis Mission a success and curate AI-ready datasets, develop transformative AI models to extract rare particle signatures from increasingly high volumes of data, operate accelerators and detectors in real-time and extremely high data-rate environments, and create more realistic and accurate simulations of complex physical processes.
- QIS: Co-develop quantum information experiment, theory, and technology research aligned with HEP science drivers and explore new capabilities in quantum sensing and computing. HEP will continue to support the SC-wide National QIS Research Centers.
- Microelectronics: Accelerate R&D into sensor materials, detector devices, advances in front-end electronics, including AI-enabled edge computing; provide adaptation to high-radiation, cryogenic temperature, or low radioactive background environments. HEP will co-support the multi-disciplinary, multi-team awards that comprise the cross-SC Microelectronics Science Research Centers (MSRCs).

Facility Operations

The Request will support three scientific user facilities: the Fermilab Accelerator Complex, the Facility for Advanced Accelerator Experimental Tests II (FACET-II), and the Brookhaven Accelerator Test Facility (ATF). These facilities will operate 2,800, 2,080, and 2,250 hours, respectively. BeamNetUS will provide user access to thirteen U.S. beam test facilities. HEP also supports laboratory-based accelerator and detector test facilities, and supports the maintenance and operations of large-scale experiments and facilities that are not based at a DOE national laboratory, such as the U.S. A Toroidal LHC Apparatus (ATLAS) and Compact Muon Solenoid (CMS) detectors at the Large Hadron Collider (LHC) at the European Organization for Nuclear Research (CERN) in Geneva, Switzerland; Sanford Underground Research Facility (SURF) in Lead, South Dakota; the NSF-DOE Vera C. Rubin Observatory in Chile; and the Dark Energy Spectroscopic Instrument (DESI) mounted on NSF’s Mayall telescope at Kitt Peak National Observatory in Arizona.

Projects

The Request will support the Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment (LBNF/DUNE-US) and Proton Improvement Plan II (PIP-II) construction projects. The Request will also support three Major Item of Equipment (MIE) projects: 1) Accelerator Controls Operations Research Network (ACORN), 2) High-Luminosity Large Hadron Collider (HL-LHC) ATLAS Detector Upgrade, and 3) HL-LHC CMS Detector Upgrade.

High Energy Physics
Funding

	(dollars in thousands)			
	FY 2025 Enacted	**FY 2026 Enacted**	**FY 2027 Request**	**FY 2027 Request vs FY 2026 Enacted**
High Energy Physics				
Energy Frontier, Research	66,835	52,757	23,627	-29,130
Energy Frontier, Facility Operations and Experimental Support	51,750	50,400	55,000	+4,600
Energy Frontier, Projects	33,700	28,400	11,812	-16,588
Total, Energy Frontier Experimental Physics	**152,285**	**131,557**	**90,439**	**-41,118**
Intensity Frontier, Research	58,103	48,533	24,832	-23,701
Intensity Frontier, Facility Operations and Experimental Support	221,000	226,900	243,439	+16,539
Intensity Frontier, Projects	10,000	10,000	21,000	+11,000
Total, Intensity Frontier Experimental Physics	**289,103**	**285,433**	**289,271**	**+3,838**
Cosmic Frontier, Research	47,409	43,040	19,094	-23,946
Cosmic Frontier, Facility Operations and Experimental Support	56,500	52,543	55,700	+3,157
Cosmic Frontier, Projects	4,500	–	–	–
Total, Cosmic Frontier Experimental Physics	**108,409**	**95,583**	**74,794**	**-20,789**
Theoretical, Computational, and Interdisciplinary Physics, Research	169,042	–	–	–
Theoretical,Comp,&InterPhy,Facility Operations and Experimental Supp	8,845	–	–	–
Total, Theoretical, Computational, and Interdisciplinary Physics	**177,887**	**–**	**–**	**–**
Advanced Technology R&D, Research	72,886	–	–	–
Advanced Technology R&D, Facility Operations and Experimental Support	48,000	–	–	–
Total, Advanced Technology R&D	**120,886**	**–**	**–**	**–**
Theoretical and Interdisciplinary Physics, Research	–	44,039	21,792	-22,247
Total, Theoretical and Interdisciplinary Physics	**–**	**44,039**	**21,792**	**-22,247**
Accelerator & Technology R&D, Research	–	242,247	193,549	-48,698
Accel & Tech R&D, Facility Operations & Experimental Support	–	62,297	40,613	-21,684
Total, Accelerator & Technology R&D	**–**	**304,544**	**234,162**	**-70,382**
Subtotal, High Energy Physics	**848,570**	**861,156**	**710,458**	**-150,698**

(dollars in thousands)

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Construction				
18-SC-42 Proton Improvement Plan II (PIP-II), FNAL	125,000	114,000	105,000	-9,000
11-SC-40 Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment	251,000	260,000	305,000	+45,000
Subtotal, Construction	**376,000**	**374,000**	**410,000**	**+36,000**
Total, High Energy Physics	**1,224,570**	**1,235,156**	**1,120,458**	**-114,698**

High Energy Physics
Explanation of Major Changes

	(dollars in thousands)
	FY 2027 Request vs FY 2026 Enacted
Energy Frontier Experimental Physics The Request will decrease due to the planned reduction for the HL-LHC ATLAS and CMS Detector Upgrade Projects, in accordance with their baselined funding profiles. Concurrently, funding will increase to prioritize essential upgrades to the U.S.-based software and computing infrastructure. This ensures efficient analysis of the HL-LHC's exponentially large datasets and allows for a strategic focus of research funding on the highest impact areas.	**-41,118**
Intensity Frontier Experimental Physics The Request includes targeted increases to ramp up the ACORN project hardware procurement, provide Other Project Costs (OPC) for PIP-II consumables, and enhance support for SURF and the Fermilab Accelerator Complex. This increased support will enable the latter to operate 2,800 hours annually, including critical General Plant Projects (GPPs) and Accelerator Improvement Projects (AIPs). These increases are offset by rebalancing programmatic priorities within research. Concurrently, research funding will strategically focus on maximizing scientific return from ongoing experiments and making critical contributions to the LBNF/DUNE project.	**+3,838**
Cosmic Frontier Experimental Physics The Request strategically focuses resources on maximizing scientific return from leading dark energy, dark matter, and Cosmic Microwave Background (CMB) experiments. Funding for research decreases while operations increases to prioritize data collection and production from the NSF-DOE Vera C. Rubin Observatory, DESI, and SuperCDMS-SNOLAB, utilizing AI/ML to improve efficiency and accelerate discoveries in dark energy and dark matter.	**-20,789**
Theoretical and Interdisciplinary Physics The Request will prioritize maintaining HEP research capacity, workforce training, and career pathways for individuals and institutions, strategically focusing support on key theoretical research groups to sustain momentum in the most promising areas of high energy physics.	**-22,247**

	(dollars in thousands) FY 2027 Request vs FY 2026 Enacted
Accelerator & Technology R&D The FY 2027 Request for Accelerator & Technology R&D reflects an overall programmatic change. Strategic investment is directed to the Genesis Mission to expand distributed computing activities and curate AI-ready data from experiments and facilities. The Request will also support FACET-II and ATF to operate 2,080 and 2,250 hours, respectively, and will support BeamNetUS. Remaining budget changes allow the subprogram to focus resources on strategic priorities within General Accelerator R&D, Computational HEP, and Detector R&D, enhancing its highest impact areas and delivering world-leading scientific contributions despite overall programmatic constraints.	**-70,382**
Construction The Request will increase support for LBNF/DUNE for ongoing construction of Far Site Conventional Facilities—Buildings and Site Infrastructure, continued installation of far detector components and cryogenic infrastructure, and the design and reviews needed to transition into the execution phases of Near Site Conventional Facilities and Beamline and Near Detector; while decreasing support for PIP-II in accordance with the baselined funding profiles.	**+36,000**
Total, High Energy Physics	**-114,698**

Basic and Applied R&D Coordination
The General Accelerator R&D (GARD), Accelerator Stewardship, Accelerator Development, AI/ML, and QIS activities advance crosscutting technology R&D and supply chain risk reduction efforts that support the mission of HEP and other Office of Science programs.

Technology R&D activities are guided by experts from DOE, other federal agencies, universities, national laboratories, and the private sector who help identify key research areas and supply chain needs beyond the SC research mission. Cross-cutting accelerator R&D is closely coordinated within SC and with partner agencies[b] to ensure federal stakeholders have input in crafting funding opportunity announcements, reviewing applications, and evaluating the efficacy and impact of funded activities. To ensure commercial viability, funded activities are expected to include collaboration with one or more U.S. companies to guide the early-stage R&D. Coordination across the U.S. government occurs through interagency discussions and via the Presidential Council of Advisors on Science and Technology (PCAST) and the National Quantum Coordination Office.

Formulation of the GARD activity is based on input from the community, including high-level advice on long term facility goals from HEPAP and P5, and more detailed technical advice developed through a series of Roadmap Workshops[c]. Formulation of the Accelerator Stewardship, Accelerator Development, and AI/ML activities are based on guidance from other SC Programs, federal advisory committee reports, community input, data capture, and Basic Research Needs workshops[d] held in conjunction with other federal agencies.

To maximize impact, the HEP QIS research activity collaborates with the Department of Commerce's National Institute of Standards and Technology on both quantum metrology and quantum sensor development and with NASA on quantum computing and sensing. The SC National QIS Research Center (NQISRC) efforts engage industry to connect use-inspired research with development efforts, and it utilizes partnerships to improve technology for quantum computing and networking.

Program Accomplishments
Vera C. Rubin Observatory begins its 10-year Legacy Survey of Space and Time (LSST) (Cosmic Frontier Experimental Physics)
In FY 2026, NSF-DOE Vera C. Rubin Observatory began its ten-year wide-field, ground-based, optical and near-infrared imaging Legacy Survey of Space and Time (LSST), providing an unprecedented data set that will be used by the Dark Energy Science Collaboration (DESC) to probe the mysteries of dark energy and dark matter, along with enabling scientific studies by the wider astronomical community. Data preview 2 (DP2) using data from the science verification and commissioning phases taken in FY 2025 was released in FY 2026. Data release 1 (DR1), with early data from the full LSST dataset will be released in FY 2027, enabling early cosmology results. In June 2025, Rubin successfully unveiled its first science images[e] to a global audience, demonstrating its capability to capture vast swaths of the night sky with exceptional clarity. Its 8.4-meter primary mirror and 3.2-gigapixel camera, the largest digital camera ever built, will image the entire visible southern sky every few nights. The resulting LSST dataset will allow DESC to constrain cosmological

[b] Specifically, with the National Institutes of Health/National Cancer Institute (NIH/NCI); ultrafast laser technology R&D with the Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA); and microwave and high power accelerator R&D coordinated with the National Nuclear Security Administration (NNSA) and DOD, the Department of Homeland Security's Domestic Nuclear Detection Office in the Countering Weapons of Mass Destruction Office (DHS/CWMD), Department of Commerce's National Institute of Standards and Technology (NIST) and the National Science Foundation/Mathematical and Physical Sciences (NSF/MPS) Division.
[c] Roadmap Workshop reports may be found at https://science.osti.gov/hep/Community-Resources/Reports
[d] Basic Research Needs workshop reports may be found at https://science.osti.gov/ardap/Resources
[e] https://www.energy.gov/science/articles/ever-changing-universe-revealed-first-imagery-nsf-doe-vera-c-rubin-observatory

parameters with unparalleled precision, test alternative models of dark energy, and search for deviations from the standard cosmological model.

High Energy Physics Hardware-Aware Artificial Intelligence Research (Artificial Intelligence and Machine Learning)

The Office of High Energy Physics held a Hardware-Aware AI Research review for ambitious applications to develop AI systems that require expert knowledge of particle physics detectors and facilities. Among the projects selected from this review, a multi-laboratory award was made to seven DOE national laboratories for the project titled, "ML-Enhanced Online Monitoring and Control of HEP Accelerators at the Scientific Frontier." This project will develop AI that will enable real-time control of particle accelerators, AI-expert systems to assist human operators of complex DOE Office of Science supported experiments and facilities, and AI to develop novel low power Application Specific Integrated Circuits (ASICs) necessary to process the torrent of data from future experiments. Collectively, the selected projects are expected to bring AI to the edge of future DOE SC experiments and facilities to efficiently deliver more impactful science.

LBNL uses quantum computers to watch fundamental physics (Quantum Information Science)

Lawrence Berkeley National Laboratory is working to use quantum computers to simulate a class of problems known as lattice gauge theories, which includes the strong nuclear force. Traditionally, these problems require very large amounts of supercomputer time. In classical computing, it is particularly difficult to access non-equilibrium states, and many calculations are limited to looking at "steady-state" behavior. Quantum computers are not subject to these limitations, raising the exciting prospect that they could allow for a real-time simulation of processes like the formation of protons and neutrons, allowing us to observe the detailed dynamics of how fundamental physics gives rise to the building blocks of matter, particularly in extreme environments like just after the Big Bang. LBNL researchers have realized new theoretical models that reduce the amount of quantum simulation power required to implement these models by 17-19 orders of magnitude.[f] Additionally, they were able to demonstrate the observation of a phenomenon known as "string-breaking" on a 133-qubit superconducting quantum computer. This work was supported by HEP's Quantum Information Science Enabled Discovery (QuantISED) program.

Muon g-2 announces most precise measurement of the magnetic anomaly of the muon (Intensity Frontier Experimental Physics)

The Muon g-2 experiment conducted that the Fermilab National Accelerator Laboratory has released their third and final measurement of the muon magnetic anomaly[g]. The final result is in perfect agreement with the experiment's previous results and is the world's most precise measurement yet of the magnetic moment of the muon. This long-awaited value is the world's most precise measurement of the muon magnetic anomaly at 127 parts-per-billion, surpassing even the original experimental design goal of 140 parts-per-billion. The Muon g-2 collaboration presented the third and final measurement of the muon magnetic anomaly in Ramsey Auditorium on June 3, 2025.

DOE-supported researchers on the Dark Energy Spectroscopic Instrument (DESI) experiment used AI/ML techniques to show that dark energy is not static but evolves with time (Cosmic Frontier Experimental Physics)

DESI's 2025 results using data from almost 15 million galaxies and quasars taken during its first 3 years of operations provide the most precise measurement of our expanding universe, indicating a dark energy that is evolving over time, instead of being a cosmological constant as first postulated by Einstein. DESI's first cosmological publication exceeded 1,000 citations, making it the most cited HEP result of the year. From its location at NSF's Kitt Peak National Observatory, DESI uses a state-of-the-art robotic fiber-fed focal plane that captures light from 5,000 galaxies simultaneously and ten 3-channel spectrographs to make the most accurate 3-

[f] https://arxiv.org/abs/2503.11888
[g] https://news.fnal.gov/2025/06/muon-g-2-most-precise-measurement-of-muon-magnetic-anomaly/

dimensional map of the universe to date. The data were used to unravel the history of cosmic accelerations over 11 billion years, from the present to when the universe was less than 3 billion years old, revealing the nature of dark energy, which causes the acceleration of the expansion of the universe. Combinations of DESI baryon acoustic oscillation data with CMB data (Planck experiment) point to a time-varying dark energy with a confidence level of 3.1 sigma. When combined with various supernova data sets, this increases to 2.8 to 4.2 sigma. This counters the assumption that Einstein's cosmological constant is in fact a constant, with a 0.3 percent accuracy averaged over DESI's full redshift range. At best, the leading standard model of cosmology (Lambda-CDM), with its relative fractions of dark energy and cold dark matter is incomplete, and at worst, it is incorrect. As DESI continues its planned 7-year survey to map the cosmos from the early universe to the present day, it will continue to provide more refined results leading to unparalleled insights that revolutionize our understanding of the composition, history and fate of the universe.

High Energy Physics
Energy Frontier Experimental Physics

Description

The Energy Frontier Experimental Physics subprogram supports U.S. researchers at the international Large Hadron Collider (LHC), participating in the ATLAS and CMS experiments. These large, international collaborations greatly benefit from U.S. researchers' contributions, who represent approximately 20-25 percent of the ATLAS and CMS collaborations and play key leadership roles. This subprogram addresses four of the six P5 science drivers, as detailed below.

- ***Reveal the secrets of the Higgs boson***
  LHC experiments measure the Higgs boson's properties with exquisite precision to determine if it behaves as predicted by the Standard Model.
- ***Search for direct evidence of new particles***
  Direct searches at the LHC aim to discover new particles, leveraging increased collision rates to enable more precise studies. Over a decade of LHC running has produced vast datasets, which have been crucial for innovative analyses.
- ***Pursue quantum imprints of new phenomena***
  LHC researchers probe for evidence of physics beyond the Standard Model. Upgraded LHC detectors will be more sensitive to potential deviations from the Standard Model.
- ***Determine the nature of dark matter***
  LHC collisions could potentially produce dark matter particles, inferring their properties through the behavior of the other particles. Such "indirect" detection complements experiments at the Cosmic and Intensity Frontiers.

Research

This activity supports scientists at research institutions and the DOE national laboratories who work on the ATLAS and CMS experiments by serving in many expert roles – from designing equipment to analyzing data and publishing results. Advanced computational techniques, including AI/ML, contribute to:

- **Analyzing Higgs boson decay patterns:** Precisely measuring the characteristic properties of the Higgs particle, revealing subtle deviations from the Standard Model and providing insights into new physics.
- **Processing enormous volumes of LHC data:** Identifying new particle signatures, suppressing background noise, and optimizing search strategies.
- **Investigating complex collision events:** Exploring challenging collision topologies, detecting subtle imprints of new phenomena, and identifying deviations from expected particle behavior.
- **Searching for dark matter signatures:** Pinpointing potential dark matter signals in LHC collision data.
- **Future colliders R&D:** Physics studies and pre-conceptual R&D to advance the design of international future colliders, such as the Future Circular Collider[h], hosted by CERN, and a Muon Collider[i], potentially hosted in the U.S.

Facility Operations and Experimental Support

The U.S. LHC Detector Operations activity maintains U.S.-built components of the large multi-purpose ATLAS and CMS detectors and supports the U.S.-based computer infrastructure used to analyze LHC data, including the Tier 1 computing centers at Brookhaven National Laboratory (BNL) and FNAL for each respective experiment. These centers provide 24/7 support, store and manage data, perform reprocessing, and store output.

[h] A future electron-positron collider is expected to provide large samples of Higgs bosons, enabling more precise measurements of the particle, exploring new direct production processes, and offering indirect sensitivity to higher energy scales.

[i] A 10 TeV parton center-of-momentum muon collider could provide unparalleled increases in the ability to produce and search for new particles compared to existing capabilities.

Projects

CERN is upgrading the LHC to the High-Luminosity LHC (HL-LHC), increasing the collision rate and the amount of data collected to enable unprecedented precision measurements and explore new physics. HEP contributed to the accelerator project by building and delivering the next-generation superconducting accelerator components, leveraging U.S. expertise. The HL-LHC will create challenging detector conditions, making the HL-LHC ATLAS and CMS Detector Upgrades critical investments to ensure continued operation and maximize scientific return.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Energy Frontier Experimental Physics	**$131,557**	**$90,439**	**-$41,118**
Research	$52,757	$23,627	-$29,130
Funding continues support for researchers actively involved in the ATLAS and CMS experiments, prioritizing the use of AI/ML techniques to sustain progress in fundamental physics discovery.		The Request will continue support for researchers actively involved in the ATLAS and CMS experiments, prioritizing the use of AI/ML techniques to sustain progress in fundamental physics discovery. Support will also continue targeted physics studies and pre-conceptual R&D efforts that advance the proposed future colliders.	Research activity will strategically focus on the highest impact areas within the Energy Frontier subprogram. Research funding will prioritize exploring new physics using innovative AI/ML tools at the LHC and making critical contributions to the HL-LHC detector upgrades, while continuing focused efforts on future collider pre-conceptual R&D.
Facility Operations and Experimental Support	$50,400	$55,000	+$4,600
Funding continues to support vital LHC detector components and computing infrastructure, utilizing AI/ML to optimize performance and ensure reliable, high-quality data for U.S. researchers.		The Request will support vital ATLAS and CMS detector maintenance activities and planned refurbishments of the U.S. computing infrastructure during an extended four-year long technical stop of the LHC, beginning in July 2026. AI/ML tools will continue to be deployed to optimize performance and ensure reliable, future high-quality HL-LHC data for U.S. researchers.	Increased funding will prioritize essential upgrades to the U.S.-based software and computing infrastructure to ensure the efficient analysis of the HL-LHC's exponentially larger datasets. This includes support for vital ATLAS and CMS detector integration and commissioning efforts for delivered components of the U.S.-built HL-LHC detector upgrades, critical during the extended technical stop.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Projects $28,400	$11,812	-$16,588
Funding supports fabrication activities for the HL-LHC ATLAS and the HL-LHC CMS Detector Upgrades.	The Request will support the completion of the fabrication activities for the HL-LHC ATLAS and the HL-LHC CMS Detector Upgrades, with U.S.-built components being delivered to the experiments for their installation and integration.	Funding will support the final critical phase of U.S. contributions to the HL-LHC detector upgrades. The reduced funding level reflects progress towards the completion of fabrication under the planned project profile and the delivery of U.S.-built components, enabling their installation and integration by collaborators on the experiments.

High Energy Physics
Intensity Frontier Experimental Physics

Description

The Intensity Frontier Experimental Physics subprogram investigates rare processes using high-power beams and intense sources to make precision measurements of fundamental particle properties. These measurements probe for new phenomena not directly observable at the Energy Frontier, either because these phenomena occur at much higher energy or involve extremely weak interactions. This subprogram addresses four of the six P5 science drivers, as detailed below.

- ***Elucidate the mysteries of neutrinos***
  Research into fundamental neutrino properties may reveal important clues about the unification of forces and the early history of the universe, addressing the Standard Model's limitations regarding neutrino mass and oscillations.
- ***Search for direct evidence of new particles***
  Experiments seeking direct evidence for new particles, whether heavy particles produced at colliders or light particles produced with high intensity, can ignite major paradigmatic shifts.
- ***Pursue quantum imprints of new phenomena***
  Experiments using intense particle beams can reveal quantum imprints of new phenomena beyond the reach of Energy Frontier accelerators. The physics of quarks and leptons is particularly sensitive to these imprints.
- ***Determine the nature of dark matter***
  Experiments with highly efficient detectors within intense accelerator beams offer an opportunity to explore theoretical models with new particles and forces that rarely interact with normal matter.

<u>Research</u>

This activity supports scientists at research institutions and DOE national laboratories who work in many roles on experiments involving neutrinos, muons, and rare processes – from designing equipment to analyzing data. A major focus is accelerator-based neutrino physics at Fermi National Accelerator Laboratory (FNAL), including the current Short-Baseline Neutrino (SBN) program, which searches for neutrino types beyond the three currently described in the Standard Model, and the LBNF/DUNE, a future U.S.-hosted world-leading neutrino research facility. Advanced computational techniques, including AI/ML, contribute to:

- **Enhanced data processing:** AI/ML algorithms are being used to efficiently process the massive datasets generated by neutrino experiments, accelerating the search for new physics.
- **Improved signal identification:** AI/ML techniques enhance the ability to distinguish faint signals from background noise, increasing the sensitivity of rare decay experiments.
- **Optimized detector performance:** AI/ML is being used to monitor and optimize detector performance, maximizing data quality and experiment up time.

<u>Facility Operations and Experimental Support</u>

This activity covers the costs of managing Intensity Frontier facilities and running experiments, including the Fermilab Accelerator Complex User Facility, the South Dakota Science and Technology Authority (SDSTA) cooperative agreement, and LBNF/DUNE-US Operations.

The Fermilab Accelerator Complex encompasses the operation of all accelerators and beamlines at FNAL; the technical infrastructure supporting the accelerator complex and operation of detectors; scientific computing; and user support. Facility improvements are managed via Accelerator Improvement Project (AIP) and General Plant Project (GPP) portfolios. AI/ML is widely applied in areas such as data analysis and accelerator controls to enhance efficiency, improve accuracy, and unlock new insights from complex datasets.

The SDSTA cooperative agreement funds basic services and critical infrastructure upgrades at the Sanford Underground Research Facility (SURF) in South Dakota. SURF will be the future home of the DUNE far site detectors, which are currently under construction.

LBNF/DUNE-US Operations supports ongoing scientific and technical activities essential for the future operation of DUNE. These activities, which must be performed well in advance of physics data taking, include the development of complex software and computing systems, notably those incorporating AI/ML. This funding is distinct from the support provided to the Fermilab Accelerator Complex, the host facility SURF, or the capital expenditures of the LBNF/DUNE Project.

Projects

FNAL is upgrading its outdated accelerator control system with a modern system capable of utilizing advances in AI/ML to control its high-performance accelerators providing added flexibility, greater scientific productivity, and enhanced efficiency of operations. The Accelerator Controls Operations Research Network (ACORN) project is critical for upgrading obsolete hardware and software systems that are necessary for operations of PIP-II and LBNF.

High Energy Physics
Intensity Frontier Experimental Physics

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Intensity Frontier Experimental Physics	**$285,433**	**$289,271**	**+$3,838**
Research	$48,533	$24,832	-$23,701
Funding maintains support for researchers actively involved in ongoing experiments and future projects, prioritizing the use of AI/ML techniques to sustain progress in fundamental physics discovery.		The Request will support researchers actively involved in the ongoing experiments and future projects. Emphasis will be placed on collaborative efforts and the efficient application of AI/ML to drive discoveries within the leading experiments.	Research activity will strategically focus on the highest impact areas within the Intensity Frontier subprogram. Research funding will prioritize exploring new physics from operating neutrino experiments and making critical contributions to the LBNF/DUNE project.
Facility Operations and Experimental Support	$226,900	$243,439	+$16,539
Funding continues supporting the Fermilab Accelerator Complex and SURF, carefully balancing the operational needs of the user community with the need to reduce deferred maintenance and to advance modernization efforts, such as AI/ML upgrades.		The Request will continue supporting the Fermilab Accelerator Complex and SURF, carefully balancing the operational needs of the user community with the need to reduce deferred maintenance, including a GPP to replace a 354kV substation transformer that provides power to the accelerator, and to advance modernization efforts, such as AI/ML upgrades. The Request will also support critical activities, like developing software and computing infrastructure, essential for the timely operation of DUNE.	Increased funding will prioritize critical infrastructure modernization at SURF and the Fermilab Accelerator Complex, including addressing deferred maintenance, essential for sustaining high-quality operational support for the user community.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Projects $10,000	$21,000	+$11,000
Funding supports the ACORN MIE system design and other related engineering activities.	The Request will support major hardware procurements for ACORN and will support new consumable costs as PIP-II transfers major subsystems to operations.	Increased funding will support the ramp-up in ACORN hardware procurement. This increase will also provide OPC funding for consumables, supporting PIP-II's transition to operational status.

High Energy Physics
Cosmic Frontier Experimental Physics

Description

The Cosmic Frontier Experimental Physics subprogram uses measurements and observations from naturally occurring data to probe fundamental physics questions about dark matter, dark energy, the cosmic inflationary era, and neutrino properties; and to search for new phenomena. Experiments are conducted at ground-based observatories and facilities, space-based missions, and detectors deep underground. This subprogram addresses four of the six P5 science drivers as described below:

- ***Determine the nature of dark matter***
  Direct-detection experiments search for dark matter particles, complementing accelerator-based searches performed in the Energy and Intensity Frontiers.
- ***Understand what drives cosmic evolution***
  Spectroscopic and imaging surveys of galaxies will determine the nature of dark energy. Measurements of the CMB signal and light from distant galaxies map cosmic acceleration and inform researchers about the era of inflation.
- ***Elucidate the mysteries of neutrinos***
  Dark energy experiments using large-scale structures and the CMB will constrain neutrino properties, complementing measurements in the Intensity Frontier.
- ***Search for Direct Evidence of New Particles***
  Studies of the CMB may reveal relic particles from the early universe, leaving imprints that can be investigated.

Research

This activity supports scientists at research institutions and DOE national laboratories across the U.S. These scientists work together on projects in many roles – from designing experiments to analyzing data. Advanced computational techniques, including AI/ML, contribute to:

- **Accelerate data analysis**: Handle the massive datasets generated by these experiments, identifying patterns and anomalies that would be impossible for humans to find manually.
- **Optimize experimental design**: Use AI/ML to simulate different experimental configurations and identify the most efficient and effective designs.
- **Automate operations**: Use AI/ML techniques to optimize in real time the data collection from very sensitive and complex experimental systems more efficiently than could be done by traditional computing algorithms.
- **Improve simulations**: Create more realistic and accurate simulations of complex physical processes, such as the behavior of dark matter particles or the evolution of the universe.

Major experiments like the Dark Energy Spectroscopic Instrument (DESI) and facilities such as the NSF-DOE Vera C. Rubin Observatory are driving progress in understanding dark energy. This activity also leads the global effort to detect and characterize dark matter through experiments like LZ and SuperCDMS-SNOLAB.

Facility Operations and Experimental Support

This activity covers the costs of running Cosmic Frontier experiments, including maintenance, operation, and data collection, handling, and dissemination. DESI is located on the NSF's Mayall Telescope in Arizona and managed by LBNL. DOE and NSF jointly operate the Rubin Observatory in Chile, with SLAC managing DOE's responsibilities. The LZ and SuperCDMS-SNOLAB dark matter experiments are located deep underground. LBNL manages LZ operations at SURF in South Dakota, and SLAC manages DOE's responsibilities for SuperCDMS-SNOLAB at the Sudbury Neutrino Observatory in Canada, in partnership with NSF and Canada[j].

[j] Canadian funding for SuperCDMS-SNOLAB operations is provided by the Ministry for Innovation, Science, and Economic Development through the Canada Foundation for Innovation (CFI).

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Cosmic Frontier Experimental Physics	**$95,583**	**$74,794**	**-$20,789**
Research	$43,040	$19,094	-$23,946
Funding continues to support researchers exploring dark energy and dark matter, emphasizing collaborative efforts and the efficient application of AI/ML to drive discoveries within the leading experiments.		The Request will continue to support researchers exploring dark energy, dark matter, and inflation using the CMB. Emphasis will be placed on collaborative efforts and the efficient application of AI/ML to drive discoveries within the leading experiments.	Research funding will strategically focus on the highest impact areas within the Cosmic Frontier subprogram. Research funding will prioritize discoveries in dark energy and dark matter.
Facility Operations and Experimental Support	$52,543	$55,700	+$3,157
Funding continues to support the collection, processing, and analysis of data from leading Cosmic Frontier experiments.		The Request will continue to support the enhanced collection, processing, and analysis of data from leading Cosmic Frontier experiments.	Increased funding will support the optimal operation of key Cosmic Frontier experiments, particularly the Rubin Observatory, DESI, and SuperCDMS-SNOLAB.

High Energy Physics
Theoretical and Interdisciplinary Physics

Description

The Theoretical and Interdisciplinary Physics subprogram develops the mathematical, phenomenological, and computational tools needed to understand the behavior of particles and fields, as well as the fundamental nature of space and time. This theoretical research is essential for interpreting experimental results in other HEP subprograms, directly contributing to all six P5 science drivers and supporting the Energy, Intensity, Cosmic Frontiers, and Accelerator and Technology R&D. This subprogram also promotes connections with new research areas (e.g., AI/ML, QIS) and institutions through workshops, collaborations, and workforce training programs.

Theory

The HEP theory activity supports world-leading research groups at research institutions and national laboratories, enabling them to address key HEP research areas. Laboratory groups focus on data-driven investigations and calculations of experimentally observable quantities. Research institutions focus on building models of physics beyond the Standard Model and studying their phenomenology and on mathematical theory (e.g., string theory, quantum field theory), aiming to develop a more complete understanding of the universe. Specific examples of AI/ML and QIS applications include:

- **Accelerated computations and data analysis:** Using AI/ML to speed up calculations and extract insights from datasets, identifying potential signatures of new physics.
- **Model building with AI/ML:** Employing AI/ML to explore models beyond the Standard Model and identify those consistent with data.
- **Quantum simulations:** Utilizing quantum computers to simulate complex quantum systems, including quantum field theories.
- **QIS-inspired theoretical techniques:** Developing non-perturbative techniques in field theory and quantum gravity using QIS to understand fundamental aspects of the universe.

Mission-Critical Talent Pathways

This activity expands participation in HEP through strategic talent pipelines and use-inspired research, including:

- **DOE Established Program to Stimulate Competitive Research (EPSCoR):** Strengthens research capacity in U.S. states and territories with limited federal research funding, thereby reaching communities and institutions with limited involvement in the HEP portfolio.
- **Science Accelerating Growth and Engagement (SAGE) Journey internships:** Attract undergraduate talent to DOE national laboratories, providing early-stage skill training through hands-on research experiences. This low-risk, high-reward program is designed to develop talent to fill mission-critical needs, offering a fast track to potential full-time positions upon degree completion.
- **Veteran Applied Laboratory Occupational Retraining (VALOR)**: Provides technical readiness and skill transition for veterans entering civilian careers. Through specialized training and career placement at FNAL, VALOR participants fill vital operational and mission-support roles within the lab infrastructure, ensuring facility reliability and safety.

High Energy Physics
Theoretical and Interdisciplinary Physics

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Theoretical and Interdisciplinary Physics	**$44,039**	**$21,792**	**-$22,247**
Research	$44,039	$21,792	-$22,247
Theory	*$40,964*	*$18,792*	*-$22,172*
Funding continues to support world-leading theoretical particle physics research.		The Request will continue to support world-leading theoretical particle physics research.	Research activity will strategically focus on the highest impact theoretical research groups. Research funding will prioritize efforts that leverage the innovative application of AI/ML and QIS to sustain momentum in the most promising areas of high energy physics.
Mission-Critical Talent Pathways	*$3,075*	*$3,000*	*-$75*
Funding continues to support HEP awards through EPSCoR, and internships through SAGE Journey and VALOR.		The Request will continue to support HEP awards through EPSCoR, and internships through SAGE Journey and VALOR.	Research funding will prioritize new HEP awards through EPSCoR.

Description

The Accelerator and Technology R&D subprogram supports the cutting-edge basic research necessary to develop 21st century tools of science. The subprogram supports R&D in a wide range of areas, including: the physics of particle beams, accelerator technology, particle and radiation detection, computational methods for HEP, QIS, the Genesis Mission, and microelectronics. It also funds world-leading scientific facilities at five DOE national laboratories. Technologies developed through this subprogram contribute to all six P5 science drivers, provide broad benefits for science and society, and provide advanced training to develop a highly skilled workforce in scientific and technical fields. This subprogram achieves its goals through targeted activities in General Accelerator R&D, Accelerator Stewardship, Accelerator Development, Detector R&D, Computational HEP, Genesis Mission, QIS, and Microelectronics.

General Accelerator R&D

The GARD activity supports the fundamental science research underpinning particle accelerators, colliders, storage rings, and charged particle beams to enable future HEP discoveries. GARD also funds curiosity-driven accelerator R&D and invests in Office of Science (SC) facilities to maintain U.S. leadership. Long-term goals include dramatically improving accelerator performance—optimizing beam energy, intensity, quality, and control—while reducing cost and size. This R&D enables upgrades to existing accelerator systems, develops future HEP facilities, and provides critical accelerator components for future colliders. GARD supports scientists and engineers at research institutions and DOE national laboratories across five key areas: accelerator and beam physics, advanced acceleration concepts, particle sources and targetry, radio-frequency (RF) acceleration technology, and superconducting magnets and materials. As a cross-SC effort involving all relevant SC national laboratories and U.S. universities, GARD guides research via community-commissioned roadmaps for its thrust areas[k]. GARD also supports the graduate Traineeship Program for Accelerator Science and Engineering; this activity revitalizes education, training, and innovation in accelerator physics, developing a highly skilled workforce that benefits HEP, other SC programs, and various DOE initiatives that utilize such technologies.

Accelerator Stewardship

This activity supports use-inspired accelerator technology R&D with a wide range of applications that make use of accelerators in discovery science, medicine, industry, security, and environmental science. The activity also facilitates private sector access to a network of thirteen unique state-of-the-art accelerator R&D facilities through BeamNetUS[l], which offer complementary capabilities for research in areas such as plasma physics, material science, and advanced beam technologies. Research activities support public-private collaboration in cross-cutting accelerator technologies encompassing a wide range of areas: superconducting accelerators, beam physics, new particle sources, advanced high-intensity laser technology, high-efficiency RF power sources, and AI/ML-based accelerator controls. R&D topics are identified by Basic Research Needs Workshops[m] and implemented in close alignment with Administration priorities.

Accelerator Development

This activity fosters partnerships between industry, academia, and DOE national laboratories. These collaborations address specific supply chain vulnerabilities for scientific facilities supported by the Office of Science. Strengthening domestic accelerator technology suppliers enhances their ability to produce advanced components and drive innovation, ultimately supporting the SC mission to conduct world-leading scientific

[k] Reports may be found at https://science.osti.gov/hep/Community-Resources/Reports
[l] https://www.beamnetus.org/
[m] Reports may be found at https://science.osti.gov/ardap/Resources

research. Focus areas include advanced superconducting wire and cable, superconducting RF cavities, novel materials, and high efficiency RF power sources for accelerators. Vulnerabilities addressed by the Accelerator Development program are identified by the SC programs on a tri-annual basis.

Detector R&D

This activity supports the development of the next generation instrumentation, particle detectors, and devices that function in extreme radiation and temperature environments. This is essential for maintaining U.S. scientific leadership as the field of HEP is expanding into new research areas by leveraging state-of-the-art technologies such as quantum sensors and advanced microelectronics, including real-time AI/ML in front-end electronics. This activity also supports the graduate Traineeship Program for HEP Instrumentation. This program aims to revitalize education, training, and innovation in the physics of particle detectors and next generation instrumentation.

Computational HEP

Advanced computing R&D enables HEP scientific discoveries inaccessible through experiments, observations, or traditional theoretical methods. This activity supports the multi-laboratory HEP Center for Computational Excellence (CCE), which propels HEP computing forward by developing common software tools, adapting HEP applications for the latest high-performance computing platforms (including exascale systems), and facilitating HEP's involvement in the Genesis Mission. Computational HEP also partners with the Office of Science's Advanced Scientific Computing Research (ASCR) program through Scientific Discovery through Advanced Computing (SciDAC), ensuring optimized HEP computing ecosystems for both immediate and long-term needs. This R&D includes high fidelity modeling and simulation, vital for developing and validating AI/ML methods and techniques, and funds a graduate Traineeship Program in Computational High Energy Physics, training scientists in critical skills like AI/ML and exascale software development.

Artificial Intelligence and Machine Learning

HEP AI/ML activities strategically support the Genesis Mission. Through partnerships, HEP develops and shapes the Platform's computing ecosystem to meet its data intensive and large user needs. This involves curating exabyte scale AI-ready data and developing transformational models and techniques that significantly enhance HEP research and drive new discoveries. HEP engages broadly in the Genesis Mission, from simulation and theoretical modeling to experiment design, real-time facility operations, and AI-ready infrastructure that couples world-leading computing and experimental facilities. This activity focuses on HEP's unique contributions and the integration of cutting-edge AI technologies for a clear AI advantage in the HEP mission.

Quantum Information Science

This activity supports QIS research and technology development that either extends the scientific reach of HEP or uses HEP techniques to improve our understanding of quantum systems. The HEP QIS research activities focus on topics in fundamental Quantum Theory, advancing Quantum Sensing and Computing for HEP applications, and deploying "pathfinder" experiments that demonstrate new capabilities and expand the discovery space for both HEP and QIS. The five National QIS Research Centers, jointly supported by multiple Office of Science programs, translate fundamental research into practical QIS applications and foster collaborations that support the overall Office of Science mission.

Microelectronics

This activity supports multi-disciplinary microelectronics technologies for sensing, communication, edge computing, and power, aiming for transformative advances in energy efficiency and resilience for HEP and broader Office of Science applications. HEP contributes to the cross-SC Microelectronics Science Research Centers (MSRCs), a network of multiple team awards that directly support research in energy efficiency for microelectronics or their operation in extreme radiation and temperature environments. These teams draw researchers from national laboratories, universities, and industry in which materials, chemistry, devices, systems, architectures, and algorithms and software are developed in tandem.

Facility Operations and Experimental Support

This activity supports the maintenance and operation of two Office of Science user facilities: FACET-II (a world-leading electron beam-driven plasma wakefield acceleration facility at SLAC National Accelerator Laboratory), and the Accelerator Test Facility (ATF) at Brookhaven National Laboratory. This activity also supports accelerator and detector test facilities at FNAL and Lawrence Berkeley National Laboratory. The activity also supports the BeamNetUS program, which provides limited user access to thirteen beam test facilities across the nation. AI/ML techniques are being integrated into these facilities to optimize beam performance, automate control systems, dynamically adjust resource deployment, and accelerate data analysis.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Accelerator & Technology R&D	**$304,544**	**$234,162**	**-$70,382**
Research	$242,247	$193,549	-$48,698
General Accelerator R&D	*$42,350*	*$13,069*	*-$29,281*
Funding maintains support for key expertise while sustaining essential aspects of accelerator R&D, including the Traineeship Program for Accelerator Science and Engineering.		The Request will maintain support for key expertise while sustaining essential aspects of accelerator R&D, including the Traineeship Program for Accelerator Science and Engineering, and collider R&D. Emphasis will be placed on collaborative efforts that drive discoveries within priority program areas.	Research funding will prioritize core R&D expertise and the Traineeship Program. Resources will focus on high-priority areas like high-field magnets and high-power targets, enabling strategic R&D for future accelerator technologies.
HEP Accelerator Stewardship	*$13,055*	*$7,816*	*-$5,239*
Funding maintains targeted support for key research activities, emphasizing advancements in superconducting magnets, beam physics, and data analytics-based accelerator controls across various research sectors.		The Request will maintain targeted support for key research activities, emphasizing advancements in superconducting accelerators, advanced laser technology, beam physics, and AI/ML-based accelerator controls.	Research funding will prioritize high-impact cross-cutting research in science, medicine, security, and industry, strengthening U.S. competitiveness. With projects rolling off, new R&D will target advancements in superconducting accelerators, advanced laser technology, beam physics, and AI/ML-based accelerator controls.
Accelerator Development	*$3,966*	*$2,867*	*-$1,099*
Funding continues to support efforts to work with and strengthen domestic suppliers for critical accelerator technologies and ongoing business sector studies to inform future collaborations and strategic insights.		The Request will support efforts to strengthen domestic suppliers for critical accelerator technologies.	Research funding will begin new partnerships as older partnerships conclude, ensuring a continuous and responsive approach to supply chain vulnerabilities.

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Detector R&D	*$11,075*	*$10,268*	*-$807*
Funding maintains support for key expertise while sustaining essential aspects of Detector R&D, including the Traineeship Program in HEP Instrumentation.		The Request will maintain support for key expertise while sustaining core aspects of Detector R&D, including the Traineeship Program in HEP Instrumentation. Emphasis will be placed on collaborative efforts that drive discoveries within priority program areas.	Research funding will strategically focus on advanced particle detector technology in key areas such as novel devices and new modalities for calorimetry, tracking, and fast timing.
Computational HEP	*$18,939*	*$8,994*	*-$9,945*
Funding maintains support for key expertise while sustaining essential aspects of Computational HEP, including the Traineeship Program in Computational HEP.		The Request will prioritize computationally advanced tools and methods that maximize HEP discovery science, while continuing support for critical expertise in advanced computing and the Traineeship Program in Computational HEP.	Research funding will prioritize essential R&D, strategically shifting focus towards implementation and adaptation of AI/ML tools necessary for advancing HEP discovery science.
Artificial Intelligence and Machine Learning	*$80,851*	*$80,160*	*-$691*
Funding supports key advances from the use of AI/ML, enabling the management and analysis of vast datasets, the optimization of complex detector and particle beam systems, and the acceleration of scientific discovery through identification of subtle patterns and anomalies.		The Request will expand the HEP role in the Genesis Mission and focus the HEP AI/ML activities around collaborations to develop AI-ready datasets and transformative AI models. This activity will continue to develop the critical expertise in AI/ML necessary to develop future cutting-edge HEP facilities and experiments.	Research funding will prioritize the growth of HEP AI/ML activities in the Genesis Mission. HEP will make further investments to expand the availability of AI-ready datasets, while continuing R&D that makes use of them, to realize an AI advantage for HEP's world leading endeavors.
Quantum Information Science	*$57,066*	*$59,919*	*+$2,853*
Funding supports interdisciplinary HEP QIS efforts through individual research grants and the National QIS Research Centers.		The Request will support interdisciplinary HEP QIS efforts through individual research grants and the National QIS Research Centers, including by expanding the HEP QIS portfolio to include new approaches in quantum sensing and computing with broad	Increased research funding will support a new effort in HEP QIS to provide annual funding opportunities to researchers to allow for quick responses to new developments and maintain an agile orientation to new research opportunities.

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
		potential impact both within HEP and in the National Quantum Initiative more broadly.	
Microelectronics	*$14,945*	*$10,456*	*-$4,489*
Funding continues supporting microelectronics development at multiple national laboratories and universities as well as support for the Microelectronics Science Research Center projects.		The Request will continue supporting microelectronics development at multiple national laboratories and universities as well as support for the Microelectronics Science Research Center projects.	Research funding will prioritize the highest-impact R&D efforts, focusing support on the national laboratories and the Microelectronics Science Research Centers.
Facility Operations and Experimental Support	$62,297	$40,613	-$21,684
Funding continues support for FACET-II at SLAC and ATF at BNL, key accelerator and detector test facilities at DOE national laboratories., and user access to nine test facilities through BeamNetUS.		The Request will continue support for FACET-II at SLAC and ATF at BNL, key accelerator and detector fabrication and test facilities at DOE national laboratories, and user access to thirteen beam test facilities through BeamNetUS. Emphasis will be placed on operations of facilities that drive discoveries within priority program areas.	Funding to support user activity at the network of test facilities will ramp down as others, including BeamNetUS, is strategically sustained and expanded, upholding world-leading support for HEP research.

High Energy Physics
Construction

Description

This subprogram supports line-item construction for the entire HEP program. All Total Estimated Costs (TEC) are funded in this subprogram, including engineering, design, and construction.

18-SC-42, Proton Improvement Plan II (PIP-II), FNAL

The PIP-II construction project is enhancing the Fermilab Accelerator Complex to enable higher-power proton beams for neutrino production, facilitating groundbreaking neutrino physics discoveries. Construction includes a new 800 MeV superconducting radio-frequency (SRF) proton linear accelerator and beam transfer line, along with modifications to the existing FNAL Booster, Recycler, and Main Injector synchrotrons. International, in-kind contributions will provide some components and the cryoplant. PIP-II received Critical Decision (CD)-3 approval on April 18, 2022, with a Total Project Cost (TPC) of $978,000,000. The CD-4 milestone date is 1Q FY 2033.

11-SC-40, Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment, FNAL

The LBNF/DUNE-US construction project is a federal, state, private, and international partnership focused on advancing particle accelerators and detector technologies to enable groundbreaking research into neutrinos, the universe's most abundant yet enigmatic particles. LBNF/DUNE will investigate how muon neutrinos transform as they travel 800 miles from FNAL, where they are produced in a high-energy proton beam, to a massive detector in South Dakota. By analyzing these rare, flavor-changing transformations, the experiment aims to unravel the fundamental properties of neutrinos and address the puzzling matter-antimatter imbalance in the universe.

The LBNF/DUNE-US project is a national flagship particle physics initiative, representing the first multi-billion-dollar international science facility hosted by the United States. LBNF/DUNE-US comprises two key collaborative efforts: LBNF, responsible for the neutrino beamline at FNAL and the neutrino detector infrastructure at the Sanford Underground Research Facility (SURF) in South Dakota; and DUNE, an international collaboration defining the experiment's scientific goals, technical requirements, detector design, construction, commissioning, and subsequent research.

The DOE High Energy Physics program manages both LBNF and DUNE as a single line-item construction project: LBNF/DUNE-US. Under the leadership of DOE and FNAL, and with participation from international partners including CERN, LBNF will construct a megawatt-class neutrino source ("Near Site") at FNAL and underground caverns with cryogenic facilities ("Far Site") in South Dakota to house the DUNE detectors. DUNE involves over 1,400 scientists and engineers from more than 200 institutions across 35+ countries, with the DOE funding approximately half of DUNE under the designation DUNE-US.

The LBNF/DUNE-US project received approval for CD-1RR (Update cost range, reaffirm the alternative selection, and approve a new tailoring strategy for baselining the project into five subprojects) on February 16, 2023, with a TPC Point Estimate of $3,277,000,000. The five subprojects are:

- Far Site Conventional Facilities – Excavation (FSCF-EXC)
- Far Site Conventional Facilities – Buildings and Site Infrastructure (FSCF-BSI)
- Far Detectors and Cryogenic Infrastructure (FDC)
- Near Site Conventional Facilities and Beamline (NSCF+B)
- Near Detector (ND)

The TPC Point Estimate will be refined as the project matures. When the last subproject is baselined, the LBNF/DUNE-US TPC will be the aggregate of all subproject TPCs plus any contingency being held by the parent LBNF/DUNE-US project.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Construction	**$374,000**	**$410,000**	**+$36,000**
18-SC-42, Proton Improvement Plan II (PIP-II), FNAL	$114,000	$105,000	-$9,000
Funding supports ongoing construction of the linac building and the fabrication and testing of production RF cavities, cryomodules, and related technical systems.		The Request will support completion of the Booster connection tunnel, continued cavity fabrication and cryomodule assembly, cryomodule installation, beamline installation, and the beginning of commissioning of the injector and warm front end.	The funding decrease is consistent with the baselined funding profile.
11-SC-40, Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment, FNAL	$260,000	$305,000	+$45,000
Funding supports ongoing construction of FSCF-BSI, begin installation of far detector components at FDC, and the design and prototyping activities for NSCF+B and ND.		The Request will support ongoing construction of FSCF-BSI, continue installation of far detector components and cryogenic infrastructure at FDC, and the design and reviews needed to transition into the execution phases of NSCF+B and ND.	Increased funding is critical to accelerate the construction and installation progress, enabling achievement of key FY 2027 project milestones. This ensures timely project completion and scientific payoff.

High Energy Physics
Capital Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Capital Operating Expenses						
Capital Equipment	N/A	N/A	58,924	49,225	47,612	-1,613
Minor Construction Activities						
General Plant Projects	N/A	N/A	5,000	13,500	6,000	-7,500
Accelerator Improvement Projects	N/A	N/A	–	–	9,000	+9,000
Total, Capital Operating Expenses	**N/A**	**N/A**	**63,924**	**62,725**	**62,612**	**-113**

High Energy Physics
Capital Equipment

	(dollars in thousands)					
	Total	**Prior Years**	**FY 2025 Enacted**	**FY 2026 Enacted**	**FY 2027 Request**	**FY 2027 Request vs FY 2026 Enacted**
Capital Equipment						
Major Items of Equipment						
Energy Frontier Experimental Physics						
High Luminosity Large Hadron Collider ATLAS Upgrade Project	183,485	146,985	16,200	15,300	5,000	-10,300
High Luminosity Large Hadron Collider CMS Upgrade Project	169,750	132,338	17,500	13,100	6,812	-6,288
Intensity Frontier Experimental Physics						
Accelerator Controls Operations Research Network	93,000	–	1,000	5,000	15,000	+10,000
Total, MIEs	446,235	279,323	34,700	33,400	26,812	-6,588
Total, Non-MIE Capital Equipment	N/A	N/A	24,224	15,825	20,800	+4,975
Total, Capital Equipment	**N/A**	**N/A**	**58,924**	**49,225**	**47,612**	**-1,613**

Note:
- *The Capital Equipment table includes MIEs with a Total Estimated Cost (TEC) > $10M.*

High Energy Physics
Minor Construction Activities

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
General Plant Projects (GPP)						
GPPs (greater than $5M and $34M or less)						
High Voltage Transformer Replacement 2027	6,000	–	–	–	6,000	+6,000
Total GPPs (greater than $5M and $34M or less)	6,000	N/A	–	–	6,000	+6,000
Total GPPs $5M or less	N/A	N/A	5,000	13,500	–	-13,500
Total, General Plant Projects (GPP)	**N/A**	**N/A**	**5,000**	**13,500**	**6,000**	**-7,500**
Accelerator Improvement Projects (AIP)						
Total AIPs $5M or less	N/A	N/A	–	–	9,000	+9,000
Total, Accelerator Improvement Projects (AIP)	**N/A**	**N/A**	**–**	**–**	**9,000**	**+9,000**
Total, Minor Construction Activities	**N/A**	**N/A**	**5,000**	**13,500**	**15,000**	**+1,500**

Note:
- *GPP activities $5M and less include design and construction for additions and/or improvements to land, buildings, replacements or addition to roads, and general area improvements. AIP activities $5M and less include minor construction at an existing accelerator facility.*

High Energy Physics
Major Items of Equipment Description(s)

Energy Frontier Experimental Physics MIEs:

High-Luminosity Large Hadron Collider ATLAS Detector Upgrade Project (HL-LHC ATLAS)

The HL-LHC ATLAS Detector Upgrade Project received CD-2/3 approval on January 31, 2023, with a TPC of $200,000,000. Compared to the data-taking period prior to the HL-LHC upgrades, the ATLAS detector will be capable of collecting at least ten times more data. To enable the ATLAS detector to operate for an additional decade under such intense conditions, its silicon pixel and strip tracker, muon, and calorimeter detectors, along with its trigger and data acquisition systems, are being upgraded.[n] The FY 2027 Request for TEC funding of $5,000,000 marks the final year of funding needed, directed towards finalizing fabrication activities of U.S.-built deliverables. As components are completed, they will be delivered to the international ATLAS experiment for installation and integration into the overall upgraded detector.

High-Luminosity Large Hadron Collider CMS Detector Upgrade Project (HL-LHC CMS)

The HL-LHC CMS Detector Upgrade Project received CD-2/3 approval on April 4, 2023, with a TPC of $200,000,000. Compared to the data-taking period prior to the HL-LHC upgrades, the CMS detector will be capable of collecting at least ten times more data. To enable the CMS detector to operate for an additional decade under such intense conditions, its silicon pixel tracker and outer tracker, muon, and calorimeter detectors, along with its trigger and data acquisition systems, are being upgraded; and a novel timing detector is being added.[o] The FY 2027 Request for TEC funding of $6,812,000 marks the final year of funding needed, directed towards finalizing fabrication activities of U.S.-built deliverables. As components are completed, they will be delivered to the international CMS experiment for installation and integration into the overall upgraded detector.

Intensity Frontier Experimental Physics MIE:

Accelerator Controls Operations Research Network (ACORN)

The ACORN project received CD-0 approval on August 28, 2020, with an estimated cost range of $100,000,000 to $142,000,000. In FY 2026, HEP delegated the ACORN project to lab management. This project will replace FNAL's outdated accelerator control system with a modern system compatible with PIP-II. This new system will be capable of utilizing advances in AI/ML to enable high-performance accelerator operations for the future. The control system of the Fermilab Accelerator Complex initiates particle beam production; controls beam energy and intensity; steers particle beams to their ultimate destination; measures beam parameters; and monitors beam transport through the complex to ensure safe, reliable, and effective operations. The FY 2027 Request for TEC funding of $15,000,000 will support system design, software development, and procurement of control system hardware.

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[n] The National Science Foundation (NSF) approved support for a Major Research Equipment and Facility Construction (MREFC) project in FY 2020 to provide different scope to the HL-LHC ATLAS and HL-LHC CMS detector upgrades. DOE and NSF are coordinating their contributions to avoid duplication.

[o] The ATLAS and CMS detectors share a similar technical configuration, but employ different types of tracker subsystems, calorimeters, muon detector subsystems, and triggers.

High Energy Physics
Minor Construction Description(s)

General Plant Projects $5 Million to less than $30 Million

High Voltage Transformer Replacement
General Plant Project Details

Project Name:	High Voltage Transformer Replacement 2027
Location/Site:	Fermilab Accelerator Complex
Type:	GPP
Total Estimated Cost:	$6,000,000
Construction Design:	$0
Project Description:	The 345kV on-site substations are beyond their end of life. The substations are a critical part of the infrastructure needed to run the accelerator complex. This project would replace a single 345kV transformer.

High Energy Physics
Construction Projects Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
18-SC-42, Proton Improvement Plan II (PIP-II), FNAL						
Total Estimated Cost (TEC)	891,200	505,000	125,000	114,000	105,000	-9,000
Other Project Cost (OPC)	86,800	73,594	-	-	6,000	+6,000
Total Project Cost (TPC)	**978,000**	**578,594**	**125,000**	**114,000**	**111,000**	**-3,000**
11-SC-40, Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment						
Total Estimated Cost (TEC)	3,169,955	1,406,781	251,000	260,000	305,000	+45,000
Other Project Cost (OPC)	107,045	105,625	-	-	-	-
Total Project Cost (TPC)	**3,277,000**	**1,512,406**	**251,000**	**260,000**	**305,000**	**+45,000**
Total, Construction						
Total Estimated Cost (TEC)	**4,061,155**	**1,911,781**	**376,000**	**374,000**	**410,000**	**+36,000**
Other Project Cost (OPC)	**193,845**	**179,219**	**-**	**-**	**6,000**	**+6,000**
Total Project Cost (TPC)	**4,255,000**	**2,091,000**	**376,000**	**374,000**	**416,000**	**+42,000**

High Energy Physics
Scientific User Facility Operations

The treatment of user facilities is distinguished between two types: TYPE A facilities that offer users resources dependent on a single, large-scale machine; TYPE B facilities that offer users a suite of resources that is not dependent on a single, large-scale machine.

(dollars in thousands)

	FY 2025 Enacted	FY 2025 Current	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Scientific User Facilities - Type A					
Fermilab Accelerator Complex	**181,500**	**170,222**	**166,500**	**174,089**	**+7,589**
Number of Users	1,020	2,213	2,213	2,213	–
Achieved Operating Hours	–	4,403	–	–	–
Planned Operating Hours	5,376	4,580	4,480	2,800	-1,680
Unscheduled Down Time Hours	–	295	–	–	–
Accelerator Test Facility	**–**	**–**	**4,347**	**6,393**	**+2,046**
Number of Users	–	–	22	101	+79
Planned Operating Hours	–	–	360	2,250	+1,890
Facility for Advanced Accelerator Experimental Tests II (FACET II)	**13,000**	**11,378**	**14,500**	**10,000**	**-4,500**
Number of Users	152	133	152	100	-52
Achieved Operating Hours	–	2,625	–	–	–
Planned Operating Hours	2,640	3,120	3,120	2,080	-1,040
Unscheduled Down Time Hours	–	1,128	–	–	–
Total, Facilities	**194,500**	**181,600**	**185,347**	**190,482**	**+5,135**
Number of Users	1,172	2,346	2,387	2,414	+27
Achieved Operating Hours	–	7,028	–	–	–
Planned Operating Hours	8,016	7,700	7,960	7,130	-830
Unscheduled Down Time Hours	–	1,423	–	–	–

Note:
- *Percent optimal operations defines what is achieved at this funding level. This includes staffing, up-to-date equipment and software, operations and maintenance, and appropriate investments to maintain world leadership.*
- *In FY 2025, funding, hours, and users for the Accelerator Test Facility were requested within the Accelerator R&D and Production program. For FY 2025 Current, $7,765,000, achieved 480 hours, 59 users, with 88 unscheduled downtime hours.*
- *In FY 2026, the Fermilab Accelerator Complex will be running the Booster Neutrino Beamline with the possibility of up to 16 weeks of Main Injector running if the critical substation transformer repairs are completed on schedule.*
- *In FY 2027, the Fermilab Accelerator Complex, for 20 weeks, will operate the Booster Neutrino Beam and commission Mu2e. The Main Injector will also run once transformer replacement is complete and as funding allows. Following this run, all efforts will shift to the extensive repairs and refurbishment required to prepare the Complex for LBNF/DUNE operations.*

High Energy Physics
Scientific Employment

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Number of Permanent Ph.Ds (FTEs)	722	676	465	-211
Number of Postdoctoral Associates (FTEs)	349	327	227	-100
Number of Graduate Students (FTEs)	489	448	332	-116
Number of Other Scientific Employment (FTEs)	1,477	1,432	1,485	+53
Total Scientific Employment (FTEs)	**3,037**	**2,883**	**2,509**	**-374**

Note:
- *Other Scientific Employment (FTEs) includes technicians, engineers, computer professionals, and other support staff.*

18-SC-42, Proton Improvement Plan II (PIP-II), FNAL
Fermi National Accelerator Laboratory, FNAL
Project is for Design and Construction

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

Summary

The FY 2027 Request for the Proton Improvement Project II (PIP-II) is $105,000,000 in Total Estimated Cost (TEC) funding, part of an approved Total Project Cost (TPC) of $978,000,000. PIP-II will enhance the Fermilab Accelerator Complex to deliver higher-power proton beams for groundbreaking discoveries in neutrino physics. The project involves designing and constructing an 800 megaelectronvolt (MeV) superconducting radio frequency (SRF) proton linear accelerator and beam transfer line. It also includes modifying existing FNAL Booster, Recycler, and Main Injector synchrotrons. downstream from the new linear accelerator to accept the increased beam intensity. International in-kind contributions will provide certain components and the cryo-plant.

Significant Changes

Initiated in FY 2018, PIP-II received Critical Decision (CD)-3 (Approve Construction) approval on April 18, 2022. CD-4 (Project Completion) is planned for 1Q FY 2033.

Anticipated international in-kind technical contributions total $330,000,000 (DOE equivalent costing). Legally binding agreements are in place with all partnering countries, except for the French Atomic Energy Commission (CEA), whose agreement is expected in 2026. Non-binding Project Planning Documents (PPDs) providing additional technical details have been signed with Italian, Polish, and UK partner institutions. The signed PPD with India's Department of Atomic Energy laboratories is expected in 2026.

Significant project cost contingency usage through 4Q FY 2025 addressed changes in international in-kind contributions, bringing cryogenic distribution systems (distribution valve box, tunnel transfer lines) and portions of the radiofrequency power system (some solid-state power amplifiers) into DOE scope.

The FY 2025 Enacted funding supported linac building civil construction, prototype development and testing of SRF cavities and cryomodules, and testing of initial production cryomodules from international partners.

The FY 2026 Enacted supports completion of linac building civil construction, fabrication and testing of production SRF cavities, cryomodules, and other technical systems, and initiation of Booster connection tunnel civil construction.

The FY 2027 Request will support completion of the Booster connection tunnel, continued SRF cavity fabrication and cryomodule assembly, cryomodule and beamline installation, and the start of injector and warm front-end commissioning. Other Project Costs (OPC) funding will resume to procure consumables for subsystem commissioning.

A Level III certified Federal Project Director has been assigned and approved this construction project datasheet.

Critical Milestone History

Fiscal Year	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
FY 2027	11/12/15	7/23/18	7/23/18	12/14/20	4/18/22	4/18/22	1Q FY 2033

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; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

Fiscal Year	Performance Baseline Validation	CD-3A
FY 2027	12/14/20	3/16/21

CD-3A – Approve long-lead procurement of niobium for superconducting radio frequency (SRF) cavities and other long lead components for SRF cryomodules

Project Cost History

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	135,895	755,305	891,200	86,800	86,800	978,000
FY 2027	135,895	755,305	891,200	86,800	86,800	978,000

2. Project Scope and Justification

Scope

Specific scope elements of the PIP-II project include construction of (a) the superconducting radio frequency (SRF) linac, (b) cryoplant to support SRF operation, (c) beam transfer line, (d) modifications to the Booster, Recycler and Main Injector synchrotrons, and (e) conventional facilities:

a) 800-MeV Superconducting H^- linac consisting of a 2.1 MeV warm (normal-conducting) front-end injector and five types of SRF cryomodules that are continuous wave capable but operating initially in pulsed mode. The cryomodules include Half Wave Resonator cavities (HWR) at 162.5 MHz, two types of Single Spoke Resonator cavities (SSR1 and SSR2) at 325 MHz, Low-Beta and High-Beta elliptical cavities at 650 MHz (LB-650 and HB-650). The warm front-end injector consists of an H^- ion source, Low Energy Beam Transport (LEBT), Radiofrequency Quadrupole (RFQ) and Medium Energy Beam Transport (MEBT) that prepare the beam for injection into the SRF cryomodules. The scope includes the associated electronic power sources, instrumentation, and controls to support linac operation.

   The PIP-II Injector Test Facility at FNAL is an R&D prototype for the low-energy proton injector at the front-end of the linac, consisting of H^- ion source, LEBT, RFQ, MEBT, HWR, and one SSR1 cryomodule. It was developed to reduce technical risks for the project, with participation and in-kind contributions from the India Department of Atomic Energy (DAE) Labs. The Test Facility has successfully completed its program and has been converted to a cryomodule test stand for testing the cryomodules for the project.

b) Cryoplant with storage and distribution system to support SRF linac operation. The cryoplant is an in-kind contribution by the India DAE Labs that is similar to the cryoplant being designed and constructed for a high-intensity superconducting proton accelerator project in India.[p]

c) Beam Transfer Line from the linac to the Booster Synchrotron, including accommodation of a beam dump and future delivery of beam to the FNAL Muon Campus.

d) Modification of the Booster, Recycler and Main Injector synchrotrons to accommodate a 50 percent increase in beam intensity and construction of a new injection area in the Booster to accommodate 800-megaelectronvolt (MeV) injection.

e) Civil construction of conventional facilities, including housings, service buildings, roads, access points and utilities with the special capabilities required for the linac and beam transport line. A portion of the civil construction scope comprises the ECF subproject. That subproject scope includes the cryogenics plant building and site work. The ECF subproject was initiated in FY 2020 with a total estimated cost of $36,000,000 and was completed January 16th, 2025 for a total costs of $29,168,000. The remaining subproject funds were redistributed to the PIP-II project contingency for remaining project risks.

Significant pieces of the linac and cryogenic scope (a and b above) will be delivered as in-kind international contributions not funded by DOE. These include assembly and/or fabrication of linac SRF components and the cryoplant. The rationale or motivation behind these contributions are institutional and/or industrial technical capability, and interest in SRF technology, as well as interest in LBNF/DUNE. The construction phase scope of in-kind contributions is divided between U.S. DOE national laboratories, India Department of Atomic Energy (DAE) Labs, Italy National Institute for Nuclear Physics (INFN) Labs, French Atomic Energy Commission (CEA) and National Center for Scientific Research (CNRS)-National Institute of Nuclear and Particle Physics (IN2P3) Labs, UK Science & Technology Facilities Council (STFC) Labs, and Wroclaw University of Science and Technology in Poland, tentatively as indicated in the following table of Scope Responsibilities for PIP-II.

Construction-phase Scope Responsibilities for PIP-II Linac RF Components

Components	Quan-tity	Freq. (MHz)	SRF Cavities	Responsibility for Cavity Fabrication	Responsibility for Module Assembly	Responsibility for RF Amplifiers	Cryogenic Cooling Source and Distribution System
RFQ	1	162.5	N/A	N/A	U.S. DOE (LBNL)	U.S. DOE (FNAL)	N/A
HWR Cryomodule	1	162.5	8	U.S. DOE (ANL)	U.S. DOE (ANL)	U.S. DOE (FNAL)	India DAE Labs, Poland WUST, U.S. DOE (FNAL)
SSR1 Cryomodule	2	325	16	U.S. DOE (FNAL), India DAE Labs	U.S. DOE (FNAL)	India DAE Labs	India DAE Labs, U.S. DOE (FNAL)
SSR2 Cryomodule	7	325	35	U.S. DOE (FNAL),	U.S. DOE (FNAL)	India DAE Labs,	India DAE Labs,

[p] See Section 8.

				France CNRS (IN2P3 Lab)		U.S. DOE (FNAL)	U.S. DOE (FNAL)
LB-650 Cryomodule	9	650	36	Italy INFN (LASA)	France CEA (Saclay Lab)	India DAE Labs, U.S. DOE (FNAL)	India DAE Labs, U.S. DOE (FNAL)
HB-650 Cryomodule	4	650	24	UK STFC Labs	UK STFC Labs, U.S. DOE (FNAL)	India DAE Labs, U.S. DOE (FNAL)	India DAE Labs, U.S. DOE (FNAL)

Justification

The PIP-II project will enhance the Fermilab Accelerator Complex by providing the capability to deliver higher-power proton beams to the neutrino-generating target that serves the LBNF/DUNE program for groundbreaking discovery in neutrino physics, a major field of fundamental research in high energy particle physics. Increasing the neutrino beam intensity requires increasing the proton beam power on target. PIP-II will raise the proton beam power from 800 kW to 1,200 kW over an energy range of 60-120 GeV and will enable the eventual increase to 2,400 kW with upgrades to the Booster accelerator. The PIP-II project will provide more flexibility for future science-driven upgrades to the entire accelerator complex and increase the system's overall reliability by addressing some of the accelerator complex's elements that are far beyond their design life.

PIP-II was identified as one of the highest priorities in the 10-year strategic plan for U.S. High Energy Physics developed by the High Energy Physics Program Prioritization Panel (P5) and unanimously approved by the High Energy Physics Advisory Panel (HEPAP), advising DOE and NSF, in 2014.[q]

The project is being conducted in accordance with the project management requirements in DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*.

Key Performance Parameters (KPPs)

The Threshold KPPs represent the minimum acceptable performance that the project must achieve. The Objective KPPs represent the desired project performance. Achievement of the Threshold KPPs will be a prerequisite for approval of CD-4, Project Completion.

Performance Measure	Threshold	Objective
Linac Beam Energy	H- beam will be accelerated to 600 MeV.	H- beam will be accelerated to 700 MeV. Linac systems required for 800 MeV will be installed and tested.
Linac Beam Intensity	H- beam will be delivered to the beam absorber at the end of the linac.	H- beam with intensity of 1.3 x 10^{12} particles per pulse at 20 Hz pulse-repetition rate will be delivered to the Beam Transfer Line absorber.

[q] "Building for Discovery: Strategic Plan for U.S. Particle Physics in the Global Context," HEPAP, 2014.

Performance Measure	Threshold	Objective
Booster, Recycler and Main Injector Synchrotron Upgrades	Upgrades of the Booster, Recycler and Main Injector Synchrotrons, required to support delivery of 1.2 MW onto the LBNF target, will be installed and tested without beam.	Linac beam will be injected into and circulated in the Booster.

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Estimated Cost (TEC)				
Design (TEC)				
Prior Years	135,895	135,895	135,895	—
Total, Design (TEC)	**135,895**	**135,895**	**135,895**	**—**
Construction (TEC)				
Prior Years	359,105	359,105	182,963	—
Prior Years - IRA Supp.	10,000	10,000	—	8,021
FY 2025	125,000	125,000	139,112	1,969
FY 2026	114,000	114,000	131,733	10
FY 2027	105,000	105,000	120,632	—
Outyears	42,200	42,200	170,865	—
Total, Construction (TEC)	**755,305**	**755,305**	**745,305**	**10,000**
Total Estimated Cost (TEC)				
Prior Years	495,000	495,000	318,858	—
Prior Years - IRA Supp.	10,000	10,000	—	8,021
FY 2025	125,000	125,000	139,112	1,969
FY 2026	114,000	114,000	131,733	10
FY 2027	105,000	105,000	120,632	—
Outyears	42,200	42,200	170,865	—
Total, Total Estimated Cost (TEC)	**891,200**	**891,200**	**881,200**	**10,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Other Project Cost (OPC)				
Prior Years	73,594	73,594	73,421	–
FY 2027	6,000	6,000	619	–

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Other Project Cost (OPC)				
Outyears	7,206	7,206	12,760	–
Total, Other Project Cost (OPC)	**86,800**	**86,800**	**86,800**	**–**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Project Cost (TPC)				
Prior Years	568,594	568,594	392,279	–
Prior Years - IRA Supp.	10,000	10,000	–	8,021
FY 2025	125,000	125,000	139,112	1,969
FY 2026	114,000	114,000	131,733	10
FY 2027	111,000	111,000	121,251	–
Outyears	49,406	49,406	183,625	–
Total, TPC	**978,000**	**978,000**	**968,000**	**10,000**

Note:
- *Prior Years reflect actual costs; remaining years are cost estimates.*

4. Details of Project Cost Estimate

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design	135,895	135,895	146,314
Design - Contingency	N/A	N/A	30,686
Total, Design (TEC)	**135,895**	**135,895**	**177,000**
Construction_No_Detail	186,000	182,000	124,009
Site Preparation	13,000	13,000	12,783
Equipment	493,918	455,305	378,705
Construction Contingency	62,387	105,000	198,703
Total, Construction (TEC)	**755,305**	**755,305**	**714,200**
Total, TEC	**891,200**	**891,200**	**891,200**
Contingency, TEC	*62,387*	*105,000*	*229,389*
Other Project Cost (OPC)			
R&D	67,117	67,117	67,117
Conceptual Planning	8,324	8,324	8,324
Conceptual Design	2,855	2,855	2,855

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
OPC - Contingency	8,504	8,504	8,504
Total, Except D&D (OPC)	**86,800**	**86,800**	**86,800**
Total, OPC	**86,800**	**86,800**	**86,800**
Contingency, OPC	*8,504*	*8,504*	*8,504*
Total, TPC	**978,000**	**978,000**	**978,000**
Total, Contingency (TEC+OPC)	***70,891***	***113,504***	***237,893***

5. Schedule of Appropriations Requests

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	505,000	125,000	114,000	—	147,200	891,200
	OPC	73,594	—	—	—	13,206	86,800
	TPC	578,594	125,000	114,000	—	160,406	978,000
FY 2027	TEC	505,000	125,000	114,000	105,000	42,200	891,200
	OPC	73,594	—	—	6,000	7,206	86,800
	TPC	578,594	125,000	114,000	111,000	49,406	978,000

6. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy	1Q FY 2033
Expected Useful Life	20 years
Expected Future Start of D&D of this capital asset	1Q FY 2053

FNAL will operate the PIP-II linac as an integral part of the entire Fermilab Accelerator Complex. Related funding estimates for operations, utilities, maintenance, and repairs are incremental to the balance of the FNAL accelerator complex for which the present cost of operation, utilities, maintenance, and repairs is approximately $100,000,000 annually.

Related Funding Requirements
(dollars in thousands)

	Annual Costs		Life Cycle Costs	
	Previous Total Estimate	**Current Total Estimate**	**Previous Total Estimate**	**Current Total Estimate**
Operations	4,000	4,000	80,000	80,000
Utilities	3,000	3,000	60,000	60,000
Maintenance and Repair	2,000	2,000	40,000	40,000
Total, Operations and Maintenance	9,000	9,000	180,000	180,000

7. D&D Information

The new area being constructed in this project is not replacing existing facilities.

	Square Feet
New area being constructed by this project at FNAL	127,676
Area of D&D in this project at FNAL	—
Area at FNAL to be transferred, sold, and/or D&D outside the project, including area previously "banked"	—
Area of D&D in this project at other sites	—
Area at other sites to be transferred, sold, and/or D&D outside the project, including area previously "banked"	127,676
Total area eliminated	—

The one-for-one replacement will be met through banked space. A waiver from the one-for-one requirement to eliminate excess space at FNAL to offset PIP-II and other projects was approved by DOE Headquarters on November 12, 2009. The waiver identified and transferred to FNAL 575,104 square feet of excess space to accommodate new facilities including Mu2e, LBNF, DUNE, and other facilities, planned or anticipated for future experiments, from space that was banked at other DOE facilities. The PIP-II Project is following all current DOE procedures for tracking and reporting space utilization.

8. Acquisition Approach

DOE is acquiring the PIP-II project through Fermi Forward Discovery Group (FFDG), the Management and Operating (M&O) contractor responsible for FNAL, rather than have the DOE compete a contract for fabrication to a third party. FFDG has a strong relationship with the high energy physics community and its leadership, including many FNAL scientists and engineers. This arrangement will facilitate close cooperation and coordination for PIP-II with an experienced team of project leaders managed by FFDG, which will have primary responsibility for oversight of all subcontracts required to execute the project. The arrangement is expected to include subcontracts for the purchase of components from third party vendors as well as delivery of in-kind contributions from non-DOE partners.

Project partners will deliver significant pieces of scope as in-kind international contributions, not funded by U.S. DOE. The rationale or motivation behind these contributions are institutional and/or industrial technical capability, long-standing collaborations in the physics programs at FNAL that PIP-II will support, and interest in SRF technology. Scientific institutions from several countries, tabulated below, are engaged in discussion of potential PIP-II scope contributions within the framework of international, government-to-government science and technology agreements.

Scientific Agencies and Institutions Discussing Contributions of Scope for PIP-II

Country	Funding Agency	Institutions
U.S.	Department of Energy	Fermi National Accelerator Laboratory; Lawrence Berkeley National Laboratory; Argonne National Laboratory
India	Department of Atomic Energy	Bhabha Atomic Research Centre, Mumbai; Inter University Accelerator Centre, New Delhi;

Scientific Agencies and Institutions Discussing Contributions of Scope for PIP-II

Country	Funding Agency	Institutions
		Raja Ramanna Centre for Advanced Technology, Indore; Variable Energy Cyclotron Centre, Kolkata
Italy	National Institute for Nuclear Physics	Laboratory for Accelerators and Applied Superconductivity, Milan
France	Atomic Energy Commission National Center for Scientific Research	Saclay Nuclear Research Center; National Institute of Nuclear & Particle Physics, Paris
UK	Science & Technology Facilities Council	Daresbury Laboratory
Poland	Wroclaw University of Science and Technology	Wroclaw University of Science and Technology

For example, joint participation by U.S. DOE and the India DAE in the development and construction of high intensity superconducting proton accelerator projects at FNAL and in India is codified in Annex I to the "Implementing Agreement between DOE and Indian Department of Atomic Energy in the Area of Accelerator and Particle Detector Research and Development for Discovery Science for High Intensity Proton Accelerators," signed in January 2015 by the U.S. Secretary of Energy and the India Chairman of DAE. FNAL and DAE Labs subsequently developed a "Joint R&D Document" outlining the specific roles and goals of the collaborators during the R&D phase of the PIP-II project. This R&D agreement is expected to lead to a similar agreement for the construction phase, describing roles and in-kind contributions. DOE and FNAL have signed similar agreements with Poland, Italy, France (CNRS and IN2P3), and UK for PIP-II. DOE is coordinating with France (CEA) to develop and sign a PIP-II cooperative agreement in FY 2026; the PPD is expected to be signed the year after.

SC in coordination with FNAL has put mechanisms into place to facilitate joint consultation between the partnering funding agencies, such that coordinated oversight and actions will ensure the success of the overall program. SC is successfully employing similar mechanisms for international partnering for the DOE LBNF/DUNE-US project and for DOE participation in LHC-related projects hosted by CERN.

Domestic engineering and construction subcontractors will perform the civil construction at FNAL. FNAL is utilizing a firm fixed-price contract for architectural-engineering services to complete all remaining designs for conventional facilities with an option for construction support. The general construction subcontract has been placed on a firm-fixed-price basis, and work has begun at the laboratory.

All subcontracts will be competitively bid and awarded based on best value to the government. Fermi Site Office provides contract oversight for FFDG's plans and performance. Project performance metrics for FFDG are typically included in the M&O contractor's annual performance evaluation and measurement plan.

11-SC-40, Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment, FNAL
Fermi National Accelerator Laboratory, FNAL
Project is for Design and Construction

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

Summary

The Deep Underground Neutrino Experiment (DUNE) is an international flagship experiment to unlock the mysteries of neutrinos. DUNE will be installed in the Long-Baseline Neutrino Facility (LBNF). DUNE scientists could potentially transform our understanding about the nature of matter and the evolution of the universe. Department of Energy's Fermilab serves as the host laboratory and "near site" for DUNE, in partnership with funding agencies and more than 1,400 scientists and engineers[r] globally. The Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment (LBNF/DUNE-US) is the line-item project that enables the facilities and technologies needed to operate the experiment.

The FY 2027 Request for Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment (LBNF/DUNE-US) project is $305,000,000 of Total Estimated Cost (TEC) funding.

To improve planning and management control, the LBNF/DUNE-US scope is organized into five subprojects. The CD-1 Reaffirmation (CD-1RR), approved on February 16, 2023, established the subproject strategy and a cost range of $3,160,000,000 to $3,677,000,000. At CD-1RR approval, the Total Project Cost (TPC) Point Estimate was $3,277,000,000. This estimate was for planning purposes and will be refined as the project matures and each subproject is baselined. The aggregate of the baselined subproject TPCs must remain below the upper end of the approved cost range. The final LBNF/DUNE-US TPC, once all subprojects are baselined, will be the sum of all subproject TPCs plus any contingency being held by the parent project. As the project matures, the distribution of Project Engineering and Design (PED) and construction funds is refined for accuracy. Additionally, earlier PED investments, such as prototyping, have reduced risks and costs for future execution phases.

The five subprojects are:
- Far Site Conventional Facilities – Excavation (FSCF-EXC)
- Far Site Conventional Facilities – Buildings and Site Infrastructure (FSCF-BSI)
- Far Detectors and Cryogenic Infrastructure (FDC)
- Near Site Conventional Facilities and Beamline (NSCF+B)
- Near Detector (ND)

Significant Changes

The FY 2025 funding supported construction of FSCF-BSI; continued long-lead procurements for FDC and NSCF+B subprojects; and advanced design and other planning efforts for NSCF+B and ND.

The FY 2026 funding will continue to support FSCF-BSI construction; complete the FSCF-EXC scope; continue long-lead procurements for FDC; initiate installation of far detector components at FDC; support design and prototyping activities for NSCF+B and ND; facilitate preparations for baselining Near Site subprojects; and assist with preparations to award construction subcontracts for the Near Site facilities.

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[r] https://lbnf-dune.fnal.gov/people/dune-collaboration/

The FY 2027 Request will continue FSCF-BSI construction; proceed with fabrication and assembly of FDC long-lead procurements; support installation of far detector components and cryogenic infrastructure at FDC; and facilitate design and reviews to transition into the execution phases of NSCF+B and ND.

A Federal Project Director with a certification level 4 is assigned to this project and has approved this CPDS.

Critical Milestone History

	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
LBNF/DUNE-Overall	1/8/10	11/5/15	11/5/15	4Q FY 2027	1Q FY 2027	4Q FY 2027	1Q FY 2035
Far Site Conventional Facilities-Excavation	–	–	–	8/19/22	12/31/20	8/19/22	1Q FY 2027
Far Site Conventional Facilities-Buildings and Site Infrastructure	–	–	–	3/25/23	11/20/20	3/25/23	4Q FY 2028
Far Detectors and Cryogenic Infrastructure	–	–	–	3Q FY 2026	2Q FY 2026	3Q FY 2026	2Q FY 2034
Near Site Conventional Facilities and Beamline	–	–	–	4Q FY 2027	1Q FY 2027	4Q FY 2027	2Q FY 2034
Near Detector	–	–	–	1Q FY 2027	1Q FY 2027	4Q FY 2027	1Q FY 2035

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; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

	Performance Baseline Validation	CD-1R	CD-1RR	CD-3A	CD-3B	CD-3C
LBNF/DUNE-Overall	4Q FY 2027	11/5/15	2/16/23	3/25/23	2/28/24	2/21/25
Far Site Conventional Facilities-Excavation	8/19/22	—	2/16/23	10/27/20	–	–
Far Site Conventional Facilities-Buildings and Site Infrastructure	3/25/23	—	2/16/23	–	–	–
Far Detectors and Cryogenic Infrastructure	3Q FY 2026	—	2/16/23	2/21/23	2/28/24	2/21/25
Near Site Conventional Facilities and Beamline	4Q FY 2027	—	2/16/23	3/25/23	–	–

	Performance Baseline Validation	CD-1R	CD-1RR	CD-3A	CD-3B	CD-3C
Near Detector	1Q FY 2027	—	2/16/23	–	–	–

CD-1R – Refresh of CD-1 approval for the new Conceptual Design.

CD-1RR – Update cost range, reaffirm the alternative selection, and approve a new tailoring strategy for baselining the project in multiple subprojects.
CD-3A – Approve initial construction and long lead procurements to mitigate risks and avoid delays. The CD-3a scope for the Far Site Conventional Facilities- Excavation Subproject was for initial construction activities, including systems to prepare for large-scale cavern excavation, excavation of ancillary spaces, and establishing underground ventilation paths. The CD-3A scope for the Far Detectors and Cryogenic Infrastructure subproject is long-lead procurement of certain components of the detector electronics, photon detectors, and the anode plane assemblies. The CD-3A scope for the Near Site Conventional Facilities and Beamline subproject is long-lead procurement of shielding and accelerator kicker components, early fabrication of magnetic horn components, and wetlands work that must be completed before the corresponding USACE permit expires.
CD-3B – Approve long lead procurements to mitigate risks and avoid delays. The CD-3B scope for the Far Detectors and Cryogenic Infrastructure subproject is long-lead procurement of certain components of cryogenic systems, detector systems, and infrastructure items to support the detectors.
CD-3C – Approve long lead procurements to mitigate risks and avoid delays. The proposed CD-3C scope for the Far Detectors and Cryogenic Infrastructure subproject is long-lead procurement of certain components of cryogenic systems, detector systems, and infrastructure items to support the detectors.

Project Cost History

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	705,838	2,464,117	3,169,955	107,045	107,045	3,277,000
FY 2027	715,838	2,454,117	3,169,955	107,045	107,045	3,277,000

Notes:
- *As some subprojects are Pre-CD-2, all estimates are preliminary. The approved TPC range for CD-1RR is $3,160,000,000 to $3,677,000,000.*
- *No construction, other than site preparation and approved long-lead procurement, will be performed prior to validation of the Performance Baseline and approval of CD-3 for each subproject.*

2. Project Scope and Justification

Scope

The LBNF/DUNE-US construction project is a federal, state, private, and international partnership developing and implementing particle accelerator and detector technologies, to enable world-leading research into the fundamental physics of neutrinos, which are the most ubiquitous and mysterious particles in the universe. Neutrinos are intimately involved in nuclear decay processes and high energy nuclear reactions. LBNF/DUNE will study the transformations of muon neutrinos into electron neutrinos. Muon neutrinos produced in a high-energy beam at FNAL undergo transformations as they travel 800 miles to large underground detectors in South Dakota. Analyzing these rare, in-flight neutrino transformations is expected to illuminate the fundamental physics of neutrinos and address the puzzling matter-antimatter asymmetry crucial for our matter-dominated universe.

LBNF/DUNE will comprise a neutrino beam, massive neutrino detectors and associated cryogenics infrastructure. The beamline will be generated through new construction and modifications to the existing Fermilab Accelerator Complex. This process involves the acceleration of a primary proton beam, its interaction with a target to produce a secondary particle beam, and the subsequent decay of these particles into neutrinos within a hundreds-of-meters decay tunnel. A smaller neutrino detector will be located at FNAL to monitor the neutrino beam near its source. The massive "far site" detectors and their associated cryogenics infrastructure will be housed in large underground caverns, 4850 feet below the surface, at the Sanford Underground Research Facility (SURF), located approximately 800 miles from the beam source. The Neutrinos at the Main Injector (NuMI) beam at FNAL is an existing example of this type of neutrino beam facility. The new LBNF beamline will, however, provide a neutrino beam of greater intensity than the NuMI beam, pointing to much larger far detector modules at a greater distance than utilized by NuMI experiments.

For the LBNF/DUNE-US project, FNAL is responsible for design, construction, and operation of the major components which enable the DUNE research program including: the primary proton beam, neutrino production target, focusing structures, decay pipe, absorbers and corresponding beam instrumentation; the conventional facilities and experiment infrastructure on the FNAL site required for the near detector; and the conventional facilities and experiment infrastructure at SURF for the large detectors including the cryostats and cryogenics systems. LBNF/DUNE-US provides detector components for the DUNE research program and supports the installation and integration of detector components provided by international partners.

<u>Justification</u>
As part of implementation of High Energy Physics Advisory Panel (HEPAP)-Particle Physics Project Prioritization Panel (P5) recommendations the LBNF/DUNE-US project comprises a national flagship particle physics initiative and consists of two multinational collaborative efforts:

- LBNF is responsible for delivering the beamline and other experimental and civil infrastructure at FNAL and at SURF in South Dakota. SURF, operated by the South Dakota Science and Technology Authority (SDSTA), an agency of the State of South Dakota, hosts experiments supported by DOE, NSF, and major research universities.

- DUNE is an international scientific collaboration responsible for defining the scientific goals and technical requirements for the beam and detectors, as well as the design, fabrication of detector components and subsequent research program. The U.S. contributes to DUNE along with other international funding agencies; hence DUNE-US is the project component of this overall effort. DOE and FNAL host the international DUNE research program.

DOE's High Energy Physics program manages the DOE contributions to both construction activities as a single, line-item construction project—LBNF/DUNE-US. LBNF, with DOE/FNAL leadership, and minority participation by international partners including CERN, will construct a megawatt-class neutrino source and related facilities at FNAL (the "Near Site"), as well as underground caverns and cryogenic facilities in South Dakota (the "Far Site") needed to house the DUNE detectors. DOE will fund approximately one half of the DUNE detectors, excluding the cryostats, which will be provided by CERN. The project continues to refine its design and cost estimates as the U.S. DOE contributions to the multinational effort become better understood. The cost estimate for DOE contributions will be updated as planning continues in preparation for baselining each subproject.

FNAL and DOE have confirmed contributions to LBNF documented in international agreements from CERN, the UK, and other international partners. For the DUNE detectors, the collaboration put in place a process to complete a technical design of the detectors and divide the work of building the detectors between the collaborating institutions. The review of the detector design with a complete set of funding responsibilities by the Long Baseline Neutrino Committee began in 2019, and development of the set of funding responsibilities continues to advance appropriately. Commitments for detector contributions and associated planning are being finalized in advance of each relevant subproject being baselined. SC will manage all DOE contributions to the facility and the detectors according to DOE Order 413.3B, and FNAL will provide unified project management reporting.

The project is being conducted in accordance with the project management requirements in DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*.

Key Performance Parameters (KPPs)
The KPPs are preliminary and will be finalized and approved with each subproject.
The Threshold KPPs represent the minimum acceptable performance that the project must achieve. The Objective KPPs represent the desired project performance. Achievement of the Threshold KPPs will be a prerequisite for approval of CD-4, Project Completion. KPPs for each subproject are finalized with the approval of relevant subproject CD-2.

Performance Measure	Threshold	Objective
Far Site Conventional Facilities – Excavation (FSCF-EXC)	1) Provide power capacity at the 4850L capable of supporting 10 MW demand. 2) Provide a ventilation route capable of exhausting 200,000 Cubic Feet per Minute though the spray chamber. 3) Complete the Ross Shaft brow enlargement and the excavation of all ancillary spaces and access drifts to create a minimum of 71,500 Gross Square Feet (GSF). 4) Complete the excavation of three caverns with the following volumes including all required ground support, shotcrete placement and networked geotechnical monitoring system: a. North cavern (102,000 Cubic Yards (CY)) b. South cavern (102,000 CY) c. Central utility cavern (46,800 CY) 5) Provide a minimum of 170,000 GSF of concrete floor.	All Threshold KPPs
Far Site Conventional Facilities – Buildings and Site	1) 1200A at 12.47kV power capacity installed in the CUC (sufficient to support four cryostats/detectors). 2) Power distribution at 120/240V, 480V, and 4160V installed at the 4850L to support two	Expanded power distribution and chilled water systems installed to support four cryostats/detectors. This adds 400 tons (1.4 MW) for a total of 2000 tons (7 MW) of chilled water capacity and

Performance Measure	Threshold	Objective
Infrastructure (FSCF-BSI)	detectors, along with all general use power installed at the 4850L and 4910L. 3) Heat rejection cooling tower installed with 2,000-ton (7 MW) rejection capacity (sufficient to support four detectors. 4) 1,600 tons (5.6 MW) chilled water capacity installed to support two detectors and all general cooling loads at the 4850L.	transformers/power distribution specific to detectors 3 and 4.
Far Detector – Horizontal Drift Detector Components (FDC)	Fabricate, deliver to SURF, and install the deliverables for the Horizontal Drift detector providing coverage for at least 95 percent of the detector volume. This includes: the Anode Plane Assemblies, High Voltage field cage structures and Cathode Planes; TPC electronics; components of the Photon Detector System; and purity monitors for one horizontal-drift Liquid Argon (LAr) TPC. Deliver and install the corresponding detector parts, DAQ servers and services outside the cryostat.	Fabricate, deliver to SURF, and install the deliverables for the Horizontal Drift Detector providing full (100 percent) coverage.
Far Detector – Vertical Drift Detector Components (FDC)	Fabricate, deliver to SURF, and install the deliverables for the Vertical Drift Detector providing coverage for at least 95 percent of the detector volume. This includes: the Charge Readout Planes for the bottom drift volume, High Voltage field cage structures; electronics for the readout of the bottom charge readout planes; components of the Photon Detector System; and purity monitors for one vertical-drift LAr TPC. Deliver and install the corresponding detector parts, DAQ servers and services outside the cryostat.	Fabricate, deliver to SURF, and install the deliverables for the Vertical Drift Detector providing full (100 percent) coverage.
Far Site Cryogenic Infrastructure (FDC)	1) Design, procure, install and commission the Nitrogen refrigeration system capable of providing 300 kW cooling capacity to the detector modules. 2) Install and commission surface receiving facilities for cryogenic liquids. 3) Install and commission the Argon purification, circulation, regeneration, and condenser system for two cryostat detectors.	In addition to the threshold KPPs: 1) Commit funds for the procurement of the remaining 70 percent of the LAr for the first FD module.

Performance Measure	Threshold	Objective
	4) Install and test internal cryogenics for Gaseous Argon/LAr distribution. 5) Provide operational readiness clearance for the operation of the cryogenic systems and for filling with LAr the first two cryostats. 6) Set up the contract with options to procure the necessary amount of LAr for each of the Far Detectors' (Horizontal and Vertical drift) LAr TPC modules, per FDC Requirements. 7) Commit funds for procuring 30 percent of the LAr for each of the two far detectors.	
Far Site Far Detector Integration (FDC)* *Note that the KPPs defined for Far Detector Horizontal and Vertical Detector Components and the Cryogenic Infrastructure are pre-requisites to the KPPs for the Far Detector Integration.	1) Prior to final cryostat closure, demonstrate continuous readout of the TPC electronics and the photon detector system at room temperature, via the data acquisition system, for one week. This demonstration must achieve a live time of at least 50 percent and a minimum of 95 percent fully functional electronic readout channels. 2) Close both cryostats in preparation for purging and filling. Purge and fill both cryostats to a minimum level (30 percent) and demonstrate LAr recirculation and purification.	1) Prior to the final closure of the two cryostats, demonstrate, at room temperature, continuous readout of the TPC electronics and of the photon detector system through the data acquisition system for one week with a live time of at least 90 percent and a minimum of 99 percent fully functional electronic readout channels. 2) Completely fill the first cryostat and demonstrate LAr recirculation and purification. 3) Establish an electrical field in the drift volume of at least 250 V/cm with a live time of at least 80 percent. 4) Demonstrate that all the channels can continue to be read out in each detector module after the cryostats are filled. Observe signals from cosmic ray tracks with the charge and light detection systems. Demonstrate coincidences between TPC and photon detector signals.

Performance Measure	Threshold	Objective
		5) Perform measurements of the electron lifetime in LAr using the purity monitors for each of the two cryostats.
Near Site Conventional Facilities and Beamline (NSCF+B)	1) Primary Beamline: • Conventional facilities and beamline constructed to be capable of 2.4MW operation • Beamline under vacuum with all magnets ramped on 120 GeV operations cycle 2) Neutrino Beamline: • Conventional facilities constructed to support 2.4MW proton beam • Target Hall to support a three-horn focusing system optimized for oscillation science • Decay Region minimum 635 ft in length • Shielding and absorbers constructed to support 2.4MW operation • Horns, target, radioactive water system, and beam windows fabricated for 1.2 MW proton beam • Operation of target pile, decay pipe, horn, and absorber cooling systems • Two-horn focusing system pulsed in situ to 240kA • Target cooling system flow demonstrated in situ • Target shield pile sealed to outside air 3) ND Complex: • Cavern space with minimum volume of 700,000 cubic ft • Power infrastructure has a capacity of 2,700kVA running load	1) Primary Beamline: • 120GeV protons delivered to the absorber with the target removed 2) Neutrino Beamline: • Three horns pulsed in situ to 300kA • Muons observed downstream of absorber 3) Near Detector Complex • All threshold KPPs

Performance Measure	Threshold	Objective
	• Cooling infrastructure includes a minimum of 650 tons of chiller capacity	
Near Detector	Hardware installed for a neutrino beam monitor capable of detecting a 1 percent shift in the horn current within a period of one week of nominal 1.2MW exposure, with performance verified by simulation.	1) All Threshold KPPs using parts and components provided by both the project and international partners (in-kind). 2) Deliver a LAr Time Projection Chamber (TPC) detector system capable of measuring neutrino interactions in argon at the near site, with performance like that specified for the Far Detector, to directly support long-baseline physics measurements in the DUNE FD. 3) Enable movement of the LAr TPC near detector system to an off-axis location. 4) Enable monitoring of the on-axis neutrino beam when the LAr TPC near detector system is off-axis position.

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Estimated Cost (TEC)				
Design (TEC)				
Prior Years	632,418	632,418	491,779	—
FY 2025	46,260	46,260	73,583	—
FY 2026	29,910	29,910	121,061	—
FY 2027	3,060	3,060	24,734	—
Outyears	4,190	4,190	4,681	—
Total, Design (TEC)	**715,838**	**715,838**	**715,838**	**—**
Construction (TEC)				

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Estimated Cost (TEC)				
Prior Years	649,363	649,363	492,514	—
Prior Years - IRA Supp.	125,000	125,000	—	19,902
FY 2025	204,740	204,740	89,715	83,553
FY 2026	230,090	230,090	376,564	21,545
FY 2027	301,940	301,940	152,817	—
Outyears	942,984	942,984	1,217,507	—
Total, Construction (TEC)	**2,454,117**	**2,454,117**	**2,329,117**	**125,000**
Total Estimated Cost (TEC)				
Prior Years	1,281,781	1,281,781	984,293	—
Prior Years - IRA Supp.	125,000	125,000	—	19,902
FY 2025	251,000	251,000	163,298	83,553
FY 2026	260,000	260,000	497,625	21,545
FY 2027	305,000	305,000	177,551	—
Outyears	947,174	947,174	1,222,188	—
Total, Total Estimated Cost (TEC)	**3,169,955**	**3,169,955**	**3,044,955**	**125,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Other Project Cost (OPC)				
Prior Years	105,625	105,625	94,479	–
FY 2025	–	–	362	–
FY 2026	–	–	7,017	–
FY 2027	–	–	1,350	–
Outyears	1,420	1,420	3,837	–
Total, Other Project Cost (OPC)	**107,045**	**107,045**	**107,045**	**–**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Project Cost (TPC)				
Prior Years	1,387,406	1,387,406	1,078,772	–
Prior Years - IRA Supp.	125,000	125,000	–	19,902
FY 2025	251,000	251,000	163,660	83,553

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Project Cost (TPC)				
FY 2026	260,000	260,000	504,642	21,545
FY 2027	305,000	305,000	178,901	–
Outyears	948,594	948,594	1,226,025	–
Total, TPC	**3,277,000**	**3,277,000**	**3,152,000**	**125,000**

Note:
- *Prior Years reflect actual costs; remaining years are cost estimates.*

4. Details of Project Cost Estimate

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design	701,246	691,246	**N/A**
Design - Contingency	14,592	14,592	**N/A**
Total, Design (TEC)	**715,838**	**705,838**	**N/A**
Construction_No_Detail	1,359,163	1,369,163	**N/A**
Equipment	594,984	594,984	**N/A**
Construction Contingency	499,970	499,970	**N/A**
Total, Construction (TEC)	**2,454,117**	**2,464,117**	**N/A**
Total, TEC	**3,169,955**	**3,169,955**	**N/A**
Contingency, TEC	*514,562*	*514,562*	***N/A***
Other Project Cost (OPC)			
R&D	16,000	16,000	**N/A**
Conceptual Planning	44,958	44,958	**N/A**
Conceptual Design	31,977	31,977	**N/A**
Other OPC Costs	11,220	11,220	**N/A**
OPC - Contingency	2,890	2,890	**N/A**
Total, Except D&D (OPC)	**107,045**	**107,045**	**N/A**
Total, OPC	**107,045**	**107,045**	**N/A**
Contingency, OPC	*2,890*	*2,890*	***N/A***
Total, TPC	**3,277,000**	**3,277,000**	**N/A**
Total, Contingency (TEC+OPC)	***517,452***	***517,452***	***N/A***

Notes:
- *Each subproject will have a validated baseline at the time of each subproject's CD-2 approval.*

- *Construction involves excavation of caverns at SURF, 4,850 ft. below the surface, for technical equipment including particle detectors and cryogenic systems and construction of the housing for the neutrino-production beam line and the near detector.*
- *Technical equipment in the DOE scope, estimated here, will be supplemented by in-kind contributions of additional technical equipment, for the accelerator beam and particle detectors, from non-DOE partners as described in Section 2.*
- *"Other OPC Costs" include execution support costs including electrical power for construction* and equipment installation.

5. Schedule of Appropriations Requests

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	1,406,781	251,000	251,000	—	1,261,174	3,169,955
	OPC	105,625	—	—	—	1,420	107,045
	TPC	1,512,406	251,000	251,000	—	1,262,594	3,277,000
FY 2027	TEC	1,406,781	251,000	260,000	305,000	947,174	3,169,955
	OPC	105,625	—	—	—	1,420	107,045
	TPC	1,512,406	251,000	260,000	305,000	948,594	3,277,000

Note:
- *All estimates are preliminary.*

6. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy	1Q FY 2035
Expected Useful Life	20 years
Expected Future Start of D&D of this capital asset	1Q FY 2055

Operations and maintenance funding of this experiment will be integrated into the existing Fermilab Accelerator Complex Users Facility. Annual related funding estimates include the incremental cost of 20 years of full operation, utilities, maintenance, and repairs with the accelerator beam on. The estimates also include operations and maintenance for the remote site of the large detector. New operations and maintenance estimates were developed in 2022 based on a new study and detailed estimating. Current estimate represents an average annual cost in FY 2022 dollars.

Related Funding Requirements
(dollars in thousands)

	Annual Costs		Life Cycle Costs	
	Previous Total Estimate	Current Total Estimate	Previous Total Estimate	Current Total Estimate
Operations	22,000	22,000	440,000	440,000
Utilities	6,000	6,000	120,000	120,000
Maintenance and Repair	14,000	14,000	280,000	280,000
Total, Operations and Maintenance	42,000	42,000	840,000	840,000

7. D&D Information

The new area constructed in this project replaces existing facilities.

	Square Feet
New area being constructed by this project at FNAL	79,100
New area being constructed by this project at Sanford Underground Research Facility (SURF)	185,700
Area of D&D in this project at FNAL	—
Area at FNAL to be transferred, sold, and/or D&D outside the project, including area previously "banked"	79,100
Area of D&D in this project at other sites	—
Area at other sites to be transferred, sold, and/or D&D outside the project, including area previously "banked"	185,700
Total area eliminated	—

The new facility square footage estimates are based on the current design and updating the calculation to be consistent with DOE's real estate guidance. New facilities information will be identified and reported in accordance with DOE guidance.

8. Acquisition Approach

The Acquisition Strategy, approved as part of CD-1-RR, documents the acquisition approach. DOE is acquiring design, construction, fabrication, and operation of LBNF through the Fermi Forward Discovery Group, LLC (FFDG), the M&O contractor responsible for FNAL. FFDG and FNAL, through the LBNF Project based at FNAL, are responsible to DOE to manage and complete construction of LBNF at both the near and remote site locations. FFDG and FNAL are assigned oversight and management responsibility for execution of the international DUNE research program, to include management of the DOE contributions to DUNE. Key reasons for this approach include:

- FNAL is the site of the only existing neutrino beam facility in the U.S. and, in addition to these facilities, provides a source of existing staff and expertise to be utilized for beamline and detector construction.
- FNAL can best ensure that effective and efficient coordination of LBNF and DUNE component design, construction, and installation with other FNAL research activities.
- FNAL possesses a DOE-approved procurement system with established processes and acquisition personnel necessary to acquire the components and services for the scientific hardware, equipment, conventional facilities, accelerator beamline, and detectors for LBNF and DUNE.
- FNAL has established a close working relationship with SURF and the SDSTA, the organization that manages and operates the remote site for the far detector in Lead, South Dakota.
- FNAL has extensive experience in managing complex construction, fabrication, and installation projects, both domestic (on-site and remote off-site) and international. This includes its deep involvement with multi-institutional collaborations, such as LHC and CMS projects at CERN, and the increasingly international neutrino experiments and program.

Given its federal, state, private, and international partnership structure, the LBNF/DUNE-US project's acquisition approach is designed to effectively integrate contributions from all partners. Leading the

LBNF/DUNE-US Project, FNAL will collaborate and work with many institutions, including other DOE national laboratories (e.g. BNL, LBNL and SLAC), dozens of universities, foreign research institutions, and the SDSTA. FNAL will be responsible for overall project management, Near Site conventional facilities, and the beamline. FNAL will work with SDSTA to complete the conventional facilities construction at the SURF needed to house and outfit the DUNE far detector. With the DUNE collaboration, FNAL is also responsible for technical and resource coordination to support the DUNE far and near detector design and construction. DOE will provide in-kind contributions for DUNE detector systems, as agreed upon with the international DUNE collaboration.

International participation in the design, construction, and operation of LBNF and DUNE is essential. This is due to the inherently international nature of High Energy Physics, the global distribution of necessary talent and expertise, and DOE's lack of sufficient procurement or technical resources to perform all required construction and fabrication work. Contributions from other nations will be predominantly through the delivery of components built in their own countries by their own researchers. DOE negotiates agreements in cooperation with the Department of State on a bilateral basis with all contributing nations to specify their expected contributions and the working relationships during the construction and operation of the experiment.

DOE provides funding for the LBNF/DUNE-US Project directly to FNAL and collaborating DOE national laboratories via approved financial plans, and under management control of the LBNF/DUNE-US Project Office at FNAL, which will also manage and control DOE funding to the combination of university subcontracts and direct vendor procurements that are anticipated for the design, fabrication, and installation of LBNF and DUNE technical components. All actions will be performed in accordance with DOE approved procurement policies and procedures.

FNAL staff, or temporary staff working directly with FNAL personnel via subcontract, will perform much of the neutrino beamline component design, fabrication, assembly, and installation. The acquisition approach includes both new procurements based on existing designs, and re-purposed equipment from the Fermilab Accelerator Complex. For highly specialized components, FNAL will engage the Rutherford Appleton Laboratory (RAL) in the United Kingdom to design and fabricate them. RAL is a long-standing FNAL collaborator with proven experience in such components.

FNAL has adopted the Construction Manager/General Contractor (CM/GC) model for LBNF conventional facilities at the SURF Far Site. The Laboratory contracted with an architect/engineer (A/E) firm for design and a CM/GC subcontractor to manage the construction of these facilities. FNAL selected this strategy to reduce risk, enhance quality and safety performance, foster a more collaborative approach to construction, and enable reduced cost and shortened construction schedules through CM/GC options for self-performance or competitively bid subcontract award packages. FNAL determined that excavation scope should be openly competed as provided by the subcontract. An excavation subcontract was awarded within budget, and underground excavation was completed in FY 2024.

For the LBNF Near Site conventional facilities at FNAL, the laboratory will subcontract with an A/E firm for design and plans to utilize a traditional design-bid-build construction method, supported by additional procurements for preconstruction and construction phase services from a professional construction management firm.

The DOE and SDSTA entered a land lease for the LBNF Far Site conventional facilities on May 20, 2016, covering the area on which the DOE-funded facilities housing and supporting the LBNF and DUNE detector will be built. The lease and related realty actions provide the framework for DOE and FNAL to construct federally-funded buildings and facilities on non-federal land, and to establish a long-term (multi-decade) arrangement for DOE and FNAL to use SDSTA space to host the DUNE experiment. Modifications and improvements to the SDSTA infrastructure that directly support the LBNF/DUNE-US project are costed to the project. A cooperative agreement between HEP and SDSTA covers the costs of general facility operations, including repairs and improvements for the overall SURF site. Protections for DOE's real property interests in these infrastructure investments are acquired through the lease with SDSTA, contracts, and other agreements (e.g., easements). such as easements. DOE plans for FNAL to have responsibility for managing and operating the LBNF and DUNE far detector and facilities for a useful lifetime of 20 years and may contract with SDSTA for certain day-to-day management and maintenance services. At the end of useful life, federal regulations permit transfer of ownership to SDSTA, which is willing to accept ownership as a condition for the lease. FNAL developed an appropriate decommissioning before lease signing.

Nuclear Physics

Overview

The Nuclear Physics (NP) program supports the Administration's highest priorities to maintain U.S. leadership in nuclear science and advance artificial intelligence (AI) and quantum information science (QIS). NP delivers high-value national laboratory and university research to support the future technical workforce for the nation; operates world-unique, accelerator-based user facilities; and expands world-class research infrastructure through construction of innovative scientific instruments. NP accelerates research output through AI and quantum computing, develops novel instrumentation based on QIS, and applies new microelectronics technologies in unique experimental environments. The Genesis Mission and realization of American Science Cloud (AmSC) will profoundly impact the analysis of large, complex data sets that have in the past taken decades to decode, accelerating the understanding of matter that benefits energy, commerce, nuclear medicine, and national security.

NP's mission is to explore the nature of matter: understanding how protons and neutrons are formed from elementary particles and how they interact to form elements, observed properties, and phenomena. Addressing this mission requires a broad range of experimental capabilities and theoretical approaches. Best-in-class accelerators at scientific user facilities are used to collide particles at nearly the speed of light, producing short-lived forms of nuclear matter for experimental investigation. Theoretical advances use leadership computing facilities to explore the interactions of quarks and gluons and model complex nuclear processes. Program outcomes benefit energy, commerce, nuclear medicine, and national security.

Highlights of the FY 2027 Request

The NP FY 2027 Request for $791.4 million, a decrease of $74.7 million below the FY 2026 Enacted, balances support for priorities in forefront nuclear physics research, including AI, QIS, facility operations, and construction.

<u>Research</u>

NP is the primary steward of the nation's nuclear physics research portfolio, providing approximately 95 percent of the U.S. investment in this field. The program maintains U.S. leadership by:

- Characterizing the quark-gluon plasma using AI-ready data from the Relativistic Heavy Ion Collider (RHIC) and the Large Hadron Collider (LHC); exploring the fundamental structure of nucleons at the sub-femtometer scale at the Continuous Electron Beam Accelerator Facility (CEBAF) to lay the foundation for Day 1 science at the future Electron-Ion Collider (EIC); and probing the limits of nuclear existence, heavy element isotope production, and nuclear astrophysics phenomena at the Facility for Rare Isotope Beams (FRIB) and the Argonne Tandem Linac Accelerator System (ATLAS).
- Discovering if the neutrino is its own anti-particle via the search for neutrino-less double beta decay (NLDBD).
- Advancing nuclear theory methods for quantum chromodynamics (QCD) and interpretation of experimental data.
- Curating reliable, accurate Nuclear Data for basic nuclear research and nuclear technologies, including fusion.
- Advancing AI tools and application of AmSC to significantly increase nuclear data analysis efficiency and precision, improve the quality of accelerator operations, and enhance the efficiency of experimental planning.
- Applying key nuclear science expertise for innovation in qubit research and quantum theory, for QIS technologies for future sensors, and for the pursuit of ultraprecise nuclear clocks.

Facility Operations

Funding supports activities for the safe, robust operations of the NP scientific user facilities, enabling world-class science:

- CEBAF operates 3,300 hours for the highest priority 12 GeV experiments.
- ATLAS operates 5,950 hours for compelling research in nuclear structure and astrophysics.
- FRIB operates 4,000 hours discovering and characterizing nuclei at the extremes of the nuclear chart.
- RHIC collider operations ended in FY 2026. Funding will support recovery and reuse activities and operation of the RHIC hadron injector complex for beam studies, isotope production, and to remain mission ready for the EIC.

Projects

The Request includes continued support for design and early construction for the EIC, the highest priority for facility construction in the Long Range Plan for Nuclear Physics to maintain U.S. leadership in nuclear physics and accelerator technology. No new funding is requested for two ongoing MIEs, the LEGEND-1000 ton scale NLDBD experiment and the High Rigidity Spectrometer at FRIB. These projects will make progress using prior year balances.

Nuclear Physics
Funding

	(dollars in thousands)			
	FY 2025 Enacted	**FY 2026 Enacted**	**FY 2027 Request**	**FY 2027 Request vs FY 2026 Enacted**
Nuclear Physics				
Medium Energy, Research	51,455	46,932	31,410	-15,522
Medium Energy, Operations	146,242	155,000	156,613	+1,613
Total, Medium Energy Physics	**197,697**	**201,932**	**188,023**	**-13,909**
Heavy Ion, Research	47,454	46,312	33,662	-12,650
Heavy Ion, Operations	187,000	182,805	140,000	-42,805
Heavy Ion, Projects	2,850	2,850	–	-2,850
Total, Heavy Ion Physics	**237,304**	**231,967**	**173,662**	**-58,305**
Low Energy, Research	76,967	61,592	45,755	-15,837
Low Energy, Operations	134,646	143,597	147,005	+3,408
Low Energy, Projects	5,259	17,000	–	-17,000
Total, Low Energy Physics	**216,872**	**222,189**	**192,760**	**-29,429**
Theory, Research	63,727	55,053	36,989	-18,064
Total, Nuclear Theory	**63,727**	**55,053**	**36,989**	**-18,064**
Subtotal, Nuclear Physics	**715,600**	**711,141**	**591,434**	**-119,707**
Construction				
20-SC-52 Electron Ion Collider (EIC), BNL	110,000	155,000	200,000	+45,000
Subtotal, Construction	**110,000**	**155,000**	**200,000**	**+45,000**
Total, Nuclear Physics	**825,600**	**866,141**	**791,434**	**-74,707**

Nuclear Physics
Explanation of Major Changes

	(dollars in thousands)
	FY 2027 Request vs FY 2026 Enacted
Medium Energy Physics The Request will support CEBAF accelerator complex operations for 3,300 hours. The Request will support the highest priority research, including participation in the SC initiatives for QIS, AI, and microelectronics.	**-13,909**
Heavy Ion Physics The Request will support RHIC hadron injector complex operation for beam studies and to remain mission ready for future EIC operations. Funding will support the highest priority research in heavy ion nuclear physics at universities and national laboratories, including support for QIS and AI. The Request also will support Established Program to Stimulate Competitive Research (EPSCoR), including early career awards in EPSCoR jurisdictions.	**-58,305**
Low Energy Physics The Request will support operations of two low energy user facilities: the ATLAS facility, which operates for 5,950 hours, and FRIB, which will provide beam time for 4,000 hours. The Request will sustain operations of the 88-Inch Cyclotron for a limited in-house nuclear science program focused on the search for element 120 and as an electronics irradiation capability. Funding will support the highest priority nuclear structure and nuclear astrophysics at universities and national laboratories.	**-29,429**
Nuclear Theory Funding will support the highest priority theory research efforts at national laboratories and universities, the U.S. Nuclear Data Program, specialized Lattice QCD computing hardware at Thomas Jefferson National Accelerator Facility (TJNAF), and participation in the Scientific Discovery through Advanced Computing (SciDAC) program. The Request will support initiatives in AI and QIS.	**-18,064**
Construction The Request will provide funding for the EIC to continue Project Engineering and Design activities and execute long-lead procurements and early construction.	**+45,000**
Total, Nuclear Physics	**-74,707**

Basic and Applied R&D Coordination

The NP mission supports the pursuit of unique opportunities for R&D integration and coordination with other DOE Program Offices, Federal agencies, and non-Federal entities, including coordination across DOE on AI; across SC and with other agencies on QIS; coordination of neutrino research and international partnerships in accelerator research and development with HEP; on forefront computing resources and technical expertise through the SciDAC projects and Lattice QCD research (ASCR and HEP); cross-section and decay data coordination through the U.S. Nuclear Data Program (National Nuclear Security Administration [NNSA], Nuclear Energy [NE], Advanced Research Projects Agency-Energy [ARPA-E], Defense Threat Reduction Agency [DTRA], Department of Homeland Security [DHS], Nuclear Regulatory Commission [NRC], National Science Foundation [NSF], National Institutes of Health [NIH], National Aeronautics and Space Administration [NASA], and DOE ASCR, BES, FES, IPR, and HEP); capabilities and techniques to test electronics for radiation sensitivity (NASA and DOD); accelerator research and enhancing U.S.-based supply chains for critical accelerator technologies (HEP); and research in developing neutron, gamma, and particle beam sources with applications in cargo screening (NNSA and DHS).

Program Accomplishments

Reconstructing Nuclear Collisions to Uncover Uranium's Shape

Nuclear physicists at Brookhaven National Laboratory demonstrated a new way to reveal the shapes of atomic nuclei, using the flow patterns of particles emerging from high-energy collisions of nuclei. Nuclear shapes determine which atoms can fission, decay in exotic processes, and dominate the mechanics of astrophysical processes. High energy nuclear collisions initiated with the Relativistic Heavy Ion Collider melt the protons and neutrons of nuclei to free their inner building blocks, quarks and gluons. The resulting quark-gluon plasma depends on the shape of the high-energy nuclear collisions. Using results from the STAR detector, researchers compared the flow and momentum of particles emerging from collisions with hydrodynamic expansion models to reveal uranium's oblong shape, consistent with other methods, but also new details, including differences in the relative lengths of uranium's three principal axes. The findings suggest that these nuclei are more complex than previously thought, and that the new method can provide deeper insight into other nuclei.

Final Majorana Demonstrator Results to Describe Neutrinoless Double-Beta Decay

The Majorana Demonstrator concluded data collection, performing the most sensitive neutrinoless double-beta decay search to date, benefiting from its operation in vacuum, excellent energy resolution, and low backgrounds. Neutrinoless double-beta decay, an ultra-rare nuclear process, can help explain why matter dominates the universe. Interpreting this result is subject to uncertainties from nuclear theory computations. Efforts led by Oak Ridge National Laboratory and Los Alamos National Laboratory put bounds on theory by measuring the closely related process of two-neutrino double-beta decay to excited states. The experiment set a half-life limit of $T_{1/2} > 8.3 \times 10^{25}$ y, corresponding to a range of limits on the effective neutrino mass of $m_{\beta\beta} <$ (113-269) meV. This work helps maintain U.S. scientific leadership in search for physics beyond the Standard Model.

Unleashing AI for More Powerful Particle Accelerators

Three of the nation's most powerful particle accelerators rely on superconducting radiofrequency (SRF) accelerator technology: the Continuous Electron Beam Accelerator Facility (CEBAF) at the Thomas Jefferson Accelerator Facility, the Spallation Neutron Source at Oak Ridge National Laboratory, and the Linac Coherent Light Source at the SLAC National Accelerator Laboratory. Studies used AI models of SRF accelerator operations, tested using real operations data from CEBAF in real- time and in recorded data mode. The AI models proved capable of identifying operational anomalies in real- time, predicting anomalies before operations are impacted, lowering levels of radiation, and load-balancing components.

Nuclear Physics
Medium Energy Physics

Description

The Medium Energy Physics subprogram focuses on experimental tests of the theory of the strong interaction, known as Quantum Chromodynamics (QCD). The Request advances AI, QIS, and microelectronics tools that directly impact the speed and efficiency of QCD research.

Medium energy scientists aim to address specific questions including: How does QCD generate the spectrum and structure of conventional and exotic hadrons? How do the mass and spin of the nucleon emerge from the quarks and gluons inside and their dynamics? How are the pressure and shear forces distributed inside the nucleon? How does the quark–gluon structure of the nucleon change when bound in a nucleus? How are hadrons formed from quarks and gluons produced in high-energy collisions?

The research activity supports high priority research at universities and national laboratories and carries out high priority experiments primarily at CEBAF, Thomas Jefferson National Accelerator Facility (JLab). Scientists use various experimental approaches to determine the distribution of up, down, and strange quarks, their antiquarks, and gluons within protons and neutrons, as well as clarifying the role of gluons in confining the quarks and antiquarks within hadrons. Experiments that scatter electrons off protons, neutrons, and nuclei are used to elucidate the effects of the quark and gluon spins within nucleons, and the effect of the nuclear medium on the quarks and gluons. The subprogram also supports experimental searches for higher-mass "excited states" and exotic hadrons predicted by QCD, as well as studies of their various production mechanisms and decay properties.

CEBAF operations provide high quality beams of polarized electrons that allow scientists to extract information on the quark and gluon structure of protons and neutrons from measurements of how the electrons scatter when they collide with nuclei. CEBAF also uses highly-polarized electrons to make challenging precision measurements that may reveal processes that violate a fundamental symmetry of nature, called parity, in order to search for physics beyond what is currently described by the Standard Model of particle physics. These capabilities are unique in the world. Universities and national laboratories conduct complementary, focused experiments that require different capabilities.

A high scientific priority for this community is addressing an outstanding grand challenge question of modern physics: how the fundamental properties of the proton such as its mass and spin are dynamically generated by the extraordinarily strong color fields resulting from dense systems of gluons in nucleons and nuclei. In the future, the Electron-Ion Collider (EIC) will address this science. Scientists and accelerator physicists from the Medium Energy subprogram are strongly engaged and play significant leadership roles in the development of the scientific agenda and implementation of the EIC.

Transformative accelerator research and development (R&D) efforts advance approaches in superconducting radiofrequency (SRF) technology and accelerator science aimed at improving the operations of existing facilities and developing next-generation facilities for nuclear physics. Nuclear physicists participate in activities related to QIS and quantum computing (QC), in coordination with other SC research programs. NP-specific efforts include R&D on quantum sensors to enable precision measurements, development of quantum sensors based on atomic-nuclear interactions, and development of quantum computing algorithms applied to quantum mechanical systems and NP topical problems. Scientists leverage AI-ready data sets and AmSC to increase nuclear science research output and enhance accelerator facility operations. Scientists participate in the SC initiative on microelectronics R&D, emphasizing unique microelectronics that survive in cryogenic and high radiation environments.

The Request also continues support for honoraria for awards, including the Enrico Fermi Awards and the Ernest Orlando Lawrence Awards.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Medium Energy Physics	**$201,932**	**$188,023**	**-$13,909**
Research	$46,932	$31,410	-$15,522
Funding continues to support high priority experiments; develop, implement, and maintain scientific instrumentation; analyze data and publish experimental results; and train students in nuclear and accelerator science. Funding supports continued analysis of RHIC polarized proton beam data to investigate the origin of proton spin and supports the development of the EIC scientific program. Funding continues transformative accelerator science to improve operations of current and future NP facilities including applications of AI/ML. Research on microelectronics and quantum sensors to enable precision measurements will continue.		The Request will continue to support high priority experiments; develop, implement, and maintain scientific instrumentation; analyze data and publish experimental results; and train students in nuclear and accelerator science. The Request will continue accelerator science research and development to benefit accelerator performance, including applications of AI. Research on microelectronics and quantum sensors to enable precision measurements will continue.	The Request will focus investment on the highest priority research that utilizes CEBAF, RHIC data, and other facilities. Funding increases for AI approaches in the analysis of QCD data sets utilizing AmSC.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Operations $155,000	$156,613	+$1,613
Funding for operations of the CEBAF facility supports high priority experiments in 12 GeV science, providing 3,300 operational hours for research, beam development, and beam studies. Funding supports mission readiness of the CEBAF accelerator including all power and consumables, activities to reduce helium consumption and improve accelerator performance and reliability, high priority capital equipment, accelerator improvement, and key computing capabilities. Funding supports required staff for operations and participation in accelerator and SRF R&D. Lab GPP continues to advance the most urgent components of the campus strategy for infrastructure.	The Request for operations of the CEBAF facility will support high priority experiments in 12 GeV science, providing 3,300 operational hours for research, beam development, and beam studies. The Request will support mission readiness of the CEBAF including high priority capital equipment, accelerator improvement, and key computing capabilities. Lab GPP will support campus strategy infrastructure needs.	The Request will maintain operations hours while continuing support of the highest priority experiments and activities to improve CEBAF reliability and performance.

Description

The Heavy Ion Physics subprogram focuses on studies of nuclear matter at extremely high densities and temperatures, leveraging discovery opportunities in sensing, simulation, and computing with QIS and QC. This subprogram supports curation of data sets from colliders worldwide for AmSC and the development of AI models that bridge experiments with theory and shorten the time to science outcomes from complex experiments.

Heavy ion physicists strive to answer overarching questions in nuclear physics, including: How do the fundamental interactions between quarks and gluons lead to the perfect fluid behavior of the quark-gluon plasma (QGP)? What are the limits on the fluid behavior of matter? What are the properties of quantum chromodynamic (QCD) matter? What is the correct phase diagram of nuclear matter?

Scientists used the Relativistic Heavy Ion Collider (RHIC) to pioneer the study of condensed quark-gluon matter at the extreme temperatures, characteristic of the infant universe. With careful measurements, nuclear physicists have accumulated data using the Solenoid Tracker at RHIC (STAR) detector and the super Pioneering High Energy Nuclear Interaction eXperiment (sPHENIX) detector to gain insights into the processes early in the creation of the universe, and how protons, neutrons, and other parts of normal matter developed from that plasma. Analyses of these data are critical to understanding the physical characteristics of the QGP and discovering whether a critical point exists demonstrating a first order phase transition between normal nuclear matter and the QGP.

Collaboration at the Large Hadron Collider (LHC) at CERN provides U.S. researchers the opportunity to investigate states of matter under substantially different initial conditions than those provided by RHIC. Data collected by A Large Ion Collider Experiment (ALICE), the Compact Muon Solenoid (CMS), and ATLAS detectors confirm that the QGP discovered at RHIC is also seen at the higher energy, and comparisons of results from LHC to those from RHIC have led to important new insights.

Understanding how the fundamental properties of the proton such as its mass and spin are dynamically generated is a U.S. nuclear science community high scientific priority. The answer to this question is key to addressing an outstanding grand challenge problem of modern physics: how QCD—the theory of the strong force that explains all strongly interacting matter in terms of quarks interacting via the exchange of gluons—acts in detail to generate the “macroscopic” properties of protons and neutrons. The NSAC Long Range Plan identified the EIC as the highest priority for facility construction and recommended its expeditious completion. BNL and JLab are partners in design and construction of the EIC at BNL, incorporating AI broadly in its early stages to enable new analysis techniques and ensure efficient operation of the facility. Scientists and accelerator physicists from this sub-program play significant leadership roles in the development of the scientific agenda and implementation of the EIC.

Over the course of the construction and implementation of the EIC, RHIC operations funding will decrease as scientific staff, engineers and technicians move from RHIC operations to the EIC project. RHIC accelerator scientists have critical core competencies in collider operations that cannot easily be replaced; their support is embedded in the EIC total project cost. Throughout the EIC project, the temporary reprioritization of funds from the collider facility operations budget to the construction budget will effectively offset funds needed to implement the EIC, enabling a cost-effective path forward to the implementation of this world-leading facility.

The RHIC collider operations ended in FY 2026. The RHIC hadron injector complex operations will continue for beam studies to maintain readiness for EIC operations; maintain symbiotic, parallel, cost-effective operations of the Brookhaven Linac Isotope Producer Facility (BLIP) supported by the DOE Isotope Program to produce research and commercial isotopes critically needed by the Nation; and support the NASA Space Radiation Laboratory Program for the study of space radiation effects applicable to human space flight and mission electronics.

EPSCoR will focus on development of capacity and infrastructure for NP research in EPSCoR jurisdictions.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Heavy Ion Physics	**$231,967**	**$173,662**	**-$58,305**
Research	$46,312	$33,662	-$12,650
Funding continues to support heavy ion research at universities and national laboratories for high priority experiments; to develop, implement, and maintain scientific instrumentation; to analyze data and publish experimental results; to contribute to the future EIC science program; and to train students in nuclear and accelerator science. Support continues for participation and instrumentation upgrades for international experiments (ALICE, CMS, and ATLAS LHC). Funding continues transformative accelerator science for current and future NP facilities, including applications of AI/ML. Research continues for QIS and EPSCoR grants and early career awards.		The Request will support heavy ion research at universities and national laboratories for high priority experiments; the development, implementation, and maintenance of scientific instrumentation; analysis of data and publication of experimental results; contributions to the future EIC science program; and the training of students in nuclear and accelerator science. Support will continue for participation and instrumentation upgrades for international experiments. The Request will continue accelerator science research and development, including applications of AI. Research will continue for QIS, EPSCoR grants, and early career awards.	Funding will focus on the highest priority heavy ion and QIS research and curating AI-ready collider data for AmSC to hasten research outcomes.
Operations	$182,805	$140,000	-$42,805
Funding supports RHIC operations at 1,500 hours to complete the science program with sPHENIX and support the RHIC injector complex including high priority facility and instrumentation capital equipment, high priority accelerator improvement projects, and computing capabilities for analysis.		The Request will support RHIC hadron injector complex operations for beam studies and the recovery and reuse of RHIC infrastructure for EIC. Funding will support high priority facility capital equipment to maintain mission readiness, as will continued investments in computing infrastructure.	RHIC operations will transition to focus on ensuring the RHIC hadron injector complex is ready to support future EIC operations. Funding will be reprioritized to support EIC.

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Projects	$2,850	$ —	-$2,850
EIC OPC funds support the research and development that mitigates technical risk for design of accelerator and detector subsystems.		EIC OPC funds are no longer requested with the completion of research and development activities associated with the EIC accelerator and detector.	Research and development activities for the EIC project will be completed as planned.

Description

The Nuclear Theory subprogram includes activities in nuclear theory, computation, and nuclear data. The Request provides growing support for the application of AmSC to accelerate nuclear science by incorporating next generation AI models at the nexus of experiment, simulation, and theory that cross multiple energy scales. Nuclear theorists are active in QIS and QC, supporting developments topical to NP and other SC programs.

The nuclear theory activity simultaneously addresses fundamental questions on the physics of the very small (protons, neutrons, and fundamental particles) and the physics of the very large (nuclear reactions in the sun, neutron stars). Nuclear theory is inherently multidisciplinary as its fundamental questions are directly connected to other areas of science. Theoretical nuclear physics is invested in the development of new QIS tools to describe 99 percent of the visible matter in the universe and the underlying mechanism that holds together quarks and gluons within the nucleus of atoms. Major themes include extreme states of matter in the known universe displaying the largest temperatures and energy per volume; origins of the elements in the cosmos; and the role of the neutrino in the evolution of the early universe. This activity has a pioneering footprint in the interpretation of data obtained from experimental nuclear science, development of new high-performance supercomputers, novel AI architectures, and new numerical algorithms with applications to other areas of science and industry of direct benefit to U.S. national security and technology superiority. Collaborations within the university and national laboratory communities are also supported under this activity to address highest priority topics in nuclear theory that merit concentrated, team-based theoretical efforts.

This subprogram leverages lattice QCD computational tools that are critical for understanding and interpreting data from RHIC, LHC, and CEBAF. NP supports lattice QCD computing with investment in dedicated computational resources. The activity supports SciDAC, a collaborative program with ASCR that partners NP scientists and computer experts to address major scientific challenges that require capabilities of supercomputer facilities.

The nuclear data activity maintains the U.S. Nuclear Data Program (USNDP), targets high-priority nuclear data needs of relevance to the NP mission, and leads an interagency working group including the NNSA, NE, FES, DOE IP, and other federal agencies to coordinate targeted experimental efforts. The USNDP provides current, accurate, and authoritative data to basic and applied areas of nuclear science and engineering, maintaining public access to extensive nuclear physics databases of national and international importance and supporting approximately five million nuclear data retrievals annually. Research addresses gaps in nuclear data through targeted experiments and development/use of theoretical models. The National Nuclear Data Center (NNDC) at BNL manages the USNDP. The NNDC is designated as an SC Public Reusable Research (PuRe) Data Resource, a designation commensurate with high standards of data management, resource operation, and scientific impact.

Nuclear theorists conduct R&D on quantum sensors to enable precision measurements and develop quantum sensors based on atomic-nuclear interactions. They also perform R&D on nuclear physics techniques to enhance qubit coherence times and develop quantum computing algorithms applied to quantum mechanical systems and NP topical problems. In partnership with other SC programs, NP continues its role in jointly stewarding National QIS Research Centers that focus on building the fundamental tools and science base necessary for the U.S. leadership in QIS.

Nuclear Physics
Nuclear Theory

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Nuclear Theory	**$55,053**	**$36,989**	**-$18,064**
Research	$55,053	$36,989	-$18,064
Funding supports high priority theoretical research at universities and national laboratories. Theorists continue to focus on applying QCD to nucleon structure and hadron spectroscopy, the force between nucleons, and the structure of light nuclei. Advanced dynamic calculations to describe relativistic nuclear collisions and nuclear structure and reactions continue. Funding supports the fifth year of SciDAC grants, the fourth year of theory topical collaborations, and high priority QIS efforts. Target investments continue development of cutting-edge AI/ML techniques of relevance to nuclear science research.		The Request will support high priority theoretical research at universities and national laboratories for the interpretation of experimental results and exploration of new ideas and hypotheses that identify potential areas for future experimental investigation. The Request will support the first year of new SciDAC grants, the fifth year of theory topical collaborations, and high priority QIS efforts. Funding supports investments to pre-train and fine tune domain specific AI models relevant to nuclear science research.	Investments will focus on the highest priority research in nuclear theory, with expanded support for AI and leveraging AmSC to accelerate nuclear theory outcomes.
Funding continues USNDP efforts to collect, evaluate, and disseminate nuclear physics data for basic nuclear research and for applied nuclear technologies.		The Request will maintain USNDP efforts to collect, evaluate, and disseminate nuclear physics data to meet the needs for basic nuclear research and priority applications in government, academia, and industry.	USNDP will target areas most impactful to nuclear science and interagency partners.

Nuclear Physics
Low Energy Physics

Description

The Low Energy Physics subprogram includes activities in nuclear structure and nuclear astrophysics and fundamental symmetries. Scientists leverage AmSC and tailored AI models to boost nuclear science discovery timelines and enhance the performance of accelerator facility operations and associated scientific instruments. QIS R&D includes quantum sensors to enable precision measurements, development of quantum sensors based on atomic-nuclear interactions, and development of quantum computing algorithms applied to quantum mechanical systems and NP topical problems.

Questions associated with nuclear structure include: What is the nature of the nuclear force that binds protons and neutrons into stable nuclei and rare isotopes? What are the limits of nuclear existence? What is the nature of neutron stars? How does matter behave at the most extreme densities in the universe? Relevant nuclear astrophysics questions are: What are the origins of the elements in the cosmos? What are the nuclear reactions that drive stars and stellar explosions? NP research activities address these questions primarily using beams of stable and rare isotopes to develop a comprehensive description of nuclei and reveal new nuclear phenomena.

The ATLAS facility at the Argonne National Laboratory (ANL) is an SC scientific user facility and the world's premiere facility for stable beams, providing high-quality beams of all stable elements up to uranium and selected short-lived nuclei beams using the Neutron-generator Upgrade to the Californium Rare Ion Breeder Upgrade (nuCARIBU) ion source. Increasing ATLAS capabilities via a Multi-User Upgrade are underway to address user demand. FRIB at Michigan State University (MSU), an SC scientific user facility since FY 2020, provides beams of rare isotopes to test the limits of nuclear existence and advance understanding of the atomic nucleus and the evolution of the cosmos. FRIB's scientific reach will be enhanced with the implementation of the Gamma-Ray Tracking Array (GRETA) and the High Rigidity Spectrometer (HRS). This activity supports operations of the LBNL 88-Inch Cyclotron for an in-house program studying the properties of newly discovered elements as well as conducting searches for new super-heavy elements. NASA and industry exploit capabilities at the 88-Inch Cyclotron to develop radiation-resistant electronics for their missions. In addition, smaller university-based accelerator facilities are supported through this activity to address specific research areas.

Questions related to fundamental symmetries of nature addressed in low energy nuclear physics experiments include: What is the origin of the matter–antimatter imbalance in the universe? Are neutrinos their own antiparticles, and how do they acquire mass? Are there more forces than the four we know about? Are there undiscovered, light, weakly-interacting particles? Low energy experiments uniquely addresses aspects of these questions through precision studies using neutron and electron beams and decays of nuclei, including beta decay, double-beta decay, and the search for neutrino-less double beta decay (NLDBD). NP is the steward of neutrino mass measurements and the search for NLDBD. NP has funded neutrino experiments, playing critical roles in partnerships with NSF and in successful international experiments that include U.S. scientific leadership. This activity supports experiments probing electric dipole moments of atoms that would provide evidence for the violation of time reversal invariance and shed light on the matter/anti-matter imbalance in the universe.

The NSAC LRP recommended as the highest priority for new experiment construction that the U.S. lead an international consortium to undertake a NLDBD campaign. The observation of NLDBD would have profound consequences for understanding the physical universe. NP, including this activity, has invested in R&D on candidate technologies for next–generation ton-scale NLDBD experiments. In the near-term, within the NLDBD program, NP will focus on implementing the Large Enriched Germanium Experiment for Neutrinoless Double Beta Decay one ton (LEGEND-1000) project, in collaboration with international partners. LEGEND-1000 will deploy germanium-76 isotope incorporated into an array of solid-state detectors to reach a NLDBD lifetime limit of 10^{28} years within a planned ten-year measurement window, with rare event identification enhanced by AI. The High Rigidity Spectrometer research project and Ton Scale Neutrinoless Double Beta Decay major item of equipment will continue progress using prior year funds.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Low Energy Physics	**$222,189**	**$192,760**	**-$29,429**
Research	$61,592	$45,755	-$15,837
Funding supports high priority university and laboratory nuclear structure and nuclear astrophysics efforts. Scientists are participating in the characterization of recently discovered elements and search for new ones. Scientists utilize AI/ML that can promote automated platforms to improve machine performance and reliability and advance detector design and data processing. High priority research in NLDBD and fundamental symmetries continues with a strategic mix of efforts.		The Request will continue support of high priority university and laboratory nuclear structure and nuclear astrophysics efforts including the search for new isotopes and elements. Scientists will prepare AI-ready datasets to promote automated platforms for improved machine performance and data processing. High priority research in fundamental symmetries will continue.	Investment will focus on the highest priority research, including experiments at ATLAS and FRIB, and precision studies with neutron and electron beams. Funding will expand AI efforts and utilize AmSC for discovery science.
Operations	$143,597	$147,005	+$3,408
ATLAS operates for 5,950 hours and FRIB operates for 4,000 hours. Funding supports operations, staff, maintenance, as well as the implementation of new detector and accelerator capabilities at both facilities. Funding sustains operations of the 88-Inch Cyclotron with focus on newly-discovered heavy elements.		ATLAS will operate for 5,950 hours and FRIB will operate for 4,000 hours. The Request will fund operations, staff, maintenance, as well as the implementation of upgraded capabilities at both facilities. The Request will sustain operations of the 88-Inch Cyclotron with a continued focus on newly-discovered heavy elements.	The Request will maintain operating hours while continuing support for the highest priority experiments at FRIB, ATLAS, and the 88-Inch Cyclotron.

Description

This subprogram supports line-item construction for NP, including engineering, design, and construction. Other project costs (OPCs) are funded in the relevant subprograms.

<u>20-SC-52, Electron Ion Collider EIC, BNL</u>

The FY 2027 Request of $200,000,000 will continue the construction effort for the EIC, which will be located at BNL. The estimated TPC range for the EIC project at CD-1, Approve Alternative Selection and Cost Range, is $1.7 billion to $2.8 billion. BNL has teamed with TJNAF to lead the development and implementation of the EIC. The EIC scope includes an electron injector, rapid cycling synchrotron, an electron storage ring, modifications to one of the two RHIC ion rings, one interaction region with a detector, support buildings, and other infrastructure. AI will contribute to all phases of the EIC, from design to future operations, where optimization of such a large-scale experiment is a complex problem characterized by multiple parameters. Application of the hardware and models developed under the Genesis Mission to EIC construction will provide insight on hidden correlations among the design parameters and will identify optimal tradeoff solutions in a multidimensional space of the objectives. The project has attracted international collaboration and contributions. The State of New York has approved $100 million for the construction of buildings to house equipment and technical infrastructure supporting the EIC accelerator and detector.

The EIC project will increasingly rely on RHIC scientists, engineers, and technicians as RHIC activities ramp down. This workforce has critical core competencies in collider operations essential to RHIC now and eventually to EIC operations. They cannot easily be replaced. The temporary reprioritization of funds from the collider facility operations budget to the construction budget will enable a cost-effective path forward to the implementation of this world-leading facility.

The EIC will maintain U.S. leadership in nuclear physics and accelerator technology. AI-ready data sets generated by EIC and processed on AmSC will accelerate the pace in addressing the outstanding question on how the fundamental properties of the proton, such as its mass and spin, are dynamically generated by the extraordinarily strong color fields resulting from dense systems of gluons in nucleons and nuclei, which has been a high priority for the U.S. nuclear science community for decades. The answer to this question is key to addressing a grand challenge problem of modern physics: how quantum chromodynamics—the theory of the strong force, which explains all strongly interacting matter in terms of quarks interacting via the exchange of gluons—acts to generate the "macroscopic" properties of protons and neutrons. The NSAC LRP recommends "…the expeditious completion of the EIC as the highest priority for facility construction."

A National Academies study, charged to independently assess the impact, uniqueness, and merit of the science that would be enabled by U.S. construction of an electron-ion collider, gave a strong endorsement to a U.S.-based EIC, and recognized its critical role in maintaining U.S. leadership in nuclear science and accelerator R&D. Scientists and accelerator physicists from both the Medium Energy and Heavy Ion subprograms are actively engaged in the development of the scientific agenda, design of the facility, and development of scientific instrumentation for the proposed EIC scope. Critical Decision-0 (CD-0), Approve Mission Need, was received on December 19, 2019, followed by CD-1, Approve Alternative Selection and Cost Range, on June 29, 2021, and CD-3A, Approve Long Lead Procurements, on March 28, 2024.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Construction	**$155,000**	**$200,000**	**$45,000**
20-SC-52 Electron Ion Collider (EIC), BNL	$155,000	$200,000	$45,000
Funding continues to advance engineering and design and initiate construction. RHIC operations includes a “reprioritization” of expert workforce from the RHIC facilities operations budget to support the EIC OPC and TEC request.		The Request will continue to advance engineering and design and initiate construction with the completion of RHIC collider operations. Expert workforce from RHIC collider operations will be reprioritized to support the EIC request.	Funding will continue to support engineering and design efforts and early construction activities following the end of operations of the RHIC collider.

Nuclear Physics
Capital Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Capital Operating Expenses						
Capital Equipment	N/A	N/A	14,861	29,048	12,048	-17,000
Minor Construction Activities						
General Plant Projects	N/A	N/A	1,642	1,642	1,642	–
Accelerator Improvement Projects	N/A	N/A	2,675	5,211	35,211	+30,000
Total, Capital Operating Expenses	**N/A**	**N/A**	**19,178**	**35,901**	**48,901**	**+13,000**

Capital Equipment

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Capital Equipment						
Major Items of Equipment						
Low Energy Physics						
High Rigidity Spectrometer	137,241	45,080	3,259	15,000	–	-15,000
Ton-Scale Neutrinoless Double Beta Decay (NLDBD) MIE	412,660	10,800	2,000	2,000	–	-2,000
Total, MIEs	549,901	55,880	5,259	17,000	–	-17,000
Total, Non-MIE Capital Equipment	N/A	N/A	9,602	12,048	12,048	–
Total, Capital Equipment	**N/A**	**N/A**	**14,861**	**29,048**	**12,048**	**-17,000**

Notes:
- *The Capital Equipment table includes MIEs with a Total Estimated Cost (TEC) > $10M.*
- *The High Rigidity Spectrometer (HRS) is not an MIE, but a research project supported on a cooperative agreement with Michigan State University.*
- *The current estimated TEC for the NLDBD MIE is $410,660,000. With the focus of this MIE on the LEGEND-1000 project and a planned CD-1 review in FY 2026, revisions to the TEC are likely. In FY 2025 the $2,000,000 designated for TEC was redirected to OPC funding.*

Minor Construction Activities

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
General Plant Projects (GPP)						
Total GPPs $5M or less	N/A	N/A	1,642	1,642	1,642	–
Total, General Plant Projects (GPP)	**N/A**	**N/A**	**1,642**	**1,642**	**1,642**	**–**
Accelerator Improvement Projects (AIP)						
AIPs (greater than $5M and $34M or less)						
BNL-Cryo-Upgrade AIP	30,000	–	–	–	30,000	+30,000
Total AIPs (greater than $5M and $34M or less)	30,000	N/A	–	–	30,000	+30,000
Total AIPs $5M or less	N/A	N/A	2,675	5,211	5,211	–
Total, Accelerator Improvement Projects (AIP)	**N/A**	**N/A**	**2,675**	**5,211**	**35,211**	**+30,000**
Total, Minor Construction Activities	**N/A**	**N/A**	**4,317**	**6,853**	**36,853**	**+30,000**

Notes:

- *GPP activities $5M and less include design and construction for additions and/or improvements to land, buildings, replacements or addition to roads, and general area improvements. AIP activities $5M and less include minor construction at an existing accelerator facility.*

Nuclear Physics
Major Items of Equipment Description(s)

Low Energy Physics:

High Rigidity Spectrometer (HRS) Research Project
The HRS will enhance the scientific impact of the FRIB fast beam science program by providing luminosity gain factors up to one hundred for neutron-rich isotopes, with the largest gains for the most neutron-rich species. The HRS will allow experiments with beams of rare isotopes at the maximum production rates for fragmentation or in-flight fission. The NSAC LRP recognized that the HRS will push the study of unstable nuclei toward the driplines, increasing the scientific reach of FRIB. The HRS is funded through a cooperative agreement with MSU and is not a capital asset (MIE). HRS received CD-0 approval in November 2018, and CD-1 in September 2020, with a TPC range of $85,000,000 to $111,400,000. The performance baseline for the High Transmission Beam Line (HTBL) subproject of HRS was approved in March 2025 with a TPC of $49,700,000 and CD-4 in Q2 FY 2030. The FY 2027 Request does not include new funding for the HRS. Prior year funds will support the construction of the HTBL as well as the management team, coordination of collaboration activities, and preliminary engineering and design work for the Spectrometer Section (SPS) subproject of HRS towards future critical decision points.

Low Energy Physics:

Ton-Scale Neutrino-less Double Beta Decay (NLDBD) Program MIE
The Ton-Scale NLDBD Program, implemented by deploying experiments instrumenting a large volume of a specially selected isotope to detect neutrino-less nuclear beta decays where within a single nucleus, two neutrons decay into two protons and two electrons with no neutrinos emitted directly supports the NP mission to explore all forms of nuclear matter. NLDBD can only occur if neutrinos are their own anti-particles and the observation of "lepton number violation" in such neutrino-less beta decay events would have profound consequences for present understanding of the physical universe. The goal of the ton-scale program is to reach a lifetime limit of 10^{28} years with high confidence within a measurement window of five to ten years enabled by the implementation of AI techniques for data cleaning, analysis, and event classification. NLDBD received CD-0 approval in November 2018 with a TPC range of $215,000,000 to $250,000,000. Within the Ton-Scale NLDBD program, NP is prioritizing the LEGEND-1000 project, making use of germanium-76 isotope incorporated in an array of solid-state detectors. The FY 2027 Request does not include new funding for LEGEND-1000 and will make progress using prior year balances. Management activities and preparations for establishing the cost range and evaluation of alternatives are supported by prior year funds.

Nuclear Physics
Construction Projects Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
20-SC-52, Electron Ion Collider (EIC), BNL						
Total Estimated Cost (TEC)	2,493,500	299,240	110,000	155,000	200,000	+45,000
Other Project Cost (OPC)	306,500	92,300	2,850	2,850	-	-2,850
Total Project Cost (TPC)	**2,800,000**	**391,540**	**112,850**	**157,850**	**200,000**	**+42,150**
Total, Construction						
Total Estimated Cost (TEC)	**2,493,500**	**299,240**	**110,000**	**155,000**	**200,000**	**+45,000**
Other Project Cost (OPC)	**306,500**	**92,300**	**2,850**	**2,850**	**-**	**-2,850**
Total Project Cost (TPC)	**2,800,000**	**391,540**	**112,850**	**157,850**	**200,000**	**+42,150**

Nuclear Physics
Scientific User Facility Operations

The treatment of user facilities is distinguished between two types: TYPE A facilities that offer users resources dependent on a single, large-scale machine; TYPE B facilities that offer users a suite of resources that is not dependent on a single, large-scale machine.

(dollars in thousands)

	FY 2025 Enacted	FY 2025 Current	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Scientific User Facilities - Type A					
Relativistic Heavy Ion Collider	**187,000**	**187,000**	**182,805**	**140,000**	**-42,805**
Number of Users	990	1,033	1,000	–	-1,000
Achieved Operating Hours	–	2,189	–	–	–
Planned Operating Hours	3,264	2,189	1,500	–	-1,500
Unscheduled Down Time Hours	–	716	–	–	–
Continuous Electron Beam Accelerator Facility	**146,242**	**145,742**	**155,000**	**156,613**	**+1,613**
Number of Users	1,650	1,736	1,730	1,650	-80
Achieved Operating Hours	–	3,236	–	–	–
Planned Operating Hours	3,294	3,236	3,400	3,300	-100
Unscheduled Down Time Hours	–	509	–	–	–
Facility for Rare Isotope Beams	**102,336**	**102,336**	**110,000**	**111,727**	**+1,727**
Number of Users	900	1,073	1,050	1,100	+50
Achieved Operating Hours	–	4,069	–	–	–
Planned Operating Hours	3,713	4,069	4,000	4,000	–
Unscheduled Down Time Hours	–	320	–	–	–
Argonne Tandem Linac Accelerator System	**25,110**	**25,110**	**26,110**	**27,416**	**+1,306**
Number of Users	430	453	450	450	–
Achieved Operating Hours	–	6,423	–	–	–
Planned Operating Hours	5,952	6,423	5,800	5,950	+150
Unscheduled Down Time Hours	–	384	–	–	–
Total, Facilities	**460,688**	**460,188**	**473,915**	**435,756**	**-38,159**
Number of Users	3,970	4,295	4,230	3,200	-1,030
Achieved Operating Hours	–	15,917	–	–	–
Planned Operating Hours	16,223	15,917	14,700	13,250	-1,450
Unscheduled Down Time Hours	–	1,929	–	–	–

Notes:

- *RHIC operations as an SC User Facility ended following the completion of collider operations in FY 2026. Operation of the RHIC hadron injector complex will continue for beam studies and to maintain readiness for future EIC operations.*

Nuclear Physics
Scientific Employment

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Number of Permanent Ph.Ds (FTEs)	790	756	715	-41
Number of Postdoctoral Associates (FTEs)	312	245	164	-81
Number of Graduate Students (FTEs)	440	331	241	-90
Number of Other Scientific Employment (FTEs)	1,044	1,007	946	-61
Total Scientific Employment (FTEs)	**2,586**	**2,339**	**2,066**	**-273**

Note:
- *Other Scientific Employment (FTEs) includes technicians, engineers, computer professionals, and other support staff.*

20-SC-52 Electron Ion Collider (EIC), BNL
Brookhaven National Laboratory, BNL
Project is for Design and Construction

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

Summary
The EIC project will acquire facilities, infrastructure, systems, and equipment that will enable scientists to investigate the basic building blocks of nuclei and how quarks and gluons, the particles inside neutrons and protons, interact dynamically via the strong force to generate the fundamental properties of neutrons and protons, such as mass and spin. The EIC will be one of the first large-scale experiments to leverage AI for autonomous experimentation and near real-time control starting at design. The FY 2027 Request for the EIC is $200,000,000 of TEC funding. Critical Decision (CD)-1, Approve Alternative Selection and Cost Range, attained on June 29, 2021, included a TPC range of $1,700,000 to $2,800,000,000.

Significant Changes
The EIC project was initiated in FY 2020. The project most recent Critical Decision (CD) is CD-3A, Approve Long-Lead_Procurement, received on March 28, 2024. The estimated completion date (CD-4) of 1Q FY 2036 includes schedule contingency validated by peer review. The most recent Federal review completed in August 2025 confirmed the need for continued elaboration of the scope to define the subprojects strategy intended to leverage different levels of design maturity and improve the project's affordability. The first subproject could attain CD-2, Approve Performance Baseline, in Q2 FY 2026.

In FY 2026, the EIC team focused on preliminary design of the infrastructure, collider machine, and detector instrumentation while executing long-lead procurements. FY 2027 activities will include completing planning and design for conventional infrastructure and technical systems, executing long-lead procurements, pursuing agreements with potential in-kind contributors, and initiating execution of the first subproject. FY 2027 funding will support constructability studies and adjustments to validate technical assumptions and to reduce project risk.

The project has an assigned Federal Project Director (FPD) certified at Level 2.

Critical Milestone History

Fiscal Year	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
FY 2027	12/19/19	01/12/21	6/29/2021	2Q FY 2026	2Q FY 2027	2Q FY 2027	1Q FY 2036

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; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

Fiscal Year	Performance Baseline Validation	CD-3A	CD-3B
FY 2027	TBD	3/28/2024	2Q FY 2026

CD-3A – Approve Long-Lead Procurements, for specialty materials procurement, including electrical infrastructure, magnets, refrigerators for the satellite cryogenics plant, and components for the injector, radio frequency power amplifier, and the detector.
CD-3B – Approve Long-Lead Procurements, for transportation, inspection, and refurbishment of excess magnets from Argonne National Laboratory and additional materials for the accelerator and detector.

Project Cost History

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	262,000	2,231,500	2,493,500	306,500	306,500	2,800,000
FY 2027	252,000	2,241,500	2,493,500	306,500	306,500	2,800,000

Note:
- *This project has not received CD-2 approval; therefore, funding estimates are preliminary.*
- *In FY 2025, the CD-1 point estimate was used as the basis for this table. Beginning in FY 2026, the upper bound of the CD-1 TPC range was the basis for this table.*

2. Project Scope and Justification

Scope

The scope of this project is to design and build the EIC at BNL that will fulfill the scientific gap as identified in the Long Range Plan for Nuclear Science. BNL has partnered with TJNAF to implement the EIC project. The EIC will have performance parameters that include a high average beam polarization of greater than 70 percent for both electrons and light ions, and the capability to accommodate ion beams from deuterons to the heaviest stable nuclei. The EIC will also have variable center of mass energies from 20 to 100 GeV and upgradable to 140 GeV, high average collision luminosity from 10^{33} -10^{34} $cm^{-2}s^{-1}$, one detector and one interaction region at project completion, and the capacity to accommodate a second interaction region and a second detector.

The scope also includes a new electron injection system and storage ring while taking full advantage of the existing infrastructure by modifying the existing hadron facility of the RHIC infrastructure at BNL.

The electron system will include a highly polarized room temperature photo-electron gun and a 3 GeV electron linac injector. It will include a transfer line that brings the electrons into the storage ring at the energy of 5, 10, and 18 GeV that will be installed in a new tunnel adjacent to the existing 2.4-mile circular RHIC tunnel.

Modifications to the existing hadron system include the injection, transfer line and storage ring to increase beam energy to 275 GeV. It will include a strong-hadron-cooling system to reduce and maintain the hadron beam emittance to the level needed to operate with the anticipated luminosity of 10^{33} - 10^{34} $cm^{-2}s^{-1}$.

The interaction region will have superconducting final focusing magnets, crab cavities, and spin rotators to provide longitudinally polarized beams for collisions, where the outgoing particles will be collected by one detector.

An enhanced 2 K liquid helium cryogenic plant is provided for the superconducting radiofrequency cavities, with enhanced water-cooling capacity and cooling towers and chillers to stabilize the environment in the existing tunnel. Civil construction will also include electrical systems, service buildings, and access roads.

It is anticipated that non-DOE funding sources such as international collaborators and the State of New York, will contribute $250 million to the EIC project ($100 million from New York state, and $150 million from international collaborators). The timeframe for commitments by non-DOE contributors will vary throughout the life of the project and become more certain as planning for the project progresses. New York state committed to its contribution on February 7, 2024. All non-DOE funding sources will be incorporated into the project through the change control process once baselined.

Justification

The last four Long Range Plan reports have supported the EIC. The current Long Range Plan recommends the EIC as the highest priority for new facility construction. Consistent with that vision, in 2016 NP commissioned a National Academies of Sciences, Engineering, and Medicine study by an independent panel of experts to assess the uniqueness and scientific merit of such a facility. The report, released in July 2018, strongly supports the scientific case for building a U.S. based EIC, documenting that an EIC will advance the understanding of the origins of nucleon mass, the origin of the spin properties of nucleons, and the behavior of gluons.

The project is being conducted in accordance with the project management requirements in DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets.*

Key Performance Parameters (KPPs)

The KPPs are preliminary and may change prior to setting the performance baseline at CD-2. The threshold KPPs represent the minimum acceptable performance that the project must achieve for success. The objective KPPs represent the performance the project has planned to achieve. Achievement of the Threshold KPPs will be a prerequisite for approval of CD-4, Approve Project Completion.

Performance Measure	Threshold	Objective
Center-of-Mass	Center-of-mass energy measured in the range of 20 GeV- 100 GeV.	Center-of-mass energy measured in the range of 20 GeV- 140 GeV.
Accelerator	Accelerator installed and capable of delivering beams of protons and a heavy nucleus such as Au.	Ability to deliver a versatile choice of beams from protons and light ions to heavy ions such as Au.
Detector	Detector installed and subsystems tested with cosmic rays.	Inelastic scattering events in the e-p and e-A collisions measured in Detector.
Polarization	Hadron beam polarization of > 50 percent and electron beam polarization of > 40 percent measured at E_{cm} = 100 GeV.	Hadron beam polarization of > 60 percent and electron beam polarization of > 50 percent measured at E_{cm} = 100 GeV.

Performance Measure	Threshold	Objective
Luminosity	Luminosity for e-p collisions measured up to 1.5×10^{32} cm^{-2} s^{-1}.	Luminosity for e-p collisions measured up to 1.0×10^{33} cm^{-2} s^{-1}.

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Estimated Cost (TEC)				
Design (TEC)				
Prior Years	152,000	152,000	131,300	—
Prior Years - IRA Supp.	20,000	20,000	—	15,234
FY 2025	50,000	50,000	89,729	5,218
FY 2026	30,000	30,000	30,000	—
Total, Design (TEC)	**252,000**	**252,000**	**251,029**	**20,452**
Construction (TEC)				
Prior Years	19,000	19,000	—	—
Prior Years - IRA Supp.	108,240	108,240	—	2,972
FY 2025	60,000	60,000	—	24,579
FY 2026	125,000	125,000	—	58,240
FY 2027	200,000	200,000	200,000	21,997
Outyears	1,729,260	1,729,260	2,055,963	—
Total, Construction (TEC)	**2,241,500**	**2,241,500**	**2,255,963**	**107,788**
Total Estimated Cost (TEC)				
Prior Years	171,000	171,000	131,300	—
Prior Years - IRA Supp.	128,240	128,240	—	18,206
FY 2025	110,000	110,000	89,729	29,797
FY 2026	155,000	155,000	30,000	58,240
FY 2027	200,000	200,000	200,000	21,997
Outyears	1,729,260	1,729,260	2,055,963	—
Total, Total Estimated Cost (TEC)	**2,493,500**	**2,493,500**	**2,506,992**	**128,240**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Other Project Cost (OPC)				
Prior Years	82,300	82,300	78,234	–
Prior Years - IRA Supp.	10,000	10,000	–	9,865
FY 2025	2,850	2,850	3,274	95
FY 2026	2,850	2,850	3,000	40

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Other Project Cost (OPC)				
Outyears	208,500	208,500	208,500	–
Total, Other Project Cost (OPC)	**306,500**	**306,500**	**293,008**	**10,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Project Cost (TPC)				
Prior Years	253,300	253,300	209,534	–
Prior Years - IRA Supp.	138,240	138,240	–	28,071
FY 2025	112,850	112,850	93,003	29,892
FY 2026	157,850	157,850	33,000	58,280
FY 2027	200,000	200,000	200,000	21,997
Outyears	1,937,760	1,937,760	2,264,463	–
Total, TPC	**2,800,000**	**2,800,000**	**2,800,000**	**138,240**

4. Details of Project Cost Estimate

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design	178,000	178,000	**N/A**
Design - Contingency	84,000	84,000	**N/A**
Total, Design (TEC)	**262,000**	**262,000**	**N/A**
Construction_No_Detail	1,624,500	1,624,500	**N/A**
Construction Contingency	607,000	607,000	**N/A**
Total, Construction (TEC)	**2,231,500**	**2,231,500**	**N/A**
Total, TEC	**2,493,500**	**2,493,500**	**N/A**
Contingency, TEC	*691,000*	*691,000*	***N/A***
Other Project Cost (OPC)			
R&D	86,500	86,500	**N/A**
Conceptual Design	11,000	11,000	**N/A**
Other OPC Costs	209,000	209,000	**N/A**
Total, Except D&D (OPC)	**306,500**	**306,500**	**N/A**
Total, OPC	**306,500**	**306,500**	**N/A**
Contingency, OPC	***N/A***	*N/A*	***N/A***
Total, TPC	**2,800,000**	**2,800,000**	**N/A**

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total, Contingency (TEC+OPC)	***691,000***	***691,000***	***N/A***

Note:
- *This project has not received CD-2 approval; therefore, funding estimates are preliminary.*
- *The upper bound of the CD-1 TPC range is the basis for this table.*

5. Schedule of Appropriations Requests

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	299,240	110,000	110,000	—	1,974,260	2,493,500
	OPC	92,300	2,850	2,850	—	208,500	306,500
	TPC	391,540	112,850	112,850	—	2,182,760	2,800,000
FY 2027	TEC	299,240	110,000	155,000	200,000	1,729,260	2,493,500
	OPC	92,300	2,850	2,850	—	208,500	306,500
	TPC	391,540	112,850	157,850	200,000	1,937,760	2,800,000

Note:
- *In FY 2025, the CD-1 point estimate was used as the basis for this table. Beginning in FY 2026, the upper bound of the CD-1 TPC range was the basis for this table.*

6. Related Operations and Maintenance Funding Requirements

Over the course of the acquisition of the EIC, experienced RHIC scientists, engineers, and technicians will assume EIC project responsibilities. A gradual transition will balance the need for the scientific experts to continue to support RHIC while ramping up the EIC project. These individuals represent the scientific and technical workforce that are essential to the operations of a complex facility like RHIC and eventually, the EIC. They have critical core competencies in collider operations that cannot easily be replaced, and they represent the core facility operations force of RHIC and the EIC. The Request for RHIC Operations includes a reprioritization of the expert workforce from the RHIC facility operations budget to support the project under the EIC TEC request. The temporary reprioritization of funds from the facility operations budget to the construction budget will reduce the amount of new funds needed to implement the EIC, enabling a cost-effective path forward to the implementation of this world-leading facility. As the EIC nears CD-4 when the machine will be restarted, the scientists, engineers and technicians that are needed to operate the EIC will be transferred back to the facility operations budget.

Start of Operation or Beneficial Occupancy	1Q FY 2036
Expected Useful Life	50 years
Expected Future Start of D&D of this capital asset	1Q FY 2086

Related Funding Requirements
(dollars in thousands)

	Annual Costs		Life Cycle Costs	
	Previous Total Estimate	Current Total Estimate	Previous Total Estimate	Current Total Estimate
Operations, Maintenance and Repair	167,000	175,000	13,500,000	14,000,000

7. D&D Information

As part of the upgrade and renovation of the existing accelerator facilities, up to 366,000 square feet of new industrial space will be built as service buildings to house mechanical and electrical equipment. Construction will also include a new tunnel to house the electron injection and rapid cycling synchrotron. The new area will not replace existing facilities.

	Square Feet
New area being constructed by this project at BNL	366,000
Area of D&D in this project at BNL	0
Area at BNL to be transferred, sold, and/or D&D outside the project, including area previously "banked"	N/A
Area of D&D in this project at other sites	N/A
Area at other sites to be transferred, sold, and/or D&D outside the project, including area previously "banked"	N/A
Total area eliminated	0

8. Acquisition Approach

SC selected BNL as the site for the EIC on January 9, 2020. NP approved the Acquisition Strategy in conjunction with CD-1. DOE will utilize the expertise of the Management and Operating contractors at BNL and TJNAF to manage the project including the design, fabrication, monitoring cost and schedule, and delivering the technical performance specified in the KPPs. A certified Earned Value Management System based on those that already exist at both laboratories will evaluate project progress and ensure consistency with DOE Order 413.3B, Program and Project Management for the Acquisition of Capital Assets. SC will evaluate the M&O contractor's performance through the annual laboratory performance appraisal process. SC and the M&O will draw from lessons learned from other SC projects and other similar facilities in planning and executing the EIC project.

Isotope R&D and Production

Overview

The Office of Isotope R&D and Production (IRP) is championing the transformative potential of the Genesis Mission, Quantum Information Science (QIS), fusion energy, and critical materials management (CMM). This strategic alignment underscores a national commitment to asserting American energy dominance and ensuring unrivaled American leadership in critical and emerging technologies. IRP's dedicated efforts in isotope research and production are foundational to these initiatives, providing the essential materials that enable breakthroughs in areas such as advanced computing, next-generation energy systems, and secure supply chains.

IRP is strategically targeting growth related to isotope production and commercial availability, particularly in support of the Genesis Mission and the broader objective of American energy dominance, including responsiveness to relevant Executive Orders. Proactive engagement ensures that critical resources are available for developing advanced reactors and fuel cycles, enabling breakthroughs in QIS, and securing vital materials. Continued momentum in these areas has the potential to further accelerate U.S. progress and solidify global leadership.

IRP's core mission is to ensure a robust and secure domestic supply of isotopes vital for America's national security, scientific advancement, medical progress, and industrial competitiveness. As the nation's sole domestic provider for approximately 300 isotopes IRP is strategically reinforcing U.S. independence, fostering industry engagement, and fortifying infrastructure through dedicated research, robust operations, and the strategic transition of technology to the private sector. The FY 2027 budget request reflects a focused investment of $168.6 million, targeting high-impact isotope supply chain and advancing transformative technologies, from healthcare innovation to quantum computing.

Highlights of the FY 2027 Request

The IRP FY 2027 Request of $168.6 million, a decrease of $1.4 million below the FY 2026 Enacted level, reflects critical, forward-looking investments aligned with the Administration's vision for America's future. This request strategically integrates research, facility operations, and essential line-item construction projects to directly address high-impact critical isotope supply chains. These investments are pivotal for advancing transformative technologies across diverse sectors, including life-saving medical treatments, national security, semiconductor and microelectronics manufacturing, groundbreaking quantum computing, advanced energy systems like fission reactors and fusion machines, and next-generation power sources such as nuclear batteries and radioisotope power sources. These efforts directly support the Administration's Strategic Goals, particularly in asserting American energy dominance and ensuring unrivaled American leadership in critical and emerging technologies.

The FY 2027 IRP strategy is built on four foundational pillars. These pillars are designed to drive significant advancement and maximize impact:

R&D - Driving isotope innovation for national priorities: The FY 2027 Request reflects an $8.4 million decrease below the FY 2026 Enacted level. The IRP research portfolio strives to strategically deliver immediate and long-term advantages essential for national security and economic prosperity through research, development, demonstration and deployment of critical isotopes. IRP will prioritize core efforts that secure domestic supply chains for isotopes vital to national priorities, including advancements in cancer diagnosis and treatment, fusion energy, microelectronics, and quantum computing. High-priority research in artificial intelligence and machine learning to improve efficiencies and automation in isotope science and advanced manufacturing will benefit production capabilities. The Request maintains support for research to advance the production of isotopes for quantum computing and microelectronics, with a clear aim to strengthen the onshoring of manufacturing supply chains. As funding is available, strategic investments will continue to advance and de-risk production and processing technologies, paving the way for future transitions to the private sector and fostering a vibrant commercial ecosystem.

Facility Operations - Securing domestic isotope production: The FY 2027 Request reflects an increase of $12.8 million above the FY 2026 Enacted level for direct investment in the Nation's self-reliance and energy security. In FY 2027, IRP will drive the ramp-up of new capabilities, significantly enhancing America's self-sufficiency in isotope production. A key focus will be on onshoring production for essential isotopes, thereby establishing new domestic production lines vital for national independence. Operations will continue to expand for a range of new capabilities, including the Stable Isotope Production Facility and multiple new electromagnetic ion separators. These strategic investments will support safe and reliable operations across production sites, empowering scientists and engineers to operate at needed capacity. Maintenance activities will be strategically prioritized based on critical needs to ensure continuous safe and reliable operations within available resources. Staffing will be maintained at the National Isotope Development Center (NIDC) to assess market needs and handle increasing interfaces with the stakeholder community. IRP will continue efforts to support priorities in energy dominance, and Project Genesis through growth in heavy water and helium-3 inventory and production of strontium-90, carbon-14, iridium-192, krypton-85, and americium-241, and californium-252.

Projects - Enhancing, expanding, and modernizing U.S. infrastructure: The FY 2027 Request reflects a decrease of $5.9M below the FY 2026 Enacted level and represents a targeted investment in enhancing, expanding, and modernizing critical U.S. infrastructure. Critical funding for the Radioisotope Processing Facility (RPF) will advance preliminary engineering design, a crucial step in establishing state-of-the-art radiochemical processing capabilities. Concurrently, the Stable Isotope Production and Research Center (SIPRC) will continue its rapid progress, establishing large-scale stable isotope enrichment capacity in the U.S. This is a monumental stride towards regaining a capability once lost, directly challenging foreign dominance, and mitigating U.S. dependence on sensitive foreign supply chains for vital isotopes. These efforts are foundational to building a secure, resilient, and independent domestic isotope supply.

Public Private Partnership - Strengthening industry interactions, collaborations, and partnerships: IRP investments will maximize output and enhance the reliability of production facilities through robust public-private partnerships. By fostering continuous engagement with stakeholders, the IRP actively cultivates new partnerships to support growth in the commercial isotope market. The IRP is proactively defining the needs and capabilities across federal and industrial facilities to establish clear lines of support for the efficient transition of isotopes into the commercial market. These partnerships are instrumental in strengthening existing capabilities, ensuring industry readiness to leverage from federal advancements, and paving a clear path for future commercial isotope production, thereby securing long-term national benefits.

Isotope R&D and Production
Funding

	(dollars in thousands)			
	FY 2025 Enacted	**FY 2026 Enacted**	**FY 2027 Request**	**FY 2027 Request vs FY 2026 Enacted**
Isotope R&D and Production				
Isotopes, Research	36,365	33,132	24,769	-8,363
Isotopes, Operations	80,371	77,368	90,203	+12,835
Subtotal, Isotope R&D and Production	**116,736**	**110,500**	**114,972**	**+4,472**
Construction				
20-SC-51 U.S. Stable Isotope Production and Research Center (SIPRC), ORNL	45,900	50,000	45,100	-4,900
24-SC-92 Clinical Alpha Radionuclide Producer (CARP), BNL	–	1,000	–	-1,000
24-SC-91 Radioisotope Processing Facility, ORNL	7,000	8,500	8,500	–
Subtotal, Construction	**52,900**	**59,500**	**53,600**	**-5,900**
Total, Isotope R&D and Production	**169,636**	**170,000**	**168,572**	**-1,428**

Basic and Applied R&D Coordination
IRP closely coordinates with various federal agencies, such as the National Aeronautics and Space Administration (NASA), the Department of Defense (DoD), the Office of the Director of National Intelligence (ODNI), the National Institute of Standards and Technology (NIST), the Federal Bureau of Investigations (FBI), the Department of Agriculture, the Department of Homeland Security (DHS), and the National Science Foundation (NSF), Food and Drug Administration (FDA). This collaboration ensures that critical isotopes are available for federal missions, industrial applications, and academic research. The IRP conducts a biennial Workshop on Federal Isotope Supply and Demand to anticipate and address evolving needs along with establishing an R&D path to meet those needs. In parallel, the IRP actively coordinates with industry stakeholders to understand market dynamics and support their evolving capabilities, ensuring a prepared and responsive domestic ecosystem for isotope production and processing.

The IRP leads the Interagency Group on He-3 to determine annual federal allocations from reserves. The IRP also collaborates with other DOE Offices on domestic supply chains of valuable isotopes, such as americium-241, He-3, heavy curium, strontium-90, promethium-147, and krypton-85.

Isotope R&D and Production

Description

Research

Research activities are the bedrock of IRP, driving both fundamental discoveries and applied solutions. IRP strategically funds core research at national laboratories and universities, fostering innovation in isotope production and related technologies. This encompasses stable and radioisotopes, competitive research opportunities, Office of Science initiatives, maintenance of core competencies in staff and equipment at university facilities, individual university research projects, and comprehensive workforce development. Core research focuses on identifying and developing new production pathways and enhancing the efficiency, reliability, and cost-effectiveness of existing processes. This work aims to ensure a stable, affordable, and accessible supply of critical isotopes for diverse applications, while strategically developing processes adaptable for future industrial scale-up

To position America atop the global isotope sector, IRP executes a world-leading research program focused on breakthrough isotope production, enrichment, and chemical separation technologies. It prioritizes the development of industrially adaptable processes for commercial scale-up. The program's isotope manufacturing and R&D activities yield significant collateral benefits through training and workforce development. These efforts cultivate future domestic expertise for industry and the national laboratories in nuclear medicine, accelerator science, nuclear engineering, nuclear physics, isotope enrichment, and radiochemistry – disciplines vital not only to isotope production and processing, but also to basic and applied nuclear and radiochemical science. Research and production activities develop and employ techniques and platform technologies in artificial intelligence (AI), machine learning (ML), autonomization, microelectronics, robotics, and advanced manufacturing, enhancing efficiency and exploring new frontiers.

IRP supports core research at Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), Los Alamos National Laboratory (LANL), Oak Ridge National Laboratory (ORNL), and Pacific Northwest National Laboratory (PNNL) to conduct innovative research for novel or advanced production and chemical separation techniques for critical isotopes. Core research support is also provided to the University Isotope Network (UIN) institutions, which are essential for strengthening domestic supply chains and fostering national research competitiveness while playing a key role in workforce development. The UIN is currently comprised of the University of Washington (UW) Medical Cyclotron Facility, the University of Missouri Research Reactor (MURR), FRIB Isotope Harvesting at Michigan State University (MSU), University of Alabama-Birmingham (UAB), University of Wisconsin-Madison (UWM), and Texas A&M University (TAMU). These universities have unique capabilities: UW and TAMU operate multi-particle cyclotrons, highlighted by the development of full-scale production of the alpha-emitter astatine-211 for cutting-edge cancer therapy, and the UW cyclotron distributes a variety of isotopes and provides crucial target fabrication expertise for the UIN. MURR boasts the highest flux university research reactor in the United States and recognized expertise in current Good Manufacturing Practices (cGMP) protocols, making it invaluable for IRP's production and processing of critical isotopes such as lutetium-177 for cancer therapy research, gadolinium-153 for brachytherapy, nuclear medicine imaging, and Single-Photon Emission Computed Tomography (SPECT) myocardial perfusion imaging, and terbium-161 for cancer treatment. The UAB cyclotron features four beamlines and associated target stations to produce a variety of radioisotopes, as well as specialized hot cells for preparation of human-use and preclinical radiopharmaceuticals. At Michigan State University, the innovative FRIB Isotope Harvesting project repurposes unwanted waste from nuclear physics research into valuable research assets.

A key priority for IRP is fostering a strong national core competency in stable isotope enrichment. Enriched stable isotopes are foundational for numerous applications, including the production of all radioisotopes, which are vital in medicine, industry, and research. The production of each enriched stable isotope requires an intense research campaign. The program provides core research funding for stable isotopes to ORNL and supports machine design optimized for production of isotopes of interest for quantum computing as part of the SC QIS Initiative. Similarly, support through the SC initiatives also promotes growth in radioisotope development. Participation in the Microelectronics initiative enables production of isotopes needed for semiconductors and microelectronics manufacturing, particularly for critical defense applications (e.g., krypton-85 for electronics testing, deuterium for performance).

The IRP's competitive research funding supports universities and national laboratories, specifically research to develop novel isotopes of interest to U.S. stakeholders and establish secure domestic isotope supply chains, with a strategic emphasis on developing processes and technologies that can be matured and transferred to the private sector for commercial production. For example, IRP is working to develop technology to detritiate legacy heavy water at Savannah River National Laboratory (SRNL). Other examples of competitive research topics include the production of isotopes for next-generation advanced fission reactors and fusion reactors, innovative medical isotopes, new sources of helium-3, rare isotopes for nuclear forensics, critical nuclear data measurements, radioisotope enrichment technology, advanced targetry, modular automated systems, and robotics. Support for AI/ML enables growth in areas to facilitate more effective techniques for highly cumbersome isotope production processes, and to promote modern solutions to increase efficiencies and opportunities.

Another high priority research area is the development of transformative medical isotopes for enhanced disease diagnosis and treatment, with the ultimate goal of reducing cancer mortality. There is escalating global interest in alpha and beta emitters for revolutionary cancer and infectious disease therapy and diagnostics. The IRP is often the sole global source for many of these isotopes or leading the way in innovative research and manufacturing to make them available.

IRP supports training and development opportunities for students and post-docs to foster a vibrant workforce for isotope production and to advance workforce capabilities.

IRP invests in the Nation's future nuclear chemistry and biomedical researchers through support for the Nuclear Chemistry Summer School (NCSS) program. The NCSS, also supported by SC's Basic Energy Sciences (BES) and Nuclear Physics (NP) programs, consists of an intensive six-week program of formal accredited lectures on the fundamentals of nuclear science, radiochemistry, and their applications in related fields, supplemented by laboratory practicums focusing on state-of-the-art instrumentation and technology used routinely in basic and applied nuclear science.

Facility Operations

IRP supports activities at National Laboratories related to reactor, accelerator, and enrichment facilities. This support encompasses expert staff for managing, operating, and maintaining facilities and equipment for isotope production and enrichment. Strategic investments ensure safe, cost-effective, and reliable operations. The program also supports equipment for chemical processing (e.g., hot cells and glove boxes), pre-operations of stable isotope equipment, inventory management and dispensing, advanced manufacturing capabilities, operations support and assembly, and the National Isotope Development Center (NIDC).

As a critical function of the Department, IRP strategically manages the irradiation of targets, using particle accelerators and nuclear research reactors across national laboratories and domestic universities. Following irradiation, these targets undergo specialized chemical processing within dedicated radiological or nuclear facilities, equipped with sophisticated equipment, to extract radioisotopes of critical interest. In addition to the direct production of these isotopes, the IRP also recovers radioisotopes from legacy waste streams, used nuclear fuel, and existing inventories, achieving the dual benefit of reducing waste volumes while generating valuable products.

Furthermore, IRP manages the national repository of stable isotopes, a legacy of the Manhattan Project's calutrons. The limited nature of this inventory increases the United States' reliance on foreign suppliers for crucial materials. The IRP is dedicated to developing modern stable isotope enrichment capabilities, revitalizing domestic manufacturing, replenishing critical inventories, and fostering U.S. economic resilience, prosperity, competitiveness, and self-reliance. IRP also serves as the steward of national isotope inventories beyond DOE's legacy repository, including helium-3 (He-3), vital for a multitude of applications including cryogenics, quantum information science, fusion energy research, and national security.

The IRP network of facilities produces a diverse range of isotopes:

- Accelerators: The Isotope Production Facility (IPF) at LANL, the Brookhaven Linac Isotope Producer (BLIP) facility at BNL, and the Low Energy Accelerator Facility (LEAF) at ANL are key assets. These proton and electron accelerators provide continuous year-round availability of medical radioisotopes. The IPF operates in conjunction with the National Nuclear Security Administration (NNSA) Los Alamos Neutron Science Center (LANSCE), while BLIP operates with the Relativistic Heavy Ion Collider, which will transition to the Electron Ion Collider. BNL also operates the MIRP cyclotron for specialized medical isotopes and isotopes for fundamental research. ANL's LEAF, the program's only electron accelerator, provides unique pathways for producing essential medical radioisotopes.

- Research Reactors: The IRP leverages the capabilities of three research reactors: the High Flux Isotope Reactor (HFIR) at ORNL, the Advanced Test Reactor (ATR) at INL, and the University of Missouri Research Reactor (MURR). These reactors contribute to isotope production, and related chemical processing and handling equipment is supported at each site.

- Chemical Processing: Processing capabilities are supported at PNNL for isotopes like strontium-90, radium-226, krypton-85, and lead-212. At INL, the ATR ensures a reliable domestic supply of cobalt-60. At the Y-12 National Security Complex, the IRP supports the preparation and packaging of lithium isotopes and uranium-235, while americium-241 is recovered from NNSA plutonium processes at LANL. Helium-3 is extracted from NNSA-owned tritium beds at the Savannah River Site, and the radioisotope separator at INL enriches radioisotopes for nuclear forensics.

- Enrichment Technologies: Individual electromagnetic ion separators are assembled and operated at ORNL. Thermal diffusion enrichment capabilities are operated at PNNL. IRP-supported research demonstrated the feasibility of new Electromagnetic Isotope Separation (EMIS) and gas centrifuge (GC) technologies and re-established a prototype general enriched stable isotope production capability in the U.S. The Stable Isotope Production Facility (SIPF) Major Item of Equipment (MIE) at ORNL established the first full-scale GC cascade to enrich stable isotopes. The implementation of SIPF is beginning transition to routine operations to produce enriched xenon-129 in FY 2026.

The NIDC, located at ORNL, manages IRP business operations, including sales, contract negotiations, marketing assessments, public outreach, quality control, packaging, and transportation. It facilitates regular and frequent interfaces between IRP and industrial, academic, and medical communities to ensure that strategies are evidence-based and informed by stakeholder interactions, including critical engagement to facilitate the readiness of industry to undertake future domestic isotope production and processing. In particular, the IRP biennially canvasses the broad federal community for isotope demands to align priorities with evidence-based program evaluations.

The IRP is the sole domestic supplier of over 300 isotopes for the Nation, supporting national security, medical, industry and R&D. Some examples of how these isotopes impact America:

- Cancer therapy and imaging diagnostics: actinium-225, actinium-227, astatine-211, cerium-134, scandium-47, scandium-44, holmium-166m, gadolinium-153, tungsten-188, lutetium-177, strontium-89, strontium-90, tin-117m, vanadium-48, manganese-52, manganese-54, gold-199, terbium-161, cobalt-55, and cobalt-60
- Cancer and infectious disease therapy and research: bismuth-213, lead-212, lead-203, astatine-211, copper-67, thorium-227, thorium-228, radium-223, and radium-224
- Pharmaceutical and agrochemical applications: carbon-14
- Feedstock for isotopes that treat prostate cancer: ytterbium-176, radium-226
- Nuclear forensics: neptunium-236
- Explosives detection and nuclear batteries: nickel-63
- Neutron detectors for homeland security applications and fusion research: lithium-6
- Cryogenics and radiation detection: helium-3
- Industrial radiography: iridium-192, selenium-75
- Nuclear reactor start-up, oil and gas exploration and production well logging: californium-252
- Quantum computing research, medical standards, and industrial sources: barium-133
- Microelectronics manufacturing and quality control: krypton-85
- Nuclear batteries and power sources: strontium-90, promethium-147, americium-241, and thulium-170
- Use as targets for discovery of new super heavy elements: berkelium-249, americium-243, uranium-238, plutonium-242, plutonium-244, californium-249, californium-251, einsteinium-254, and curium-248
- Heavy element chemistry research: fermium-257
- Oceanography modeling: silicon-32
- Quantum memory: ytterbium-171

Developing an economically and technically viable commercial market for an isotope can take decades. The IRP is proactively working to grow its R&D capabilities to de-risk and accelerate this transition. Through strategic research in production methodologies, advanced chemical separations, and innovative enrichment techniques, IRP is working to develop processes that are not only efficient but also readily adaptable for industrial scale-up. This commitment to early-stage process optimization and technological maturity is critical for fostering a seamless hand-off to the private sector, ensuring a seamless transition that does not disrupt isotope supply or hinder ongoing research. IRP remains dedicated to working closely with industry to commercialize promising technologies and promote the growth of independent domestic producers. Once domestic commercial production is established, IRP ceases production to avoid competition with the private sector, as was historically illustrated by strontium-82 for cardiac heart imaging and germanium-68 for medical diagnostics.

As a Mission Essential Function for the DOE Office of Science, IRP maintains operations of production facilities and management of national inventories to effectively mitigate disruptions in isotope supply chains during national emergencies. Revenue generated from isotope customer sales directly supports the production and distribution of isotopes, fostering sustainable program for continuity of operations.

<u>Projects</u>

IRP is strategically executing two line-item construction projects to strengthen U.S. isotope supply chains and reduce dependence on foreign countries. The Stable Isotope Production and Research Center (SIPRC) project will re-establish large-scale stable isotope enrichment in the United States and the Radioisotope Processing Facility (RPF) will address the critical need for modernized nuclear and radiochemistry capabilities.

Isotope R&D and Production

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Isotope R&D and Production	**$170,000**	**$168,572**	**-$1,428**
Isotopes, Research	$33,132	$24,769	-$8,363
Funding supports the highest priority R&D activities at national laboratories, focused on urgently establishing domestic supply chains to establish U.S. independence and mitigate disruptions caused by geopolitical events. Competitive research at domestic universities are prioritized based on alignment with Administration priorities and available funding. The UIN continues to produce high-priority research, “boutique” radioisotopes, and isotopes to address urgent domestic needs The recently completed FRIB Isotope Harvesting Project achieves routine operations. Funding continues efforts to develop isotopes for quantum computing and to strengthen the domestic supply chain for microelectronics manufacturing, and support advances in AI/ML to enhance the efficiency of isotope production processes. Funding supports the ramp up the recovery of heavy curium from the Mark 18-A targets.		The Request will strategically direct resources to maintain support for the most critical activities. While these investments will help secure immediate national needs, this R&D funding will provide the foundational groundwork for future industrial transition of isotope production and processing. Approximately 15% of total IRP funding will support essential research and development (R&D) at national laboratories and universities, focusing on high-priority needs like quantum computing isotopes, microelectrons supply chains and leveraging AI/ML for enhanced efficiency.	The Request will support strategic investments for IRP core mission capabilities. Funding will prioritize the foundational R&D essential for continuous, safe, and effective isotope production, and for securing critical supply chains against immediate disruptions.

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Isotopes, Operations	$77,368	$90,203	+$12,835
The Request supports facility operations at all production facilities and processing sites with an emphasis on addressing gaps in high priority isotope supply chains. Prioritized investments are supporting targeted modernization and refurbishment activities to enhance operational safety, robustness, and reliability. The funding sustains support for the MIRP Facility, which produces and processes isotopes used for cancer treatments and fundamental research, and new units of EMIS to enrich stable isotopes in short supply as they transition to routine operations. Staffing is maintained at NIDC to manage growing interfaces with stakeholders.		The Request will support facility operations at all production and processing sites, with a primary emphasis on addressing critical isotope supply gain gaps. Prioritized investments will support growth of key new capabilities such as the Stable Isotope Production Facility and electromagnetic ion separators, enriching stable isotopes in short supply. Staffing for the National Isotope Development Center will remain fully supported to manage growing stakeholder interfaces, ensuring maximum impact on immediate national needs and fostering long-term innovation and industrial growth.	Funding will increase to support new production capabilities and bolster critical supply chains for isotope production, ensuring growing a stable and reliable supply of urgently needed materials. Maintenance activities will be strategically prioritized based on critical needs to ensure continuous safe and reliable operations within available resources.

Isotope R&D and Production
Construction

Description

The Isotope Research & Development and Production Program (IRP) collaborates with federal agencies and industry to secure American isotope independence and mitigate disruptions across critical isotope supply chains. To support this, IRP invests in new capabilities through construction projects that support the Administration's strategy to ensure U.S. leadership in critical technologies. These new facilities will enable enhanced U.S. self-reliance through innovative research and development, increased processing capability, and expanded production of critical isotopes, including those not available elsewhere. Currently, IRP offers a catalog of 300 isotopes as the sole domestic supplier.

IRP strategically executes two line-item construction projects:

<u>24-SC-91, Radioisotope Processing Facility (RPF)</u>
The Radioisotope Processing Facility (RPF) at Oak Ridge National Laboratory (ORNL) is a pivotal investment to secure America's critical supply chains, mitigate dependence on geopolitical sensitive countries, and meeting U.S. demand for isotopes essential to national defense, space exploration, energy security, and next generation medical treatments. Expanding U.S. radioisotope chemical processing and development capacity is crucial to bolster domestic supply chains and unleash innovative R&D that underpins Administration priorities. The RPF is planned as a Hazard Category 2 nuclear facility, equipped to process the higher specific activity targets that are irradiated in a reactor, such as the High Flux Isotope Reactor (HFIR) at ORNL. Current chemical processing capabilities are aged and at capacity, limiting the ability of the U.S. to onshore isotope supply chains and meet U.S. demand. The RPF will address this lack of available radiochemical processing equipment and modernize U.S. capabilities. RPF's modular design further allows flexible reconfiguration to meet evolving radioisotope needs without costly facility modifications. The RPF's modernized, flexible infrastructure will provide significant opportunities for strategic public-private partnerships, enabling industry to access cutting-edge processing capabilities. This active engagement will accelerate industry's expansion within the domestic market, fostering a robust and resilient U.S. supply chain that is essential for long-term economic prosperity.

The RPF received CD-0, Approve Mission Need, approval on April 29, 2021, and CD-1, Approve Alternative Selection and Cost Range, approval on February 26, 2026. The total cost range is projected at $510,000,000 to $900,000,000. This range reflects enhanced understanding of design parameters and nuclear safety protocols achieved during the conceptual design. This, combined with evolving market costs associated with specialized radiochemical equipment, has led to adjustments in both budget and timeline to maintain optimal alignment with mission objectives. The project is assessing the impacts to estimated costs and schedule from available funding, inflation, and supply chain constraints since project initiation.

<u>20-SC-51, U.S. Stable Isotope Production and Research Center (SIPRC)</u>
The Stable Isotope Production and Research Center (SIPRC) at ORNL is a foundational project for asserting American leadership in critical and emerging technologies, including quantum information science and fusion energy. It will reestablish versatile, large-scale stable isotope enrichment capacity in the United States. Given that Russia is the major producer of most stable isotopes, and China is a rapidly emerging leader, SIPRC is strategic for national and economic security. Once constructed, SIPRC will provide a secure supply of stable isotopes that are catalysts for American industry, next-generation medicine, and groundbreaking research, directly supporting the Administration's vision for a secure and prosperous nation.

SIPRC received CD-1, Approve Alternative Selection and Cost Range, and Subproject 1 CD-3A, Approve Long Lead Procurement, approvals on November 4, 2021. The project received approval for Subproject 1 CD-3B, Approve Long Lead Procurement, on July 19, 2023. Subproject 1, Facility and EMIS, received approval for

CD-2, Approve Performance Baseline as well as CD-3, Approve Start of Construction, on March 15, 2024. The project received approval for Subproject 2 CD-3A, Approve Long Lead Procurement, on March 24, 2026. The Total Project Cost (TPC) point estimate is $325,000,000 with a preliminary TPC range of $187,000,000 to $338,000,000, approved at CD-1.

Isotope R&D and Production
Construction

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Construction	**$59,500**	**$53,600**	**-$5,900**
24-SC-91, Radioisotope Processing Facility (RPF)	$8,500	$8,500	$ —
Funding supports TEC of the RPF at ORNL. RPF will address a lack of available radiochemical processing infrastructure for reactor target processing which inhibits production of critical isotopes. RPF continues and mitigates U.S. dependence on foreign radioisotope supply chains.		The Request will support addressing radiochemical processing infrastructure for reactor target processing, modernize our production capabilities, and position the Department for strategic public private partnerships. This facility will mitigate U.S. dependence on foreign radioisotope supply chains.	Funding will support preliminary engineering design.
20-SC-51, U.S. Stable Isotope Production and Research Center (SIPRC)	$50,000	$45,100	-$4,900
Funding continues design and construction of the U.S. SIPRC at ORNL, according to project plans, to provide large scale stable isotope production capacity for the Nation and mitigate U.S. dependence on foreign capabilities.		Funding will continue design and construction of the U.S. SIPRC at ORNL according to project plans. SIPRC will re-establish large-scale stable isotope production capacity for the Nation and mitigate U.S. dependence on foreign capabilities.	The funding decrease will prioritize construction activities through TEC funding as design activities come to a close.
24-SC-92, Clinical Alpha Radionuclide Producer (CARP)	$1,000	$ —	-$1,000
CARP is currently on a strategic pause and funds are requested to be reprogrammed to higher priority activities.		No funding requested in FY 2027.	CARP is paused and funds are redirected to higher priority activities.

Isotope R&D and Production
Capital Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Capital Operating Expenses						
Capital Equipment	N/A	N/A	8,082	767	7,002	+6,235
Total, Capital Operating Expenses	**N/A**	**N/A**	**8,082**	**767**	**7,002**	**+6,235**

Isotope R&D and Production
Construction Projects Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
24-SC-91, Radioisotope Processing Facility (RPF), ORNL						
Total Estimated Cost (TEC)	834,000	8,500	7,000	8,500	8,500	-
Other Project Cost (OPC)	65,406	14,600	-	-	-	-
Total Project Cost (TPC)	**899,406**	**23,100**	**7,000**	**8,500**	**8,500**	**-**
24-SC-92, Clinical Alpha Radionuclide Producer (CARP), BNL						
Total Estimated Cost (TEC)	2,000	1,000	-	1,000	-	-1,000
Other Project Cost (OPC)	2,085	2,085	-	-	-	-
Total Project Cost (TPC)	**4,085**	**3,085**	**-**	**1,000**	**-**	**-1,000**
20-SC-51, U.S. Stable Isotope Production and Research Center (SIPRC), ORNL						
Total Estimated Cost (TEC)	289,800	131,900	45,900	50,000	45,100	-4,900
Other Project Cost (OPC)	5,600	3,200	-	-	600	+600
Total Project Cost (TPC)	**295,400**	**135,100**	**45,900**	**50,000**	**45,700**	**-4,300**
Total, Construction						
Total Estimated Cost (TEC)	**1,125,800**	**141,400**	**52,900**	**59,500**	**53,600**	**-5,900**
Other Project Cost (OPC)	**73,091**	**19,885**	**-**	**-**	**600**	**+600**
Total Project Cost (TPC)	**1,198,891**	**161,285**	**52,900**	**59,500**	**54,200**	**-5,300**

Notes:

- *The Radioisotope Processing Facility (RPF) point estimate is $640,000,000; the estimated TPC is displayed at the upper TPC range of $899,406,000 because RPF is not yet baselined. The complete estimated TPC (based on upper TPC range) does not include $594,000 in OPC funding included in the Nuclear Physics program for prior years. The complete estimated cost of the TPC (upper range) for RPF, combining the Nuclear Physics and Isotope R&D and Production funding, is $900,000,000. This project is not baselined and the TPC estimates are currently being re-evaluated to consider available funding, supply chain challenges, and inflation since initiation.*

- *The preliminary TPC for the U.S. Stable Isotope Production and Research Center (SIPRC) of $295,400,000 does not include $29,600,000 ($24,000,000 TEC and $5,600,000 OPC) included in the Nuclear Physics program for prior years. The complete preliminary total for SIPRC, combining the Nuclear Physics and Isotope R&D and Production funding, is $325,000,000. For SIPRC, Subproject 1 is baselined; Subproject 2 and Subproject 3 are not yet baselined.*

- *The Clinical Alpha Radionuclide Producer (CARP) was put on a strategic hold in FY 2025. All remaining funds have been requested to be reprogrammed to higher priority program activities.*

Isotope R&D and Production
Scientific Employment

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Number of Permanent Ph.Ds (FTEs)	55	55	41	-14
Number of Postdoctoral Associates (FTEs)	27	27	16	-11
Number of Graduate Students (FTEs)	26	26	14	-12
Number of Other Scientific Employment (FTEs)	240	240	235	-5
Total Scientific Employment (FTEs)	**348**	**348**	**306**	**-42**

Note:
- *Other Scientific Employment (FTEs) includes technicians, engineers, computer professionals, and other support staff.*

24-SC-91, Radioisotope Processing Facility (RPF)
Oak Ridge National Laboratory, ORNL
Project is for Design and Construction

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

Summary

The FY 2027 Request for the Radioisotope Processing Facility (RPF) is $8,500,000 of Total Estimated Cost (TEC) funding. The CD-1 preliminary Total Project Cost (TPC) point estimate is planned at $640,000,000 with a TPC range of $510,000,000 to $900,000,000.

Significant Changes

This project data sheet (PDS) is an update of the FY 2026 PDS; this project is not a new start in FY 2027. The most recent DOE Order 413.3B approved CD is CD-1, Approve Alternative Selection and Cost Range, which was approved on February 26, 2026, 2021.

The FY 2027 Request will provide support for continuing limited preliminary engineering design for both the facility and the innovative modular hot cell approach. These design activities are driven by the strategic imperative to ensure the uninterrupted production of key radioisotopes while supporting the clean-out and planned decommissioning of legacy nuclear facilities. This project will strategically position the United States to decisively mitigate foreign isotope dependencies and will facilitate the development of mature processes for emerging isotopes, thereby bolstering the domestic industrial base and securing essential supply chains, including those for critical minerals. In FY 2025, the project cost and schedule increased due to impacts from supply chain constraints and advances in design maturity but remained stable since that time. The resulting cost range, schedule, and technical scope has been, and will continue to be thoroughly assessed and validated through multiple evidence-based independent peer reviews.

A Federal Project Director (FPD) with certification Level III has been assigned to RPF.

Critical Milestone History

Fiscal Year	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
FY 2027	4/29/21	2Q FY 2026	2/26/26	3Q FY 2031	3Q FY 2031	3Q FY 2031	2Q FY 2040

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; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

Fiscal Year	Performance Baseline Validation	CD-3A	CD-3B
FY 2027	2Q FY 2030	1Q FY 2029	3Q FY 2030

CD-3A – Approve Long-Lead Procurements (Early Site Preparation)
CD-3B – Approve Long-Lead Procurements (Modular Hot Cell Fabrication)CD-

Project Cost History

This project has a preliminary point estimate of $640,000,000 and a corresponding TPC range of $510,000,000 to $900,000,000; the PDS is written to the upper limit of the TPC range as the project is not baselined. No construction, excluding approved long-lead procurement, will be performed until the project performance baseline has been validated and CD-3 has been approved.

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	79,000	755,000	834,000	66,000	66,000	900,000
FY 2027	79,000	755,000	834,000	66,000	66,000	900,000

Notes:
- *This project has not received CD-2 approval; therefore, funding estimates are preliminary.*
- *Since project is at CD-0, the funding estimates correlate to the upper end of the estimated TPC range.*

2. Project Scope and Justification

Scope

The scope of this project includes design and construction of a new 90,000 square foot Hazard Category 2 radioisotope processing facility, and the specialized equipment for chemically processing radioisotopes, with particular focus on irradiated reactor targets. RPF will be a purely technical facility (i.e., minimal office and staff amenities) dedicated to research and operations and located on the Oak Ridge National Laboratory (ORNL) main campus. The design is planned to support up to eight new radioisotope processing bays and be equipped with sufficient hot cells grouped to support new product lines and research and development activities intended to scale production to meet U.S. demand. Facility design concepts will include separate bays needed to support reconfigurable heavy shielding for transloading of irradiated targets and waste handling and storage of radioactive materials. The facility will be designed to incorporate other operations required to successfully produce isotopes such as staging and repair of manipulators and other equipment as well as the supporting infrastructure necessary for efficient operations such as cranes to assist in moving casks within the facility. Construction of the proposed facility will also integrate safety-by-design, quality-by-design, and safeguards-by-design standards to ensure safe and efficient future operations.

Justification

The RPF supports the nation's strategy to secure critical supply chains, mitigate dependence on geopolitically sensitive countries, and meet U.S. demand for isotopes essential to national defense, American energy dominance, and life-saving medical treatments. To bolster domestic supply chains and unleash innovative R&D, expanding U.S. radioisotope chemical processing and development capacity is crucial. The RPF is planned as a Hazard Category 2 nuclear facility, equipped to process the higher specific activity targets. Current radiochemical processing capabilities are aged and at capacity, constraining America's ability to onshore critical supply chains and meet surging domestic demands. The RPF directly addresses this capability gap by providing a modernized state-of-the-art facility. Its innovative modular design ensures flexible reconfiguration to meet evolving national needs without costly modifications, guaranteeing long-term value and adaptability.

This modernized infrastructure, combined with its inherent flexibility, will also provide significant opportunities for strategic public-private partnerships. Such collaborations will enable industry to access cutting-edge processing capabilities, leverage national laboratory expertise, and reduce the high capital investment required for such complex operations. This active engagement will help accelerate industry's expansion within the domestic market, fostering robust and resilient U.S. supply chains essential for national and economic security.

The project is being conducted in accordance with the project management requirements in DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, and all appropriate project management requirements will be met.

Key Performance Parameters (KPPs)
Preliminary Key Performance Parameters (KPPs) are defined at CD-1 and may change as each subproject continues towards CD-2, Approve Performance Baseline. CD-1 approval was received February 26, 2026. At CD-2 approval, the KPPs will be baselined. The Threshold KPPs represent the minimum acceptable performance that the project must achieve. The Objective KPPs represent the desired project performance. Achievement of the Threshold KPPs will be a prerequisite for approval of CD-4, Project Completion.

Performance Measure	Threshold	Objective
Design/construct building	TBD	TBD
Instrumentation design/development	TBD	TBD

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Estimated Cost (TEC)				
Design (TEC)				
Prior Years	8,500	8,500	—	—
FY 2025	7,000	7,000	—	—
FY 2026	8,500	8,500	18,000	—
FY 2027	8,500	8,500	13,000	—
Outyears	46,500	46,500	48,000	—
Total, Design (TEC)	**79,000**	**79,000**	**79,000**	**—**
Construction (TEC)				
Outyears	755,000	755,000	755,000	—
Total, Construction (TEC)	**755,000**	**755,000**	**755,000**	**—**
Total Estimated Cost (TEC)				

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Estimated Cost (TEC)				
Prior Years	8,500	8,500	—	—
FY 2025	7,000	7,000	—	—
FY 2026	8,500	8,500	18,000	—
FY 2027	8,500	8,500	13,000	—
Outyears	801,500	801,500	803,000	—
Total, Total Estimated Cost (TEC)	**834,000**	**834,000**	**834,000**	**—**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Other Project Cost (OPC)				
Prior Years	4,594	4,594	3,450	–
Prior Years - IRA Supp.	10,600	10,600	–	8,178
FY 2025	–	–	439	1,319
FY 2026	–	–	705	1,103
Outyears	50,806	50,806	50,806	–
Total, Other Project Cost (OPC)	**66,000**	**66,000**	**55,400**	**10,600**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Project Cost (TPC)				
Prior Years	13,094	13,094	3,450	–
Prior Years - IRA Supp.	10,600	10,600	–	8,178
FY 2025	7,000	7,000	439	1,319
FY 2026	8,500	8,500	18,705	1,103
FY 2027	8,500	8,500	13,000	–
Outyears	852,306	852,306	853,806	–
Total, TPC	**900,000**	**900,000**	**889,400**	**10,600**

Note:

- *Since project is still at CD-0, the funding estimates in the tables above correlate to the upper end of the estimated TPC range.*

4. Details of Project Cost Estimate

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design	59,000	59,000	**N/A**
Design - Contingency	20,000	20,000	**N/A**
Total, Design (TEC)	**79,000**	**79,000**	**N/A**
Construction_No_Detail	500,000	500,000	**N/A**
Construction Contingency	255,000	255,000	**N/A**
Total, Construction (TEC)	**755,000**	**755,000**	**N/A**
Total, TEC	**834,000**	**834,000**	**N/A**
Contingency, TEC	*275,000*	*275,000*	***N/A***
Other Project Cost (OPC)			
Conceptual Design	15,194	15,194	**N/A**
Start-up	33,000	33,000	**N/A**
OPC - Contingency	17,806	17,806	**N/A**
Total, Except D&D (OPC)	**66,000**	**66,000**	**N/A**
Total, OPC	**66,000**	**66,000**	**N/A**
Contingency, OPC	*17,806*	*17,806*	***N/A***
Total, TPC	**900,000**	**900,000**	**N/A**
Total, Contingency (TEC+OPC)	***292,806***	***292,806***	***N/A***

Note:

- *Since project is at CD-0, the funding estimates correlate to the upper end of the estimated TPC range.*

5. Schedule of Appropriations Requests

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	8,500	7,000	7,000	—	811,500	834,000
	OPC	15,194	—	—	—	50,806	66,000
	TPC	23,694	7,000	7,000	—	862,306	900,000
FY 2027	TEC	8,500	7,000	8,500	8,500	801,500	834,000
	OPC	15,194	—	—	—	50,806	66,000
	TPC	23,694	7,000	8,500	8,500	852,306	900,000

6. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy	2Q FY 2040
Expected Useful Life	—
Expected Future Start of D&D of this capital asset	—

Related Funding Requirements
(dollars in thousands)

	Annual Costs		Life Cycle Costs	
	Previous Total Estimate	**Current Total Estimate**	**Previous Total Estimate**	**Current Total Estimate**
Operations	N/A	TBD	N/A	TBD
Utilities	N/A	TBD	N/A	TBD
Maintenance and Repair	N/A	TBD	N/A	TBD
Total, Operations and Maintenance	N/A	TBD	N/A	TBD

7. D&D Information

	Square Feet
New area being constructed by this project at ORNL	~90,000
Area of existing facility(ies) being replaced	0
Area of any additional D&D space to meet the "one-for-one" requirement	0

8. Acquisition Approach

The ORNL Management and Operating (M&O) contractor, UT Battelle, will perform the acquisition for this project, overseen by the DOE Oak Ridge National Laboratory Site Office. The M&O contractor will consider various acquisition approaches and project delivery methods and will be responsible for awarding and administering all subcontracts related to this project. SC will evaluate the M&O contractor's performance through the annual laboratory performance appraisal process.

SC and the M&O will draw from lessons learned from other SC projects and other similar facilities in planning and executing the project.

20-SC-51, U.S. Stable Isotope Production and Research Center (SIPRC)
Oak Ridge National Laboratory, ORNL
Project is for Design and Construction

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

Summary

The FY 2027 Request for the U.S. Stable Isotope Production and Research Center (SIPRC) is $45,100,000 of Total Estimated Cost (TEC) funding and $600,000 of Other Project Costs (OPC). The current Total Project Cost (TPC) point estimate is $325,000,000 with a preliminary TPC range of $187,000,000 to $338,000,000.

Significant Changes

This project data sheet (PDS) is an update of the FY 2026 PDS; the project is not a new start in FY 2027. The most recent DOE Order 413.3B approved Critical Decisions (CD) for SIPRC is CD-1, "Approve Alternative Selection and Cost Range", approved on November 4, 2021. Additionally, the most recent CD approvals for SIPRC Subproject 1 (SP1) are CD-3B, "Approve Long-Lead Procurements" approved on July 19, 2023; and CD-2/3, "Approve Performance Baseline and Approve Start of Construction" approved on March 15, 2024, which authorized the start of SP1 construction-related activities. The project received CD-3A approval for SP2 on March 24, 2026. CD-2/3 for SP3 anticipated in 2Q FY 2027 and SP2 in 3Q FY 2027.

The FY 2027 Request will support construction activities that include completing funding for conventional construction activities and procurement of electromagnetic isotope separation (EMIS) equipment, as well as supporting the start of construction activities for SP2 and SP3. OPC funding is included and supports pre-operational activities for SP1 as the EMIS equipment transitions to Operations in early FY 2028. To significantly increase IRP's stable isotope research capacity, the scope of Subproject 3 (SP3) changed from a test cascade infrastructure to single machine test stands. Single machine testing is foundational for advancing stable isotope process gas knowledge and significantly improves cascade design. The change is not expected to impact the total project costs or the completion date for SP1, however the schedule of SP2 and SP3 is expected to be extended by approximately one year due to the programmatic changes. Preliminary Key Performance Parameters have been modified to reflect the change in isotope for operational demonstration for SP2 and the change to single machine test stands in SP3. The technical approach, cost, and schedule of both SP2 and SP3 will be assessed through evidence-based peer review in FY 2026 and will be revalidated prior to SP2 and SP3 CD-2/3.

A Federal Project Director (FPD) with certification Level III and a Deputy Federal Project Director have been assigned to the SIPRC.

Critical Milestone History

	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
SIPRC Project	1/4/19	2/26/21	11/4/21	3Q FY 2027	3Q FY 2027	3Q FY 2027	3Q FY 2033
SIPRC SP1 - Facility and EMIS	1/4/19	2/26/21	11/4/21	3/15/24	3/15/24	3/15/24	4Q FY2030
SIPRC SP2 - Gas Centrifuge Cascade	1/4/19	2/26/21	11/4/21	3Q FY 2027	3Q FY 2027	3Q FY 2027	3Q FY 2033

	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
SIPRC SP3 - Translational Research for Isotopic Gases (TRIG)	1/4/19	2/26/21	11/4/21	2Q FY 2027	2Q FY 2027	2Q FY 2027	2Q FY 2032

Notes:
- *Dates shown in the SIPRC Project row in table above correspond to the latest subproject date (broken out by subproject in rows below).*
- *The estimated schedules shown are preliminary.*

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; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

	Performance Baseline Validation	CD-3A	CD-3B	CD-3C
SIPRC Project	3Q FY 2027	11/4/21	7/19/23	–
SIPRC SP1 - Facility and EMIS	3/15/24	11/4/21	7/19/23	–
SIPRC SP2 - Gas Centrifuge Cascade	3Q FY 2027	N/A	N/A	3/24/26
SIPRC SP3 - Translational Research for Isotopic Gases (TRIG)	2Q FY 2027	N/A	N/A	N/A

Note:
- *Dates shown in the SIPRC Project row in table above correspond to the latest subproject date (broken out by subproject below). Dates shown for CD-3C are anticipated.*

CD-3A for Subproject 1 – Approve Long-Lead Procurements (EMIS components and Facility Site Preparation)
CD-3B for Subproject 1 – Approve Long-Lead Procurements (Additional EMIS components)
CD-3C for Subproject 2 – Approve Long-Lead Procurements (Additional GC components)

Project Cost History

The overall SIPRC project is at CD-1, with a preliminary point estimate inclusive of SP1, SP2, and SP3, of $325,000,000 and Total Project Cost (TPC) range of $187,000,000 to $338,000,000. No construction, excluding for approved long-lead procurement, will be performed until the project performance baseline has been validated and CD-3 has been approved. SP1, Facility and EMIS, is at CD-2/3, with a baseline estimate of $231,500,000.

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	30,300	283,500	313,800	11,200	11,200	325,000
FY 2027	30,300	283,500	313,800	11,200	11,200	325,000

2. Project Scope and Justification

Scope

The scope of this project includes the design and construction of an approximately 64,000 square feet facility, and the associated instrumentation and equipment needed to re-establish large-scale enriched stable isotope production in the United States. Multiple electromagnetic isotope separator systems (EMIS), a gas centrifuge cascade, and single machine test stands will be designed and installed in the new facility which will also include adequate space for prototype systems development and future additional machines. The laboratory considered the optimal number of production systems for each type of technology as part of the alternatives analysis for CD-1. SIPRC will be a technical facility (i.e., minimal office and staff amenities) located on the Oak Ridge National Laboratory (ORNL) main campus. Gas centrifuges and electromagnetic separators are based on existing designs leveraging prior projects and R&D supported by the Office of Isotope R&D and Production (IRP).

Justification

The Stable Isotope Production and Research Center (SIPRC) at Oak Ridge National Laboratory directly supports the Administration's strategy to secure critical supply chains and ensure unrivaled American leadership in critical and emerging technologies. This project will re-establish a domestic versatile, large-scale stable isotope enrichment capacity that directly addresses reliance on foreign suppliers. Given that Russia is the major producer of most stable isotopes, and China is a rapidly emerging leader, SIPRC is a strategic imperative for national and economic security. Once constructed, SIPRC will provide stable isotopes that are catalysts for American innovation across sectors vital to the Administration's priorities, including medicine, quantum information science, fusion energy, and national security. The current domestic capacity is insufficient to meet the Nation's growing demands and inventories are depleted. By launching an expanded national capability in gas centrifuge and electromagnetic isotope separation (EMIS) technologies, SIPRC will drive American competitiveness and self-reliance for decades to come.

The project is being conducted in accordance with the project management requirements in DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, and all appropriate project management requirements will be met.

Key Performance Parameters (KPPs)

Preliminary Key Performance Parameters (KPPs) are defined at CD-1 and may change as each subproject continues towards CD-2, "Approve Performance Baseline". CD-1 approval was received November 4, 2021. SP1 KPPs are baselined; at SP2 and SP3 CD-2 approval, those KPPs will be baselined. The Threshold KPPs represent the minimum acceptable performance that the project must achieve. The Objective KPPs represent the desired project performance. Achievement of the Threshold KPPs will be a prerequisite for approval of CD-4, Project Completion.

Summary of preliminary KPPs is indicated below.

Performance Measure	Threshold	Objective
Design/construct building	SP1 – Facility and EMIS: Beneficial occupancy of the facility obtained.	SP1 – Facility and EMIS: Beneficial occupancy of the facility obtained.
Instrumentation design/development	SP1 – Facility and EMIS: Ninety percent (90 percent) of the EMIS machines complete a functional operability demonstration of individual EMIS machines running with gas for 4 hours.	SP1 – Facility and EMIS: One hundred percent (100 percent) of the EMIS machines complete a functional operability demonstration of individual EMIS machines running with gas for 4 hours.
	SP2 – Gas Centrifuge Cascade: a. The SIPRC project will complete the validation and verification (V&V) of the controls system with the completed documentation of the process. b. The SIPRC project will complete documented system leak tests with results meeting the requirements laid out in the systems requirements documents. c. The SIPRC project will complete a mechanical operability test of the completed production GCIS cascade.	SP2 – Gas Centrifuge Cascade: The SIPRC project will complete a Xenon gas test of the constructed cascade. Evidence of completion will be the report on the results of the gas test.
	SP3 – Translational Research for Isotopic Gases (TRIG): a. Construct 2 single machine test stands b. Complete the V&V of the control system with the completed documentation of the process. c. Complete documented system leak tests with results meeting the requirements laid out in the Systems Requirements Document(s).	SP3 – Translational Research for Isotopic Gases (TRIG): a. Construct 3 single machine test stands b. Complete the V&V of the control system with the completed documentation of the process. c. Complete documented system leak tests with results meeting the requirements laid out in the Systems Requirements Document(s).

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Estimated Cost (TEC)			
Design (TEC)			
Prior Years	27,000	27,000	14,628
FY 2025	3,300	3,300	2,249
FY 2026	—	—	4,000
FY 2027	—	—	7,365
Outyears	—	—	2,058
Total, Design (TEC)	**30,300**	**30,300**	**30,300**
Construction (TEC)			
Prior Years	53,900	53,900	21,923
Prior Years - IRA Supp.	75,000	75,000	—
FY 2025	42,600	42,600	45,179
FY 2026	50,000	50,000	70,000
FY 2027	45,100	45,100	94,821
Outyears	16,900	16,900	51,577
Total, Construction (TEC)	**283,500**	**283,500**	**283,500**
Total Estimated Cost (TEC)			
Prior Years	80,900	80,900	36,551
Prior Years - IRA Supp.	75,000	75,000	—
FY 2025	45,900	45,900	47,428
FY 2026	50,000	50,000	74,000
FY 2027	45,100	45,100	102,186
Outyears	16,900	16,900	53,635
Total, Total Estimated Cost (TEC)	**313,800**	**313,800**	**313,800**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Other Project Cost (OPC)			
Prior Years	8,800	8,800	6,099
FY 2027	600	600	1,947
Outyears	1,800	1,800	3,154
Total, Other Project Cost (OPC)	**11,200**	**11,200**	**11,200**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Project Cost (TPC)			
Prior Years	89,700	89,700	42,650
Prior Years - IRA Supp.	75,000	75,000	–
FY 2025	45,900	45,900	47,428
FY 2026	50,000	50,000	74,000
FY 2027	45,700	45,700	104,133
Outyears	18,700	18,700	56,789
Total, TPC	**325,000**	**325,000**	**325,000**

4. Details of Project Cost Estimate

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design	26,800	26,800	**N/A**
Design - Contingency	3,500	3,500	**N/A**
Total, Design (TEC)	**30,300**	**30,300**	**N/A**
Construction_No_Detail	217,300	217,300	**N/A**
Construction Contingency	66,200	66,200	**N/A**
Total, Construction (TEC)	**283,500**	**283,500**	**N/A**
Total, TEC	**313,800**	**313,800**	**N/A**
Contingency, TEC	*69,700*	*69,700*	***N/A***
Other Project Cost (OPC)			
Conceptual Design	8,800	8,800	**N/A**
Start-up	1,700	1,700	**N/A**
OPC - Contingency	700	700	**N/A**
Total, Except D&D (OPC)	**11,200**	**11,200**	**N/A**
Total, OPC	**11,200**	**11,200**	**N/A**
Contingency, OPC	*700*	*700*	***N/A***
Total, TPC	**325,000**	**325,000**	**N/A**
Total, Contingency (TEC+OPC)	***70,400***	***70,400***	***N/A***

5. Schedule of Appropriations Requests[a]

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	155,900	45,900	45,900	—	66,100	313,800
	OPC	8,800	—	—	—	2,400	11,200
	TPC	164,700	45,900	45,900	—	68,500	325,000
FY 2027	TEC	155,900	45,900	50,000	45,100	16,900	313,800
	OPC	8,800	—	—	600	1,800	11,200
	TPC	164,700	45,900	50,000	45,700	18,700	325,000

6. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy	3Q FY 2033
Expected Useful Life	30 years
Expected Future Start of D&D of this capital asset	3Q FY2063

Note: Start of Operations reflects the initiation of phased implementation of operations for the EMIS units.

Related Funding Requirements
(dollars in thousands)

	Annual Costs		Life Cycle Costs	
	Previous Total Estimate	Current Total Estimate	Previous Total Estimate	Current Total Estimate
Operations	33,295	33,295	1,106,807	1,106,807
Utilities	4,053	4,053	133,735	133,735
Maintenance and Repair	2,992	2,992	90,458	90,458
Total, Operations and Maintenance	40,340	40,340	1,331,000	1,331,000

Note: Life Cycle Costs includes escalation.

7. D&D Information

	Square Feet
New area being constructed by this project at ORNL	64,000
Area of existing facility(ies) being replaced	0
Area of any additional D&D space to meet the "one-for-one" requirement	0

The new area being constructed in this project is not replacing existing facilities. Any existing space that is freed up from consolidating activities into SIPRC will likely be repurposed.

[a] The project does not have CD-2 approval; FY 2025 schedules and costs are estimates consistent with the updated preliminary point estimate.

8. Acquisition Approach

The ORNL Management and Operating (M&O) contractor, UT Battelle, will perform the acquisition for this project, overseen by the DOE Oak Ridge National Laboratory Site Office. The M&O contractor will be responsible for awarding and administering all subcontracts related to this project. SC will evaluate the M&O contractor's performance through the annual laboratory performance appraisal process. SC and the M&O will draw from lessons learned from other SC projects and other similar facilities in planning and executing the project.

Isotope Production and Distribution Program Fund

<u>**Overview**</u>

The Department of Energy's (DOE) Isotope Production and Distribution Program Fund provides a vital financial mechanism (revolving fund) for the Office of Isotope R&D and Production (IRP). This fund is instrumental in driving a secure and reliable domestic supply of isotopes, which are essential materials for advancing American medicine, national security, industry, and strategic research. The overarching goal of IRP, enabled by this fund, is to establish the United States as the global leader in isotope innovation and to secure American isotope independence and mitigate disruptions across critical isotope supply chains in alignment with key Administration priorities.

The DOE Isotope Production and Distribution Program Fund relies on two key funding sources: direct appropriations to IRP and revenue from isotope sales. Together, these two funding sources allow the IRP to produce and sell radioactive and stable isotopes, byproducts, surplus materials, and related isotope services to federal agencies, universities, industry, and some international partners.

The National Isotope Development Center (NIDC), situated at the Oak Ridge National Laboratory, handles IRP's business operations. NIDC manages customer contracts, marketing, and coordinates isotope production. Isotope sales are priced to recover full costs, aligning with standard business practices, while supporting both R&D for and supply of isotopes for critical applications. The revolving fund allows for continuous implementation, independent of the federal budget cycle and fluctuating sales revenue, allowing IRP to maintain continuity of operations.

Annual appropriations support facility operations, research and development, and line-item projects. Customer revenues offset the costs of producing, dispensing, packaging, and shipping isotopes. About 95 percent of the revolving fund is dedicated to operations, R&D, and production, with approximately five percent available to cover changes in revenue and costs.

The revolving fund is capitalized through annual appropriations to cover the costs of facility operations, research and development (R&D), and line-item projects, and through revenues from customers to offset the costs of producing, dispensing, packaging, and shipping isotopes. Approximately 95 percent of the revolving funds are dedicated to operations, R&D, and production activities, with approximately 5-10 percent available to ensure operational stability and cover changes in revenue and costs.

In FY 2026, an estimated total of $258.0 million will be deposited into the revolving fund. This consists of the FY 2026 Enacted level of $170.0 million, plus anticipated collections by NIDC of $88 million. In FY 2026, IRP expects to sell over 135 different radioactive and stable isotopes to a broad range of research and commercial customers, including major pharmaceutical companies, industrial stakeholders, and researchers at hospitals, national laboratories, other federal agencies, universities, and private companies.

IRP supplies isotopes and related services to the Nation under the authority of the Atomic Energy Act of 1954, which outlines the U.S. Government's role in isotope distribution. The Isotope Production and Distribution Program Fund was established by the 1990 Energy and Water Development Appropriations Act (Public Law 101-101) and amended by the 1995 Energy and Water Development Appropriations Act (Public Law 103-316).

<u>Highlights of the FY 2027 Request</u>

In FY 2027, the Department anticipates continued demand growth in both radioactive and stable isotopes driven by the Administration's focus on groundbreaking advancements in fusion energy, quantum technologies, and next-generation cancer therapies. The IRP remains committed to strengthening U.S. independence from foreign isotope supply chains and is addressing high-risk areas to ensure that the U.S. has access to isotopes vital for scientific discovery, essential industrial applications, Administration priorities, and combating cancer.

The IRP's FY 2027 Request is $168.6 million, a decrease of $1.4 million below the FY 2026 Enacted level. In FY 2027, the revolving fund resources, including the IRP Request combined with anticipated collections by the NIDC, will be strategically deployed to advance the following program priorities:

- Enhancing, expanding and securing domestic isotope production
- Strengthening industry interactions, collaborations, and partnerships
- Driving isotope innovation through strategic research, development, demonstration, and deployment

Workforce Development for Teachers and Scientists

Overview

The Genesis Mission led by the Department of Energy (DOE) will usher in a new age of science and technology as well as reinvigorate U.S. workforce and future-ready U.S. talent development to address the Nation's most challenging scientific problems. The Genesis Mission will greatly raise awareness and excitement of the unique hands-on learning, research, and development opportunities for students, educators, and professionals at DOE national laboratories, especially in areas of artificial intelligence, quantum information science, fusion energy, and critical minerals and materials. Workforce Development for Teachers and Scientists (WDTS) long-standing partnerships and programs with all 17 DOE national laboratories will grow the U.S. science and technology talent needed to advance scientific discovery, drive technological innovation, and secure American energy dominance.

The WDTS program's mission is to ensure that DOE has a sustained pipeline for the science, technology, engineering, and mathematics (STEM) workforce. Accomplishing this mission involves continued support for undergraduate internships, graduate thesis research opportunities, and visiting faculty research appointments; administration of the Albert Einstein Distinguished Educator Fellowship for K–12 STEM teachers for the federal government; annual, nationwide middle and high school science competitions culminating in the National Science Bowl® finals in Washington, D.C; and pathway programs to connect more students to training opportunities at DOE national laboratories. Through these activities, WDTS plays a critical role in strengthening the U.S. STEM pipeline to meet Administration priorities and further America's global leadership in science and technology.

Highlights of the FY 2027 Request

The WDTS FY 2027 Request of $30.0 million is a decrease of $2.0 million from the FY 2026 Enacted level. The FY 2027 Request prioritizes funding for workforce training programs that attract and train students and educators for STEM learning and authentic hands-on research experiences at DOE national laboratories. The Request continues support for undergraduate internships, graduate thesis research, and visiting faculty program to help sustain a skilled scientific and technical workforce pipeline. The Request continues support for the technology infrastructure modernization and program evaluation activity, which is critically important for sustaining the workforce training programs. It prioritizes support for the DOE National Science Bowl®, a signature STEM competition testing middle and high school students' knowledge in science and mathematics, including activities to advance Artificial Intelligence (AI) education. In FY 2025, about a quarter of the WDTS training opportunities for students and educators were in artificial intelligence areas and this is expected to increase in future years. By encouraging and preparing U.S. students to pursue STEM careers, WDTS addresses DOE's mission critical talent needs to advance Administration priorities and support U.S. global leadership in science and technology.

Workforce Development for Teachers and Scientists
Funding

(dollars in thousands)

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Workforce Development for Teachers and Scientists				
Science Undergraduate Laboratory Internship (SULI)	15,300	15,300	11,200	-4,100
Community College Internship Program (CCI)	2,000	2,300	3,000	+700
Visiting Faculty Program (VFP)	2,100	2,100	2,000	-100
Office of Science Graduate Student Research (SCGSR) Program	5,000	5,200	5,000	-200
Internships and Visiting Faculty Activities at DOE Labs	**24,400**	**24,900**	**21,200**	**-3,700**
Albert Einstein Distinguished Educator Fellowship	**1,200**	**1,200**	**1,100**	**-100**
National Science Bowl	**3,100**	**3,400**	**6,100**	**+2,700**
Technology Development and On-Line Application	**700**	**900**	**500**	**-400**
Evaluation	**300**	**300**	**300**	**–**
Outreach	**1,300**	**1,300**	**800**	**-500**
Total, Workforce Development for Teachers and Scientists	**31,000**	**32,000**	**30,000**	**-2,000**

Program Accomplishments

Science Undergraduate Laboratory Internship (SULI) — In FY 2025, WDTS supported approximately 1,159 placements. Among the participants, about 98 percent reported high quality research experience and positive impacts to their educational and career goals, about 94 percent would consider a career at DOE national laboratories, and about 99 percent would recommend SULI to their peers.

Community College Internship Program (CCI) — In FY 2025, WDTS supported 189 placements for students from community colleges. Among the participants, about 98 percent reported high quality training experience, 99 percent would recommend CCI to their peers, and 97 percent reported positive impacts to their educational and career goals. Additionally, 94 percent of participants reported that they would consider a job or career at DOE national laboratories.

Visiting Faculty Program (VFP) — In FY 2025, WDTS supported a total of 103 faculty and 28 student VFP placements. All VFP Faculty participants reported a positive impact on their careers, and all expressed interest in continuing their research collaboration. All participants would recommend VFP to their peers.

Office of Science Graduate Student Research (SCGSR) Program — The two solicitations from FY 2024 resulted in a total of 141 new awards and the FY 2025 Solicitation 1 produced 70 new awards. FY 2025 Solicitation 2 is under review. The SCGSR program continued to expand its recruitment efforts to attract more graduate applicants to strengthen the U.S. energy scientific workforce. In FY 2025, SC continued its pilot for supplements to SCGSR awardees for international research collaboration experience at prestigious, world class institutions in ally countries. Following a successful first pilot with CERN (European Organization for Nuclear Research) in 2024, SC completed a second cohort with CERN as well as a first cohort with RIKEN Center for Computational Science in Japan in areas of AI, Quantum, and Data Science. Based on participant feedback, these activities contributed to the preparation of future U.S. research leaders and strengthening of U.S. global leadership in critical and emerging technologies.

Albert Einstein Distinguished Educator Fellowship (AEF) — In FY 2025, one WDTS-sponsored AEF participant held a WDTS office appointment and five received placements in Congressional offices. Nine other teachers were sponsored by the following Federal agencies: Library of Congress, Department of Defense, Department of Homeland Security, and U.S. Geological Survey. The AEF Program continues to equip teachers with access to a national network of education leaders and programs, a better understanding of the challenges and possibilities in STEM education, and a renewed passion for making a significant contribution to the educational community.

National Science Bowl® (NSB) — In FY 2025, more than 3,500 middle school students (from 448 schools) and 6,400 high school students (from 846 schools) participated in 115 regional competitions. Forty-nine U.S. States, the District of Columbia, and Puerto Rico were represented at regionals. More than 2,000 volunteers also participated in the local and national competitions. In April 2025, 47 middle school teams and 68 high school teams competed at the National Science Bowl® Championship Finals at the National Conference Center in Leesburg, Virginia, which featured a live web-streaming broadcast of the event to a broad public audience. The NSB continued to inspire young students nationwide to continue striving for high levels of academic success and to follow their passions in STEM, and hopefully, to consider a career to support the DOE mission. Leveraging the NSB leadership and national network, SC led the OSTP’s interagency task force to establish an implementation plan and launched the public website (part of ai.org) for the Presidential AI Challenge.

Technology Development and On-Line Application — In FY 2025, the critical upgrade of the online system platform continued. Upon completing the transition of the online application modules for individual programs, the design for administration access management and associated major features has been initiated. The upgrade has significantly increased cybersecurity and system performance through modernizing the online technology supporting all WDTS programs. WDTS continued to add new features to the mentor resource center to better support mentors at DOE national laboratories. WDTS implemented an online portal for DOE national laboratories to submit annual implementation plan and annual summary reports to ensure efficiency and effectiveness of program execution. Modules using data analysis and visualization capability continue to be updated and have demonstrated their usefulness in producing annual program data summary reports to all host DOE national laboratories, compiling data for WDTS evaluation projects, and producing information to address inquiries from internal, external stakeholders, and American public.

Evaluation — In FY 2025, WDTS, in collaboration with Oak Ridge Institute for Science and Education (ORISE), continued building a comprehensive evaluation portfolio to support evidence-based management of workforce development programs and initiatives in WDTS and SC. The program completed a set of evaluation projects based on pre- and post-survey of program participants by term or year, including assessing how undergraduate internships affected participants on their STEM skills/knowledge, education plan, and career goals. The program completed an outcome analysis of "where they are" for past CCI participants. The program completed a study of mentoring based on mentor surveys, which provided insights to better support mentors at DOE national laboratories. WDTS started preparation for a longitudinal evaluation study of the impacts of WDTS-sponsored undergraduate internship programs at DOE national laboratories, including submission of a Paperwork Reduction Act application for OMB approval.

Outreach — In FY 2025, in collaboration with DOE laboratories, ORISE, and institutions of higher education, WDTS supported and co-hosted a series of virtual events (Application Assistance Workshops, IGNITE Off, Internship Abstract Competition, and Virtual Internship Fair) to actively engage students and faculty at all levels and to attract them to apply to workforce training opportunities. In addition to virtual events, WDTS conducted in-person workshops and panels at professional society conferences to recruit applicants and promote DOE, SC, and WDTS opportunities. WDTS supported activities for DOE national laboratories to form and strengthen partnerships with community colleges, which lays a foundation for further development to meet the evolving needs for a modernized technical workforce, especially in DOE mission-critical frontiers including AI, Quantum Information Science, Nuclear Technology, Fusion Energy, Biotechnology, Critical Minerals and Materials, and Radioactive Waste Management. The effort aims to leverage partnerships between DOE national laboratories and local/regional community colleges to co-develop and deliver interdisciplinary pathways to produce well-prepared technical professionals readily employable by DOE national laboratories and regional energy industry partners.

Workforce Development for Teachers and Scientists

Description

Activities at the DOE Laboratories

WDTS supports activities such as the SULI, CCI, VFP, and SCGSR programs, and innovative pathways. One of the primary goals of these programs is to prepare students to enter STEM careers that are especially relevant to the DOE mission. By providing hands-on research experiences at DOE laboratories under the direction of scientist/engineer mentors, these activities provide workforce training opportunities for participants to engage in authentic research and discovery learning. WDTS activities are aligned with the Administration's goals for preparing a highly skilled future U.S. workforce.

SULI places students from two- and four-year undergraduate institutions as paid interns in science and engineering research activities at DOE laboratories, working with laboratory staff scientists and engineer mentors on projects related to DOE programs. Appointments are for ten weeks during the summer term and 16 weeks during the fall and spring terms.

CCI places community college students as paid interns in technological activities at DOE laboratories, working under the supervision of a laboratory technical professional or research development mentor. CCI provides dedicated technical training for community college students who are interested in technical careers and provides a pathway for those who plan to pursue further educational objectives beyond community college. Appointments are for ten weeks during the summer, fall, and spring terms.

The VFP goal is to increase the competitiveness of faculty members at U.S. institutions of higher education serving many undergraduate students, including all HBCUs, to expand the reach of the Office of Science. The VFP offers dual-track opportunities for both enhancing research capacity and innovating STEM teaching and learning at faculty members' home institutions through extended research collaboration with DOE national laboratories. Appointments are for 10 weeks in the summer.

SCGSR's goal is to prepare graduate students for STEM careers critically important to the SC mission by providing graduate thesis research opportunities at DOE laboratories. The SCGSR program provides supplemental awards for graduate students to pursue part of their graduate thesis research at a DOE laboratory or facility in areas that address scientific challenges central to the SC mission, including artificial intelligence, quantum information science, fusion energy, and critical minerals and materials. U.S. graduate students pursuing Ph.D. degrees in science areas aligned with the SC mission are eligible for research awards to conduct part of their graduate thesis research at a DOE laboratory or facility in collaboration with a DOE laboratory scientist. Research award terms range from three months to one year.

Given Administration priorities, especially the launch of the Genesis Mission, WDTS explores innovative pathway programs for students and educators to have hands-on science experience and gain access to modern science resources with exposure to career opportunities at DOE national laboratories.

Albert Einstein Distinguished Educator Fellowship

The Albert Einstein Distinguished Educator Fellowship Act of 1994 charges DOE with administering a fellowship program for elementary and secondary school mathematics and science teachers that focuses on bringing teachers' real-world expertise to government to help inform federal STEM education programs. Selected teachers spend 11 months in a Federal agency or a Congressional office. WDTS manages the Albert Einstein Distinguished Educator Fellowship Program for the Federal government. SC sponsors placement opportunities in WDTS and in Congressional offices. Other Federal agencies sponsor placement opportunities in their own offices. Participating agencies include the Department of Defense, Department of Homeland Security, the U.S. Geological Survey, the National Science Foundation, National Aeronautics and Space Administration, and the Library of Congress. The Fellows provide educational expertise, years of teaching experience, and personal insights to these offices to advance Federal STEM education programs.

National Science Bowl®

The DOE National Science Bowl® is a nationwide academic competition testing students' knowledge in all areas of mathematics and science, including energy. High school and middle school students are quizzed in a fast-paced, question-and-answer format. Approximately 340,000 students have participated in the National Science Bowl® throughout its 35-year history, and it is one of the Nation's largest science competitions. WDTS manages the National Science Bowl® and sponsors the National Science Bowl® finals competition. Regional competitions rely upon volunteers, and numerous local organizations, both public and private, support them. Leveraging the NSB national network, SC will also lead a national AI challenge.

Technology Development and On-Line Application

This activity modernizes on-line systems used to manage application solicitations, review applications, and facilitate data collection, curation, and compilation to support evaluation for WDTS programs. The Request continues to support a project to develop, build, and launch new online application and program support systems, with evolving new elements that improve cybersecurity and accessibility to applicants, advance program oversight and assessment, and support more efficient management and execution of programs.

Evaluation

This activity supports work to assess whether WDTS programs meet established goals. This is accomplished through triennial reviews of its program performers, of WDTS itself, and of program performance. These reviews involve peer reviews and Federal Advisory Committee-commissioned Committee of Visitors reviews. In addition, as an important part of assessing STEM workforce training programs, the activity supports efforts to measure short-term program outcomes and assess longer-term program impact. The supported activities include the compilation and analysis of data and other materials, including pre- and post-participation surveys, participant deliverables, notable outcomes (publications, presentations, patents, etc.), and longitudinal participant tracking/outcome analysis. WDTS is also tracking and reporting how its programs, and activities at DOE labs and SC scientific user facilities, fulfill program goals and objectives. In 2023 and 2024, an outcome analysis of over 3,000 SULI participants during 2004 and 2011 was conducted. Between 11 to 17 years post-appointment, over 95% of the SULI alumni have obtained at least a bachelor's degree, about 66% graduate degrees, about 71% remain in STEM fields or occupations, with 56% in industry, 13% universities, and about 5% DOE. In 2024, an outcome analysis of 423 SCGSR alumni who graduated in 2021 or earlier shows nearly 100% doctoral degree completion in STEM fields with 24% employment in DOE national laboratories, 41% industry, and 26% universities. The evaluation studies provide evidence to show the effectiveness of the WDTS programs. Continued efforts will be made to leverage the evaluation to ensure program effectiveness and management excellence.

Outreach

WDTS engages in outreach activities, some in cooperation with other DOE program offices and select federal agencies, to widely publicize its opportunities. The WDTS website (https://science.osti.gov/wdts) is the most widely used tool for prospective program participants to obtain information about WDTS, and it provides a gateway to accessing online applications for the WDTS programs. To help increase the applicant pool, WDTS conducts outreach via multiple venues with consistent brand messaging, such as hosting panels for and giving presentations to various stakeholder groups, sharing information with professional societies, and using virtual platforms to host internship and career fairs. WDTS leverages SC's social media resources to amplify the program opportunities to a broad range of stakeholders. WDTS collaborates with DOE host laboratories and facilities to attract and recruit applicants and to develop innovative training models to meet evolving scientific and technical workforce needs for DOE, energy industry, and the nation. The Laboratory Equipment Donation Program (LEDP) is operated under Outreach and provides excess laboratory equipment to STEM faculty at accredited post-secondary educational institutions. Through the General Services Administration Energy Asset Disposal System, DOE sites identify excess equipment, and colleges and universities can then search for equipment of interest and apply via the website. The equipment is free, but the receiving institutions pay for shipping costs.

Workforce Development for Teachers and Scientists

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Workforce Development for Teachers and Scientists	**$32,000**	**$30,000**	**-$2,000**
Activities at the DOE Laboratories	*$24,900*	*$21,200*	*-$3,700*
Science Undergraduate Laboratory Internship (SULI)	*$15,300*	*$11,200*	*-$4,100*
Funding for SULI supports approximately 1,008 students.		The Request for SULI will support approximately 738 students.	The funding will support 270 fewer students.
Community College Internship Program (CCI)	*$2,300*	*$3,000*	*+$700*
Funding for CCI supports approximately 174 students.		The Request for CCI will support approximately 200 students.	The increase of funding will support activities at DOE national laboratories to work with local/regional community colleges for training more technical professionals for DOE and energy industry.
Visiting Faculty Program (VFP)	*$2,100*	*$2,000*	*-$100*
Funding for the VFP supports approximately 66 faculty and 32 students.		The Request for the VFP will support approximately 65 faculty and 28 students.	The funding will support 1 fewer faculty and 4 fewer students.
Office of Science Graduate Student Research (SCGSR) Program	*$5,200*	*$5,000*	*-$200*
Funding for the SCGSR program supports approximately 145 graduate students. Funding supports an international research collaboration allowance to provide opportunities for SCGSR awardees to access unique international expertise and/or instrumentation and gain hands-on experience conducting research in an international environment.		The Request for the SCGSR program will support approximately 140 graduate students. The Request supports an international research collaboration allowance to provide opportunities for SCGSR awardees to access unique international expertise and/or instrumentation and gain hands-on experience conducting research in an international environment.	Funding will support 5 fewer students.

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Albert Einstein Distinguished Educator Fellowship	$1,200	$1,100	-$100
Funding supports 5 Fellows due to increased cost for hosting Fellows and administrating programs.		The Request will support 4 Fellows due to increased cost for hosting Fellows and administrating programs.	The funding will support 1 fewer Fellow.
National Science Bowl®	$3,400	$6,100	+$2,700
Funding supports the National Finals and provide central management of over 110 virtual and in-person regional events, involving more than 14,000 students from all fifty states, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands.		The Request will support the National Finals and provide central management of over 110 virtual and in-person regional events, involving more than 14,000 students from all fifty states, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands. The request includes support for continuing the national AI challenge.	The increase of funding will support the national AI Challenge and K-12 activities in support of the Executive Order titled "Advancing Artificial Intelligence Education for American Youth".
Technology Development and On-Line Application	$900	$500	-$400
Funding continues development and operation of the on-line systems and supports new development to meet the evolving needs of the programs. The online application and review system is the backbone infrastructure for the application, review, laboratory placement, award/participation management, outreach, and evaluation of WDTS workforce training programs at DOE national laboratories.		The Request will continue development and operation of the on-line systems and support new development to meet the evolving needs of the programs. The online application and review system is the backbone infrastructure for the application, review, laboratory placement, award/participation management, outreach, and evaluation of WDTS workforce training programs at DOE national laboratories.	The funding will focus on development of new features with higher priority for sustaining the online system.

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Evaluation	$300	$300	$ —
Funding supports a comprehensive evaluation portfolio with short- and long-term projects for assessing WDTS program performance and producing knowledge to inform evidence-based management and evaluation practice.		The Request will support a comprehensive evaluation portfolio with short- and long-term projects for assessing WDTS program performance and producing knowledge to inform evidence-based management and evaluation practice.	No change in funding.
Outreach	$1,300	$800	-$500
Funding supports outreach activities in collaboration with DOE host labs and facilities. WDTS will focus the support on recruitment to DOE research and development training opportunities in DOE mission-relevant fields of study. Support will continue for the LEDP program.		The Request will support activities for promoting WDTS programs to broad audiences to recruit more applicants and to leverage institutional partnerships to prepare scientific and technical workforce in DOE priority areas. Support will continue for the LEDP program.	The funding will focus on various outreach activities of higher priority to advancing DOE workforce mission.

Science Laboratories Infrastructure

Overview

The Science Laboratories Infrastructure (SLI) program's mission is to support scientific and technological innovation at the Office of Science (SC) National Laboratories by funding enabling infrastructure that fosters safe, effective, reliable, and resilient operations to increase American competitive advantage. Robust and reliable core infrastructure—including high-capacity electrical distribution, industrial cooling, steam, and other critical utility systems—ensures that advanced scientific instruments, supercomputers, quantum testbeds, and other research platforms can operate continuously at peak performance without interruptions or safety risks, enabling the national labs to sustain intensive AI and quantum computing workloads critical to achieving the Genesis Mission's ambitious scientific and innovation goals. SLI's main priorities are to transform and modernize SC's enabling physical assets (including major utility systems) while providing modern facilities that enable innovative scientific discoveries at velocity and scale. SLI funds line-item construction projects; General Plant Projects (GPP) (minor construction less than $34 million); Payments in Lieu of Taxes (PILT) to local communities around the Argonne, Brookhaven, and Oak Ridge National Laboratories (ANL, BNL, and ORNL); nuclear operations at ORNL; landlord responsibilities across the Oak Ridge Reservation; and the Laboratory Operations Apprenticeship program.

SC manages an infrastructure portfolio worth nearly $32 billion, across 10 national laboratories, encompassing nearly 24 million gross square feet (gsf) with almost 1,600 government-owned buildings and trailers serviced by over 1,300 miles of utilities. SC assets at the national laboratories include major research and user facilities, laboratory and office buildings, support facilities, and a vast network of utilities and required support capabilities. Delivering SC mission outcomes requires thoughtful stewardship of both research facilities and the required enabling infrastructure.

SC laboratories conduct annual assessments of the condition, utilization, and mission readiness of buildings and support infrastructure. In FY 2024, the assessments rated 42 percent of the general-purpose buildings substandard or inadequate to meet mission needs. In addition, 67 percent of the utility systems were rated as substandard or inadequate while 35 percent of the remaining support infrastructure was rated as substandard or inadequate. Substandard and inadequate condition of facilities results in operational inefficiencies, reduced resiliency and reliability, unplanned outages, costly repairs, and elevated safety risks. In collaboration with SC programs and the laboratories, SLI plans and executes modernization and revitalization projects to manage risk and reduce the impact of documented deficiencies on the SC mission.

SC and the laboratories integrate the assessment results with scientific mission needs through the development of comprehensive Campus Strategies during the bi-annual laboratory planning process. To support current and future capabilities and asset life-cycle management, each laboratory's Campus Strategy[a] identifies activities and infrastructure investments, such as line-item construction and GPPs. SC leadership uses these Campus Strategies, in concert with SC evaluations of infrastructure needs, to inform the SLI budget requests.

In FY 2025, SC invested nearly $884 million in maintenance, repair, and construction to sustain and enhance its general-purpose infrastructure. These investments stemmed from a variety of funding sources, including Federal appropriations for line-item construction, GPPs, laboratory overhead funding of Institutional GPPs (IGPPs), and maintenance and repair activities. The SLI investments in line-item construction and GPPs provide the critical backbone of laboratory operations and are key elements of this overall investment strategy.

[a] https://science.osti.gov/-/media/lp/pdf/laboratory-planning-process/FY-2022-ALPs-for-Web.pdf

Highlights of the FY 2027 Request

The SLI FY 2027 Request of $217.2 million is a decrease of $8.2 million below the FY 2026 Enacted level. The FY 2027 Request continues to focus on improving infrastructure across the SC national laboratory complex and supports ongoing construction projects:

1. Critical Infrastructure Recovery & Renewal at Princeton Plasma Physics Laboratory (PPPL);
2. Argonne Utilities Upgrade project at Argonne National Laboratory (ANL);
3. Linear Assets Modernization Project at Lawrence Berkeley National Laboratory (LBNL);
4. Critical Utilities Infrastructure Revitalization Project at SLAC National Accelerator Laboratory (SLAC); and
5. Utilities Infrastructure Project at Fermi National Accelerator Laboratory (FNAL).

The FY 2027 Request will support these utilities projects that reinforce the foundational infrastructure required for the SC laboratory complex to deliver on the Genesis Mission and other key DOE priorities. Expanded and modernized electrical distribution, steam, compressed-air capacity, and other systems ensure that AI, quantum, high-performance computing, and other scientific discovery assets can operate reliably to drive breakthroughs in national competitiveness and energy innovation.

The FY 2027 Request also includes funding for Minor Construction Projects (GPPs), which are an essential component of our infrastructure modernization portfolio. GPPs address urgent and targeted enabling infrastructure and utility needs across SC laboratories and facilities such as building HVAC systems, chilled water plants, electrical systems components (switches/transformers), fire safety capabilities, emergency generators, site security improvements, and office/laboratory modernization. Minor construction projects have a maximum cost of $34 million and fewer administrative requirements than line-item construction projects. This makes GPPs well suited to quickly address the most pressing revitalization and emergency repair needs and to avoid unplanned and disruptive interruptions. SLI evaluates GPP proposals using multiple criteria including mission impact, readiness, cost savings (including energy and water), resilience, and reliability.

SLI will select minor construction projects essential to sustaining the Laboratory's role in advancing DOE initiatives, including the Genesis Mission, fusion, and advanced computing. These projects allow SC sites to quickly address infrastructure capability gaps and will ensure resilient, mission-ready operations to drive breakthroughs in national competitiveness and energy innovation.

The FY 2027 Request will continue to support the Laboratory Operations Apprenticeship program to ensure the highly specialized skills and training needed at national laboratories to maintain and operate unique complex capabilities remain available. SC will rely on PPPL's experience running a United States Department of Labor (DOL)-registered apprenticeship program to meet the growing needs of fusion energy and engineering craft skills and will incorporate additional SC Labs to support a new generation of technicians, developing skills that apply to laboratory operations, as well as growing leading edge technology sectors critical to our national priorities.

Science Laboratories Infrastructure
Funding

(dollars in thousands)

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Science Laboratories Infrastructure				
Payment In Lieu of Taxes (PILT)	5,119	5,119	5,000	-119
OR Landlord	7,032	7,032	7,500	+468
Facilities and Infrastructure	42,692	40,000	50,000	+10,000
KG12 - Laboratory Operations Apprenticeship	3,000	3,000	3,000	–
Oak Ridge Nuclear Operations	46,000	46,000	46,000	–
Subtotal, Science Laboratories Infrastructure	**103,843**	**101,151**	**111,500**	**+10,349**
Construction				
21-SC-71 Princeton Plasma Innovation Center (PPIC), PPPL	30,000	34,600	–	-34,600
21-SC-72 Critical Infrastructure Recovery & Renewal (CIRR), PPPL	10,000	9,400	12,282	+2,882
20-SC-72 Seismic and Safety Modernization (SSM), LBNL	23,000	–	–	–
20-SC-73 CEBAF Renovation and Expansion (CEBAF), TJNAF	11,000	26,000	–	-26,000
20-SC-77 Argonne Utilities Upgrade (AU2), ANL	3,000	2,250	1,500	-750
20-SC-78 Linear Assets Modernization Project (LAMP), LBNL	25,000	19,000	25,000	+6,000
20-SC-79 Critical Utilities Infrastructure Revitalization (CUIR), SLAC	20,000	15,000	18,075	+3,075
20-SC-80 Utilities Infrastructure Project (UIP), FNAL	35,000	18,000	48,815	+30,815
Subtotal, Construction	**157,000**	**124,250**	**105,672**	**-18,578**
Total, Science Laboratories Infrastructure	**260,843**	**225,401**	**217,172**	**-8,229**

Science Laboratories Infrastructure
Explanation of Major Changes

	(dollars in thousands) FY 2027 Request vs FY 2026 Enacted
Construction Funding supports five ongoing line-item projects at ANL, FNAL, LBNL, PPPL, and SLAC.	**-18,578**
Total, Science Laboratories Infrastructure	**-8,229**

Program Accomplishments
Line-Item Construction Projects
Since FY 2006, SLI invested $1.6 billion to successfully complete 20 mission-enabling line-item construction projects that provided state-of-the-art science user support facilities, renovated, and repurposed aged facilities, upgraded inadequate core infrastructure and systems, and removed excess facilities. These investments began nearly 20 years ago with an SC decision to modernize infrastructure across the SC-stewarded laboratory complex. With these investments, SLI constructed approximately 1.4 million gsf of new and modernized existing space. As a result, an estimated 3,200 laboratory users and researchers now occupy newly constructed and/or modernized buildings that better support scientific and technological innovation in a collaborative environment. SLI has been recognized with 14 DOE Secretary's Achievement Awards for its contributions to the SC mission.

GPP upgrades across SC Laboratories
From FY 2016 through FY 2025 SLI has funded nearly $341 million in 54 laboratory core infrastructure improvement projects including electrical and utility improvements, building renovations, safety upgrades, resilience and other site improvement projects. Examples of FY 2025 SLI GPP investments in core infrastructure include Substation 549 Transformer Upgrades at ANL, Building 680 Upgrade Entrance Portal at BNL, Bethel Valley Central Campus 4000 Area 2.4kv to 13.8kv Upgrade at ORNL, and Reactive Power Compensation at SLAC.

Nuclear Operations Support at Oak Ridge National Laboratory
From FY 2016 through FY 2025 SLI has funded $306 million of nuclear operations support for the Nonreactor Nuclear Facilities Division (NNFD) at ORNL, driving high performance in isotope production and other hot cell work. This funding has supported facility maintenance, equipment upgrades and replacements, utilities and facility costs, and small upgrade projects to nuclear infrastructure. ORNL recently completed a high bay crane modernization project, improving operator safety and operational efficiency.

Description

The SLI Infrastructure Support subprogram invests in enabling infrastructure and specific laboratory operations. The Facilities and Infrastructure activity is critical for upgrading and replacing enabling infrastructure systems (e.g., utility systems, site-wide services, and general-purpose facilities) to improve reliability, resilience, effectiveness, and performance, as well as addressing emerging needs or end-of-life requirements. This subprogram also supports nuclear operations at ORNL, stewardship needs (e.g., roads and grounds maintenance) across the Oak Ridge Reservation, the Laboratory Operations Apprenticeship program, and Payments In Lieu of Taxes (PILT).

Facilities and Infrastructure

This activity supports urgent and emerging core infrastructure needs that are most efficiently addressed through minor construction investments (general plant projects of less than $34 million). SC laboratories conduct annual condition assessments of their core infrastructure to determine the investment needs for these basic systems that form the backbone of their campuses. SLI uses these assessments to maintain and update an integrated and prioritized list of critical core infrastructure investment priorities across all 10 laboratories. Projects are rigorously evaluated for mission criticality and readiness, cost savings (including energy and water cost savings), remediation of environmental, safety, and health issues, resilience, and reliability. The highest priority projects are selected for funding based on the totality of these criteria and availability of funds.

SLI will select minor construction projects essential to sustaining the Laboratory's role in advancing DOE initiatives, including the Genesis Mission, fusion, and advanced computing. These projects allow SC sites to quickly address infrastructure capability gaps and will ensure resilient, mission-ready operations to drive breakthroughs in national competitiveness and energy innovation.

Oak Ridge Nuclear Operations

This activity supports critical DOE nuclear operations required to safely operate ORNL's non-reactor nuclear facilities (i.e., Buildings 7920, 7930, 3525, and 3025E) and associated support facilities. These facilities support a variety of users including SC programs, the National Nuclear Security Administration, the Office of Nuclear Energy (NE), and other federal agencies. This funding provides general operations support, maintenance and repair of hot cells and supporting systems, and ensures compliance with safety standards and procedures.

OR Landlord

This activity supports landlord responsibilities, including infrastructure, for the 24,000-acre Oak Ridge Reservation and DOE facilities in the city of Oak Ridge, Tennessee. The funding supports maintenance of roads, grounds, other infrastructure, and support and improvement of environmental protection, safety, and health.

Payment In Lieu of Taxes (PILT)

The Department is authorized to provide discretionary payments to state and local government authorities for real property that is not subject to taxation because it is owned by the United States Federal Government and operated on behalf of the Department. Under this authorization, PILT is provided to communities around ANL, BNL, and ORNL to compensate for lost tax revenues for land removed from local tax rolls. PILT payments are negotiated between the Department and local governments based on land values and tax rates.

Laboratory Operations Apprenticeship

This activity continues to support the development of SC's Laboratory Operations Apprenticeship program. SC HQ partners with the Management and Operating (M&O) contractors to develop a pipeline of highly and uniquely skilled trade and craft employees at SC's national laboratories, to ensure continued maintenance and operations of the unique, complex capabilities that enable American energy and technological advantage.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Infrastructure Support	**$101,151**	**$111,500**	**+$10,349**
Facilities and Infrastructure	$40,000	$50,000	+$10,000
Funding continues to support the highest priority enabling infrastructure needs across the SC complex. Projects over $5 million being considered are: Building 510 Upgrade Electrical Substation - Phase I at BNL, Water Supply Tank 82 and Electrical Pump Upgrade at LBNL, 3410 Central Utility Plant (CUP) Cooling Tower Upgrade at PNNL, and Electrical Rehabilitation - 12kV Cable Replacement - Region 4 at SLAC.		The Request will support the highest priority enabling infrastructure needs across the SC complex. Projects over $5 million being considered are: Copper Communication Utilities Replacement and Upgrade at FNAL, Bethel Valley West Campus 2000/3000 Area 2.4kv to 13.8kV Upgrade at ORNL, and RF Roof Replacements (C40) at PPPL.	The funding will continue to support at least three new GPPs at multiple laboratories, addressing some of the highest risks and needs for operations.
Oak Ridge Nuclear Operations	$46,000	$46,000	$ —
Funding supports the general operations and maintenance of ORNL's non-reactor nuclear facilities by the Office of Science.		The Request will support the general operations and maintenance of ORNL's non-reactor nuclear facilities by the Office of Science.	Funding will continue to support critical activities needed to operate and maintain the non-reactor nuclear facilities at ORNL.
OR Landlord	$7,032	$7,500	+$468
Funding continues to support landlord responsibilities across the Oak Ridge Reservation and in Oak Ridge. Activities include maintenance of roads, grounds, other infrastructure, and support and improvement of environmental protection, safety, and health.		The Request will support landlord responsibilities across the Oak Ridge Reservation and in Oak Ridge. Activities include maintenance of roads, grounds, other infrastructure, and support and improvement of environmental protection, safety, and health.	Funding will continue to support OR landlord requirements.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Payment In Lieu of Taxes (PILT) $5,119	$5,000	-$119
Funding supports PILT payments to communities around ANL, BNL, and ORNL.	The Request will provide funding for PILT payments to communities around ANL, BNL, and ORNL.	Funding will support the anticipated PILT requirements.
Laboratory Operations Apprenticeship $3,000	$3,000	$ —
Funding supports a program for technician- and craft-level apprenticeships in the SC complex.	The Request will support a program for technician- and craft-level apprenticeships in the SC complex.	Funding will continue development of the Laboratory Operations Apprenticeship program.

Science Laboratories Infrastructure
Construction

Description
The mission of the Science Laboratories Infrastructure (SLI) construction program is to support scientific and technological innovation at the SC national laboratories by modernizing enabling infrastructure and fostering effective operations at required velocity and scale. SLI's line-item construction projects are focused on infrastructure necessary to execute priority operations and will modernize SC's general-purpose physical assets and facilities through new construction recapitalization, and modernization that increase operational effectiveness and enable cutting edge scientific discovery and innovation.

Robust and reliable core infrastructure—including high-capacity electrical distribution, industrial cooling, steam, and other critical utility systems—ensures that advanced scientific instruments, supercomputers, quantum testbeds, and other research platforms can operate continuously at peak performance without interruptions or safety risks, enabling the national labs to sustain intensive AI and quantum computing workloads critical to achieving the Genesis Mission's ambitious scientific and innovation goals.

The FY 2027 Request includes funding for five ongoing line-item construction projects:

1. Critical Infrastructure Recovery & Renewal at PPPL;
2. Argonne Utilities Upgrade at ANL;
3. Linear Assets Modernization Project at LBNL;
4. Critical Utilities Infrastructure Revitalization at SLAC; and
5. Utilities Infrastructure Project at FNAL.

These utilities projects reinforce the foundational infrastructure required for the laboratory complex to deliver on the Genesis Mission and other key DOE priorities.

This Request includes no new line-item construction projects.

<u>21-SC-72, Critical Infrastructure Recovery & Renewal, PPPL</u>
The Critical Infrastructure Recovery & Renewal (CIRR) project at PPPL will revitalize critical infrastructure that supports the PPPL campus. Upgrades that may be completed as part of the CIRR project include: the electrical distribution system; standby power; chilled water generation and distribution; underground distribution networks; HVAC systems; and communication systems.

CIRR was delegated to the Laboratory Director on April 29, 2025. Prior to the delegation, CIRR received DOE Order 413.3B CD-3A approval, Approve Long-Lead Procurements and Site Preparation Activities, on April 24, 2025. Future project milestones will be finalized in accordance with PPPL's plan for project execution during FY 2026. The current preliminary TEC range for this project is $80,100,000 to $96,000,000. The preliminary TPC range for this project is $81,800,000 to $97,700,000. The preliminary TEC point estimate is $87,300,000 and the TPC point estimate for this project is $89,000,000.

<u>20-SC-77, Argonne Utilities Upgrade, ANL</u>
The Argonne Utilities Upgrade (AU2) project at ANL will revitalize and selectively upgrade ANL's existing major utility systems to increase the reliability, capability, and safety of ANL's infrastructure to meet the DOE's mission. The project will focus on systems such as steam, water, and chilled water.

AU2 was delegated to the Laboratory Director on April 29, 2025. Prior to the delegation, AU2 received DOE Order 413.3B CD-3A approval, Approve Site Preparation Activities, on September 14, 2023. Future project milestones will be finalized in accordance with the M&O contractor's plan for project execution. The last of two subprojects anticipates approval of CD-2, Approve Performance Baseline, in the fourth quarter of FY 2032. This project is pre-CD-2; therefore, schedule estimates are subject to change. The preliminary TEC range for this project is $172,000,000 to $290,250,000. The preliminary TPC range for this project is $173,000,000 to $291,250,000. The preliminary TEC point estimate is $215,000,000 and the TPC point estimate for this project is $216,000,000.

20-SC-78, Linear Assets Modernization Project, LBNL
The Linear Assets Modernization Project (LAMP) at LBNL will upgrade high priority utility systems to increase the reliability, capability, resiliency, and safety of LBNL's infrastructure to meet the DOE's mission. The project will upgrade utility systems including, but not limited to, domestic water, natural gas, storm drain, sanitary sewer, electrical, and communications.

LAMP was delegated to the Laboratory Director on April 29, 2025. Prior to the delegation, LAMP received DOE Order 413.3B CD-1 approval, Approve Alternative Selection and Cost Range, on April 13, 2022. Future project milestones will be finalized in accordance with the M&O contractor's plan for project execution. The preliminary TEC range for this project is $164,000,000 to $376,000,000. The preliminary TPC range for this project is $170,000,000 to $386,000,000. The preliminary TEC is $236,000,000 and the preliminary TPC estimate for this project is $242,000,000.

20-SC-79, Critical Utilities Infrastructure Revitalization, SLAC
The Critical Utilities Infrastructure Revitalization (CUIR) project's primary objective is to close enabling infrastructure gaps to support multi-program science enablers by increasing reliability, resiliency, and service capacity in electrical, mechanical, and civil systems site-wide. The CUIR project will address the critical campus-wide utility and infrastructure deficiencies by replacing, repairing, and modernizing the highest risk water/fire protection, sanitary sewer, storm drain, electrical, and cooling water system deficiencies.

CUIR was delegated to the Laboratory Director on April 29, 2025. Prior to the delegation, CUIR received DOE Order 413.3B CD-3A approval, Approve Long-Lead Procurement and Early Site Preparation, on May 8, 2023. Future project milestones will be finalized in accordance with the M&O contractor's plan for project execution. The last of three subprojects anticipates approval of CD-2, Approve Performance Baseline, in the third quarter of FY 2029. This project is pre-CD-2; therefore, schedule estimates are subject to change. The preliminary TEC range for this project is $160,000,000 to $306,000,000. The preliminary TPC range for this project is $165,000,000 to $311,000,000. The preliminary TEC estimate is $204,000,000 and the preliminary TPC estimate for this project is $208,500,000.

20-SC-80, Utilities Infrastructure Project, FNAL
The Utilities Infrastructure Project (UIP) at FNAL will modernize selected potions with the highest risk to major utility systems across the FNAL campus. For example, this project will upgrade the industrial cooling water system, potable water distribution system, sanitary sewer and storm collection systems, natural gas distribution system, electrical distribution system, and the Central Utility Building. In doing so, upgrades will increase capacity, reliability, and personnel safety across critical services.

UIP received its most recent DOE Order 413.3B Critical Decision (CD) approval, CD-3A, Approve Long Lead Procurement, on December 6, 2024. The last of three subprojects anticipates approval of CD-2, Approve Performance Baseline, in the third quarter of FY 2031. This project is pre-CD-2; therefore, schedule estimates are subject to change. The preliminary TEC range for this project is $248,000,000 to $403,000,000 and the preliminary TPC range of $252,000,000 to $411,000,000. These cost ranges encompass the most feasible preliminary alternatives at this time. The preliminary TEC estimate is $310,000,000 and the preliminary TPC estimate for this project $314,000,000.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request		Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Construction	**$124,250**		**$105,672**	**-$18,578**
21-SC-71, Princeton Plasma Innovation Center, PPPL	$34,600		$ -	-$34,600
FY 2026 is the final year of funding for this project and supports construction activities.		No Funding is requested.		No Funding is requested.
21-SC-72, Critical Infrastructure Recovery & Renewal, PPPL	$9,400		$12,282	+$2,882
Funding supports construction activities.		The Request will support construction activities.		Funding will support construction activities.
20-SC-73, CEBAF Renovation and Expansion, TJNAF	$26,000		$ -	-$26,000
FY 2026 is the final year of funding for this project and supports construction activities.		No funding is requested.		No Funding is requested.
20-SC-77, Argonne Utilities Upgrade, ANL	$2,250		$1,500	-$750
Funding supports construction activities.		The Request will support construction activities.		Funding will support construction activities.
20-SC-78, Linear Assets Modernization Project, LBNL	$19,000		$25,000	+$6,000
Funding supports construction activities.		The Request will support construction activities.		Funding will support construction activities.
20-SC-79, Critical Utilities Infrastructure Revitalization, SLAC	$15,000		$18,075	+$3,075
Funding supports construction activities.		The Request will support construction activities.		Funding will support construction activities.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
20-SC-80, Utilities Infrastructure Project, FNAL $18,000	$48,815	+$30,815
Funding supports construction activities.	The Request will support construction activities.	Funding will support construction activities.

Note:
- *Other Project Costs (OPC) are funded through laboratory overhead.*

Science Laboratories Infrastructure
Capital Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Capital Operating Expenses						
Minor Construction Activities						
General Plant Projects	N/A	N/A	42,692	40,000	50,000	+10,000
Total, Capital Operating Expenses	**N/A**	**N/A**	**42,692**	**40,000**	**50,000**	**+10,000**

Minor Construction Activities

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
General Plant Projects (GPP)						
GPPs (greater than $5M and $34M or less)						
Substation 549 Transformer Upgrades	9,791	–	9,791	–	–	–
Building 680, Upgrade Entrance Portal at BNL	11,200	–	11,200	–	–	–
Bethel Valley Central Campus 4000 Area 2.4kv to 13.8 kV Upgrade at ORNL	9,690	–	9,690	–	–	–
Reactive Power Compensation at SLAC	7,765	–	7,765	–	–	–
B/510 Upgrade Electrical Substation - Phase I	7,000	–	–	7,000	–	-7,000
Water Supply Tank 82 and Electric Pump Upgrade	8,000	–	–	8,000	–	-8,000
3410 Central Utility Plant (CUP) Cooling Tower Upgrade at PNNL	8,100	–	–	8,100	–	-8,100
Electrical Rehabilitation - 12kV Cable Replacement - Region 4 at SLAC	5,194	–	–	5,194	–	-5,194
Copper Communication Utilities Replacement and Upgrade at FNAL	10,000	–	–	–	10,000	+10,000
Bethel Valley West Campus 2000/3000 Area 2.4kv to 13.8kv Upgrade at ORNL	32,711	–	–	–	32,711	+32,711
RF Roof Replacements (C40)* at PPPL	7,289	–	–	–	7,289	+7,289
Total GPPs (greater than $5M and $34M or less)	116,740	N/A	38,446	28,294	50,000	+21,706
Total GPPs $5M or less	N/A	N/A	4,246	11,706	–	-11,706
Total, General Plant Projects (GPP)	**N/A**	**N/A**	**42,692**	**40,000**	**50,000**	**+10,000**

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Total, Minor Construction Activities	**N/A**	**N/A**	**42,692**	**40,000**	**50,000**	**+10,000**

Note:
- *GPP activities $5M and less include design and construction for additions and/or improvements to land, buildings, replacements or addition to roads, and general area improvements. AIP activities $5M and less include minor construction at an existing accelerator facility.*

	Total	FY 2025 Enacted	FY 2026 Annualized CR	FY 2027 Request	FY 2027 Request vs. FY 2026 Annualized CR ($ Change)
Institutional General Plant Projects (IGPP)					
IGPPs (greater than or equal to $5M and less than $30M)					
Renovate 4500S Ground Floor Wing 1, ORNL	12,300	–	–	12,300	+12,300
Renovate 4505 High Bay, ORNL	9,000	–	–	9,000	+9,000
Modernize Building 4501 HVAC System, ORNL	18,000	–	–	18,000	+18,000
Modernize Building 3500 MEP Systems, ORNL	33,200	–	–	33,200	+33,200
B66 4th Floor Lab Upgrades, LBNL	25,000	25,000	–	–	–
Fire Alarm Panel Replacements, LBNL	8,000	–	–	8,000	+8,000
SW-A8 Power Resiliency, LBNL	30,000	–	30,000	–	-30,000
B73 Office and Laboratory Buildout	30,000	–	30,000		-30,000
B62 Space Renovation, LBNL	15,000	–	–	15,000	+15,000
B55 Space Renovation, LBNL	6,000	–	–	6,000	+6,000
B70A Space Renovation, LBNL	5,000	–	–	5,000	+5,000
B74 Space Renovation, LBNL	5,000	–	–	5,000	+5,000
Modernize Bldg., 4508 , ORNL	8,000	–	8,000	–	-8,000
Improve 7667 Low level Waste Site, ORNL	21,000	–	21,000	–	-21,000
Improve 7603 Basement and 7608 Vault, ORNL	12,500	–	12,500	–	-12,500
Improve East Security Portal Infrastructure, ORNL	6,700	–	–	6,700	+6,700
Construct Bethel Valley Support Facility, ORNL	19,000	–	19,000	–	-19,000
Construct Melton Valley Campus Support Facility, ORNL	12,000	12,000	–	–	–
Construct Melton Valley Portable Water Main, ORNL	16,000	–	–	16,000	+16,000
Construct Central Campus Support, ORNL	16,900	–	–	16,900	+16,900
Construct Laboratory Protection Training Capability, ORNL	16,900	–	–	16,900	+16,900
Construct Craft Support Services Facility, ORNL	33,500	–	–	33,500	+33,500
Construct Fabrication and Inspection Services Support Facility, ORNL	32,100	–	–	32,100	+32,100
Construct Roads & Grounds Maintenance Operations Facility, ORNL	21,400	–	–	21,400	+21,400
Construct East Campus Operations Support Facility, ORNL	16,900	–	–	16,900	+16,900
Construct Field Deployment Readiness Facility, ORNL	34,000	–	–	34,000	+34,000
Secure Computational and Data Sciences, PNNL	32,000	32,000	–	–	–
Shipping and Receiving Replacement, PNNL	15,000	15,000	–	–	–
PSL Lab Renovation, PNNL	14,000	14,000	–	–	–
Physical Access Control System Upgrade, PNNL	25,500	–	–	25,500	+25,500
318 HVAC Upgrade, PNNL	8,500	8,500	–	–	–
Building 223 Renovation, ANL	6,000	–	–	6,000	+6,000
Building 222 Service Level Renovation, ANL	10,000	–	–	10,000	+10,000
Building 362 Renovation, ANL	15,000	–	–	15,000	+15,000
Secure Space Compliance Upgrades, ANL	15,000	–	–	15,000	+15,000

High Voltage Substation Resilience and Redundancy Upgrades - Substation 551, ANL	22,000	–	22,000	–	-22,000
B/902 Power Upgrade - 3000kVA Substation, BNL	10,000	–	10,000	–	-10,000
B2 Space Renovation, LBNL	5,000	–	–	5,000	+5,000
Construct Multiprogram Office Building , ORNL	24,500	–	24,500	–	-24,500
Modernize 2000/3000 Area Utilities, ORNL	29,300	–	29,300	–	-29,300
Modernize Mechanical Utilities in East Campus, ORNL	29,900	–	29,900	–	-29,900
300 Area Storage Facility (formerly 325WSPAD Upgrade), PNNL	19,000	–	19,000	–	-19,000
NSR Collaboration Center, PNNL	10,000	–	–	10,000	+10,000
Total IGPPs (greater than or equal to $5M and less than $30M)	**754,100**	**106,500**	**255,200**	**392,400**	**+137,200**
Total IGPPs less than $5M	**74,335**	**32,326**	**20,301**	**21,708**	**+1,407**
Total, Institutional General Plant Projects (IGPP)	**828,435**	**138,826**	**275,501**	**414,108**	**+138,607**

Note:

- *Institutional General Plant Projects (IGPPs) are indirect funded minor construction activities that are general institutional in nature and address general purpose, site-wide needs.*

Science Laboratories Infrastructure
Construction Projects Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
22-SC-71, Critical Infrastructure Modernization Project (CIMP) - ORNL						
Total Estimated Cost (TEC)	1,000	1,000	–	–	–	–
Other Project Cost (OPC)	2,500	2,000	–	500	–	-500
Total Project Cost (TPC)	**3,500**	**3,000**	**–**	**500**	**–**	**-500**
21-SC-71, Princeton Plasma Innovation Center (PPIC), PPPL						
Total Estimated Cost (TEC)	107,500	42,900	30,000	34,600	–	-34,600
Other Project Cost (OPC)	2,200	1,923	–	–	277	+277
Total Project Cost (TPC)	**109,700**	**44,823**	**30,000**	**34,600**	**277**	**-34,323**
21-SC-72, Critical Infrastructure Recovery & Renewal (CIRR), PPPL						
Total Estimated Cost (TEC)	87,300	16,150	10,000	9,400	12,282	+2,882
Other Project Cost (OPC)	1,700	1,392	–	–	–	–
Total Project Cost (TPC)	**89,000**	**17,542**	**10,000**	**9,400**	**12,282**	**+2,882**
20-SC-72, Seismic and Safety Modernization (SSM), LBNL						
Total Estimated Cost (TEC)	141,000	118,000	23,000	–	–	–
Other Project Cost (OPC)	4,000	3,561	–	–	–	–
Total Project Cost (TPC)	**145,000**	**121,561**	**23,000**	**–**	**–**	**–**
20-SC-73, CEBAF Renovation and Expansion (CEBAF), TJNAF						
Total Estimated Cost (TEC)	87,000	50,000	11,000	26,000	–	-26,000
Other Project Cost (OPC)	3,300	1,492	–	–	–	–
Total Project Cost (TPC)	**90,300**	**51,492**	**11,000**	**26,000**	**–**	**-26,000**
20-SC-74, Craft Resources Support Facility (CRSF), ORNL						
Total Estimated Cost (TEC)	40,000	40,000	–	–	–	–
Other Project Cost (OPC)	900	850	–	50	–	-50
Total Project Cost (TPC)	**40,900**	**40,850**	**–**	**50**	**–**	**-50**
20-SC-77, Argonne Utilities Upgrade (AU2), ANL						
Total Estimated Cost (TEC)	215,000	27,007	3,000	2,250	1,500	-750
Other Project Cost (OPC)	1,000	1,000	–	–	–	–
Total Project Cost (TPC)	**216,000**	**28,007**	**3,000**	**2,250**	**1,500**	**-750**
20-SC-78, Linear Assets Modernization Project (LAMP), LBNL						
Total Estimated Cost (TEC)	236,000	53,725	25,000	19,000	25,000	+6,000
Other Project Cost (OPC)	6,000	3,263	–	–	–	–
Total Project Cost (TPC)	**242,000**	**56,988**	**25,000**	**19,000**	**25,000**	**+6,000**

	(dollars in thousands)					
	Total	**Prior Years**	**FY 2025 Enacted**	**FY 2026 Enacted**	**FY 2027 Request**	**FY 2027 Request vs FY 2026 Enacted**
20-SC-79, Critical Utilities Infrastructure Revitalization (CUIR), SLAC						
Total Estimated Cost (TEC)	204,000	64,925	20,000	15,000	18,075	+3,075
Other Project Cost (OPC)	4,500	2,783	250	250	–	-250
Total Project Cost (TPC)	**208,500**	**67,708**	**20,250**	**15,250**	**18,075**	**+2,825**
20-SC-80, Utilities Infrastructure Project (UIP), FNAL						
Total Estimated Cost (TEC)	310,000	66,500	35,000	18,000	48,815	+30,815
Other Project Cost (OPC)	4,000	2,050	–	–	–	–
Total Project Cost (TPC)	**314,000**	**68,550**	**35,000**	**18,000**	**48,815**	**+30,815**
19-SC-74, BioEPIC, LBNL						
Total Estimated Cost (TEC)	165,000	165,000	–	–	–	–
Other Project Cost (OPC)	2,200	1,536	–	664	–	-664
Total Project Cost (TPC)	**167,200**	**166,536**	**–**	**664**	**–**	**-664**
Total, Construction						
Total Estimated Cost (TEC)	**1,593,800**	**645,207**	**157,000**	**124,250**	**105,672**	**-18,578**
Other Project Cost (OPC)	**32,300**	**21,850**	**250**	**1,464**	**277**	**-1,187**
Total Project Cost (TPC)	**1,626,100**	**667,057**	**157,250**	**125,714**	**105,949**	**-19,765**

21-SC-72, Critical Infrastructure Recovery & Renewal, PPPL
Princeton Plasma Physics Laboratory, PPPL
Project is for Design and Construction

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

Summary

The FY 2027 Request for the Critical Infrastructure Recovery & Renewal (CIRR) project is $12,282,000 of Total Estimated Cost (TEC) funding. The preliminary TEC range for this project is $80,100,000 to $96,000,000. The preliminary Total Project Cost (TPC) range for this project is $81,800,000 to $97,700,000. Currently, these cost ranges encompass the most feasible preliminary alternatives. The preliminary TPC point estimate for this project is $89,000,000.

Princeton Plasma Physics Laboratory's (PPPL's) increasingly unreliable and antiquated utility infrastructure is negatively impacting laboratory operations. Scientific productivity is dependent on a capable, available, flexible, maintainable, reliable, and resilient support infrastructure. This project will provide critical infrastructure needed to operate the laboratory missions safely and efficiently. These systems will be modern and energy efficient, reducing the operating cost and improving the resilience of the facilities.

This utilities project reinforces the foundational infrastructure for PPPL to support the Genesis Mission and other key DOE priorities. Primarily, expanded and modernized chilled water to ensure scientific discovery assets can operate reliably to drive breakthroughs in national competitiveness and energy innovation.

Significant Changes

On April 29, 2025, CIRR was delegated to Laboratory Director. Prior to that delegation, the project received DOE Order 413.3B Critical Decision (CD)-3, Approve Long-Lead Procurements and Site Preparation Activities, on April 24, 2025.

Critical Milestone History

Fiscal Year	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
FY 2027	9/16/19	2/23/21	2/23/21	TBD	3Q FY 2025	TBD	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; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

Fiscal Year	Performance Baseline Validation	CD-3A
FY 2027	TBD	4/24/25

CD-3A – Approve Long-Lead Procurements and Site Preparation Activities

Project Cost History

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	9,680	77,620	87,300	1,700	1,700	89,000
FY 2027	9,680	77,620	87,300	1,700	1,700	89,000

Notes:
- *Funding estimates are preliminary as a formal baseline has not been established.*
- *Other Project Costs (OPC) are funded through laboratory overhead.*

2. Project Scope and Justification

Scope

The CIRR project at PPPL will revitalize critical infrastructure that supports the PPPL campus to ensure reliability and resilience. Upgrades that are completed as part of the CIRR project include: the electrical distribution system; standby power; chilled water generation and distribution; HVAC systems; and communication systems. The scientific activities that require reliable and resilient utilities include National Spherical Torus Experiment-Upgrade (NSTX-U), Facility for Laboratory Reconnection Experiments (FLARE), and Lithium Tokamak Experiment-Beta (LTX-β).

The long-lead equipment procurement was approved on April 24, 2025.

Justification

PPPL is a key DOE contributor to plasma science and directly supports the DOE mission to make fusion energy a practical reality and further U.S. economic competitiveness. To maintain system operability, it is essential to have reliable infrastructure in place. The current systems are past their useful life, obsolete, unreliable, and inefficient. Portions of the current system are part of the original infrastructure built in 1958. To maintain current missions and enable future ones, the infrastructure must be upgraded with modern, efficient, and reliable systems.

CIRR will deliver modern and resilient general-purpose infrastructure which will be more reliable, efficient, and sustainable and meet current industry standards. For example, replacing the obsolete hot deck/cold deck HVAC system will not only result in repair savings, but will generate energy savings as well. This project is being designed to consider the best available and most efficient technology to enhance operations and maintenance of new systems and equipment.

Upgrading these utility systems directly enhances the Laboratory's ability to advance DOE's flagship initiatives such as the Genesis Mission, fusion energy development, and expanded computing needs. Modern, resilient infrastructure provides the stable power, chilled water, industrial HVAC, etc. systems necessary for the continuous operation of advanced scientific instruments and high-demand computing resources that position the U.S. as a global technology leader.

The project is being conducted in accordance with Office of Science delegated authority using sound project management principles.

Key Performance Parameters (KPPs)

The KPPs are preliminary and may change as the project matures. The KPPs will be finalized in accordance with M&O contractor's plan for project execution. The Threshold KPPs represent the minimum acceptable performance that the project must achieve. The Objective KPPs represent the desired project performance. Achievement of the Threshold KPPs will be a prerequisite for approval of project completion.

Performance Measure	Threshold	Objective
Chilled Water Generation	▪ Install new Central Chilled Water Plant equipment and cooling tower cells to ensure distribution of 2,000 tons of cooling capacity to the site.	
Communications Distribution Network	▪ Complete redundant fiber optic connection between Princeton University's High-Performance Computing Research Center and the PPPL Computer Center (PPLCC). ▪ Replace 10,000 linear feet of legacy fiber optic cable between PPLCC and network distribution closets across site.	▪ Provide redundant fiber optic connections between redundant PPLCC network core and critical network distribution closets. ▪ Provide fully divergent pathway for new service provider connection to the PPLCC.
Electrical Distribution & Standby Power	▪ Improve mission readiness of the primary electrical distribution system in the 138 kV Yard by replacing XQT-2, XVT-1 transformers. ▪ Provide 2600kW generator for C-Site. ▪ Replace Q1 Switchgear and shift Q6 switchgear loads to Q1. ▪ Upgrade 2 Substations for priority buildings and facilities.	▪ Replace existing 26 kV OCB VB-1 to improve resilience of back-up power source. ▪ Replace 1 substation for priority buildings and facilities.
HVAC Systems	▪ Upgrade 2 HVAC system equipment for priority buildings on C-Site.	▪ Upgrade up to 5 HVAC system equipment priority buildings on C-Site.

Performance Measure	Threshold	Objective
Underground Distribution Network	▪ Replace 800 L.F. of chilled water main piping that has exceeded its useful life expectancy and is prone to failure.	

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Estimated Cost (TEC)			
Design (TEC)			
Prior Years	9,680	9,680	3,213
FY 2025	—	—	6,467
Total, Design (TEC)	**9,680**	**9,680**	**9,680**
Construction (TEC)			
Prior Years	6,470	6,470	—
FY 2025	10,000	10,000	1,950
FY 2026	9,400	9,400	8,400
FY 2027	12,282	12,282	13,000
Outyears	39,468	39,468	54,270
Total, Construction (TEC)	**77,620**	**77,620**	**77,620**
Total Estimated Cost (TEC)			
Prior Years	16,150	16,150	3,213
FY 2025	10,000	10,000	8,417
FY 2026	9,400	9,400	8,400
FY 2027	12,282	12,282	13,000
Outyears	39,468	39,468	54,270
Total, Total Estimated Cost (TEC)	**87,300**	**87,300**	**87,300**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Other Project Cost (OPC)			
Prior Years	1,392	1,392	1,392
Outyears	308	308	308
Total, Other Project Cost (OPC)	**1,700**	**1,700**	**1,700**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Project Cost (TPC)			
Prior Years	17,542	17,542	4,605
FY 2025	10,000	10,000	8,417
FY 2026	9,400	9,400	8,400
FY 2027	12,282	12,282	13,000
Outyears	39,776	39,776	54,578
Total, TPC	**89,000**	**89,000**	**89,000**

4. Details of Project Cost Estimate

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design	7,510	7,510	**N/A**
Design - Contingency	2,170	2,170	**N/A**
Total, Design (TEC)	**9,680**	**9,680**	**N/A**
Construction_No_Detail	60,230	60,230	**N/A**
Construction Contingency	17,390	17,390	**N/A**
Total, Construction (TEC)	**77,620**	**77,620**	**N/A**
Total, TEC	**87,300**	**87,300**	**N/A**
Contingency, TEC	*19,560*	*19,560*	***N/A***
Other Project Cost (OPC)			
Conceptual Planning	200	200	**N/A**
Conceptual Design	1,300	1,300	**N/A**
OPC - Contingency	200	200	**N/A**
Total, Except D&D (OPC)	**1,700**	**1,700**	**N/A**
Total, OPC	**1,700**	**1,700**	**N/A**
Contingency, OPC	*200*	*200*	***N/A***
Total, TPC	**89,000**	**89,000**	**N/A**
Total, Contingency (TEC+OPC)	***19,760***	***19,760***	***N/A***

5. Schedule of Appropriations Requests

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	16,150	10,000	9,400	—	51,750	87,300
	OPC	1,392	—	—	—	308	1,700
	TPC	17,542	10,000	9,400	—	52,058	89,000

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2027	TEC	16,150	10,000	9,400	12,282	39,468	87,300
	OPC	1,392	—	—	—	308	1,700
	TPC	17,542	10,000	9,400	12,282	39,776	89,000

Notes:
- *Funding estimates are preliminary as a formal baseline has not been established.*
- *Other Project Costs (OPC) are funded through laboratory overhead.*

6. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy	TBD
Expected Useful Life	50 years
Expected Future Start of D&D of this capital asset	N/A

Related Funding Requirements
(dollars in thousands)

	Annual Costs		Life Cycle Costs	
	Previous Total Estimate	**Current Total Estimate**	**Previous Total Estimate**	**Current Total Estimate**
Operations	1,100	1,100	55,000	55,000
Utilities	N/A	N/A	N/A	N/A
Maintenance and Repair	1,000	1,000	50,000	50,000
Total, Operations and Maintenance	2,100	2,100	105,000	105,000

7. D&D Information

This project replaces critical infrastructure components; no new construction area is anticipated to be constructed in this project, and it will not replace existing facilities.

	Square Feet
New area being constructed by this project at PPPL	None
Area of D&D in this project at PPPL	None
Area at PPPL to be transferred, sold, and/or D&D outside the project, including area previously "banked"	None
Area of D&D in this project at other sites	None
Area at other sites to be transferred, sold, and/or D&D outside the project, including area previously "banked"	None
Total area eliminated	None

8. Acquisition Approach

The PPPL Management and Operating (M&O) Contractor, Princeton University, is performing the acquisition for this project, overseen by the Princeton Site Office. The M&O contractor is responsible for awarding and managing all subcontracts related to this project.

The Office of Science delegated Project Management Executive responsibilities to the National Laboratory Director. The project will be managed and delivered by the M&O Contractor. SC will evaluate the M&O contractor's performance through the annual laboratory performance appraisal process.

20-SC-77, Argonne Utilities Upgrade, ANL
Argonne National Laboratory, ANL
Project is for Design and Construction

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

Summary

The FY 2027 Request for the Argonne Utilities Upgrade (AU2) project is$1,500,000 of Total Estimated Cost (TEC) funding. The preliminary TEC range for this project is $172,000,000 to $290,250,000. The preliminary Total Project Cost (TPC) range for this project is $173,000,000 to $291,250,000. Currently, these cost ranges encompass the most feasible preliminary alternatives. The preliminary TPC point estimate for this project is $216,000,000.

This utilities project reinforces the foundational infrastructure for ANL to support the Genesis Mission and other key DOE priorities. Primarily, expanded and modernized chilled water to ensure scientific discovery assets can operate reliably to drive breakthroughs in national competitiveness and energy innovation.

On April 29, 2025, AU2 was delegated to the Laboratory Director. Prior to the delegation, the project received DOE Order 413.3B Critical Decision (CD)-3A, Approve Site Preparation, on September 14, 2023.

Significant Changes

This Construction Project Data Sheet (CPDS) is an update to the FY 2026 CPDS and does not include a new start for FY 2026. FY 2027 funds will support construction activities.

Critical Milestone History

	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
AU2 - Overall, ANL	5/17/19	10/30/20	7/1/21	4Q FY 2032	1Q FY 2030	4Q FY 2032	3Q FY 2035
AU2 - Chilled Water Plant , ANL	–	–	–	3Q FY 2030	3/15/24	3Q FY 2030	2Q FY 2034
AU2 - Steam Plant and Utility Piping, ANL	–	–	–	4Q FY 2032	4Q FY 2029	4Q FY 2032	3Q FY 2035

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; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

	Performance Baseline Validation	CD-3A
AU2 - Overall, ANL	4Q FY 2029	9/14/23
AU2 - Chilled Water Plant , ANL	3Q FY 2030	9/14/23
AU2 - Steam Plant and Utility Piping, ANL	4Q FY 2032	1Q FY 2032

CD-3A – Long Lead Procurements and Site Preparation Activities.

Project Cost History

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	15,000	200,000	215,000	1,000	1,000	216,000
FY 2027	15,000	200,000	215,000	1,000	1,000	216,000

Notes:
- *Funding estimates are preliminary as a formal baseline has not been established.*
- *Other Project Costs (OPC) are funded through laboratory overhead.*

2. Project Scope and Justification

Scope
The preliminary scope of the AU2 project includes upgrading failing 1940s-era utilities across the ANL campus. These utilities include steam, water, and chilled water. To facilitate its execution, the AU2 project is comprised of two subprojects consisting of scope needed to achieve complete and usable assets. Subproject 1 is the Chilled Water and Utility Piping Upgrades and consists of site preparation and demolition, which was completed via CD-3A and will be followed by construction of a new chilled water plant when construction is authorized. Subproject 2 is the Steam and Utility Piping Upgrades and consists of modernization such as an existing boiler, replacement and modernization of several major utility systems, including steam and condensate, domestic water, canal water, and sewer systems.

Justification
An efficient, maintainable, and reliable infrastructure is critical to the success and mission capability of ANL's research facilities. Revitalizing and upgrading the near century old major utility systems including steam, water, and chilled water systems is a mission need for ANL to overcome current limitations in meeting modern demands. For example, steam is a critical infrastructure for Argonne facilities; the Advanced Photon Source (APS) is dependent on the steam utility for holding extremely tight temperature and humidity ranges required for beam line operations and stability.

Improving the performance and resilience of utilities would allow major pieces of scientific equipment to operate more efficiently and effectively with modern engineered controls. Upgrading these utility systems directly enhances the Laboratory's ability to advance DOE's flagship initiatives such as the Genesis Mission and expanded computing needs. Modern, resilient infrastructure provides the steam, chilled water, etc. systems necessary for the continuous operation of advanced scientific instruments and high-demand computing resources that position the U.S. as a global technology leader.

AU2 will reduce operational risks in critical infrastructure and utility support systems and provide more resilient, efficient, and sustainable general-purpose infrastructure. The project will include installation of a combination of data collection and monitoring systems that enable predicting failures and making adjustments that minimize impacts to mission critical scientific operations.

The project is being conducted in accordance with Office of Science delegated authority using sound project management principles.

Key Performance Parameters (KPPs)

The KPPs are preliminary and may change as the project matures. The KPPs will be finalized in accordance with the M&O contractor's plan for project execution. The Threshold KPPs comprise the minimum scope required to fulfill the Mission Need. The Objective KPPs indicate potential project scope enhancements, consistent with the project's Mission Need, which could be executed if the project experiences favorable cost and schedule performance. Achievement of the Threshold KPPs will be a prerequisite for project completion.

Performance Measure	Threshold	Objective
Chilled Water and Utility Piping Upgrades (Cooling Systems).	▪ Construct a new 6,300-ton chilled water plant with N+1 reliability. ▪ Modernize, replace, or construct new distribution piping for 5,000 linear feet of utility piping.	▪ Equipment and controls upgrades at the 371 and 528 chilled water plants. ▪ Modernize five domestic water tanks. ▪ Potential capacity upgrades, new equipment, equipment replacements, and various other utility system reliability projects to increase reliability of laboratory internal utilities.
Steam and Utility Piping Upgrades (Steam & Condensate, Water Supply, Sewer).	▪ Recapitalize one (1) existing boiler in Building 108. ▪ Modernize, replace or construct new distribution piping for 2,500 linear feet of utility piping.	▪ Recapitalize one additional boiler in Building 108. ▪ Modernize, replace or construct new distribution piping for up to 15,000 linear feet of utility piping and support structures (e.g., vaults, pipe supports, valves, culverts, etc.). ▪ Install between 50 and 250 new smart meters.

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Estimated Cost (TEC)			
Design (TEC)			
Prior Years	11,000	11,000	7,270
FY 2025	—	—	199
FY 2026	—	—	275
FY 2027	—	—	275
Outyears	4,000	4,000	6,981
Total, Design (TEC)	**15,000**	**15,000**	**15,000**
Construction (TEC)			
Prior Years	16,007	16,007	1,468

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Estimated Cost (TEC)			
FY 2025	3,000	3,000	—
FY 2026	2,250	2,250	—
FY 2027	1,500	1,500	—
Outyears	177,243	177,243	198,532
Total, Construction (TEC)	**200,000**	**200,000**	**200,000**
Total Estimated Cost (TEC)			
Prior Years	27,007	27,007	8,738
FY 2025	3,000	3,000	199
FY 2026	2,250	2,250	275
FY 2027	1,500	1,500	275
Outyears	181,243	181,243	205,513
Total, Total Estimated Cost (TEC)	**215,000**	**215,000**	**215,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Other Project Cost (OPC)			
Prior Years	1,000	1,000	1,000
Total, Other Project Cost (OPC)	**1,000**	**1,000**	**1,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Project Cost (TPC)			
Prior Years	28,007	28,007	9,738
FY 2025	3,000	3,000	199
FY 2026	2,250	2,250	275
FY 2027	1,500	1,500	275
Outyears	181,243	181,243	205,513
Total, TPC	**216,000**	**216,000**	**216,000**

4. Details of Project Cost Estimate

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design	13,400	13,400	**N/A**
Design - Contingency	1,600	1,600	**N/A**
Total, Design (TEC)	**15,000**	**15,000**	**N/A**
Construction_No_Detail	162,600	162,600	**N/A**
Construction Contingency	37,400	37,400	**N/A**
Total, Construction (TEC)	**200,000**	**200,000**	**N/A**
Total, TEC	**215,000**	**215,000**	**N/A**
Contingency, TEC	*39,000*	*39,000*	***N/A***
Other Project Cost (OPC)			
Conceptual Planning	1,000	1,000	**N/A**
Total, Except D&D (OPC)	**1,000**	**1,000**	**N/A**
Total, OPC	**1,000**	**1,000**	**N/A**
Contingency, OPC	***N/A***	*N/A*	***N/A***
Total, TPC	**216,000**	**216,000**	**N/A**
Total, Contingency (TEC+OPC)	***39,000***	***39,000***	***N/A***

5. Schedule of Appropriations Requests

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	27,007	3,000	1,500	—	183,493	215,000
	OPC	1,000	—	—	—	—	1,000
	TPC	28,007	3,000	1,500	—	183,493	216,000
FY 2027	TEC	27,007	3,000	2,250	1,500	181,243	215,000
	OPC	1,000	—	—	—	—	1,000
	TPC	28,007	3,000	2,250	1,500	181,243	216,000

Notes:
- *Funding estimates are preliminary as a formal baseline has not been established.*
- *Other Project Costs (OPC) are funded through laboratory overhead.*

6. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy	SP-1: 2Q FY 2034 SP-2: 3Q FY 2035
Expected Useful Life	50 years
Expected Future Start of D&D of this capital asset	SP-1: 2Q FY 2084 SP-2: 3Q FY 2085

Related Funding Requirements
(dollars in thousands)

	Annual Costs		Life Cycle Costs	
	Previous Total Estimate	**Current Total Estimate**	**Previous Total Estimate**	**Current Total Estimate**
Operations	2,955	2,955	147,750	147,750
Utilities	4,423	4,423	221,150	221,150
Maintenance and Repair	739	739	36,950	36,950
Total, Operations and Maintenance	8,117	8,117	405,850	405,850

7. D&D Information

The new area being constructed in this project does not replace existing facilities.

	Square Feet
New area being constructed by this project at ANL	20,221
Area of D&D in this project at ANL	10,473
Area at ANL to be transferred, sold, and/or D&D outside the project, including area previously "banked"	None[b]
Area of D&D in this project at other sites	None
Area at other sites to be transferred, sold, and/or D&D outside the project, including area previously "banked"	None
Total area eliminated	None

8. Acquisition Approach

The ANL Management and Operating (M&O) Contractor, UChicago Argonne, LLC, is performing the acquisition for this project, overseen by the Argonne Site Office. The M&O contractor is responsible for awarding and managing all subcontracts related to this project.

The Office of Science delegated Project Management Executive responsibilities to the National Laboratory Director. The project will be managed and delivered by the M&O Contractor. SC will evaluate the M&O contractor's performance through the annual laboratory performance appraisal process.

[b] With the implementation of OMB's Reduce the Footprint initiative, DOE no longer maintains the space bank. Footprint is managed using the Facility Information Management System, with the decisions on additions and offsets made in accordance with the DOE Real Property Efficiency Plan.

20-SC-78, Linear Assets Modernization Project, LBNL
Lawrence Berkeley National Laboratory, LBNL
Project is for Design and Construction

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

Summary
The FY 2027 Request for the Linear Assets Modernization Project is $25,000,000 of Total Estimated Cost (TEC) funding. The preliminary TEC range for this project is $164,000,000 to $376,000,000. The preliminary Total Project Cost (TPC) range for this project is $170,000,000 to $386,000,000. Currently, these cost ranges encompass the most feasible preliminary alternatives. The preliminary TPC estimate for this project is $242,000,000.

LAMP will upgrade high priority utility systems to increase the reliability, capability, resilience, and safety of LBNL's infrastructure to meet DOE's mission. The project will upgrade utility systems, including, but not limited to, domestic water, natural gas, electrical, and communication.

This utilities project reinforces the foundational infrastructure for LBNL to support the Genesis Mission and other key DOE priorities. Primarily, expanded and modernized chilled water to ensure scientific discovery assets can operate reliably to drive breakthroughs in national competitiveness and energy innovation.
On April 29, 2025, LAMP was delegated to the Laboratory Director. Prior to that delegation, the project received DOE Order 413.3B Critical Decision (CD) for LAMP, CD-1, Approve Alternative Selection and Cost Range, was approved on April 13, 2022.

Significant Changes
The M&O has executed the award with the design-build contractor.

Critical Milestone History

Fiscal Year	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
FY 2027	5/17/19	4/13/22	4/13/22	TBD	TBD	TBD	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; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

Fiscal Year	Performance Baseline Validation	CD-3A
FY 2027	TBD	TBD

CD-3A – Approve Long-Lead Procurements and Site Preparation Activities.

Project Cost History

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	43,800	192,200	236,000	6,000	6,000	242,000
FY 2027	43,800	192,200	236,000	6,000	6,000	242,000

Notes:
- *Funding estimates are preliminary as a formal baseline has not been established.*
- *Other Project Costs (OPC) are funded through laboratory overhead.*

2. Project Scope and Justification

Scope

LAMP will upgrade the highest priority utility systems to increase the reliability, capability, and safety of LBNL's infrastructure to meet the DOE's mission. The utility systems include, but are not limited to, domestic water, natural gas, storm drain, sanitary sewer, electrical, and communication.

The project will aim to upgrade the most critical utility components considering operational risk and efficiencies, redundancy, utility bundling, and capacity needed for strategic growth, including expanding the primary electrical substation capacity at Grizzly Peak to power advanced supercomputing capability (NERSC-10) to full capacity and meet future lab power needs. LAMP will also implement a multi-system approach for the renewal and improvement of LBNL's utility assets, considering geographical limitations as well as potential synergies with nearby sustainment and improvement projects, that provide opportunities for enhancement. In addition to electrical expansion, the LAMP scope will upgrade multiple utility systems providing for overall increased reliability and ease of maintenance.

Justification

SC uses the capabilities of LBNL to execute 23 of the 24 core capabilities and the mission of multiple SC program offices, including ASCR, BER, BES, and HEP. The SC mission and multiple scientific programs require increased reliability, capability, and safety of LBNL's utility infrastructure. Utility infrastructure represents almost half of LBNL's large, deferred maintenance backlog and represents a significant capability gap in LBNL's ability to provide reliable and safe services to meet DOE's mission needs. Existing infrastructure is insufficient to support planned facility modernization and growth. Without a modern utility infrastructure backbone, future growth of the science mission at LBNL may not be achievable. For these reasons, direct infrastructure investment is necessary to address deferred maintenance reduction, restore operational reliability, increase resiliency, and provide the backbone necessary for scientific advancements.

LAMP will deliver modern and resilient general-purpose infrastructure which will be more efficient and sustainable. It will be designed to consider the best available and most efficient technology to enhance operations and maintenance of new systems and equipment and includes installation of a combination of data collection and monitoring systems that enable predicting failures and extreme weather events and adjusting in real time to minimize impacts to mission critical scientific operations. The initial stages of the project will enable an optimized NERSC-10 upgrade, which will play a central role in breakthrough science.

Upgrading these utility systems directly enhances the Laboratory's ability to advance DOE's flagship initiatives such as the Genesis Mission and expanded computing needs. Modern, resilient infrastructure provides the stable power and other systems necessary for the continuous operation of advanced scientific instruments and high-demand computing resources that position the U.S. as a global technology leader.

The project is being conducted in accordance with Office of Science delegated authority using sound project management principles.

Key Performance Parameters (KPPs)
The KPPs are preliminary and may change as the project matures. The KPPs will be finalized in accordance with the M&O contractor's plan for project execution. The Threshold KPPs represent the minimum acceptable performance that the project must achieve. The Objective KPPs represent the desired project performance. Achievement of the baselined Threshold KPPs will be a prerequisite for project completion.

Performance Measure	Threshold	Objective
Storm Drainage System, Hydrauger/ Slope Stability	Install 1,000 Linear Feet of hydraugers.	Install up to 5,500 Linear Feet of hydraugers.
Sanitary Sewer	Install 150 Linear Feet of pipe.	Install up to 7,000 Linear Feet of pipe.
High Pressure City Water	Install new 12" ductile iron pipe (DIP) water main and remove existing main in the East Canyon Corridor.	Install new 12" DIP water main and remove existing main in the McMillan Corridor.
Communications & Data	Install 2,600 Linear Feet of ductbank.	Install up to 14,500 Linear Feet of ductbank with manholes and cables. (Lawrence Corridor).
Electrical Distribution/Grizzly Substation	Expand the Grizzly Substation to 70 MW capacity.	Expand the Grizzly Substation up to 150 MW capacity with two redundant lines with SCADA for new equipment.
		Provide a new SCADA Control Building.
		Provide two remote SCADA Control Rooms.
		Provide SCADA remote control and monitoring of existing and new circuit breakers.
		Install up to 400 Linear Feet of electrical feeders segregating lines 1 and 2 for SW-A1.
		Install SCADA for existing 115kV equipment.
	Install 2,700 Linear Feet of electrical feeders segregating lines 1 and 2.	Install up to 8,300 Linear Feet of electrical feeders segregating lines 1 and 2.
		Feed B59 (NERSC-10) with up to 80 MW of electrical power with 3,500 Linear Feet of redundant and segregated lines.

Performance Measure	Threshold	Objective
		Install up to 14,000 Linear Feet of electrical feeders and Pad Mounted Switches for electrical distribution loops, segregating lines 1 and 2.
		Provide up to 3 SCADA remote controls and monitoring of existing and new circuit breakers.
Natural Gas	Install 200 Linear Feet of pipe.	Install up to 5,500 Linear Feet of pipe. (Lawrence Corridor).
Compressed Air	Not Applicable	Install up to 7,500 Linear Feet of pipe.
Controls	Not Applicable	Install up to 150 Smart Meters for new wet utility construction.
		Provide integration with SCADA.
		Provide integration with Microgrid enhancement.

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Estimated Cost (TEC)			
Design (TEC)			
Prior Years	30,400	30,400	8,990
FY 2025	13,400	13,400	6,021
FY 2026	—	—	16,000
FY 2027	—	—	12,789
Total, Design (TEC)	**43,800**	**43,800**	**43,800**
Construction (TEC)			
Prior Years	23,325	23,325	—
FY 2025	11,600	11,600	—
FY 2026	19,000	19,000	25,000
FY 2027	25,000	25,000	35,000
Outyears	113,275	113,275	132,200
Total, Construction (TEC)	**192,200**	**192,200**	**192,200**
Total Estimated Cost (TEC)			
Prior Years	53,725	53,725	8,990
FY 2025	25,000	25,000	6,021
FY 2026	19,000	19,000	41,000
FY 2027	25,000	25,000	47,789
Outyears	113,275	113,275	132,200

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Estimated Cost (TEC)			
Total, Total Estimated Cost (TEC)	**236,000**	**236,000**	**236,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Other Project Cost (OPC)			
Prior Years	3,263	3,263	3,263
Outyears	2,737	2,737	2,737
Total, Other Project Cost (OPC)	**6,000**	**6,000**	**6,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Project Cost (TPC)			
Prior Years	56,988	56,988	12,253
FY 2025	25,000	25,000	6,021
FY 2026	19,000	19,000	41,000
FY 2027	25,000	25,000	47,789
Outyears	116,012	116,012	134,937
Total, TPC	**242,000**	**242,000**	**242,000**

4. Details of Project Cost Estimate

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design	37,250	37,250	**N/A**
Design - Contingency	6,550	6,550	**N/A**
Total, Design (TEC)	**43,800**	**43,800**	**N/A**
Construction_No_Detail	165,135	165,135	**N/A**
Construction Contingency	27,065	27,065	**N/A**
Total, Construction (TEC)	**192,200**	**192,200**	**N/A**
Total, TEC	**236,000**	**236,000**	**N/A**
Contingency, TEC	*33,615*	*33,615*	***N/A***
Other Project Cost (OPC)			
Conceptual Planning	2,610	2,610	**N/A**

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Conceptual Design	2,190	2,190	**N/A**
OPC - Contingency	1,200	1,200	**N/A**
Total, Except D&D (OPC)	**6,000**	**6,000**	**N/A**
Total, OPC	**6,000**	**6,000**	**N/A**
Contingency, OPC	*1,200*	*1,200*	***N/A***
Total, TPC	**242,000**	**242,000**	**N/A**
Total, Contingency (TEC+OPC)	***34,815***	***34,815***	***N/A***

5. Schedule of Appropriations Requests

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	53,725	25,000	13,100	—	144,175	236,000
	OPC	3,263	—	—	—	2,737	6,000
	TPC	56,988	25,000	13,100	—	146,912	242,000
FY 2027	TEC	53,725	25,000	19,000	25,000	113,275	236,000
	OPC	3,263	—	—	—	2,737	6,000
	TPC	56,988	25,000	19,000	25,000	116,012	242,000

Notes:
- *Funding estimates are preliminary as a formal baseline has not been established.*
- *Other Project Costs (OPC) are funded through laboratory overhead.*

6. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy	4Q FY 2031
Expected Useful Life	50 years
Expected Future Start of D&D of this capital asset	N/A

Related Funding Requirements
(dollars in thousands)

	Annual Costs		**Life Cycle Costs**	
	Previous Total Estimate	**Current Total Estimate**	**Previous Total Estimate**	**Current Total Estimate**
Operations	1,200	1,200	60,000	60,000
Utilities	12	12	600	600
Maintenance and Repair	3,000	3,000	150,000	150,000
Total, Operations and Maintenance	4,212	4,212	210,600	210,600

7. D&D Information

This project replaces critical infrastructure components; no new construction area is anticipated to be constructed in this project and it will not replace existing facilities.

	Square Feet
New area being constructed by this project at LBNL	None
Area of D&D in this project at LBNL...	None
Area at LBNL to be transferred, sold, and/or D&D outside the project, including area previously "banked"	None[c]
Area of D&D in this project at other sites	None
Area at other sites to be transferred, sold, and/or D&D outside the project, including area previously "banked"	None
Total area eliminated	None

8. Acquisition Approach

The LBNL Management and Operating (M&O) Contractor, University of California, is performing the acquisition for this project, overseen by the Berkeley Site Office. The M&O contractor is responsible for awarding and managing all subcontracts related to this project.

The Office of Science delegated Project Management Executive responsibilities to the National Laboratory Director. The project will be managed and delivered by the M&O Contractor. SC will evaluate the M&O contractor's performance through the annual laboratory performance appraisal process.

[c] With the implementation of OMB's Reduce the Footprint initiative, DOE no longer maintains the space bank. Footprint is managed using the Facility Information Management System, with the decisions on additions and offsets made in accordance with the DOE Real Property Efficiency Plan.

20-SC-79, Critical Utilities Infrastructure Revitalization, SLAC
SLAC National Accelerator Laboratory, SLAC
Project is for Design and Construction

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

Summary

The FY 2027 Request for the Critical Utilities Infrastructure Revitalization (CUIR) project is $18,075,000 of Total Estimated Cost (TEC) funding. The preliminary Total Estimated Cost (TEC) range for this project is $160,000,000 to $306,000,000. The preliminary Total Project Cost (TPC) range for this project is $165,000,000 to $311,000,000. Currently, these cost ranges encompass the most feasible preliminary alternatives. The preliminary TPC point estimate for this project is $208,500,000.

The primary objective of this project is to close utilities infrastructure gaps, risks, and impediments, such as utility piping breaks, power fluctuations, faults, and cooling water interruptions, to support multi-program science missions at SLAC. Evolving technologies, instruments, experimental parameters, sensitivities, and complexity require increased reliability, resiliency, and service levels in electrical, mechanical, and civil systems site wide. The CUIR project will address the critical campus-wide utility and infrastructure issues by recapitalizing and modernizing the highest risk water/fire protection, sanitary sewer, storm drain, electrical, and cooling water system deficiencies. These needs have been identified through condition assessments, inspections, and recommendations from subject matter experts responsible for stewardship of the systems.

This utilities project reinforces the foundational infrastructure for SLAC to support the Genesis Mission and other key DOE priorities. Expanded and modernized electrical distribution, water/fire protection, etc. systems ensure that high-performance computing assets can operate reliably to drive breakthroughs in national competitiveness and energy innovation at required velocity and scale to support mission execution.

On April 29, 2025, CUIR was delegated to the Laboratory Director. Prior to that delegation, the project received DOE Order 413.3B approved Critical Decision (CD) is CD-3A, Approve Long-Lead Procurement and Early Site Preparation, which was approved on May 8, 2023. After being delegated, the M&O officially baselined (similar to DOE Order 413.3B CD-2, Approve Performance Baseline) Subproject 1 on June 25, 2025.

Significant Changes

This Construction Project Data Sheet (CPDS) is an update to the FY 2026 CPDS and does not include a new start for FY 2027. The FY 2027 Request will support activities in accordance with SLAC's plan for project execution.

Critical Milestone History

	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
CUIR - Overall, SLAC	5/17/19	4/15/21	1/21/22	3Q FY 2029	1Q FY 2029	3Q FY 2029	1Q FY 2035
CUIR - Critical Electrical Work, SLAC	–	–	–	6/18/25	6/18/25	6/18/25	4Q FY 2031
CUIR - Linac Utilities and Equipment, SLAC	–	–	–	1Q FY 2029	4Q FY 2028	1Q FY 2029	4Q FY 2032

	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
CUIR - Sitewide Utilities, SLAC	–	–	–	3Q FY 2029	1Q FY 2029	3Q FY 2029	1Q FY 2035

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; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

	Performance Baseline Validation	CD-3A
CUIR - Overall, SLAC	3Q FY 2029	5/8/23
CUIR - Critical Electrical Work, SLAC	6/18/25	5/8/23

CD-3A – Approve Long-Lead Procurements and Site Preparation Activities.

Project Cost History

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	26,045	177,955	204,000	4,500	4,500	208,500
FY 2027	48,227	155,773	204,000	4,500	4,500	208,500

Notes:
- *Funding estimates are preliminary as a formal baseline has not been established.*
- *Other Project Costs (OPC) are funded through laboratory overhead.*

2. Project Scope and Justification

Scope

CUIR's preliminary scope is to update major electrical gear and instrumentation for the two-mile long klystron gallery and accelerator housing constructed in 1962. Additionally, it will upgrade underground domestic water/fire protection, sanitary sewer, and storm drain systems site-wide. To facilitate its execution, CUIR is comprised of 3 subprojects to achieve complete and usable assets:

- Critical Electrical System Improvements: Subproject to replace and upgrade electrical components that present the greatest risk of failure or substandard performance of the Linac and associated Science projects.
- Critical Civil Utilities Replacement and Upgrade Subproject: Subproject to upgrade the storm drain, sanitary sewer and domestic/fire water piping along the Linac.
- Critical Mechanical Utilities Upgrade: Subproject will replace waveguide water heat exchangers, controls and pumps.

Justification

SLAC is currently implementing a Campus Strategy designed to support the DOE Science Mission, increase reliability, and minimize costs through safe, effective, resilient, and efficient operations.

Disruptions caused by power fluctuations, faults, and cooling water interruptions, and utility piping breaks have frequently impacted science research site wide. Electrical systems, pumps, and motors fail, valves on piping systems freeze, and there are inoperable or unsafe electrical components that require broad outages to respond and repair. Workarounds and administrative controls have been placed on existing equipment and systems because they are underrated, not operating as intended, or not designed/operational for today's science needs, which results in create tremendous inefficiencies and safety concerns, and sub-optimized operations.

The objective of the CUIR project is to reduce risks and close the capability gaps identified in SLAC's infrastructure assessments and surveys as they relate to storm water, sanitary sewer, domestic water/fire protection, electrical, and cooling water systems. The CUIR project will reduce operational risks in critical infrastructure and utility support systems for all science programs and aims to retire an estimated $18,000,000 in deferred maintenance. These existing reliability gaps will continue to impede operational efficiency, resilience, reliability, productivity, and competitive viability in science programs and other related science research breakthroughs until they are filled. The project will include installation of a combination of data collection and monitoring systems that enable predicting failures and other events affecting operations, to make adjustments that minimize impacts to mission critical scientific operations.

Upgrading these utility systems directly enhances the Laboratory's ability to advance DOE's flagship initiatives such as the Genesis Mission and expanded computing needs. Modern, resilient infrastructure provides the electrical, water/waste water, fire protection, and other systems necessary for the continuous operation of advanced scientific instruments and high-demand computing resources that position the U.S. as a global technology leader.

The project is being conducted in accordance with Office of Science delegated authority using sound project management principles.

<u>Key Performance Parameters (KPPs)</u>
The KPPs are preliminary and may change as the project matures. The KPPs will be finalized in accordance with the M&O contractor's plan for project execution. The Threshold KPPs comprise the minimum scope required to fulfill the Mission Need. The Objective KPPs indicate potential project scope enhancements, consistent with the project's Mission Need, which could be executed if the project experiences favorable cost and schedule performance. Achievement of the Threshold KPPs will be a prerequisite for project completion.

Performance Measure	Threshold	Objective
Subproject 1: Critical Electrical System Improvements		
	Install four (4) 12kV feeder cables and connect two feeders to final loads.*	Install eight (8) 12kV feeder cables and connect eight feeders to final loads.
	Install two (2) medium voltage switchgear at the Master Substation (MSS) to allow feeder cable selection. *	None

Performance Measure	Threshold	Objective
	Install one (1) 230kV 60MVA (or larger) transformer. *	Install two (2) 230kV 65MVA transformers and four (4) fault current limitation equipment.**
	Install one (1) substation to provide 3.5MVA power*	None
	Install one (1) medium voltage switchgear at Sector 4 to allow feeder cable selection. *	None
	Replace monitoring equipment to provide monitoring and supervisory control input at eight (8) cubicles with one (1) integration hub, and one (1) Circuit Breaker Operating Remote Panel.	Replace monitoring equipment to provide monitoring and supervisory control input at fourteen (14) cubicles with one (1) integration hub, and one (1) Circuit Breaker Operating Remote Panel.
** Electrical equipment required to deliver noted threshold scope will be acquired upon approval of CD-3A.* *** Electrical equipment necessary to deliver noted objective scope, which may be acquired after approval of CD-3A to provide project team adequate time to integrate objective scope into Subproject 1 outage planning and construction schedule development.*		
Subproject 2: Critical Civil Utilities Replacement and Upgrades		
	Replace 12,000 linear feet of domestic/fire water piping. Install submeters, flow and pressure sensors at two (2) domestic water main branches.	Replace 18,000 linear feet of domestic/fire water piping. Install submeters, flow and pressure sensors at four (4) domestic water main branches.
	Replace 2,700 linear feet of water main, laterals, and valves. Install five (5) backflow preventors and five (5) fire hydrants. Install submeter flow and pressure sensors at one (1) domestic water key node.	None
	Replace 1,000 linear feet of sanitary sewer piping. Install sensors to measure sewage flow, Total Dissolved Solids (TDS) at two (2) effluent stations.	Install sensors to measure sewage flow, Total Dissolved Solids (TDS) at five (5) existing effluent stations.

Performance Measure	Threshold	Objective
	Replace or re-line 5,000 linear feet of storm drain piping.	Replace or re-line 10,000 linear feet of storm drain piping.
	Data Analytics Plan to enhance monitoring and operation performance for utility systems.	Data Analytics Plan to integrate substation and water-cooling system monitor output into recommended data-analytics platform.
Subproject 3: Subproject 3: Critical Mechanical Utilities Upgrades		
	Replace eleven (11) Waveguide water heat exchangers, controls, and pumps.	None
	Replace four (4) Klystron water heat exchangers, four (4) controls, and four (4) pumps.	Replace 1,000 LF of Klystron piping system.
	Replace eleven (11) Accelerator, Klystron, and Waveguide monitoring devices.	None
	Install two (2) natural gas main meters, replace six (6) existing BTU energy meter, and integrate each into data analytics platform.	Install four (4) main meters and eight (8) submeters for natural gas, replace twelve (12) energy BTU meters and integrate each into the data analytics platform.
	None	Replace ten (10) programmable logic controller (PLC) to provide Data Analytics input.
	None	Integrate substation and water-cooling system monitor output into data-analytics platform.

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Estimated Cost (TEC)			
Design (TEC)			

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Estimated Cost (TEC)			
Prior Years	18,895	18,895	5,472
FY 2025	-15,237	-15,237	4,125
FY 2026	3,925	3,925	5,628
FY 2027	2,195	2,195	5,688
Outyears	38,449	38,449	27,314
Total, Design (TEC)	**48,227**	**48,227**	**48,227**
Construction (TEC)			
Prior Years	46,030	46,030	8,887
FY 2025	35,237	35,237	9,121
FY 2026	11,075	11,075	39,366
FY 2027	15,880	15,880	9,794
Outyears	47,551	47,551	88,605
Total, Construction (TEC)	**155,773**	**155,773**	**155,773**
Total Estimated Cost (TEC)			
Prior Years	64,925	64,925	14,359
FY 2025	20,000	20,000	13,246
FY 2026	15,000	15,000	44,994
FY 2027	18,075	18,075	15,482
Outyears	86,000	86,000	115,919
Total, Total Estimated Cost (TEC)	**204,000**	**204,000**	**204,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Other Project Cost (OPC)			
Prior Years	2,783	2,783	2,783
FY 2025	250	250	250
FY 2026	250	250	250
Outyears	1,217	1,217	1,217
Total, Other Project Cost (OPC)	**4,500**	**4,500**	**4,500**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Project Cost (TPC)			
Prior Years	67,708	67,708	17,142

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Project Cost (TPC)			
FY 2025	20,250	20,250	13,496
FY 2026	15,250	15,250	45,244
FY 2027	18,075	18,075	15,482
Outyears	87,217	87,217	117,136
Total, TPC	**208,500**	**208,500**	**208,500**

Notes:

- *In FY 2025, prior year budget authority, obligations, and costs were reallocated between sub-projects following the completion of design activities.*

4. Details of Project Cost Estimate

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design	40,929	24,600	**N/A**
Design - Contingency	7,298	3,106	**N/A**
Total, Design (TEC)	**48,227**	**27,706**	**N/A**
Construction_No_Detail	129,810	139,144	**N/A**
Construction Contingency	25,963	37,150	**N/A**
Total, Construction (TEC)	**155,773**	**176,294**	**N/A**
Total, TEC	**204,000**	**204,000**	**N/A**
Contingency, TEC	*33,261*	*40,256*	***N/A***
Other Project Cost (OPC)			
Conceptual Planning	N/A	4,500	**N/A**
Lab Overhead (OPC)	4,500	N/A	**N/A**
Total, Except D&D (OPC)	**4,500**	**4,500**	**N/A**
Total, OPC	**4,500**	**4,500**	**N/A**
Contingency, OPC	***N/A***	*N/A*	***N/A***
Total, TPC	**208,500**	**208,500**	**N/A**
Total, Contingency (TEC+OPC)	***33,261***	***40,256***	***N/A***

5. Schedule of Appropriations Requests

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	64,925	20,000	10,000	—	109,075	204,000
	OPC	2,783	250	250	—	1,217	4,500
	TPC	67,708	20,250	10,250	—	110,292	208,500
FY 2027	TEC	64,925	20,000	15,000	18,075	86,000	204,000
	OPC	2,783	250	250	—	1,217	4,500
	TPC	67,708	20,250	15,250	18,075	87,217	208,500

Notes:
- *Funding estimates are preliminary as a formal baseline has not been established.*
- *Other Project Costs (OPC) are funded through laboratory overhead.*

6. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy	1Q FY 2035
Expected Useful Life	Average 30 years (based system)
Expected Future Start of D&D of this capital asset	N/A

Related Funding Requirements
(dollars in thousands)

	Annual Costs		Life Cycle Costs	
	Previous Total Estimate	**Current Total Estimate**	**Previous Total Estimate**	**Current Total Estimate**
Operations	8,673	8,673	260,176	260,176
Utilities	10,487	10,487	314,624	314,624
Maintenance and Repair	8,461	8,461	253,833	253,833
Total, Operations and Maintenance	27,621	27,621	828,632	828,632

7. D&D Information

The new area being constructed in this project is not replacing existing facilities.

	Square Feet
New area being constructed by this project at SLAC..	3000 gsf
Area of D&D in this project at SLAC...	None

Area at SLAC to be transferred, sold, and/or D&D outside the project, including area previously "banked"	None[d]
Area of D&D in this project at other sites	None
Area at other sites to be transferred, sold, and/or D&D outside the project, including area previously "banked"	None
Total area eliminated	None

8. Acquisition Approach

The SLAC Management and Operating (M&O) contractor, Stanford University, is performing the acquisition for this project, overseen by the Stanford Site Office. The M&O contractor is responsible for awarding and managing all subcontracts related to this project.

The Office of Science delegated Project Management Executive responsibilities to the National Laboratory Director. The project will be managed and delivered by the M&O Contractor. SC will evaluate the M&O contractor's performance through the annual laboratory performance appraisal process.

[d] With the implementation of OMB's Reduce the Footprint initiative, DOE no longer maintains the space bank. Footprint is managed using the Facility Information Management System, with decisions on additions and offsets made in accordance with the DOE Real Property Efficiency Plan.

20-SC-80, Utilities Infrastructure Project, FNAL
Fermi National Accelerator Laboratory, FNAL
Project is for Design and Construction

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

Summary

The FY 2027 Request for the Utilities Infrastructure Project (UIP) is $48,815,000 of Total Estimated Cost (TEC) funding. The preliminary Total TEC range for this project is $248,000,000 to $403,000,000. The preliminary Total Project Cost (TPC) range for this project is $252,000,000 to $411,000,000. Currently, these cost ranges encompass the most feasible preliminary alternatives. The preliminary TPC point estimate for this project is $314,000,000.

This project will modernize and upgrade obsolete and deteriorated utilities infrastructure at Fermi National Accelerator Laboratory (FNAL) and provide resiliency, reliability, and increased safety of operations to ensure the infrastructure can continue supporting the DOE's scientific missions. This utilities project reinforces the foundational infrastructure for FNAL to support the Genesis Mission and other key DOE priorities. Primarily, expanded and modernized chilled water to ensure scientific discovery assets can operate reliably to drive breakthroughs in national competitiveness and energy innovation.

A Federal Project Director with the appropriate certification level has been assigned to this project.

Significant Changes

This Construction Project Data Sheet (CPDS) is an update to the FY 2026 CPDS and is not a new start for FY2027. The FY 2027 Request will support construction activities after the appropriate CD approvals.

The most recent DOE Order 413.3B approved Critical Decision (CD) is CD-3A, Approve Long-Lead Procurements and Site Preparation Activities, which was approved for subprojects 1 and 2 on December 6, 2024.

Critical Milestone History

	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
UIP - Overall, FNAL	5/17/19	–	2/23/22	3Q FY 2031	2Q FY 2031	3Q FY 2031	3Q FY 2035
UIP - New Chill Water Plant, Cent Utility Buil d Upgrades, FNAL	–	–	–	4Q FY 2027	2Q FY 2026	4Q FY 2027	4Q FY 2031
UIP - Kautz Road Substation Replacement, FNAL	–	–	–	4Q FY 2027	2Q FY 2026	4Q FY 2027	4Q FY 2031
UIP - Linear Utilities, FNAL	–	–	–	3Q FY 2031	2Q FY 2031	3Q FY 2031	3Q FY 2035

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; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

	Performance Baseline Validation	CD-3A	CD-3B
UIP - Overall, FNAL	–	12/6/24	2Q FY 2026
UIP - New Chill Water Plant, Cent Utility Build Upgrades, FNAL	3Q FY 2026	12/6/24	2Q FY 2026
UIP - Kautz Road Substation Replacement, FNAL	3Q FY 2026	12/6/24	2Q FY 2026
UIP - Linear Utilities, FNAL	3Q FY 2031	4Q FY 2029	–

CD-3A – Approve Long-Lead Procurements and Site Preparation Activities.

Project Cost History

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	45,980	264,020	310,000	4,000	4,000	314,000
FY 2027	48,424	261,576	310,000	4,000	4,000	314,000

Notes:
- *This project has not received CD-2 approval; therefore, funding estimates are preliminary.*
- *Other Project Costs (OPC) are funded through laboratory overhead.*

2. Project Scope and Justification

Scope

UIP's preliminary scope includes upgrading the highest risk major utility systems across the FNAL campus. Specifically, this project will first evaluate and identify the condition and risks of failure and inadequate performance of the industrial cooling water system, potable water distribution system, sanitary sewer and storm collection systems, natural gas distribution system, electrical distribution system, Kautz Road Substation, and the Central Utility Building. Selected portions of the systems with the highest risk of impact to operations will then be replaced or upgraded to assure safe, reliable, and efficient service to mission critical facilities. As such, the project will perform upgrades to obsolete, end-of-life components, which will increase capacity, reliability, and personnel safety for critical utilities. Long-lead procurements (e.g., mechanical, and electrical equipment) and site preparation was approved via a CD-3A, on 12/6/2024. A CD-3B for additional long-lead procurements is planned for second quarter FY2026.

To facilitate its execution, UIP is comprised of three subprojects consisting of scope needed to achieve complete and usable assets.

- Subproject 1: the New Chilled Water Plant and Central Utility Plant Upgrades Subproject plans to (a) expand the existing Central Utility Building to provide chilled water capacity to support current and future loads, and (b) modernize the existing section of the Central Utility Building systems such as hot water and low conductivity water systems.

- Subproject 2: the Kautz Road Substation Replacement Subproject plans to enhance the reliability of the Kautz Road Substation and reduce safety risks to personnel by replacing aging infrastructure, facilitating energy control, and reducing arc-flash incident energies.
- Subproject 3: the Linear Utilities Replacement Subproject plans to revitalize aging linear utilities across the FNAL site including sanitary sewers, domestic water, industrial cooling water, natural gas, and electrical feeders and equipment. These improvements will enhance system reliability and reduce deferred maintenance.

The primary construction phase of Subprojects 1 and 2 need to occur during FNAL's FY 2028–2030 Long Accelerator Shutdown to minimize disruption to the accelerator complex.

Justification

DOE's Office of Science (SC) advances new experiments, international partnerships, and research programs to transform the understanding of nature and to advance U.S. energy, economic and national security interests. This mission requires the modernization and upgrades of obsolete and severely deteriorated utilities infrastructure at FNAL. SC has identified recapitalization of FNAL's Central Utilities Building and distributed site utility infrastructure to as a priority need ensure the stewardship of SC's investments and to provide modern, world-class facilities for scientific experiments and research.

Although there has been substantial investment in recent years to modernize and construct new research facilities at FNAL, much of FNAL's utility infrastructure serving these facilities is over 50 years old, is beyond useful life and suffering from failures, decreased reliability, lack of redundancy, and limitations in capacity. As such, there is an urgent need to revitalize and selectively upgrade FNAL's existing major utility systems to ensure reliable service, meet capacity requirements, and enable readiness of facilities critical to the research mission.

Upgrading these utility systems directly enhances the Laboratory's ability to advance DOE's flagship initiatives such as the Genesis Mission and expanded computing needs. Modern, resilient infrastructure provides the electrical, water, and other systems necessary for the continuous operation of advanced scientific instruments and high-demand computing resources that position the U.S. as a global technology leader.

The UIP will reduce operational risks in critical enabling infrastructure and utility support systems and increase resilience, efficiency, reliability, productivity, and competitive viability in science programs. The project includes installation of a combination of data collection and monitoring systems that enable predicting failures and other events affecting operations and making adjustments to minimize impacts to mission critical scientific operations.

The project is being conducted in accordance with the project management requirements in DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*.

Key Performance Parameters (KPPs)

The KPPs are preliminary and may change as the project continues towards CD-2. At CD-2 approval, the KPPs will be baselined. The Threshold KPPs comprise the minimum scope required to fulfill the Mission Need. The Objective KPPs indicate potential project scope enhancements, consistent with the project's Mission Need, which could be executed if the project experiences favorable cost and schedule performance. Achievement of the Threshold KPPs will be a prerequisite for approval of CD-4, Project Completion.

Performance Measure	Threshold	Objective
Chilled Water Plant and CUB Upgrades	• Construct an addition to CUB for chilled water production (5,000 tons cooling capacity) • Install chillers • Install arc-resistant switchgear • Install boilers to cover historical heating load of 11.4 MMBH, with natural gas boilers for emergency backup • Provide vibration monitoring of chillers, cooling towers, and pumps integrated with AI/ML predictive analytics	▪ Increase chilled water production to 6,000 tons cooling capacity. ▪ Upgrade chillers to magnetic bearing chillers ▪ Install heat recovery chillers to provide heating to Wilson Hall with electric boiler backup
Kautz Road Substation	▪ Replace the KRS Control House to improve arc flash safety requirements ▪ Replace bus duct ▪ Replace T-85 Transformer ▪ Replace 345kV Circuit Breaker	• Replace Harmonic Filter Components • Replace CCVTs, metering transformers
Linear Utilities Replacement	▪ Revitalize 5 miles of the Industrial Cooling Water system.	▪ Revitalize 16 miles of the Industrial Cooling Water system.
	▪ Revitalize 5 miles of the Domestic Water System (DWS).	▪ Revitalize 19 miles of the Domestic Water System (DWS).
	▪ Revitalize 3.5 miles of the Sanitary Sewer systems.	▪ Revitalize 11 miles of the Sanitary Sewer System.
	▪ Revitalize 2 miles of underground Natural Gas lines.	▪ Revitalize 22 miles of underground Natural Gas lines.
	▪ Revitalize 2 miles of electrical distribution feeders and associated unit substations, transformers, etc.	▪ Revitalize 65 miles of electrical distribution feeders and associated unit substations, transformers, etc. ▪ Provide Electrical Code upgrades to Master Substation ▪ Revitalize 100 percent of the High-Pressure Sodium exterior lights along

Performance Measure	Threshold	Objective
		sidewalks, roads, and parking lots with LED.

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Estimated Cost (TEC)			
Design (TEC)			
Prior Years	22,280	22,280	11,275
FY 2025	21,144	21,144	6,148
FY 2026	—	—	2,077
Outyears	5,000	5,000	28,924
Total, Design (TEC)	**48,424**	**48,424**	**48,424**
Construction (TEC)			
Prior Years	44,220	44,220	—
FY 2025	13,856	13,856	4,427
FY 2026	18,000	18,000	18,000
FY 2027	48,815	48,815	52,711
Outyears	136,685	136,685	186,438
Total, Construction (TEC)	**261,576**	**261,576**	**261,576**
Total Estimated Cost (TEC)			
Prior Years	66,500	66,500	11,275
FY 2025	35,000	35,000	10,575
FY 2026	18,000	18,000	20,077
FY 2027	48,815	48,815	52,711
Outyears	141,685	141,685	215,362
Total, Total Estimated Cost (TEC)	**310,000**	**310,000**	**310,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Other Project Cost (OPC)			
Prior Years	2,050	2,050	2,050
Outyears	1,950	1,950	1,950
Total, Other Project Cost (OPC)	**4,000**	**4,000**	**4,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs
Total Project Cost (TPC)			
Prior Years	68,550	68,550	13,325
FY 2025	35,000	35,000	10,575
FY 2026	18,000	18,000	20,077
FY 2027	48,815	48,815	52,711
Outyears	143,635	143,635	217,312
Total, TPC	**314,000**	**314,000**	**314,000**

Note:

- *In FY 2025, prior year budget authority, obligations, and costs were reallocated between sub-projects following the completion of design activities.*

4. Details of Project Cost Estimate

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design	44,022	42,750	**N/A**
Design - Contingency	4,402	6,200	**N/A**
Total, Design (TEC)	**48,424**	**48,950**	**N/A**
Construction_No_Detail	214,997	215,700	**N/A**
Construction Contingency	46,579	45,350	**N/A**
Total, Construction (TEC)	**261,576**	**261,050**	**N/A**
Total, TEC	**310,000**	**310,000**	**N/A**
Contingency, TEC	*50,981*	*51,550*	***N/A***
Other Project Cost (OPC)			
Conceptual Planning	880	880	**N/A**
Conceptual Design	1,170	1,170	**N/A**
OPC - Contingency	1,950	1,950	**N/A**
Total, Except D&D (OPC)	**4,000**	**4,000**	**N/A**
Total, OPC	**4,000**	**4,000**	**N/A**
Contingency, OPC	*1,950*	*1,950*	***N/A***
Total, TPC	**314,000**	**314,000**	**N/A**
Total, Contingency (TEC+OPC)	***52,931***	***53,500***	***N/A***

5. Schedule of Appropriations Requests

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	66,500	35,000	12,000	—	196,500	310,000
	OPC	2,050	—	—	—	1,950	4,000
	TPC	68,550	35,000	12,000	—	198,450	314,000
FY 2027	TEC	66,500	35,000	18,000	48,815	141,685	310,000
	OPC	2,050	—	—	—	1,950	4,000
	TPC	68,550	35,000	18,000	48,815	143,635	314,000

Notes:
- *This project has not received CD-2 approval; therefore, funding estimates are preliminary.*
- *Other Project Costs (OPC) are funded through laboratory overhead.*

6. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy	3Q FY 2035
Expected Useful Life	30 years
Expected Future Start of D&D of this capital asset	N/A

Related Funding Requirements
(dollars in thousands)

	Annual Costs		Life Cycle Costs	
	Previous Total Estimate	Current Total Estimate	Previous Total Estimate	Current Total Estimate
Operations	287	287	8,610	8,610
Utilities	577	577	17,310	17,310
Maintenance and Repair	287	287	8,610	8,610
Total, Operations and Maintenance	1,151	1,151	34,530	34,530

7. D&D Information

The new area being constructed in this project is not replacing existing facilities.

	Square Feet
New area being constructed by this project at FNAL	10,000 – 30,000
Area of D&D in this project at FNAL...	None
Area at FNAL to be transferred, sold, and/or D&D outside the project, including area previously “banked”	None[e]
Area of D&D in this project at other sites	None

[e] With the implementation of OMB’s Reduce the Footprint initiative, DOE no longer maintains the space bank. Footprint is managed using the Facility Information Management System, with decisions on additions and offsets made in accordance with the DOE Real Property Efficiency Plan.

Area at other sites to be transferred, sold, and/or D&D outside the project, including area previously "banked"	None
Total area eliminated	None

8. Acquisition Approach

The FNAL Management and Operating (M&O) contractor, Fermi Forward Discovery Group, LLC (FFDG) FNAL Research Alliance LLC, will perform the acquisition for this project, overseen by the FNAL Site Office. The M&O contractor is responsible for awarding and managing all subcontracts related to this project. Project performance metrics will be performed by in-house management and Project Controls. SC will evaluate the M&O contractor's performance through the annual laboratory performance appraisal process

SC and the M&O contractor will draw from lessons learned from other SC projects and other similar facilities in planning and executing the project.

Safeguards and Security

Overview

The Office of Science (SC) Safeguards and Security (S&S) program is designed to ensure critical Federally-mandated security measures are in place to protect the array of government and national security assets, information, and data entrusted to SC. These assets are critical to accomplishing the SC mission of basic research in key scientific fields such as physics, materials science, computing, and chemistry, as well as fundamental scientific research related to energy and includes vital support for Executive Order 14363, *Launching the Genesis Mission,* and providing a secure artificial intelligence (AI) platform for sharing our Nation's scientific research.

Potential threats to SC high-consequence assets come from an array of evolving sources that the DOE's Office of Intelligence/Counterintelligence, National intelligence agencies, and local law enforcement agencies follow, to include transnational terrorists, domestic terrorists, criminals, disgruntled employees, malevolent insiders motivated for financial or ideological reasons, and foreign national visitors with the malicious intent of performing espionage. In response to an evolving threat landscape, the federal government and DOE recently revised several security policies to ensure critical assets remain protected. Implementation will continue to be executed through a risk-informed decision-making process that will facilitate capability expansion in the most consequential areas. An important factor contributing to an increase of potential threats at SC laboratories is the tremendous growth of local infrastructure bringing homes, schools, and commercial businesses close to laboratory boundaries.

The security measures employed at each of the 10 Science National Laboratories and three federal sites are based on National and DOE requirements. The requirements are solidified in DOE policies approved by the Secretary or Deputy Secretary of Energy and reflect the Department's acceptable level of risk. SC ensures these policies are formally incorporated in contracts at each of the SC sites, and Federal line management provides oversight to ensure implementation is cost effective and achieves the required level of security performance.

To counter security threats and support operations, the physical security program continually looks to decrease reliance on human-based protection services and leverage the latest security technologies and tactics, to include AI systems and software, to enhance program performance and effectiveness. Beginning in FY 2027, SC will implement an Artificial Intelligence (AI) for Operations initiative aimed at combining enhanced data collection and analysis with AI tools to streamline mission-critical functions and provide predictive, insight-driven information for enterprise risk management. SC's S&S program also provides funding for cybersecurity for the laboratories' information technology systems to protect SC mission systems, computers, networks, and data from unauthorized access and virtual incursion from many of these same threats.

The S&S program supports specialists in nuclear material control and accounting; advanced security systems and centralized alarm monitoring stations; classified and unclassified controlled information; personnel vetting, to include employees and foreign visitors; protective forces; and cybersecurity. Across the 10 laboratories and three SC federal facilities, there are nearly 550 physical security and 170 cyber professionals supporting the SC mission. Funding is vital to sustain the services of these security professionals, as approximately 90 percent of the physical security requirement is labor-based. The SC security workforce is responsible for the protection of over 20,000 acres, 1,500 buildings, and a combined laboratory workforce population exceeding 94,000 (including guest researchers, users, employees, etc.).

SC's S&S program is also incorporating emerging technology and security requirements to protect the scientific mission at each of the SC sites. These efforts require upcoming investments in AI to align with America's AI Action Plan and progressive cyber initiatives to support a wide range of Executive Orders. An increase in human capital investment and enhancements to logging, monitoring and identity credentialing and access management system will be needed to support the Genesis Mission and the security of the American Science Cloud. This current profile will enable the SC program to continue to meet the most critical current requirements.

Highlights of the FY 2027 Request

The S&S FY 2027 Request for S&S is $202.5 million, which is $12.5 million above the FY 2026 Enacted level. The FY 2027 Request for Physical Security is $113.4 million and will support baseline compliance with federal standards and maintenance of a sustained secure Physical Security posture for current SC complex requirements. The increase to Cybersecurity program of $6.6 million will fully fund the Continuous Diagnostics and Mitigation reporting requirement ensuring compliance to the federal mandate. The FY 2027 Request will also provide initial support to SC's anticipated contributions to Cybersecurity for the Genesis Mission and initial implementation of security vetting practices that will protect the integrity of the Genesis platform. This budget will support annual labor rate increases and sustain security operations. The FY 2027 Request will support employment of nearly 550 physical security and 170 cybersecurity professionals. The FY 2027 Request will support the maintenance and replacement of the highest priority end-of-life security systems across the 13 SC laboratories and sites.

Description

The S&S program is organized into seven program elements:

1. Protective Forces
2. Security Systems
3. Information Security
4. Cybersecurity
5. Personnel Security
6. Material Control and Accountability
7. Program Management

<u>Protective Forces</u>

The Protective Forces program element supports security officers and security police officers that control access and protect S&S assets, along with their related equipment and training. Protective Forces at SC laboratories and facilities, and their coordinated efforts with federal and local law enforcement agencies, are our first line of defense against any violent attack against DOE personnel, contractors, and visitors. Activities within this program element include access control and security response operations as well as physical protection of the Department's critical assets and SC facilities, including critical facilities and data centers used to support the Genesis Mission. The Protective Force response and deployment configurations at SC laboratories reflect some of the most advanced tactical operator skills within the U.S. government (e.g., the armed security police officers protecting Building 3019 at ORNL), which are necessary due to the inherent consequences of protecting nuclear materials, critical program assets, and classified information. Maintaining these advanced tactical capabilities necessitates continuous, updated training to effectively align with DOE's evolving national security requirements. Additionally, the Protective Forces mission includes providing effective response to emergency situations, prohibited article inspections, security alarm monitoring, and performance testing of the Protective Force response to various event scenarios.

<u>Security Systems</u>

Detection and delay of potential threats at SC facilities is made possible by security systems that provide SC sites with advanced notification to save lives and protect DOE property, classified information, hazardous materials, and other national security assets. The Security Systems program element provides the backbone of the physical protection of Departmental personnel, material, equipment, property, and facilities. Systems currently deployed at SC sites include, but are not limited to, Homeland Security Presidential Directive 12 (HSPD-12) and local credentials, entry control points, fences, barriers, lighting, alarms, sensors, surveillance devices, access control systems, and power systems. In addition, the continued use of AI-based technologies provides further enhanced performance with respect to sites' abilities to detect, identify, track, and classify physical security threats in real-time, to include people and vehicles, at and within the site perimeter (e.g., the advanced AI-based video analytics used at Laboratories such as Argonne National Laboratory and SLAC National Accelerator Laboratory).

Information Security

The Information Security program element provides support to ensure that sensitive and classified information is accurately, appropriately, and consistently identified, reviewed, marked, protected, transmitted, stored, and ultimately destroyed. Specific activities within this element include management, planning, training, and oversight for maintaining security containers and combinations, marking documents, and administration of control systems, operations security, special access programs, technical surveillance countermeasures, and classification and declassification determinations. In particular, the classification area of this program element has experienced a significant increase in the volume of work because of SC's growth in national security activities and federal requirements to digitize millions of pages of scientific working documents, which must first undergo a classification review (e.g., since 2021, classification reviews at ORNL have increased by 94 percent).

Cybersecurity

The Cybersecurity program element develops and maintains a comprehensive program for SC's 10 national laboratories and three federal sites. This program monitors numerous advanced persistent threats (APTs) that aim to disrupt critical missions and exfiltrate vital research and intellectual property across domains such as artificial intelligence, material science, high performance computing, and basic research. The risks posed by these APTs extend beyond mission disruption and intellectual property theft to include the potential compromise of Personally Identifiable Information (PII) belonging to federal and contractor personnel. The objectives of the Cybersecurity program element are to enable mission objectives and scientific endeavors, enhance the overall security posture through the adoption of advanced security designs, and provide consistent guidance and cybersecurity procedures. Furthermore, the Cybersecurity program element plays a crucial role in responding to cyber incidents by supporting incident management, prosecution, and investigation efforts related to cyber intrusions. It also facilitates disaster and incident recovery, as well as communication within the cybersecurity community. SC Cybersecurity is intrinsically aligned with the mission to secure the American Science Cloud under the Genesis Mission, which is intended to be the world's leading scientific platform for accelerating discovery, strengthening national security, and advancing energy innovation.

Personnel Security

The Personnel Security program element is critical to identification of predictors of potentially dangerous or destructive behavior at SC laboratories as well as evaluation of individuals accessing information shared in the Genesis Mission. This includes processes for employee suitability and security clearance determinations at each site to ensure that individuals are trustworthy and eligible for access to DOE facilities, IT networks, and classified information or material. This also includes the new Federally mandated requirements for continuous evaluations, which generates thousands of additional Federal adjudications on a monthly basis. Additionally, this program element addresses the process of vetting the uncleared contractor workforce that have physical and/or logical access to federal facilities, information, and personnel. This element also includes the management of security clearance programs, adjudications, security education, and awareness programs for Federal and contractor employees. The Personnel Security program element also manages the Human Reliability Program to ensure individuals who occupy positions affording access to certain materials, nuclear explosive devices, facilities, and programs meet the highest standards of reliability and physical and mental suitability. In accordance with 50 USC 2652 and DOE Order 142.3B, *Unclassified Foreign National Access Program*, the program processes, in collaboration with Office of Intelligence (IN) and Office of Environmental, Health, Safety, and Security (EHSS), the large number of foreign visitors that engage with the 10 Science laboratories to mitigate Nation State information and intelligence collection efforts. This process includes, at a minimum, the completion of indices checks, with additional local vetting conducted when dictated by factors such as the facility being visited, the duration of the visit, and the science and technology involved.

Material Control and Accountability (MC&A)

The MC&A program element provides assurance that Departmental materials are properly controlled and accounted for at all times. The performance of this program element includes, but is not limited to, testing performance and assessing the levels of protection, control, and accountability required for the types and quantities of materials at each facility; documenting facility plans for materials control and accountability; assigning authorities and responsibilities for MC&A functions; and establishing programs to detect and report occurrences such as material theft, the loss of control or inability to account for materials, or evidence of malevolent acts.

Program Management

The Program Management program element functionally integrates and oversees the S&S Program, including Protective Forces, Security Systems, Information Security, Personnel Security, and MC&A to achieve and ensure appropriate levels of security are in place through performance assurance activities such as self-assessments, maintenance, and performance testing. The performance of this program element has direct involvement with the sites' Insider Threat Programs to deter, detect, analyze, respond to, and mitigate insider threat actions (such as espionage, sabotage, unauthorized disclosure, workplace violence, active shooter, etc.) by DOE federal and contractor employees. This program element also includes the performance of vulnerability and/or security risk assessments, which provides a technical basis for the integrated security program at the sites and the acceptance of any associated residual risk. Beginning in FY 2027, the Program Management program element will implement an Artificial Intelligence (AI) for Operations initiative aimed at combining enhanced data collection and analysis with AI tools to streamline mission-critical functions and provide predictive, insight-driven information for enterprise risk management. This initiative is aligned with America's AI Action Plan in that it will accelerate AI adoption in the federal government, enabling employee adoption of tailored tools that can be used to enhance the quality and accuracy of national laboratory oversight duties and proactively identify, mitigate, and respond to maintenance issues, security threats, and safety risks, resulting in cost and time savings and fewer disruptions to scientific and engineering innovation.

Safeguards and Security
Funding

(dollars in thousands)

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Safeguards and Security				
Protective Forces	57,732	57,428	59,645	+2,217
Security Systems	21,068	20,686	21,009	+323
Information Security	5,830	5,801	5,978	+177
Cybersecurity	82,497	82,497	89,097	+6,600
Personnel Security	10,553	10,680	11,118	+438
Material Control and Accountability	3,494	3,548	3,880	+332
Program Management	8,826	9,360	11,773	+2,413
Total, Safeguards and Security	**190,000**	**190,000**	**202,500**	**+12,500**

Safeguards and Security
Explanation of Major Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Safeguards and Security	**$190,000**	**$202,500**	**$12,500**
Protective Forces	$57,428	$59,645	+$2,217
Funding maintains support for security officers and their required equipment, and at some sites, advanced armament specifically analyzed and required to combat advanced threats to our weapons grade nuclear materials. Additionally, funding supports training for these perishable skills, thereby ensuring the readiness of our security officers at all SC laboratories.		The Request will support current baseline security officer and equipment requirements. Also, funding will support training for the protective force to ensure the readiness of our security officers at all SC laboratories.	Funding will support expanding levels of operations and training for Protective Forces.
Security Systems	$20,686	$21,009	+$323
Funding maintains support for the security systems in place as well as continued implementation of security modifications and enhancements that support the deterrence, sensing, and assessment of an array of threats to our range of assets.		The Request will maintain support for existing security systems. Security modifications and enhancements will continue on a priority basis.	Funding will address current operations. Additionally, funding will support the replacement of the highest priority end of life security systems across the 13 SC sites.
Information Security	$5,801	$5,978	+$177
Funding maintains support for the personnel, equipment, training, and systems necessary to ensure the growing SC mission and associated sensitive and classified information is safeguarded at SC laboratories.		The Request will maintain support for current personnel, equipment, training, and systems.	Funding will support sustained levels for Information Security activities.

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Cybersecurity	$82,497	$89,097	+$6,600
Funding supports investments in cyber infrastructure and cyber capability including new cyber tools, incident response enhancements, cyber workforce development, data protections, and protections for unique SC facilities and capabilities that cannot be protected with commercial tools. Additionally, the funding continues implementation of Executive Order 14028 requirements at both federal and Management & Operating sites to build out Maximum MFA, Maximum Encryption, Cloud Strategy/Security, Improved Logging and Supply Chain Management, Zero Trust Infrastructure, Secure Critical Software, Controlled Unclassified Information cyber protections, participate in the Department of Homeland Security Continuous Diagnostics and Monitoring program, build out Industrial Control Systems protections, and protect Government Furnished Equipment on foreign travel.		The Request will support investments in cyber infrastructure and cyber capability. The Request will continue implementation of Executive Order 14028 requirements at both federal and Management & Operating sites to continue current efforts to build out Maximum MFA, Maximum Encryption, Cloud Strategy/Security, Improved Logging and Supply Chain Management, Zero Trust Infrastructure, Secure Critical Software, Controlled Unclassified Information cyber protections, AI protections, AmSC under the Genesis mission, participate in the Department of Homeland Security Continuous Diagnostics and Monitoring program build out Industrial Control Systems protections, and protect Government Furnished Equipment on foreign travel.	Funding will support sustained efforts to continue implementing Executive Order 14028 requirements to include Zero Trust Infrastructure and additional scope of work involving the American Science Cloud under the Genesis Mission.
Personnel Security	$10,680	$11,118	+$438
Funding continues support for processing of clearances and the vetting of uncleared personnel of the large workforce at SC laboratories as well as SC Headquarters security investigations. Also, funding supports the processing of the large number of foreign visitors that engage with the 10 Science laboratories, which is vital to thwarting known Nation State		The Request will support processing of clearances and the vetting of uncleared personnel at SC laboratories, multiple Office of Environmental Management laboratories as well as SC Headquarters. The Request will provide support to the processing of the large number of foreign visitors that engage with the 10 Science laboratories, which could exacerbate insider threat risks by	Funding will provide support for personnel security at increased overhead and inflation rates, and also the additional scope of work involving the American Science Cloud under the Genesis Mission.

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
information and intelligence collection efforts.		impeding rapid investigative reviews and continuous evaluations. The request will also support vetting and authentication of personnel requesting access to the American Science Cloud.	
Material Control and Accountability	$3,548	$3,880	+$332
Funding continues to support functions ensuring Departmental materials are properly controlled and accounted for at all times and to detect and report occurrences such as material theft, the loss of control or inability to account for materials, or evidence of malevolent acts.		The Request will maintain support functions ensuring Departmental materials will be properly controlled and accounted for at all times and to detect and report occurrences such as material theft, the loss of control or inability to account for materials, or evidence of malevolent acts.	Funding will provide support for MC&A activities at increased overhead and inflation rates.
Program Management	$9,360	$11,773	+$2,413
Funding continues support for oversight, administration, analysis, and planning for security programs at SC laboratories and provides integration of all security elements and security procedures protecting SC Research missions. In addition, funding ensures all security programs and elements will continue to perform as designed through on-going testing and assurance activities.		The Request will maintain support for oversight, administration, analysis, and planning for security programs at SC laboratories and provides integration of all security elements and security procedures protecting SC Research missions. In addition, the Request will ensure all security programs and elements will continue to perform as designed through on-going testing and assurance activities. This Request will provide initial funding to an AI for Operations initiative aimed at refining AI use cases and piloting AI tools across national laboratory operations.	Funding will provide support for Program Management activities at increased overhead and inflation rates while beginning new work in support of AI for Operations.

Program Direction

Overview

The Office of Science (SC) Program Direction (PD) budget is instrumental in supporting the highly skilled federal workforce essential for developing and overseeing SC investments and advancing critical Administration priorities. This includes foundational research in areas such as advanced computing, cybersecurity, quantum information sciences, artificial intelligence and machine learning (AI/ML), critical materials, fusion energy and isotope research and production. Furthermore, SC's efforts are vital for the construction and operation of scientific user facilities, all of which are paramount to bolstering the American scientific enterprise and national competitiveness.

SC continues to attract, retain, and contract sophisticated and experienced scientific and technical program and project managers, along with experts in acquisition, finance, legal, construction management, and environmental, safety, and health oversight. These dedicated professionals are crucial in ensuring SC's operations are efficient and effective. Moreover, SC is continually updating its business processes for awards management and research-related activities to meet and advance the strategic priorities set forth by the Administration.

Headquarters

The SC Headquarters (HQ) encompasses a broad range of critical functions, including its six Science program offices: Advanced Scientific Computing Research, Basic Energy Sciences, Biological and Environmental Research, Fusion Energy Sciences, High Energy Physics, and Nuclear Physics. Additionally, HQ oversees Isotope R&D and Production, Workforce Development for Teachers and Scientists, and Project Assessment. Integral to its operational effectiveness, HQ also manages several human resource (HR) management functions such as the Shared Service Center (SSC), and provides essential HQ-based field management support.

Consolidated Service Center

The Consolidated Service Center (CSC) plays a pivotal role in providing comprehensive business management, underpinning SC's federal responsibilities through robust financial management and streamlined grant and contract processing.

Site Offices

SC Site Offices are integral to the success of the ten SC national laboratories. They provide essential contract management and critical support for the execution of the scientific mission, including day-to-day business oversight, approvals for hazardous facilities operations, comprehensive safety and security oversight, management of leases and property transfers; administration of sub-contracts, and ensuring compliance with all activity approvals mandated by laws, regulations, and DOE policy.

Office of Scientific and Technical Information

Office of Scientific and Technical Information (OSTI) plays a crucial role in fulfilling the Department's statutory responsibilities by ensuring public access to the unclassified results of its extensive research investments and providing limited access to classified research results. Annually, DOE-funded researchers produce over 50,000 research publications, datasets, software, and patents. OSTI's publicly accessible databases exemplify accountability and transparency, housing more than 4 million research outputs from the 1940s to the present, showcasing the profound impact of DOE's research investments.

Highlights of the FY 2027 Request

The PD FY 2027 Request totals $206.9 million, reflecting a reduction of $20 million from the FY 2026 Enacted level, and will support approximately 568 full-time equivalents (FTEs). The Request strategically focuses on fortifying SC's federal staff at Headquarters and in the Field to effectively address the challenges presents by a significant increase in workload. This expanded workload stems from the broad scope of emerging science and technology, new security requirements, enhanced oversight, innovative outreach and communication strategies, and the integration of advanced data analytics into existing business systems. The Request allocates resources to SC's contribution to the new DOE initiative of Trusted Workforce. SC will remain committed to rigorously reviewing, analyzing, and prioritizing mission requirements, ensuring that all organizations and functions are aligning with Administration and Department program objectives and SC overarching strategic goals.

Program Direction
Funding

(dollars in thousands)

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Program Direction				
Salaries and Benefits	175,070	160,621	147,240	-13,381
Travel	2,000	2,500	3,000	+500
Support Services	27,051	36,000	28,500	-7,500
Other Related Expenses	15,500	20,500	17,775	-2,725
Working Capital Fund	7,210	7,210	10,363	+3,153
Total, Program Direction	**226,831**	**226,831**	**206,878**	**-19,953**
Federal FTE	825	600	568	-32

Technical Support				
System review and reliability analyses	1,670	1,670	1,670	–
Management Support				
Automated data processing	11,700	16,840	12,200	-4,640
Training and education	400	500	500	–
Reports and analyses, management, and general administrative services	13,281	16,990	14,130	-2,860
Total, Management Support	**25,381**	**34,330**	**26,830**	**-7,500**
Total, Support Services	**27,051**	**36,000**	**28,500**	**-7,500**

Other Related Expenses				
Rent to GSA	900	900	900	–
Rent to others	2,300	3,400	3,400	–
Communications, utilities, and miscellaneous	4,050	4,050	4,050	–
Other services	1,835	1,850	1,850	–
Operation and maintenance of facilities	1,610	1,645	1,700	+55
Supplies and materials	675	675	675	–
Equipments	4,130	7,980	5,200	-2,780
Total. Other Related Expenses	**15,500**	**20,500**	**17,775**	**-2,725**

Working Capital Fund	**7,210**	**7,210**	**10,363**	**+3,153**

Program Direction

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Program Direction	**$226,831**	**$206,878**	**-$19,953**
Salaries and Benefits	$160,621	$147,240	-$13,381
Funding supports salaries and benefits costs associated with 600 FTEs to perform scientific oversight, program and project management, essential operations support associated with science program portfolio management, and support for the Office of the Chief Human Capital Officer operating the SSC and supporting HR Advisory Offices.		The Request will support salaries and benefits costs associated with 568 FTEs to perform scientific oversight, program and project management, essential operations support associated with science program portfolio management, and support for the Office of the Chief Human Capital Officer operating the SSC and supporting HR Advisory Offices.	The Request will support the FTE levels to meet the challenges of the significant increase in workload associated with increased mission demands. The Request will incorporate the transfer of SC staff to the Office of Technology Commercialization and Office of Strategy and Technology Roadmaps as part of the DOE reorganization.
Travel	$2,500	$3,000	+$500
Funding supports facility visits where the use of electronic telecommunications is not practical for mandated on-site inspections and facility operations reviews. Funding supports the PCAST advisory committee travel.		The Request will support facility visits where the use of electronic telecommunications is not practical for mandated on-site inspections and facility operations reviews. The Request will support the PCAST advisory committee travel.	The Request will support mission critical travel while continuing videoconferencing instead of travel, where possible.
Support Services	$36,000	$28,500	-$7,500
Funding supports select administrative and professional services including: support for the SBIR/STTR program; grants and contract processing and close-out activities; accessibility to DOE's corporate multi-billion dollar R&D program through		The Request will support select administrative and professional services including: support for grants and contract processing and close-out activities; accessibility to DOE's corporate multi-billion dollar R&D program through information	The Request will support the projected support service contract requirements to include SC's portion of the DOE Trusted Workforce initiative.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
information systems managed and administered by OSTI; travel processing; correspondence control; select reports or analyses directed toward improving the effectiveness, efficiency, and economy of services and processes; and safeguards and security oversight functions. Funding supports essential information technology infrastructure; necessary upgrades to SC's financial management system; ongoing operations, maintenance, and enhancement of information technology systems; and safety management support. Funding supports federal staff training and education to maintain appropriate certifications and update skills.	systems managed and administered by OSTI; travel processing; correspondence control; select reports or analyses directed toward improving the effectiveness, efficiency, and economy of services and processes; and safeguards and security oversight functions. The Request will support essential information technology infrastructure; necessary upgrades to SC's financial management system; ongoing operations, maintenance, and enhancement of information technology systems; and safety management support. The Request will fund federal staff training and education to maintain appropriate certifications and update skills.	
Other Related Expenses $20,500	$17,775	-$2,725
Funding supports fixed requirements associated with rent, utilities, and telecommunications; building and grounds maintenance; computer/video maintenance and support; the purchasing, leasing and maintenance of IT equipment and systems to support customers' evolving needs; and site-wide health care units. It will also include miscellaneous purchases for supplies, and materials.	The Request will support fixed requirements associated with rent, utilities, and telecommunications; building and grounds maintenance; computer/video maintenance and support; the purchasing, leasing and maintenance of IT equipment and systems to support customers' evolving needs; and site-wide health care units. It will also include miscellaneous purchases for supplies, and materials.	The Request will support the projected fixed requirements for FY 2027.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Working Capital Fund $7,210	$10,363	+$3,153
Funding supports a portion of the SC contribution to the Working Capital Fund for business lines: building occupancy, copy services, supplies, printing and graphics, health services, corporate training services, mail and translation, pension studies, procurement management, and Program Management Career Development. SC research programs also will contribute to the Working Capital Fund.	The Request will support a portion of the SC contribution to the Working Capital Fund for business lines: building occupancy, copy services, supplies, printing and graphics, health services, corporate training services, mail and translation, pension studies, procurement management, and Program Management Career Development. SC research programs also will contribute to the Working Capital Fund.	The Request will support the projected charges to support SC requirements.

Public Access

The Department of Energy fulfills Legislative and Executive requirements to provide public access to outputs resulting from DOE's research and development (R&D), including journal article accepted manuscripts, technical reports, data, and software. DOE-funded R&D outputs are stewarded and made available by SC's Office of Scientific and Technical Information (OSTI). OSTI collects these outputs and descriptive information from national laboratories and grantees, provides long-term preservation, and makes them widely discoverable through OSTI search tools and by enabling indexing of this content by major commercial search engines.

In addition to existing Legislative requirements, Executive branch requirements were originally included in a 2013 Office of Science and Technology Policy (OSTP) memorandum which required peer-reviewed, journal article accepted manuscripts to be made publicly available and for each sponsoring research office to ensure funded research activities have an associated data management plan. In 2022, OSTP updated its public access guidance, requiring agencies to provide immediate access to accepted manuscripts, rather than the 12-month embargo in the 2013 memorandum; immediate access to data underlying publications as described in data management and sharing plans; and wide adoption of persistent identifiers (PIDs) for R&D outputs, awards, researchers, and organizations.

Building on the 2013 Public Access Plan, DOE published a new Plan[a] in June 2023 to address the expectations in the 2022 guidance memo. Implementation of the new plan is underway, which included revising and issuing DOE O 241.1C, "Scientific and Technical Information Management," with requirements for immediate access to accepted manuscripts, developing data management and sharing plans, and adoption of PIDs. These requirements will be specified in national labs' management and operating contracts and annual performance plans and in the terms and conditions of DOE financial assistance awards. DOE-funded researchers are required to submit accepted manuscripts, which are made publicly accessible via the official agency repository, DOE PAGES (Public Access Gateway for Energy and Science). DOE is among the top agencies implementing public access, with over 240,000 scholarly publications made publicly available in DOE PAGES (developed and hosted by OSTI) since 2014. DOE is also a federal government leader in assigning and using persistent identifiers to promote research transparency and reproducibility as well as research security. By expanding the use of PIDs for researchers, their outputs, and organizations, DOE will better enable identification of agency support for given investments, the scientists who conduct that research, the organizations they are associated with, and the R&D outputs stemming from that support.

[a] https://www.energy.gov/sites/default/files/2023-07/DOE%20Public%20Access%20Plan%202023%20-%20Final.pdf

DEPARTMENT OF ENERGY
Funding by Site Detail - PSO Request
TAS_0222 - Science - FY 2027
(Dollars in Thousands)

	Request Detail		
	Requested Total		
	FY 2025	FY 2026	FY 2027
Ames Laboratory			
Research - Basic Energy Sciences	15,240	15,240	12,515
Basic Energy Sciences	15,240	15,240	12,515
Research - High Energy Physics	700	1,440	1,440
High Energy Physics	700	1,440	1,440
Safeguards and Security - SC	1,477	1,477	1,477
Total Ames Laboratory	**17,417**	**18,157**	**15,432**
Ames Site Office			
Program Direction - SC	887	841	738
Total Ames Site Office	**887**	**841**	**738**
Argonne National Laboratory			
Research - Advanced Scientific Computing Research	225,984	248,789	241,880
Advanced Scientific Computing Research	225,984	248,789	241,880
Research - Basic Energy Sciences	296,708	323,314	279,206
Basic Energy Sciences	296,708	323,314	279,206
Research - Biological & Environmental Research	50,305	48,371	7,884
Biological and Environmental Research	50,305	48,371	7,884
Research - Fusion Energy Sciences	750	750	206
Fusion Energy Sciences	750	750	206
Research - High Energy Physics	15,981	23,840	21,478
High Energy Physics	15,981	23,840	21,478
Research - Nuclear Physics	35,602	35,813	32,511
Nuclear Physics	35,602	35,813	32,511
Research - Accelerator R&D and Production	371	0	0
Accelerator R&D and Production	371	0	0
Facilities and Infrastructure (SLI)	13,837	0	0
20-SC-77, Argonne Utilities Upgrade, ANL	3,000	2,250	1,500
Construction - Science Laboratories Infrastructure	3,000	2,250	1,500
Science Laboratories Infrastructure	16,837	2,250	1,500
Safeguards and Security - SC	10,100	10,100	10,100
Total Argonne National Laboratory	**652,638**	**693,227**	**594,765**
Argonne Site Office			
Program Direction - SC	4,603	4,358	3,810
Total Argonne Site Office	**4,603**	**4,358**	**3,810**
Berkeley Site Office			
Program Direction - SC	3,688	3,657	3,256
Total Berkeley Site Office	**3,688**	**3,657**	**3,256**
Brookhaven National Laboratory			
Research - Advanced Scientific Computing Research	2,583	2,583	3,502
Advanced Scientific Computing Research	2,583	2,583	3,502
Research - Basic Energy Sciences	221,338	258,309	243,051
24-SC-12 NSLS-II Experimental Tools - III (NEXT-III)	5,500	5,500	0
Construction - Basic Energy Sciences	5,500	5,500	0
Basic Energy Sciences	226,838	263,809	243,051
Research - Biological & Environmental Research	21,927	18,989	7,620
Biological and Environmental Research	21,927	18,989	7,620
Research - Fusion Energy Sciences	2,409	2,409	2,409
Fusion Energy Sciences	2,409	2,409	2,409
Research - High Energy Physics	59,296	62,482	51,228
11-SC-40, Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment	14,300	14,000	7,500
Construction - High Energy Physics	14,300	14,000	7,500

DEPARTMENT OF ENERGY
Funding by Site Detail - PSO Request
TAS_0222 - Science - FY 2027
(Dollars in Thousands)

	Request Detail		
	Requested Total		
	FY 2025	FY 2026	FY 2027
High Energy Physics	73,596	76,482	58,728
Research - Nuclear Physics	206,384	212,965	146,062
20-SC-52, Electron Ion Collider, BNL	82,500	116,250	150,000
Construction - Nuclear Physics	82,500	116,250	150,000
Nuclear Physics	288,884	329,215	296,062
Research - Accelerator R&D and Production	8,567	0	0
Accelerator R&D and Production	8,567	0	0
Facilities and Infrastructure (SLI)	11,200	11,918	0
Science Laboratories Infrastructure	11,200	11,918	0
Safeguards and Security - SC	14,674	14,674	14,674
Total Brookhaven National Laboratory	**650,678**	**720,079**	**626,046**
Brookhaven Site Office			
Program Direction - SC	5,043	4,972	4,421
Total Brookhaven Site Office	**5,043**	**4,972**	**4,421**
Chicago Operations Office			
Research - Fusion Energy Sciences	0	0	944
Fusion Energy Sciences	0	0	944
Total Chicago Operations Office	**0**	**0**	**944**
Consolidated Service Center - Tennessee			
Payment In Lieu of Taxes	5,119	5,119	5,000
Oak Ridge Landlord	7,032	7,032	7,500
Science Laboratories Infrastructure	12,151	12,151	12,500
Safeguards and Security - SC	6,012	6,287	6,287
Program Direction - SC	38,436	38,129	34,488
Total Consolidated Service Center - Tennessee	**56,599**	**56,567**	**53,275**
Fermi National Accelerator Laboratory			
Research - High Energy Physics	359,399	345,221	337,683
18-SC-42, Proton Improvement Plan II (PIP-II), FNAL	125,000	114,000	105,000
11-SC-40, Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment	236,700	239,900	293,000
Construction - High Energy Physics	361,700	353,900	398,000
High Energy Physics	721,099	699,121	735,683
Research - Accelerator R&D and Production	101	0	0
Accelerator R&D and Production	101	0	0
Facilities and Infrastructure (SLI)	0	0	10,000
20-SC-80, Utilities Infrastructure Project, FNAL	35,000	18,000	48,815
Construction - Science Laboratories Infrastructure	35,000	18,000	48,815
Science Laboratories Infrastructure	35,000	18,000	58,815
Safeguards and Security - SC	6,333	6,333	6,333
Total Fermi National Accelerator Laboratory	**762,533**	**723,454**	**800,831**
Fermi Site Office			
Program Direction - SC	4,980	4,921	4,372
Total Fermi Site Office	**4,980**	**4,921**	**4,372**
Idaho National Laboratory			
Research - Basic Energy Sciences	2,100	2,100	1,680
Basic Energy Sciences	2,100	2,100	1,680
Research - Fusion Energy Sciences	1,500	1,500	448
Fusion Energy Sciences	1,500	1,500	448
Total Idaho National Laboratory	**3,600**	**3,600**	**2,128**
Idaho Operations Office			
Research - Basic Energy Sciences	369	369	369
Basic Energy Sciences	369	369	369

	Request Detail		
	Requested Total		
	FY 2025	FY 2026	FY 2027
Total Idaho Operations Office	**369**	**369**	**369**
Lawrence Berkeley National Laboratory			
Research - Advanced Scientific Computing Research	266,298	285,847	273,707
Advanced Scientific Computing Research	266,298	285,847	273,707
Research - Basic Energy Sciences	223,615	245,130	209,070
18-SC-12, Advanced Light Source Upgrade (ALS-U), LBNL	50,000	50,000	50,000
Construction - Basic Energy Sciences	50,000	50,000	50,000
Basic Energy Sciences	273,615	295,130	259,070
Research - Biological & Environmental Research	189,864	182,931	125,517
Biological and Environmental Research	189,864	182,931	125,517
Research - Fusion Energy Sciences	1,386	1,386	1,650
Fusion Energy Sciences	1,386	1,386	1,650
Research - High Energy Physics	55,297	63,664	52,803
11-SC-40, Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment	0	6,100	4,500
Construction - High Energy Physics	0	6,100	4,500
High Energy Physics	55,297	69,764	57,303
Research - Nuclear Physics	22,945	20,240	15,724
Nuclear Physics	22,945	20,240	15,724
Research - Accelerator R&D and Production	1,113	0	0
Accelerator R&D and Production	1,113	0	0
Facilities and Infrastructure (SLI)	0	8,000	0
20-SC-72, Seismic and Safety Modernization, LBNL	23,000	0	0
20-SC-78, Linear Assets Modernization Project, LBNL	25,000	19,000	25,000
Construction - Science Laboratories Infrastructure	48,000	19,000	25,000
Science Laboratories Infrastructure	48,000	27,000	25,000
Safeguards and Security - SC	7,973	7,973	7,973
Total Lawrence Berkeley National Laboratory	**866,491**	**890,271**	**765,944**
Lawrence Livermore National Laboratory			
Research - Advanced Scientific Computing Research	3,174	3,174	9,668
Advanced Scientific Computing Research	3,174	3,174	9,668
Research - Basic Energy Sciences	712	712	498
Basic Energy Sciences	712	712	498
Research - Biological & Environmental Research	33,027	29,421	6,041
Biological and Environmental Research	33,027	29,421	6,041
Research - Fusion Energy Sciences	13,900	13,400	18,067
Fusion Energy Sciences	13,900	13,400	18,067
Research - High Energy Physics	1,402	2,225	1,455
High Energy Physics	1,402	2,225	1,455
Research - Nuclear Physics	2,712	2,432	2,456
Nuclear Physics	2,712	2,432	2,456
Research - Accelerator R&D and Production	1,095	0	0
Accelerator R&D and Production	1,095	0	0
Total Lawrence Livermore National Laboratory	**56,022**	**51,364**	**38,185**
Los Alamos National Laboratory			
Research - Advanced Scientific Computing Research	3,390	3,390	9,326
Advanced Scientific Computing Research	3,390	3,390	9,326
Research - Basic Energy Sciences	25,562	27,329	21,149
Basic Energy Sciences	25,562	27,329	21,149
Research - Biological & Environmental Research	40,396	39,332	3,604
Biological and Environmental Research	40,396	39,332	3,604

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Research - Fusion Energy Sciences	2,900	2,400	1,880
Fusion Energy Sciences	2,900	2,400	1,880
Research - High Energy Physics	1,502	2,010	1,920
High Energy Physics	1,502	2,010	1,920
Research - Nuclear Physics	9,888	10,253	5,125
Nuclear Physics	9,888	10,253	5,125
Research - Accelerator R&D and Production	290	0	0
Accelerator R&D and Production	290	0	0
Total Los Alamos National Laboratory	**83,928**	**84,714**	**43,004**
National Laboratory of the Rockies			
Research - Advanced Scientific Computing Research	1,963	535	205
Advanced Scientific Computing Research	1,963	535	205
Research - Basic Energy Sciences	9,328	9,328	3,824
Basic Energy Sciences	9,328	9,328	3,824
Research - Biological & Environmental Research	1,200	606	342
Biological and Environmental Research	1,200	606	342
Total National Laboratory of the Rockies	**12,491**	**10,469**	**4,371**
Oak Ridge Institute for Science and Education			
Research - Biological & Environmental Research	2,788	2,313	799
Biological and Environmental Research	2,788	2,313	799
Research - Fusion Energy Sciences	850	850	0
Fusion Energy Sciences	850	850	0
Safeguards and Security - SC	900	1,678	1,678
Total Oak Ridge Institute for Science and Education	**4,538**	**4,841**	**2,477**
Oak Ridge National Laboratory			
Research - Advanced Scientific Computing Research	266,937	281,937	290,601
Advanced Scientific Computing Research	266,937	281,937	290,601
Research - Basic Energy Sciences	446,266	528,162	444,423
24-SC-10, HFIR Pressure Vessel Replacement (PVR), ORNL	6,000	6,000	0
19-SC-14, Second Target Station (STS), ORNL	52,000	52,000	80,000
Construction - Basic Energy Sciences	58,000	58,000	80,000
Basic Energy Sciences	504,266	586,162	524,423
Research - Biological & Environmental Research	88,646	85,005	20,068
Biological and Environmental Research	88,646	85,005	20,068
Research - Fusion Energy Sciences	34,770	34,673	21,814
14-SC-60, U.S. Contributions to ITER (U.S. ITER)	200,000	170,684	77,500
Construction - Fusion Energy Sciences	200,000	170,684	77,500
Fusion Energy Sciences	234,770	205,357	99,314
Research - High Energy Physics	2,207	2,449	2,508
High Energy Physics	2,207	2,449	2,508
Research - Nuclear Physics	11,972	5,672	5,733
Nuclear Physics	11,972	5,672	5,733
Research - Accelerator R&D and Production	234	0	0
Accelerator R&D and Production	234	0	0
Oak Ridge Nuclear Operations	46,000	46,000	46,000
Facilities and Infrastructure (SLI)	9,690	0	32,711
Science Laboratories Infrastructure	55,690	46,000	78,711
Safeguards and Security - SC	31,688	31,688	31,688
Total Oak Ridge National Laboratory	**1,196,410**	**1,244,270**	**1,053,046**
Oak Ridge National Laboratory Site Office			
Program Direction - SC	8,358	8,169	7,224

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Total Oak Ridge National Laboratory Site Office	**8,358**	**8,169**	**7,224**
Office of Scientific and Technical Information			
Research - Fusion Energy Sciences	4	4	5
Fusion Energy Sciences	4	4	5
Safeguards and Security - SC	419	420	420
Program Direction - SC	12,261	11,941	10,569
Total Office of Scientific and Technical Information	**12,684**	**12,365**	**10,994**
Pacific Northwest National Laboratory			
Research - Advanced Scientific Computing Research	4,545	2,973	4,027
Advanced Scientific Computing Research	4,545	2,973	4,027
Research - Basic Energy Sciences	28,406	28,406	17,810
Basic Energy Sciences	28,406	28,406	17,810
Research - Biological & Environmental Research	139,711	151,468	65,410
24-SC-31, Microbial Molecular Phenotyping Capability (M2PC), PNNL	19,000	19,000	35,000
Biological and Environmental Research - Construction	19,000	19,000	35,000
Biological and Environmental Research	158,711	170,468	100,410
Research - Fusion Energy Sciences	1,500	1,500	2,361
Fusion Energy Sciences	1,500	1,500	2,361
Research - High Energy Physics	1,633	2,604	2,265
High Energy Physics	1,633	2,604	2,265
Research - Nuclear Physics	818	818	0
Nuclear Physics	818	818	0
Facilities and Infrastructure (SLI)	0	8,100	0
Science Laboratories Infrastructure	0	8,100	0
Safeguards and Security - SC	12,380	12,380	12,380
Total Pacific Northwest National Laboratory	**207,993**	**227,249**	**139,253**
Pacific Northwest Site Office			
Program Direction - SC	6,742	6,514	5,741
Total Pacific Northwest Site Office	**6,742**	**6,514**	**5,741**
Princeton Plasma Physics Laboratory			
Research - Fusion Energy Sciences	59,597	57,430	80,767
Fusion Energy Sciences	59,597	57,430	80,767
Facilities and Infrastructure (SLI)	0	0	7,289
21-SC-71, Princeton Plasma Innovation Center, PPPL	30,000	34,600	0
21-SC-72, Critical Infrastructure Recovery & Renewal, PPPL	10,000	9,400	12,282
Construction - Science Laboratories Infrastructure	40,000	44,000	12,282
Science Laboratories Infrastructure	40,000	44,000	19,571
Safeguards and Security - SC	4,524	4,524	4,524
Total Princeton Plasma Physics Laboratory	**104,121**	**105,954**	**104,862**
Princeton Site Office			
Program Direction - SC	2,463	2,385	2,108
Total Princeton Site Office	**2,463**	**2,385**	**2,108**
Sandia National Laboratories			
Research - Advanced Scientific Computing Research	15,495	15,495	19,259
Advanced Scientific Computing Research	15,495	15,495	19,259
Research - Basic Energy Sciences	26,690	26,082	18,501
Basic Energy Sciences	26,690	26,082	18,501
Research - Biological & Environmental Research	15,929	16,904	3,214
Biological and Environmental Research	15,929	16,904	3,214
Research - Fusion Energy Sciences	2,285	2,285	2,384
Fusion Energy Sciences	2,285	2,285	2,384

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Research - High Energy Physics	85	0	0
High Energy Physics	85	0	0
Total Sandia National Laboratories	**60,484**	**60,766**	**43,358**
Savannah River National Laboratory			
Research - Basic Energy Sciences	1,100	1,100	880
Basic Energy Sciences	1,100	1,100	880
Research - Fusion Energy Sciences	2,000	2,000	0
Fusion Energy Sciences	2,000	2,000	0
Total Savannah River National Laboratory	**3,100**	**3,100**	**880**
SLAC National Accelerator Laboratory			
Research - Basic Energy Sciences	338,735	363,698	355,587
21-SC-10, Cryomodule Repair and Maintenance Facility, SLAC	20,000	20,000	7,800
18-SC-13, Linac Coherent Light Source-II-High Energy (LCLS-II-HE), SLAC	100,000	99,343	6,000
Construction - Basic Energy Sciences	120,000	119,343	13,800
Basic Energy Sciences	458,735	483,041	369,387
Research - Biological & Environmental Research	5,100	4,373	3,208
Biological and Environmental Research	5,100	4,373	3,208
Research - Fusion Energy Sciences	6,585	6,585	7,133
Fusion Energy Sciences	6,585	6,585	7,133
Research - High Energy Physics	86,403	82,734	73,242
High Energy Physics	86,403	82,734	73,242
Research - Nuclear Physics	1,166	1,166	516
Nuclear Physics	1,166	1,166	516
Research - Accelerator R&D and Production	1,284	0	0
Accelerator R&D and Production	1,284	0	0
Facilities and Infrastructure (SLI)	7,765	10,328	0
20-SC-79, Critical Utilities Infrastructure Revitalization, SLAC	20,000	15,000	18,075
Construction - Science Laboratories Infrastructure	20,000	15,000	18,075
Science Laboratories Infrastructure	27,765	25,328	18,075
Safeguards and Security - SC	3,997	3,997	3,997
Total SLAC National Accelerator Laboratory	**591,035**	**607,224**	**475,558**
Thomas Jefferson National Accelerator Facility			
Research - Advanced Scientific Computing Research	669	669	0
Advanced Scientific Computing Research	669	669	0
Research - Basic Energy Sciences	200	200	0
Basic Energy Sciences	200	200	0
Research - Fusion Energy Sciences	0	0	500
Fusion Energy Sciences	0	0	500
Research - High Energy Physics	0	350	766
High Energy Physics	0	350	766
Research - Nuclear Physics	153,540	160,045	159,908
20-SC-52, Electron Ion Collider, BNL	27,500	38,750	50,000
Construction - Nuclear Physics	27,500	38,750	50,000
Nuclear Physics	181,040	198,795	209,908
Research - Accelerator R&D and Production	757	0	0
Accelerator R&D and Production	757	0	0
20-SC-73, CEBAF Renovation and Expansion, TJNAF	11,000	26,000	0
Construction - Science Laboratories Infrastructure	11,000	26,000	0
Science Laboratories Infrastructure	11,000	26,000	0
Safeguards and Security - SC	3,167	3,667	3,667

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Total Thomas Jefferson National Accelerator Facility	**196,833**	**229,681**	**214,841**
Thomas Jefferson Site Office			
Program Direction - SC	2,541	2,407	2,105
Total Thomas Jefferson Site Office	**2,541**	**2,407**	**2,105**
Y-12 National Security Complex			
Safeguards and Security - SC	275	0	0
Total Y-12 National Security Complex	**275**	**0**	**0**
Other			
Research - Advanced Scientific Computing Research	144,234	150,966	139,813
Advanced Scientific Computing Research	144,234	150,966	139,813
Research - Basic Energy Sciences	406,213	364,007	212,623
Basic Energy Sciences	406,213	364,007	212,623
Research - Biological & Environmental Research	178,651	117,753	34,582
Biological and Environmental Research	178,651	117,753	34,582
Research - Fusion Energy Sciences	459,564	507,801	534,183
Fusion Energy Sciences	459,564	507,801	534,183
Research - High Energy Physics	213,830	192,517	133,276
High Energy Physics	213,830	192,517	133,276
Research - Nuclear Physics	206,805	176,547	156,925
Nuclear Physics	206,805	176,547	156,925
Research - Isotope R&D and Production	116,736	110,500	114,972
20-SC-51, U.S. Stable Isotope Production and Research Center (SIPRC), ORNL	45,900	50,000	45,100
24-SC-92, Clinical Alpha Radionuclide Producer (CARP), BNL	0	1,000	0
24-SC-91, Radioisotope Processing Facility (RPF), ORNL	7,000	8,500	8,500
Construction - Isotope R&D and Production	52,900	59,500	53,600
Isotope R&D and Production	169,636	170,000	168,572
Research - Accelerator R&D and Production	7,753	0	0
Accelerator R&D and Production	7,753	0	0
Safeguards and Security - SC	0	2,305	0
Program Direction - SC	134,256	135,971	125,758
Total Other	**1,920,942**	**1,817,867**	**1,505,732**
Undesignated LPI			
Research - Advanced Scientific Computing Research	100,963	119,970	112,458
Advanced Scientific Computing Research	100,963	119,970	112,458
Research - Basic Energy Sciences	312,203	252,157	181,151
Basic Energy Sciences	312,203	252,157	181,151
Research - Biological & Environmental Research	83,456	137,534	82,678
Biological and Environmental Research	83,456	137,534	82,678
Research - Fusion Energy Sciences	0	0	3,000
Fusion Energy Sciences	0	0	3,000
Research - High Energy Physics	50,835	79,620	30,394
High Energy Physics	50,835	79,620	30,394
Research - Nuclear Physics	63,768	70,190	66,474
Nuclear Physics	63,768	70,190	66,474
Research - Accelerator R&D and Production	5,435	0	0
Accelerator R&D and Production	5,435	0	0
Workforce Development for Teachers & Scientists	31,000	32,000	30,000
Facilities and Infrastructure (SLI)	200	1,654	0
Laboratory Operations Internship	3,000	3,000	3,000
Science Laboratories Infrastructure	3,200	4,654	3,000

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Safeguards and Security - SC	86,081	82,497	97,302
Total Undesignated LPI	**736,941**	**778,622**	**606,457**
Total Funding by Site for TAS_0222 - Science	**8,240,000**	**8,400,000**	**7,138,815**