U.S. DEPARTMENT OF ENERGY | Office of Nuclear Energy

Office of Nuclear Energy

FY 2017 Budget Request

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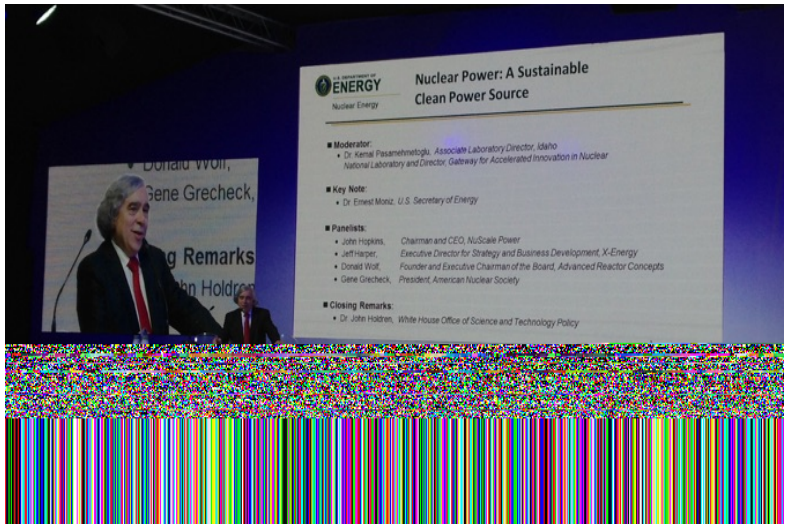
February 9, 2016

Trends in Nuclear

- Recognition of importance of nuclear – today and in the future – in meeting carbon reduction/climate goals
- Concern about financial viability of some currently operating plants, yet large carbon reduction benefits from keeping them running
- Increased interest in nuclear in some domestic and international markets
  - Gen III+
  - SMR technology
- Innovators, some utilities looking at advanced "Gen IV" nuclear as a way to move nuclear beyond electricity
  - Innovators need timely, affordable access to existing and new DOE capabilities

Nuclear Energy – Sustainably Clean Power

"To meet our emissions reduction targets and avoid the worst effects of climate change, we need to dramatically reduce power sector emissions. Switching from coal to natural gas is already reducing the U.S. carbon footprint, but it's not enough to get the deep CO_2 cuts envisioned in the President's Climate Action Plan. Reducing emissions by 80% will likely require the complete decarbonization of the power sector….



*We know **nuclear can provide 24-hour baseload power**, because it already does. Worldwide, nuclear power produces more energy than hydro, solar, wind, and geothermal power combined.*

*The bottom line is that to achieve the pace and scale of worldwide carbon reductions needed to avoid climate change, **nuclear must play a role**."*

Secretary Moniz
COP21, Paris 2015

Nuclear Energy – Mission Innovation

- At the start of the Paris climate negotiations in November, the President along with other world leaders launched Mission Innovation, a landmark commitment to dramatically accelerate public and private global clean energy innovation by investing in new technologies that will define a clean, affordable, and reliable global power mix.

- Through this initiative the U.S has committed to doubling its governmental clean energy research and development investment over five years.

- The NE FY 2017 Budget Request includes $804.2M that contributes to the Mission Innovation pledge, a decrease of $57.6M from the FY 2016 Enacted level of $861.8M

- Priority areas within NE relating to implementation of the Administration's Strategy for nuclear waste and fulfilling the Department's commitments for Small Modular Reactor Licensing Technical Support do not count towards Mission Innovation. Increases in requested funding for these programs results in reduced funding for Mission Innovation when compared to FY 2016 Enacted.

Highlights of the Nuclear Energy FY 2017 Request

FY 2016 Enacted	FY 2017 Request	FY 17 vs FY16 Delta
$986M	$994M	+$8M

Nuclear Energy accelerates integrated waste management implementation with consent-based siting and invests in emerging nuclear reactor designs and advanced fuels.

- **Small Modular Reactors ($90M)—**Complete DOE commitment for the NuScale Design Certification (DC) Project – supports NRC review of DC application, NuScale's engineering and analytical efforts to respond to NRC review issues, and work towards finalizing the SMR design.
- **Reactor Concepts ($109M)**— Continue LWRS efforts to maintain carbon free power generation by the current fleet and supports R&D of advanced reactor technologies. Consolidates sCO_2 R&D activities (STEP).
- **Fuel Cycle R&D ($250M)**—Accelerate Integrated Waste Management System storage & transportation and consent-based siting activities; initiate development and qualification phase for accident tolerant fuel to support insertion of a lead test rod or assembly in a commercial reactor by 2022; continue deep borehole field test; and continue collaboration with industry on extended storage of high-burnup used fuel.
- **Nuclear Energy Enabling Technologies ($90M)**— Supports modeling and simulation, cross-cutting technology development, nuclear user facilities, and traineeships for critical nuclear technologies.
- **Idaho National Laboratory ($356M)**—Modernization of facilities and security capabilities, including initiation of 5 year ATR reliability improvement program.
- **International Nuclear Energy Coordination ($5M)** -- Initiates development of a program for international nuclear energy education outreach to support emerging countries developing nuclear energy programs.

NE Support of US Industry Research and Development

Gateway for Accelerated Innovation in Nuclear (GAIN)

- Provides the nuclear community with access to the technical, regulatory, and financial support necessary to move advanced nuclear technologies toward commercialization while ensuring continued operation of the existing nuclear fleet.
- Integrates and facilitates efforts by private industry, universities and government researchers to test, develop and demonstrate advanced nuclear technologies.

Voucher Initiative

- DOE will fund ~$2 million in vouchers to assist small business applicants including entrepreneur-led start-ups seeking access to knowledge/capabilities available from DOE national labs so GAIN can support strong interest in nuclear energy by many new companies developing advanced nuclear energy technologies.

Energy Technology Commercialization Fund

- ~$20 million allocation from DOE's applied RD&D and commercial application budget to pursue high impact commercialization activities. Established by Energy Policy Act of 2005. Provides matching funds with private partners to promote promising energy technologies for commercial purposes. (NE FY16 = $4.3M)

SBIR/STTR

- NE provides over 3.4% of its applied RD&D funding annually to support small business research addressing focused NE mission areas. (NE FY17 est. $13.6M)

NE FY 2017 Congressional Request Funding Summary

(Dollars in Thousands)

	FY 2016 Enacted	FY 2017 Request
Integrated University Program	5,000	0
SMR Licensing Technical Support	62,500	89,600
STEP R&D	5,000	0
Reactor Concepts RD&D	141,718	108,760
Fuel Cycle R&D	203,800	249,938
Nuclear Energy Enabling Technologies	111,600	89,510
Radiological Facilities Management	24,800	7,000
Idaho Facilities Management	222,582	226,585
Idaho Sitewide Safeguards and Security	126,161	129,303
International Nuclear Energy Cooperation	3,000	4,500
Program Direction	80,000	88,700
Total, Nuclear Energy	**986,161**	**993,896**

Small Modular Reactor Licensing Technical Support

Budget Summary

$ in thousands

Program Element	FY 2016 Enacted	FY 2017 Request
SMR Licensing Technical Support	62,500	89,600
Total:	**62,500**	**89,600**

NuScale SMR

Mission

Technical support for design certification (DC) and licensing activities for SMR designs through cost-shared arrangements with industry partners in order to accelerate commercialization and deployment of SMRs that can provide safe, clean, affordable power options.

FY 2017 Planned Accomplishments

- Fullfils DOE funding commitment for the NuScale Design Certification (DC) Project – supports NRC review of DC application, NuScale's engineering and analytical efforts to respond to NRC review issues, and work towards finalizing the SMR design.
- Completes DOE's funding commitment for the site permitting and licensing projects with TVA and NuScale/Utility Partner.
  - TVA: NRC review of Early Site Permit Application, development of Combined Operating License Application (COLA).
  - NuScale/Utility Partner: Continuing development of COLA.

Reactor Concepts
Research, Development and Demonstration

Budget Summary

$ in thousands

Program Element	FY 2016 Enacted	FY 2017 Request
Light Water Reactor Sustainability	40,000	35,260
Advanced Reactor Technologies	101,718	73,500
Total:	**141,718**	**108,760**

Mission

Develop new and advanced reactor designs and technologies that advance the state of reactor technology to improve competitiveness and support meeting Nation's energy, environmental, and national security goals. Conduct R&D on advanced technologies that improve the reliability, sustain safety, and extend the life of the current LWR fleet.

FY 2017 Planned Accomplishments

- Continue LWRS pilot plant projects including Advanced Hybrid Control Room and Automated Work Packages.
- Support Fukushima reactor inspection planning.
- Continue development of advanced reactor concepts, including fast reactors, high temperature gas-cooled reactors and salt-cooled reactors.
- Research liquid metal-cooled reactor components.
- Begin final irradiation experiment for TRISO fuel qualification.
- Continue sCO2 research in advanced energy conversion techniques and turbomachinery.
- Work with the NRC (NRC) on licensing questions specific to non-light water cooled reactors.
- Initiation of implement of the Advanced Test/Demonstration Reactor Study to be completed in 2016.

Fuel Cycle Research and Development

Budget Summary

$ in thousands

Program Element	FY 2016 Enacted	FY 2017 Request
Material Recovery and Waste Form Development	32,950	23,300
Advanced Fuels	62,100	59,000
Systems Analysis & Integration	10,500	5,000
Materials Protection, Accounting & Control Technology	8,050	7,000
Used Nuclear Fuel Disposition (UNFD) Research & Development	62,500	74,338
UNFD Integrated Waste Management System	22,500	76,300
Fuel Resources	5,200	5,000
Total:	**203,800**	**249,938**

Mission

Conduct generic R&D and related activities for used nuclear fuel (UNF) and nuclear waste management strategies and technologies to support the government's responsibility to manage and dispose of the nation's commercial UNF and high-level waste.

Conduct R&D on advanced sustainable fuel cycle technologies that have the potential to improve resource utilization and energy generation, reduce waste generation, enhance safety, and limit proliferation risk.

FY 2017 Planned Accomplishments

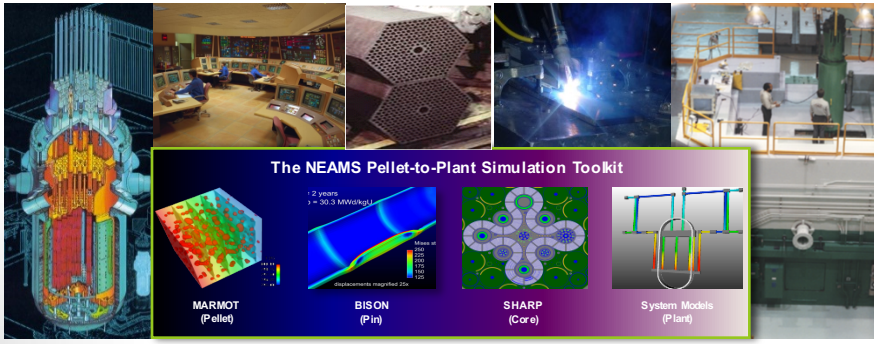
- In Advanced Fuels, the accident tolerant fuel program progresses from the feasibility phase to the development and qualification phase if viable concepts are identified in FY 2016.
- UNFD R&D will complete the characterization borehole and initiate drilling of the field test borehole and will continue with plans to adapt INL facilities to handle and examine large dry storage casks on the INL site.
- Integrated Waste Management System activities expand and become a stand-alone subprogram. Consent based siting activities accelerate to support the siting of all potential waste management facilities.

Nuclear Energy Enabling Technologies

Budget Summary

$ in thousands

Program Element	FY 2016 Enacted	FY 2017 Request
Energy Innovation Hub for Modeling & Simulation	24,300	24,300
Crosscutting Technology Development	17,000	17,185
Nuclear Energy Advanced Modeling and Simulation	27,200	23,740
Nuclear Science User Facilities	41,100	23,285
NE Traineeships	2,000	1,000
Total:	**111,600**	**89,510**



Mission

Develop crosscutting technologies that directly support and complement NE's R&D efforts and encourage transformative and creative solutions.

FY 2017 Planned Accomplishment

- HUB will demonstrate ability to model fuel performance during a loss of coolant accident
- CTD to support expanding collaborations in nuclear cyber security and the Gateway for Accelerated Innovation in Nuclear (GAIN) initiative
- NEAMS will continue TREAT mission support with analyses to improve operational efficiency and expand testing regimes
- NSUF will continue to make new irradiation and post irradiation examination (PIE) awards, expand capabilities through the Knowledge and Validation Center, and support GAIN.
- NE Traineeships will conduct a formal study to evaluate and confirm the need to implement traineeships for focused topical areas to address NE's mission-specific and critical workforce needs.

Nuclear Energy – DOE Technology Team Crosscut Support

Advanced Materials:

FY2017 activities will support research and development in advanced materials joining techniques and additive manufacturing techniques. Activities will also include the continuation of materials modeling efforts using computational thermodynamics. (Reactor Concepts $0.4M; NEET $2.0M).

Supercritical CO_2:

FY 2017 activities will include efforts to support the STEP pilot scale project through technical evaluations of risk and cost reduction option, and the development and testing of high efficiency Brayton cycle turbo-machinery and the conduct of experiments to explore liquid metal / sCO_2 heat exchanger performance. (Reactor Concepts RD&D $6.0 million).

Subsurface Science, Technology and Engineering RD&D:

FY 2017 activities include the continuation of the field test initiated in FY 2016 to support R&D of the concept of waste disposal in deep boreholes in crystalline basement rock, and R&D on characterization and performance of generic mined geologic repository media and concepts for disposal of high-level radioactive waste and used nuclear fuel. (Fuel Cycle R&D $30.5 million).

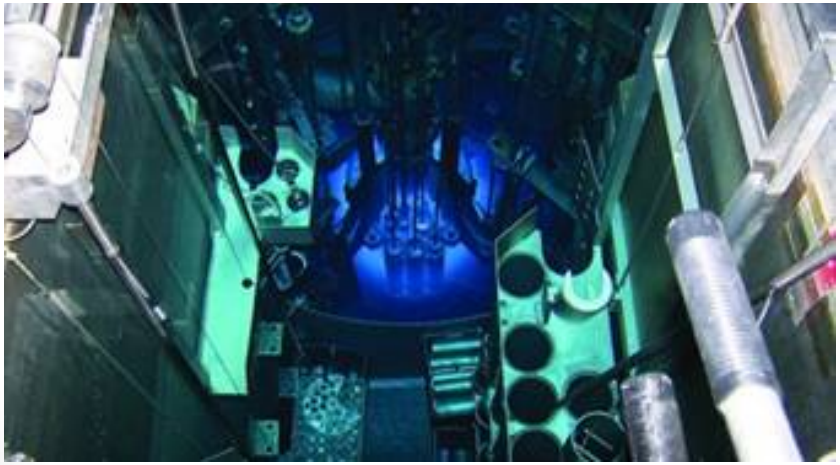
Cybersecurity:

FY 2017 activities include the protection of INL infrastructure, data and personnel (S&S $16.3 million) and NE is pursuing competitive awards through NEET, NEUP as well as SBIR related to cyber threat to our nation's nuclear reactor infrastructure, both research and power producing reactors ($3 million).

Radiological Facilities Management

Budget Summary
$ in thousands

Program Element	FY 2016 Enacted	FY 2017 Request
S&DI/ORNL Infrastructure	18,000	0*
Research Reactor Infrastructure	6,800	7,000
Total:	**24,800**	**7,000**



*$26M included in the Science budget request.

Mission

Support the continued operation of 25 U.S. university research reactors by providing fuel services and maintenance of fuel fabrication equipment.

FY 2017 Planned Accomplishments

- Procure 40 and deliver between 33 and 36 plate fuel elements required annually by MURR and MIT as determined by need and fuel availability.
- Continue TRIGA fuel alternatives analysis and continue funding remaining safety upgrades to allow resumption of TRIGA fuel fabrication operations.
- Ship up to two cask loads of lightly irradiated TRIGA fuel elements from the Irradiated Fuel Storage Facility at INL to selected university research reactor facilities.
- Complete up to 5 used fuel shipments to SRS and the INL, pending resolution of moratorium on such shipments to the INL.

Idaho Facilities Management

Budget Summary

$ in thousands

Program Element	FY 2016 Enacted	FY 2017 Request
INL Nuclear Research Reactor Operations and Maintenance	100,244	101.616
INL Non-Reactor Nuclear Research Facility Operations and Maintenance	76,340	75,379
INL Engineering and Support Facility Operations and Maintenance	31,459	29,284
INL Regulatory Compliance	12,539	14,306
16-E-200, Sample Preparation Laboratory, INL	2,000	6,000
Total:	**222,582**	**226,585**

Mission

Manage the planning, acquisition, operation, maintenance, and disposition of nuclear facilities and capabilities at the Idaho National Laboratory (INL).

FY 2017 Planned Accomplishments

- Continue investments at the Advanced Test Reactor and Materials and Fuels Complex to improve reliability and availability.
- Complete the remaining refurbishments of the Transient Reactor Test Facility.
- Initiate the resurfacing, reconstruction, and sealing of major primary roads at INL.
- Continue preliminary design and performance baseline development activities for the Sample Preparation Laboratory Project at the INL.
- Initiate the disposition of Nuclear Energy owned excess contaminated facilities at INL.

Idaho Sitewide Safeguards and Security

Budget Summary
$ in thousands

	FY 2016 Enacted	FY 2017 Request
Idaho Sitewide S&S	126,161	129,303
Total:	**126,161**	**129,303**

Mission

Provide protection of nuclear materials, classified matter, Government property, and other vital assets at the Idaho National Laboratory (INL).

FY 2017 Planned Accomplishments

- Complete critical physical security infrastructure investments to refurbish the protective force live-fire shoot house training facility, to implement redundant, independently routed communication paths for intrusion detection systems and to enhance physical security infrastructure across INL.
- Continue physical security systems life-cycle equipment replacements.
- Implement enhanced network forensic capabilities for increased intrusion detection and response.

International Nuclear Energy Cooperation

Budget Summary

$ in thousands

Program Element	FY 2016 Enacted	FY 2017 Request
International Nuclear Energy Cooperation	3,000	4,500
Total:	**3,000**	**4,500**

Mission

Serve as the overall lead for the Office of Nuclear Energy in implementing international cooperative R&D activities and support other DOE and broader USG international nuclear energy related priorities.

FY 2017 Planned Accomplishments

- Begin developing a program for nuclear energy education outreach to support diplomacy efforts with emerging countries developing nuclear energy programs.
- Complete U.S.-UK Nuclear R&D Agreement negotiations and begin R&D cooperation under the US-UK Action Plan.
- Conduct workshops and training with Ukraine to ensure reactors are able to safely manage conflict-driven grid instability.
- Support U.S.-India Civil Nuclear Energy Working Group to facilitate joint work on light water reactor projects.
- Lead U.S.-China PSA Workshop on Safety Culture and Risk Informed Regulations.
- Lead efforts to advance a multinational repository approach for emerging countries.

Program Direction

Budget Summary

$ in thousands

Program Element	FY 2016 Enacted	FY 2017 Request
Program Direction	80,000	88,700
Total:	**80,000**	**88,700**

Mission

Provide federal oversight and planning for the Nuclear Energy applied energy programs and ensure the effective, safe, and secure operation of the Idaho National Laboratory.

FY 2017 Planned Accomplishments

- Plan, manage and oversee the NE R&D program.
- Oversee $700M/year INL M&O Contract.
- Oversee approx. $250M in work for other federal agencies.
- Address recruitment and retention needs for continued success of the NE mission.
- Provide support for the increasing Working Capital Fund requirements.
- Provide support for Office of Technology Transition, Human Capital Business Partner personnel, and Office of General Council.
- PY Balances have been significantly reduced from previous years resulting in the need for additional funding to support on-going operation needs to support federal staff.