U.S. DEPARTMENT OF ENERGY

Transition 2016

CORPORATE OVERVIEW

Book One

BOOK ONE – CORPORATE OVERVIEW, CRITICAL EVENTS, AND IMPORTANT ISSUE PAPERS

Welcome to the Department of Energy!

This book provides a Corporate Overview of the Department of Energy (DOE). The opening section describes DOE's history; the changing landscape in the areas of energy, nuclear security, intelligence, science, and threats; leadership and management structure; national laboratories; headquarters, field and laboratory relationships; boards and councils; and cross-cutting and interagency initiatives. The following section includes a list of critical events occurring in 2017 that the incoming Administration will need to be aware of. The final section includes papers on important issues that the new Administration may need to address early in its tenure.

Book Two includes Appendices to the Corporate Overview. This book provides foundational information about DOE, including workforce statistics, national laboratory overviews, budget highlights, external reports about DOE, responses to those reports, contractor workforce statistics, DOE's Congressional oversight committees, and much more.

Book Three provides an organization overview for each DOE departmental element, including its staffing, budget, functions, accomplishments, challenges, and organization chart.

We hope that these books provide the DOE Agency Review Team with useful information for the transition. In addition to these books, all of these materials are available on-line in the Huddle collaboration tool to which Team members have access.

We look forward to working with you to prepare for the new Administration.

Introduction

The United States Department of Energy (DOE) is entrusted with a broad and diverse portfolio across its major mission areas of nuclear security, science, energy, and environmental remediation. At its core, DOE is a science and technology powerhouse with an unparalleled network of 17 National Laboratories. DOE spearheads innovation to successfully address national security challenges, create jobs and increase economic prosperity, boost U.S. manufacturing competitiveness, mitigate and adapt to climate change, and enhance global energy security. The Lab network provides a unique capability to the Nation in that it serves not only DOE's mission but also provides research and development support to multiple other Federal departments and agencies (e.g., Department of Defense [DoD], Intelligence Community [IC], Department of Commerce and the Environmental Protection Agency, and National Institutes of Health [NIH]), as well as numerous universities and industry partners.

A Rich History

The Department of Energy has a rich and diverse history, and one that is inextricably linked with the history of the National Labs and the evolution of science-based public policy. DOE's origins start with the Manhattan Project and the race to develop the atomic bomb during World War II. Some of the world's foremost scientists from the University of California, Berkeley, including Ernest O. Lawrence and J. Robert Oppenheimer, led the theoretical research that became the basis for the design of the atomic bomb. Both Lawrence and Oppenheimer went on to become the leading scientists of the Manhattan Project and, along with Brigadier General Leslie Groves, established a laboratory at an isolated site in Los Alamos, New Mexico, where the atomic bomb was designed and developed.

Following the war, Congress engaged in a vigorous and contentious debate over whether authority over atomic power should reside with the civilian or military branches of government. The Atomic Energy Act of 1946 settled the debate by creating the civilian Atomic Energy Commission (AEC), which took over the Manhattan Engineer District's sprawling scientific and industrial complex. The Los Alamos site later became DOE's Los Alamos National Laboratory (LANL). In 2015, parts of LANL were included in the newly-established Manhattan Project National Historical Park along with other DOE sites that were integral to the development of the atomic bomb at Hanford, Washington and Oak Ridge, Tennessee.

The government had a clear interest in controlling the production of fissionable materials while continuing to benefit from the kind of academic scientific expertise and industry capabilities that were brought to bear for the Manhattan project. To address these competing interests, the government developed a flexible agreement for managing government-owned, contractor-operated (aka "GoCo") scientific, engineering, and production facilities, later known as Management and Operating (M&O) contracts. With few exceptions, DOE still uses the M&O contract model to manage its National Laboratories, sites, and facilities, and this model is credited with being an important reason for the sustained vitality of the DOE National Laboratories.

In 1953, President Eisenhower gave his famous "Atoms for Peace" speech to the United Nation's General Assembly to promote the peaceful use of nuclear energy. Shortly thereafter, the President asked Congress to pass legislation "making it possible for American atomic energy

development, public and private, to play a full and effective part in leading mankind into a new era of progress and peace." The result was the Atomic Energy Act of 1954, which ended exclusive government use of the atom and began the growth of the commercial nuclear power industry, to be regulated by the AEC. This also added an international dimension to AEC's responsibilities in that nuclear technology was to be advanced globally for peaceful purposes. Much of DOE's authority today is still based on this Act.

In response to changing needs in the mid-1970s, in particular the oil embargoes, the AEC was abolished and, in its place, the Energy Reorganization Act of 1974 created two new agencies: the Nuclear Regulatory Commission (NRC) to regulate the nuclear power industry and the Energy Research and Development Administration (ERDA) to manage the nuclear weapon, naval reactor, and energy development programs.

The extended energy crisis of the 1970s soon demonstrated the need for more coherent governmental organization and planning around energy. The Department of Energy Organization Act created DOE in 1977 by bringing together several federal agencies and programs. The Department of Energy, activated on October 1, 1977 as the 12th Cabinet agency, assumed the responsibilities of the Energy Research and Development Administration, the Federal Energy Administration, the Federal Power Commission, and parts of several other agencies. The Federal Energy Regulatory Commission (FERC) was also established within the Department as an independent commission to regulate the natural gas, electricity, oil, and hydropower industries.

The Department of Energy brought many federal energy activities under one umbrella and provided the framework for a comprehensive and balanced national energy plan. The Department undertook responsibility for long-term, high-risk scientific research and development of energy technologies, federal power marketing, energy conservation, the nuclear weapons and non-proliferation programs, naval reactors, energy regulatory programs, and central energy data collection and analysis. The Department also acted on its new energy emergency response authorities to create the Strategic Petroleum Reserve. Most notably, the establishment of the Department brought Cabinet-level support to a unique and growing system of National Laboratories that today serves as the backbone of the Nation's scientific research enterprise and the most comprehensive research network of its kind in the world. Like the nation's energy infrastructure itself, a resource on the scale of the National Labs would be virtually impossible to build from scratch today, making support and maintenance of this system all the more critical.

While there have been several amendments to the DOE Organization Act that have changed the makeup of DOE, including one to establish the Office of Environmental Management (EM), the most significant amendment took place in 1999. The National Defense Authorization Act for Fiscal Year 2000 amended the DOE Organization Act by establishing the National Nuclear Security Administration (NNSA) as a semi-autonomous organization within the Department. The amendment (known as the NNSA Act) which took effect on March 1, 2000, provides the guidance and authority necessary for the NNSA Administrator to carry out the NNSA's various missions under the direction of the Secretary and Deputy Secretary.

Congressional and Administration interest in reshaping the profile of the Department — especially the non-nuclear programs — continued into the 2000's. This includes through

legislation such as the Energy Policy Act of 2005 which authorized what is now the Office of Technology Transitions and the "Title XVII" Loan Guarantee program; the Energy Independence and Security Act of 2007 which established the Advanced Technology Vehicles Manufacturing loan program; the America COMPETES Act of 2007 which authorized the Advanced Research Projects Agency – Energy (ARPA–E); and the American Recovery and Reinvestment Act of 2009 which provided DOE with an unprecedented level of funding for energy research, development, demonstration, and deployment (RDD&D) programs. Most recently, DOE has been given additional authorities and responsibilities for energy emergency response in the Balanced Budget Act of 2015 and the FAST Act of 2016.

Today, the Department leverages this long history and its unique scientific resources in tackling some of the most significant and daunting energy, nuclear security, economic, and environmental challenges facing the United States. DOE leads the nation in transformational RDD&D of an extensive range of clean energy and efficiency technologies. To ensure our nation's security, DOE maintains a safe, secure, and effective nuclear weapons stockpile in the absence of nuclear explosive testing; collaborates with other nations to reduce the global threat posed by the proliferation of nuclear weapons and nuclear materials; responds to nuclear terrorism; and provides safe and effective nuclear propulsion for the United States Navy. These nuclear security responsibilities give DOE a central role in carrying out President Obama's "Prague agenda" laid out in 2009. DOE also remediates the environmental legacy of over six decades of nuclear weapons and materials production — the largest and most complex clean-up effort in the world.

Changing Landscape

The United States is in the midst of a dramatic shift in its energy and nuclear security landscapes, presenting a constantly changing set of opportunities and challenges for the Department. Energy markets have been transformed as a result of decades-long investments in RDD&D; dangers posed by climate change and global warming have accelerated the need to develop a full range of energy options to support a transition to a secure, low-carbon energy system; evolving threats have created significant national security challenges in combating proliferation and nuclear terrorism; nuclear weapons and the supporting infrastructure are aging; advances in technology have created the need for greater cyber protections, especially to safeguard our energy infrastructure; and increased investment in scientific discovery has transformed our understanding of nature and strengthened the connection between advances in fundamental science and technology innovation. With a history of pushing the frontiers of science and technology, DOE is well equipped to adapt quickly to an ever-changing environment.

Changing Energy Landscape

- ***Changing Energy Profile.*** The energy profile of the United States has dramatically changed over the last decade. The United States is now the number one producer of oil and gas in the world, and we are producing more oil than we import for the first time in decades. Renewable energy technology deployment is rising rapidly and prices are falling, as described in DOE's Revolution Now report (http://energy.gov/revolution-now). Energy efficiency policies and technologies are contributing to projected slow growth in demand for electricity, and flat or declining demand for oil. Natural gas has replaced coal as the largest fuel source for power generation, while nuclear generation facilities are retiring at a much faster rate than anticipated.

- ***Energy Innovation.*** The energy landscape is changing, in part, due to the growing global awareness of the causes and effects of climate change. There is also widespread recognition that the suite of energy technologies available today will be not be sufficient to avert the worst impacts of climate change, and that an unprecedented commitment to clean energy research and technology development is needed to achieve deep cuts in emissions while simultaneously driving economic growth. In 2015 the United States joined 20 partner countries and the European Union in launching Mission Innovation (MI), a landmark commitment to accelerate global clean energy innovation as a means of addressing climate change, making clean energy affordable to consumers, and creating jobs and commercial opportunities. Each of the Mission Innovation partners has made a commitment to seek to double its investment in clean energy research and development (R&D) over five years.

- ***Aging Energy Infrastructure.*** The first installment of the Quadrennial Energy Review (QER) published in April 2015 examined energy transmission, storage, and distribution infrastructures. The report concluded that in key areas, the Nation's electricity, natural gas, and oil infrastructures have not kept pace with changes in the volumes and geography of energy production, and face significant challenges relating to aging and obsolescence. Ports, waterways, and rail systems became congested with the growing demand for handling energy commodities, and much of the relevant infrastructure, including pipelines, rail systems, ports,

and waterways, is long overdue for repairs and modernization. The QER received strong bi-partisan and private sector support and led to significant legislative action.

- ***Electrification of the Economy.*** Analysis for the second installment of the QER will showcase the urgent need for electricity system modernization due to the increasing dependence of modern life on a reliable supply of electricity. Without modernization of the grid, systems like navigation, telecommunication, financial, healthcare, emergency response, and the internet become unreliable. Yet, the threats to the grid, including geomagnetic storms, cyber and terrorist attacks, flooding, and increasingly extreme weather, have been growing even as society's dependence on the grid has increased.

- ***Energy Jobs***. The changing energy landscape has accelerated job growth across energy sectors in America, including renewables, oil, natural gas, new nuclear, and energy efficiency, while also creating challenges in certain regions. The shift has generated thousands of good-paying jobs that lay the foundation for long-term careers and provide a major opportunity for social mobility, including in disadvantaged communities. Continued growth in energy production is expected to produce 2.4 million science, technology, engineering, and math (STEM) jobs in the next three years. This increased demand for STEM jobs coupled with an aging energy workforce has, however, created a skills gap that the Department's Jobs Strategy Council is addressing. (Detailed information on the Council and its actions is included in the Boards and Councils section of this paper.)

Changing Energy Threat Environment

- ***Threats to Energy Infrastructure.*** Today, the United States faces a very different set of threats to our energy systems that guide both the structure and nature of our energy emergency responses. Threats include natural and manmade events, such as increasingly severe weather from climate change, natural disasters, electromagnetic pulses, physical attack, accidental disruption, aging infrastructure, cyber threats, and growing infrastructure interdependencies. As a result, public consciousness has been raised about the vulnerability of our electric grid and fuel supply and storage systems, as well as the need for the United States to substantially raise its efforts in addressing those vulnerabilities.

- ***DOE's New Emergency Authorities***. Recognizing the increasing threats, the Congress has enacted important new energy security measures providing the Department with greater authorities. These include: the *Fixing America's Surface Transportation (FAST) Act*, which provides DOE with authority to protect and restore critical infrastructure when the President declares a grid security emergency and the *Balanced Budget Act of 2015,* which directs the Department to establish a Strategic Petroleum Reserve modernization program to protect the United States economy from the impacts of emergency product supply disruptions. In addition, *Presidential Policy Directive-21: Critical Infrastructure Security and Resilience* assigns DOE a pivotal role in ensuring unity of effort among government and private sector partners to improve preparedness and response to all hazards in the energy sector. (Additional information on DOE authorities is included in the Appendices.) In order to effectively implement these new authorities, the Department will need to prioritize and align

its resources with these new and growing responsibilities.

Changing Nuclear Security Landscape

- ***Maintaining the Nuclear Stockpile and the Stockpile Stewardship Program (SSP).*** The nuclear weapons in the United States stockpile were designed and produced during the Cold War. This stockpile, although significantly smaller today, must continue to deter any adversary and guarantee the defense of the Nation and its allies for as long as nuclear weapons exist. In order to extend the life of the stockpile and maintain a safe, secure and effective deterrent without nuclear explosive testing, DOE's NNSA engages in critical efforts to address aging and performance issues, enhance safety features, and improve security. Through the Stockpile Stewardship Program (SSP), NNSA fields a suite of innovative experimental capabilities, diagnostic equipment, high-performance computers, and modern codes that build on past nuclear explosive test data to simulate the dynamics of nuclear weapons, and test non-nuclear components.

- ***Aging Nuclear Security Infrastructure.*** NNSA cannot accomplish its mission to sustain the nuclear deterrent, reduce nuclear threats, and support the Nuclear Navy over the long-term without reliable and modern programmatic, security, and general purpose infrastructure that provides necessary capabilities for today, allows for the opportunity to expand future capacities, and minimizes risks. More than 50 percent of NNSA's facilities are over 40 years old, and almost 30 percent date to the Manhattan Project. Current requirements to support the life extension programs, the SSP, nuclear threat reduction and nuclear propulsion are challenging this aging NNSA infrastructure. During the course of the Senate deliberation on the New START Treaty, the Administration committed to certain modernization milestones for the nuclear weapons infrastructure. (DOE's backlog of deferred maintenance is about $6.5 billion, approximately $3.7 billion of which is attributed to NNSA aging infrastructure.) These facility modernization investments cannot be deferred any longer for safe operations in support of military requirements.

- ***Nuclear Proliferation and Terrorism.*** The potential use of nuclear weapons and materials by irresponsible states or terrorists poses an increasingly significant threat to the United States. NNSA draws on its unique science and technology base to engage international partners on a range of nuclear threat reduction activities, including in supporting the Secretary in negotiating and implementing the "Iran Deal", eliminating highly enriched uranium (HEU) from 31 countries plus Taiwan, pursuing reductions in the use of HEU in civil applications, and converting or verifying the shutdown of 34 research reactors and isotope production facilities in 18 countries since 2009. While much has been accomplished, significant work remains to be done, particularly as most of the United States cooperation with Russia on physical and nuclear material security has come to an end.

  Nuclear Navy: NNSA supports the U.S. Navy through the development of nuclear reactors to power nuclear surface ships and submarines. These reactors have steamed millions of miles across the globe for 60 years without a nuclear incident. Today, the program is developing the Ohio-Class Replacement Reactor Plant, which will support the submarine leg of our nuclear triad. These new subs will use a "life of the ship" nuclear fuel core that will save taxpayers billions of dollars. Naval Reactors has also developed the reactor for the new

Ford Class aircraft carriers. The first of her class, the USS GERALD FORD, will join the fleet next year, and her propulsion plants can generate more than twice the electricity produced by reactors on current Nimitz Class carriers. To sustain safe operations and timely delivery, Naval Reactors is refueling its Land-based S8G Prototype in upstate New York, and replacing the Spent Fuel Handling Facility in Idaho. These capabilities play a critical role in the program's ability to keep the nuclear navy operating safely and effectively.

Changing Intelligence Landscape

- ***Working with Partners.*** Over the past decade, DOE's Office of Intelligence and Counterintelligence (IN) has transformed itself into a more integrated part of the nation's IC and has provided key analytical insights into some of the most difficult national security problems facing the country. In addition, under the leadership of successive Directors of National Intelligence, the IC has itself become more integrated and better able to share information, drawing on the full range of available expertise, such as that in DOE. As a formal IC member with a technical capability, IN is in a position to provide unmatched expert advice and information to DOE and other United States government policymakers, often in conjunction with non-technical colleagues from across the IC.

- ***Leveraging Lab Expertise.*** The IC also makes wide and deep use of DOE's expertise through the reimbursable Strategic Intelligence Partnership Program (SIPP). Under SIPP, sponsors are able to access the full gamut of DOE lab and site expertise to provide unparalleled intelligence research, analytic insights, and technology solutions. The DOE Labs are the IC's scientific and technical workshop.

- ***Protecting DOE Personnel, Facilities, Technology, and Networks.*** The sensitive scientific and technical nature of DOE's work makes it an attractive target for foreign actors, as well as for those interested in compromising or doing harm to DOE systems. IN works closely with its partners in the intelligence and law enforcement communities to identify and mitigate threats to DOE people, facilities, technology, and networks.

Changing Science Landscape

- ***Computational Revolution***. The dramatic growth in the power of supercomputers has led to the emergence of computational modeling and simulation as a major new pillar of science. High-performance computing (HPC) is revolutionizing multiple fields, from materials science and chemistry, to high-energy and nuclear physics, to genomics-based biology, cancer research and climate science. It is also making significant contributions to industry, enabling computational design of major capital items such as jet engines and wind turbines, and allowing virtual prototyping that can dramatically cut costs and shorten time-to-market. Initially due to their critical role in the design and analysis for nuclear weapons, DOE's National Laboratories have been pushing the frontiers of HPC since the earliest days of the field. However, China's investments in supercomputing have enabled China to leapfrog the United States in computational speed in just the past few years, challenging America's longstanding leadership in this field. DOE is now pursuing the next frontier in computing — exascale computing — positioning the United States on the cusp of a different paradigm for

tackling the most complex problems with extremely large data sets, from high fidelity climate modeling, to a sustainable nuclear deterrent without testing, to novel approaches to combatting cancer.

- ***Stewarding Cutting Edge Facilities***. Design, construction and operations of a suite of first of a kind, large-scale, unique facilities — including User Facilities — has provided unprecedented capabilities to the U.S. research community. The User Facilities that DOE supports are made available to researchers at no cost provided the proposed research is selected in a highly competitive process and the research is to be published in the open literature. Continuing to advance the state of the art in such facilities so that the United States can stay at the scientific frontier of research capabilities is a core responsibility and capability of the DOE.

- ***Materials by Design.*** Advances in designing materials at the atomic-level are dramatically changing the laborious and time-consuming trial and error materials discovery process of the past. Advanced materials are key to revolutionizing energy production, transmission, and use. Our growing capabilities to develop these new materials through simulation and through frontier nanoscale capabilities will greatly accelerate our transition to a clean energy economy. They will also transform electronics, transportation, and many other industrial sectors.
- ***Genomics Breakthrough.*** DOE has been a leader in the field of genomics since originating the Human Genome Project in the 1980s. The last decade has seen tremendous advances in the field of genomics, which are transforming our ability to draw on biology as a powerful resource for energy and environmental applications. Combined with the power of high-performance computing, our genomic knowledgebase is helping to develop the science and technology of biofuels, pursue new avenues for environmental clean-up, better understand the carbon cycle, and enhance biodefense. Further, DOE's capabilities combined with those available through the NIH can significantly advance biomedical research.

DOE Leadership and Management Structure

The Department of Energy's leadership and management structure is designed to address the evolving science, energy, security, and environmental challenges facing the Nation. The enterprise is comprised of the Office of the Secretary, including the Deputy Secretary, which provides leadership and strategic direction to achieve the Department's mission, and three Under Secretariats, which manage the core functions that carry out DOE missions with significant cross-cutting work spanning across the complex. The Department also makes extensive use of working groups, boards, and councils to address issues that cut across organizational lines. DOE has approximately 14,000 federal employees and over 100,000 National Laboratory staff and contractor employees at DOE's nuclear security plants and environmental clean-up sites at 85 field locations in 30 States.

The organization chart (Figure 1) depicts the Department's structure, and detailed descriptions of each DOE organization are included in Book 3, Organization Overviews.

Office of the Secretary

The Department of Energy Organization Act, as amended, establishes the ***Secretary,*** Deputy Secretary and Under Secretaries as the principal officers of the Department. The ***Secretary*** leads the Department of Energy across all of its missions, and serves as a member of the President's Cabinet and fourteenth in the line of Presidential succession.

The ***Deputy Secretary*** serves as a key advisor to the Secretary and is the Department's Chief Operating Officer. In that role, the Deputy Secretary leads major DOE initiatives in several priority areas, including cyber security, project management, and emergency preparedness and response. The Deputy Secretary also chairs a number of corporate councils, including, but not limited to the Energy Systems Acquisition Advisory Council (ESAAB), which provides the Deputy Secretary with recommendations on DOE's major construction projects (over $750 million); the Cyber Council, which is the principal forum for coordinating cyber-related activities across DOE; and the Emergency Incident Management Council (EIMC), which coordinates enterprise-wide efforts to prepare for, mitigate, respond to, and recover from major disruptions to energy systems and respond to all-hazard emergencies.

Full ownership of all missions by the Secretary and Deputy Secretary is key to overall departmental success, particularly as those officers represent the Department in the interagency Principals and Deputies Committee meetings. Importantly, the national security mission benefits greatly from commitment by the Secretary and Deputy Secretary. Strong support for the nuclear security mission at the Cabinet level has significantly enhanced collaboration with DOD, and broadened support across the interagency and in Congress.

The ***Associate Deputy Secretary,*** who also serves as the Department's Chief Risk Officer, supports both the Secretary and Deputy Secretary to drive improvements in mission execution and operational efficiency in such areas as project and enterprise risk management.

Several corporate organizations report directly to the Secretary, including, for example, the Office of the General Counsel, the Office of Congressional and Intergovernmental Affairs, and

the Office of Public Affairs. Some of the corporate organizations are unique to DOE and play a vital role in supporting the Secretary's efforts to achieve the Department's strategic policy goals. They are also instrumental in ensuring an enterprise-wide approach, resulting in greater consistency across the DOE complex. These organizations include:

- The ***Office of Energy Policy and Systems Analysis (EPSA)*** was created to consolidate DOE's fragmented policy-relevant activities into a central focal point for energy systems analysis and the development of Federal energy policy. EPSA carries out strategic studies and analysis, maintains and coordinates a supporting set of analytical capabilities, and conducts assessments of the strength, resiliency, and anticipated challenges of energy systems within the United States and North America. EPSA also identifies and prioritizes ways in which DOE programs may be strengthened to meet United States economic well-being, environmental quality, and energy security goals. EPSA's largest analytical effort is the development of the QER; the executive summary of the first installment is included in the Appendices to this document, and a complete copy can be found at http://www.energy.gov/epsa/downloads/quadrennial-energy-review-first-installment.

- The ***Office of the Chief Financial Officer (CFO)*** serves as a critical strategic planning organization to ensure the Department's priorities are reflected in the budget, which the CFO has primary responsibility for developing. The budget is a key strategic tool for planning and shaping initiatives in support of the Department's major mission areas, as well as initiatives that cut across organizational lines, such as high performance computing, grid modernization, and cyber security. The CFO also leads development of the DOE strategic plan and establishment of priority goals, and monitors progress in achieving the goals and objectives. The DOE Strategic Plan can be found at http://www.energy.gov/budget-performance.

- The ***Advanced Research Projects Agency – Energy (ARPA–E)*** was established by Congress in 2009 in response to a National Academies report calling for a unique energy research model to help ensure continued United States leadership in energy science and technology. It is currently funded at less than a third of the level recommended in that report. ARPA–E's mission is to overcome long-term and high-risk technological barriers in the development of energy technologies, by identifying and promoting revolutionary advances in fundamental and applied sciences. Since its inception, ARPA–E has supported more than 475 potentially transformational energy technology projects through 30 focused programs and three open funding solicitations. Many ARPA–E projects have already demonstrated early indicators of technical and commercial success. Among the first 200 projects completed, 36 companies have been formed, 45 of the agency's projects have secured more than $1.25 billion in private sector follow-on funding, and ARPA–E-developed technologies are becoming commercially available. These data are early indicators of ARPA–E's success in supporting high risk, high-impact technologies to the point where they attract investment for continued development from the private sector.

- The ***Loan Programs Office (LPO)*** was established to accelerate the domestic commercial deployment of innovative clean energy technologies and advanced vehicle and component manufacturing to help achieve the Nation's clean energy objectives. LP guarantees loans to eligible innovative clean energy projects through the Innovative Clean Energy Title XVII (Title XVII of EPAct 2005) Loan Guarantee program, and by providing direct loans to

eligible manufacturers of advanced technology vehicles and components through the Advanced Technology Vehicles Manufacturing (ATVM) program. To date, LP has invested more than $29 billion in 30 diverse Title XVII projects nationwide, while its ATVM program has supported major projects across 16 locations in eight states.

- The ***Office of International Affairs*** **(IA)** advances United States objectives in energy security and clean energy deployment and represents the Department in intergovernmental forums and bilateral and multilateral proceedings that address the development and implementation of energy and economic strategies. IA advises the Secretary, Deputy Secretary, and other DOE leadership on strategic implementation of the United States' international energy trade policies. IA works closely with the State Department, the Department of Commerce, and the National Security Council in pursuit of Administration objectives.
- The ***Office of Intelligence and Counterintelligence*** (**IN**) has long worked to identify and mitigate threats to DOE personnel, facilities, technology, and information, as well as to provide scientifically sound technical analysis of some of the nation's most challenging intelligence problems. The senior leadership team is located at Headquarters, but IN also oversees 12 Field Intelligence Elements located at laboratories and sites across the DOE complex, as well as 15 Counterintelligence Field Offices, some of which cover multiple DOE facilities. IN is an integral part of the Department's national security mission, and is well-integrated into the IC. Other agencies in the IC have relied increasingly on DOE's unmatched technical expertise.
- The ***Office of Enterprise Assessments (EA)*** provides objective assessments on behalf of the Secretary and Deputy Secretary in the areas of nuclear and industrial safety, cyber and physical security, and other critical functions as directed by the Secretary. Over the last three years, EA has performed 20 announced and unannounced cyber security assessments of DOE classified and unclassified information management systems; conducted 20 comprehensive safeguards and security assessments, including force-on-force exercises and limited-notice safeguards and security performance tests; and conducted 50 nuclear, worker safety and health, and emergency management assessments to identify weaknesses that could harm workers and the public. The results of these assessments provide valuable insights that are used to strengthen DOE operations, especially security and worker safety.

- The ***Office of the Chief Information Officer*** (CIO) is part of the Under Secretary for Management and Performance organization; however, in accordance with 44 U.S.C., Section 3506(a)(2)(A), the Chief Information Officer reports directly to the Secretary and Deputy Secretary on critical information technology issues, including cyber. Under the Deputy Secretary's leadership, the CIO, in concert with the Cyber Council, has developed the DOE Cyber Strategy to meet the challenges of the rapidly evolving cyber landscape. This Strategy is rooted in enterprise-wide collaboration, accountability, and transparency. Its underlying principles and strategic goals reflect DOE's commitment to responsible information sharing and safeguarding, together with rigorous privacy and civil liberties protections. Serving as a roadmap to a safe, secure, and resilient cyber environment, the Cyber Strategy provides a common vision, clearly articulated goals tailored to the Department's unique structure and mission, and measurable objectives to gauge progress.

The Under Secretaries

The Department of Energy's three Under Secretary positions were reorganized to address the Department's major challenges — science and energy, nuclear security, and management and performance (including environmental clean-up) — with an Under Secretary dedicated to each of these critical missions. The changes, which received Congressional support, have significantly improved DOE's ability to accomplish its missions by strengthening the synergy between science and energy and by sharpening the focus on improved management. They have also facilitated collaboration on the part of the Under Secretaries on issues that cut across organization boundaries.

The Under Secretary organizations are integral to ensuring that DOE line management has the resources and support needed to achieve their mission objectives. For example, the Under Secretary organizations coordinate the development of budget proposals with line management and advocate for those proposals. They also represent line organizations on various policy and operations councils, including the Laboratory Operations Board (LOB), Directives Review Board, and the Chief Security Officers Committee. In addition, the Under Secretaries provide oversight to ensure effective program execution, for example, by managing independent peer reviews of construction projects to assess performance and recommend improvements.

- The ***Under Secretary for Science and Energy*** (US/SE) is charged with implementing an energy strategy that closely integrates basic science, applied research, and technology demonstration and with supporting the American basic research community by building and operating cutting-edge major research facilities. These facilities serve about 32,000 researchers annually. The US/SE oversees 13 National Laboratories.

  Previously, the Department's science and energy programs were separately managed by two under secretariats. In 2013, those roles were merged into a single Under Secretary for Science and Energy to more effectively carry forth the Department's science and energy priorities and enable the transfer of results from fundamental science to applied development. This organizational structure has facilitated research initiatives that cut across organizational lines and strengthened the way the US/SE works with its 13 science and energy National Laboratories, including establishing a uniform laboratory planning process.

  Recognizing the need to better coordinate and optimize how the Department transitions early-stage research and development (R&D) to applied energy technologies through technology transfer, commercialization, and deployment activities, the ***Office of Technology Transitions*** **(TT)** was established in the Office of the Under Secretary for Science and Energy. This organization oversees and coordinates technology transitions involving Departmental programs, coordinates technology transitions across Departmental programs, administers the statutorily-created Technology Commercialization Fund, and facilitates the exchange of information on innovative technology and commercialization practices among the Department's program offices and national labs.

  The ***Under Secretary for Nuclear Security*** (US/NS), who also serves as the NNSA Administrator, is directed by the NNSA Act to maintain and enhance the safety, reliability, and performance of the United States nuclear weapons stockpile (including the ability to design, produce, and test) in order to meet national security requirements; provide the United

States Navy with safe, militarily-effective nuclear propulsion plants and ensure the safe and reliable operation of these plants; promote international nuclear safety and nonproliferation; reduce global danger from weapons of mass destruction; and support United States leadership in science and technology. NNSA has aligned these responsibilities into three core missions: maintaining the safety, security and effectiveness of the nuclear deterrent; preventing, countering and responding to proliferation and terrorism threats; and providing operational support for naval nuclear propulsion.

Within NNSA, and with the Secretary's support, improvements in management and governance have produced tangible results, including better aligned mission equities and clarified responsibilities. NNSA has also instituted rigorous analyses of alternatives; defined clear lines of authority and accountability for federal and contractor program and project management; improved cost and schedule performance; and ensured that Federal Project Directors and Contracting Officers have the appropriate skill mix and professional certifications to effectively manage NNSA's work. Efforts are now underway to institutionalize many of these changes so future administrations assume responsibility of an enterprise on a sound footing. NNSA's recent adoption of these best practices have taken an enterprise-wide approach, instilling a culture of safety, efficiency, and effectiveness across all core mission areas.

The US/NS is responsible for the oversight of three National Laboratories, two laboratories managed by Naval Reactors, several production sites, and the Nevada Nuclear Security Site.

- The ***Under Secretary for Management and Performance*** (US/MP) is responsible for the effective and efficient management of the Department's operations. The position was established in 2013 to address long-standing management challenges on difficult problems unique to DOE, especially environmental clean-up and construction of highly-complex facilities, several of which are designed to treat nuclear waste. The environmental clean-up program has already significantly reduced the Cold War legacy "footprint" of contaminated facilities by 74 percent, but the most complex and difficult projects will present management challenges for the Department for the next several decades.

  In addition to environmental clean-up, most of the Department's ***mission support functions*** (e.g., human capital management, information technology) were consolidated within this Under Secretariat to ensure that a senior leader is dedicated to the task of operational improvement and to strengthen the lines of authority and accountability of these functions. This consolidation has enabled the US/MP to institute enterprise-wide solutions to common challenges faced by organizations across the complex. For example, the US/MP is responsible for the Department's acquisition function, which is critical to DOE operations given that $25 billion of the Department's $32 billion budget is executed through contracts.

  The US/MP is also responsible for the oversight of the Savannah River National Laboratory, which has primary responsibility for research on technologies for environmental cleanup. In addition, the US/MP is responsible for numerous environmental cleanup sites across the Nation.

The US/MP chairs the LOB, which is responsible for strengthening and enhancing the partnership between the Department and the National Laboratories, and for improving performance in order to more effectively and efficiently execute the missions of the Department and the National Laboratories. (Additional information on the LOB is included in the Boards and Commissions section of this document.)

Two mission support organizations reporting to the US/MP have been established within the last several years to improve efficiency and provide greater focus on functions critical to achieving the Department's strategic goals, including:

The ***Office of Project Management Oversight and Assessments (PM)*** was established as part of the Secretary's comprehensive reform effort to address long-standing challenges in managing the Department's capital asset projects, many of which include the largest, most complex and technically challenging projects in the public or private sector. Several are one-of-a-kind projects that involve the risks and challenges of nuclear operations.

The Secretary made improving project management a key priority and took several actions to improve DOE's performance, including strengthening the ESAAB by transforming it from an ad hoc body to an institutionalized Board that meets regularly to discuss and review project management across the Department, establishing the Project Management Risk Committee (PMRC) to provide enterprise-wide project management risk assessments, and improving the peer review process.

PM supports implementation of these Secretarial-directed improvements by serving as the Executive Secretariat to the ESAAB and PMRC. PM also conducts independent peer reviews, which provide critical analysis of project performance and recommendations for improvement. In addition, PM is responsible for developing policy and guidance to institutionalize project management improvements.

The ***Office of Environment, Health, Safety and Security (AU)*** was established to provide greater focus on the development of health, environment, safety and security requirements and assistance to field organizations in implementing these requirements. Previously, these functions were performed by the same organization responsible for assessing performance of nuclear and industrial safety. Separating the requirements development and assessment functions eliminated the possibility of a conflict of interest. (The assessment function now reports directly to the Secretary.) This distinction is especially important given that the Department has the authority to regulate its activities to protect the safety and health of its workers, the public and the environment. While the Department has an excellent safety record, continued vigilance is needed to maintain a high level of performance.

Independent Organizations

The ***Energy Information Administration (EIA)*** is an independent statistical and analytical agency within the Department that collects, analyzes and disseminates independent and impartial energy information to promote sound policymaking, efficient markets and public understanding of energy and its interaction with the economy and the environment. EIA is the nation's premier source of energy information and, by law, its data, analyses, and forecasts are independent of

approval by any other officer or employee of the United States government. EIA prepares informative energy analyses, monthly short-term forecasts of energy market trends and long-term United States and international energy outlooks. Its *Annual Energy Outlook* provides vital information that is used by both United States government policymakers and energy industry leaders. The most recent publication is included in the Appendices and can be found at http://www.eia.gov/forecasts/aeo/pdf/0383(2016).pdf.

In addition, the ***Federal Energy Regulatory Commission (FERC)*** is an independent regulatory commission within the Department, established to license hydroelectric projects on federal land or navigable waters and to regulate interstate transmission of electricity, sales of electricity at wholesale, interstate sales and transportation of natural gas, and rates for transportation of oil by pipeline. These functions are not carried out by delegation from the Secretary; instead, these authorities are vested in the Commission itself. By statute, employees of FERC are not responsible to or subject to the supervision or direction of any employee of any other part of the Department, including the Secretary. However, the Secretary may delegate functions to the Commission.

DOE Installations and Operations

At its core, the Department is a science and technology organization that advances critical missions for the American people - nuclear security; scientific leadership and discovery; clean energy innovation; environmental remediation; and energy security – and meeting these challenges naturally requires a geographically dispersed presence, complex facilities, and highly-trained workforce. The map (Figure 2) shows the location of DOE's National Laboratories, production facilities, and other field sites.

National Laboratories

Founded as part of an immense national investment in scientific research during and following World War II, DOE's system of National Laboratories is comprised of 17 world-class research institutions that constitute the most comprehensive research network of its kind in the world. For more than seventy years, the National Laboratories have brought deep science and technology innovation to bear against major challenges in the United States, and they continue to serve as an integral component of the U.S. research enterprise and an invaluable strategic partners for DOE in evolving with its modern-day missions.

National Labs each have distinct but complementary resources and capabilities, with scientists, engineers, technicians, and analysts collaborating throughout the system, as well as with academia and industry, to ensure the best solutions are pursued without regard to organizational boundaries. The labs operate one-of-a-kind national scientific user facilities that are used annually by over 32,000 researchers from universities, federal laboratories, and the private sector.

National Labs fill a critical gap in the Nation's energy innovation ecosystem. Universities emphasize early discovery and tend to focus on research associated with small groups of faculty members, while companies respond to market needs and typically focus their R&D on near-term solutions or the integration of multiple technologies. National Laboratories tackle multidisciplinary problems with a long-time horizon, often coupling fundamental discovery research, technology development, and demonstration projects. In addition, the National Laboratories conduct R&D in areas that are not pursued by either universities or companies, such as helping to safeguard and manage the Nation's nuclear stockpile.

Specifically, the National Laboratories conduct activities across several main mission areas:

- Advance United States energy independence and leadership in clean energy technologies to ensure the ready availability of clean, secure, reliable, and affordable energy;
- Deliver discovery and innovation in physical, chemical, biological, engineering, and computational and information sciences that advance our understanding of the world around us;
- Enhance global, national, and homeland security by ensuring the safety and reliability of the United States nuclear deterrent, helping to prevent the proliferation of weapons of mass destruction, and securing the Nation's borders;

- Develop deployable technologies for the safe cleanup of the DOE Nuclear Complex environmental legacy from five decades of nuclear weapons development, production, and testing;
- Design, build, and operate distinctive scientific instrumentation and facilities, and make these resources available to the research community;
- Serve the national interest not only as leaders in science and technology, but also as quickly mobilized national assets in times of national need;
- Move innovation to the marketplace and strengthen United States competitiveness; and
- Train the next generation of scientists and engineers, particularly in DOE core mission areas.

DOE's National Laboratories have a substantial record of accomplishment and demonstrated return on investment for the American taxpayer. For example, the DOE National Laboratories have:

- Developed energy efficiency technologies and standards that have saved United States taxpayers over $1 trillion;
- Conducted the fundamental and applied research that enabled the shale gas revolution and the development of nuclear, photovoltaics and energy storage for transportation industries;
- Delivered forefront scientific discoveries, from new chemicals and new states of matter to an improved understanding of the origins of the universe;
- Sustained confidence in the nation's nuclear weapons stockpile in the absence of nuclear testing, identifying and dealing with arising issues in weapon systems through life extension programs;
- Provided purpose-built technical capabilities and process improvements that have achieved life cycle savings of over $5 billion to the DOE Office of Environmental Management programs; and
- Served as an "on call" resource for tackling unprecedented challenges – from the threat of unsecured nuclear materials as the Soviet Union collapsed, to the Macondo oil spill in the Gulf of Mexico, to the Fukushima nuclear disaster, to globally significant imperatives such as the negotiations on Iran's nuclear program.

Weapons Plants and Remediation Sites

In addition to its laboratories, DOE manages numerous sites that support its nuclear security and environmental clean-up missions. These sites are typically operated by specialized contractors who perform highly-technical and often hazardous work. In addition to its three laboratories, NNSA operates several nuclear weapons production facilities and the Nevada National Security Site with about 15,000 contractor employees at four sites in four states. In EM, with an annual budget of about $6 billion, over 20,000 contractor employees at 16 sites in 11 states perform vital cleanup work including the deactivation, decommissioning, decontamination and demolition of thousands of aging facilities; safe management and disposition of radioactive and hazardous liquid and solid wastes; and remediation of contamination in soil and groundwater. The majority of these contractor employees in both NNSA and EM are represented by major trade unions.

Power Marketing Administrations

The Power Marketing Administrations (PMAs) are agencies within DOE whose primary mission is to market hydroelectric power produced at Federal Dams. These multipurpose water projects are owned and operated primarily by the Department of Interior's Bureau of Reclamation and the U.S. Army Corps of Engineers. There are four PMAs — Bonneville Power Administration (BPA), Southeastern Power Administration (SEPA), Southwestern Power Administration (SWPA), and Western Area Power Administration (WAPA) — each operating in a different geographic region. In FY 2015, DOE's four PMAs marketed power from 133 Federal hydro power plants with maximum operating capabilities of 38,537 megawatts, approximately three percent of the Nation's power plant capacity.

Headquarters, Field and Laboratory Relationships

The Department's organizational philosophy is based on the concept of centralized policy development, program planning, and administrative management and support at headquarters, with decentralized program implementation and project management at the various field organizational elements. To ensure effective implementation, headquarters organizations collaborate extensively with the field, including the laboratories. Often this collaboration takes place through boards and councils, including the Laboratory Policy Council (LPC) and Laboratory Operations Board (LOB), both of which are described in the Boards and Councils section of this paper.

Within the Department's structure, there are no bureaus or equivalent independent components, with the exception of the Federal Energy Regulatory Commission (FERC), an independent regulatory commission, and the Inspector General, that function within the bounds of independent authorities granted by their respective legislation. NNSA, while being a distinct entity within the Department, operates under the policy control of the Secretary.

DOE accomplishes most of its work in the field through its National Laboratories and Plants as well as universities and other sites and facilities. Basic scientific research, energy research and development, environmental management, waste management and defense missions are carried out through an extensive network of contractors, frequently managed under M&O or Facility Management contracts. Sixteen of the 17 National Laboratories are operated through M&O contracts as Federally Funded Research and Development Centers (FFRDCs), and one (the National Energy Technology Laboratory) is a government operated Laboratory. These contractors are private industrial corporations, universities or non-profit institutions that operate DOE's government-owned/contractor-operated facilities. More information on DOE's contracts is included in the Appendices.

Relationship with DOE's Laboratories. Flexibility in pursuing the R&D activities in support of DOE's mission is enabled by the Department's unique M&O contracting model, which grew out of the Manhattan Project to ensure government control of the production of fissionable materials while obtaining the benefits of the private sector's management expertise and resources. Under this model, DOE is responsible for establishing strategic and program direction of the laboratories, while the contracted university and industry partners are responsible for determining precisely "*how*" to meet the technical and scientific challenges and to carry out programs, all in the public interest.

Recent Congressionally-mandated reports by independent organizations have recommended that DOE take action to improve its relationship with its laboratories and strengthen the partnership. These reports include the 2015 Commission to Review the Effectiveness of the National Energy Laboratories (CRENEL), the 2014 Report of the Congressional Advisory Panel on the Governance of the National Security Enterprise, and the 2015 Report of the Secretary of Energy Advisory Board (SEAB) Task Force on DOE National Laboratories. These reports can be found in the Appendices, along with DOE's responses.

As a result, the Department has been working hard to reset its relationship with its laboratories and re-build trust. Most of these efforts have been led by the LPC, chaired by the Secretary, and

the LOB, chaired by the Under Secretary for Management and Performance, which includes senior-level representation from headquarters program and mission support organizations, field organizations and laboratories. Highlights include:

- Established a forum for coordinated brainstorming at the ***National Laboratory Big Ideas Summit***, which convenes Lab scientists and DOE program leadership to explore innovative solutions to major cross-cutting energy issues. This has resulted in ***cross-cutting initiatives*** such as the Grid Modernization Laboratory Consortium, which is a multi-program, multi-lab initiative working towards an adaptive and resilient United States electric grid.

- ***Reduced transactional oversight*** by collaborating with the laboratories to identify and minimize overly burdensome oversight and to reform the system used to develop requirements (the DOE Directives system).

- ***Improved infrastructure planning*** in collaboration with the laboratories by establishing uniform infrastructure assessments, ensuring that the deferred maintenance backlog does not increase, prioritizing investments in general purpose infrastructure, and increasing the overall investment in DOE infrastructure.

- ***Piloting streamlined contract approaches,*** including a new contract with SLAC National Accelerator Laboratory which promotes a more tailored lab-specific approach to partnering and oversight.

- Expanded reliance on ***Contractor Assurance Systems*** beyond the environment, safety, security, and health areas to include business and financial systems, and emphasized through new policy the importance of establishing and maintaining productive relationships between laboratory, Federal, and corporate parent personnel.

- Strengthening ***Laboratory Planning*** efforts to establish a more uniform process throughout the Department, to engage the laboratories in strategic planning for the future, and to focus on cross-cutting initiatives.

- Instituted a ***Leadership Development Rotational Program*** offering DOE Federal and laboratory mid-level and senior employees opportunities to rotate to laboratory or Federal sites to build greater understanding of the entire DOE enterprise.

By working in partnership with the National Laboratories, the Department has made significant progress in improving its management and performance in order to more effectively and efficiently execute the missions of both the Department and the National Laboratories.

HQ Relationship with the Field. The reporting relationships between headquarters and field offices are largely managed from within DOE's three Under Secretaries with a few exceptions, including the four Power Marketing Administrations, which report to the Secretary and Deputy Secretary. This Under Secretary structure was designed to improve the Department's performance in achieving mission objectives, which requires a focused and collaborative organizational structure and management processes that create a strong framework for mission

support functions, integrated science and applied energy programs, and formal coordination mechanisms in important policy areas.

Within the Under Secretary organizations, the reporting relationships between headquarters and field offices are managed by Program Secretarial Officers (PSOs), who are the heads of the major headquarters line programs (e.g., SC, NE, FE), and in many cases are Presidential-appointed, Senate-confirmed positions. Each field office is assigned to a specific PSO who has line management responsibility for managing field activities. This ensures clear accountability and responsibility for all activities, whether performed by federal or contractor entities. The PSOs are ultimately accountable to the Secretary and Deputy Secretary, through the Under Secretaries, for all aspects of the planning and execution of their programs conducted both at headquarters and the field.

The Department has recently clarified the roles and responsibilities of headquarters PSOs and mission support organizations by reinforcing that only PSO organizations may direct the work of field organizations and their contractors, although collaboration with mission support offices is frequent and encouraged. In addition, recognizing that field organizations are closest to the work being performed, to the extent possible, PSOs delegate decision-making authority to their field organizations, including day-to-day oversight of National Laboratory activities. The one exception to this is NNSA, where each of the Federal field office managers reports directly to the Administrator.

Boards and Councils

Given its diverse, complex mission, DOE has established several, high-level boards and councils to identify issues and challenges requiring attention; facilitate collaborative, informed decision-making; and offer recommendations on challenges facing the Department. In most cases, these boards are comprised of senior leaders from headquarters program and mission support offices, field organizations and laboratories. They have been essential to building stronger relationships between headquarters, the field and the laboratories and developing strategies to achieve DOE's goals.

The below includes boards and councils, primarily chaired by the Secretary. Additional board and councils are described in the Appendices.

- The ***Secretary of Energy Advisory Board (SEAB)*** is an external Federal Advisory Committee that provides the Secretary with timely, balanced, external advice on issues concerning the Department. The Board is subject to the Federal Advisory Committee Act and the recommendations of the Board are advisory. The Board was reactivated and restructured in 2013 with four standing sub-committees to address each of the major Departmental mission areas: science, energy, nuclear security, and environmental management. Comprised of technologists, business executives, academics, and former government officials, SEAB provides advice and recommendations to the Secretary of Energy on the Department's basic and applied research and development activities, economic and national security policy, educational issues, operational issues, and any other activities and operations of the Department of Energy as the Secretary may direct. The Board conducts much of its work through ad-hoc task forces, comprised of SEAB members and outside

experts. Task Force charges, membership, and reports are posted on the SEAB website (energy.gov/seab).

Since September 2013, the Board has met quarterly, alternating venues between DOE Headquarters in Washington, DC and National Laboratories. To date, SEAB has steered twelve task forces and developed ten reports outlining their findings and recommendations to the Secretary. In addition to the studies undertaken by the SEAB task forces, the Board has offered advice at the request of the Secretary on a number of other issues of importance to the Department. SEAB's advice has been shared throughout the Department with the relevant Program Offices.

Examples of issues that Task Forces have focused on include:

- the National Laboratories (providing recommendations to improve the health and management of the labs);
- a nuclear power initiative in the period 2030 to 2050 where one or many nuclear technologies have reached technical and commercial maturity;
- opportunities and barriers for science and technology development for environmental cleanup;
- the mission and national capabilities related to next generation high performance computing;
- how FracFocus 2.0 houses the information federal and state regulatory agencies require with regard to disclosure of the chemical composition of fluids used in hydraulic fracturing;
- the management and early progress of the new management and funding mechanisms in the Department - Energy Frontier Research Centers (EFRCs), Energy Innovation Hubs (Hubs), Bioenergy Research Centers (BRCs), and ARPA-E;
- the crucial formative stages of the Quadrennial Energy Review (QER) process;
- future areas of emphasis for the Department's nuclear nonproliferation activities, which led to the first annual report to Congress, "Prevent-Counter-Respond";
- new opportunities for research cooperation between scientists from DOE and NIH laboratories and the broad scientific community that could advance the pace of progress in biomedical sciences; and
- Federal energy management challenges and opportunities to improve performance.

- ***Laboratory Policy Council (LPC).*** The LPC was established in 2013 to provide a forum to engage DOE's National Laboratories in strategic policy and program planning discussions and for DOE to provide guidance on National Laboratory activities. The LPC is chaired by the Secretary and is comprised of senior DOE leadership and several National Laboratory directors. It convenes three times a year at DOE Headquarters and serves as an important forum for exploring nascent research proposals, considering initiatives for building workforce capacity, and improving communications. The LPC also discusses progress and guidance on initiatives, such as technology transition pilots and emergency response.

  Discussions within the LPC have focused on crosscutting Departmental initiatives, DOE-laboratory studies conducted by external bodies, management challenges, research areas, and workforce and leadership diversity. LPC discussions have led to further study of issues, such as technology development for environmental management, which resulted in greater

investment in environmental management technology development, a new environmental technology development organization, and increased collaborative activities around environmental cleanup with universities, industry, and government; and diversity and inclusion, where discussions led to leadership diversity workshops organized by the Laboratories and a sharing of best practices.

Through such collaboration and follow-up, the LPC has been effective in building greater trust with the National Laboratories, accelerating the implementation of policy initiatives, and advancing the Department's mission.

- ***Laboratory Operations Board***. The LOB was chartered in October 2013 with a charge "to strengthen and enhance the partnership between the Department and the National Laboratories, and to improve management and performance in order to more effectively and efficiently execute the missions of the Department and the National Laboratories." The LOB holds monthly meetings via video teleconferencing, and meets quarterly in person. The LOB is chaired by the Under Secretary for Management and Performance and is managed by a LOB Director. Its membership includes the headquarters program office chief operating officers (COOs); the Deputy Under Secretary for Science and Energy; laboratory COOs and Chief Research Officers; the Director of the Office of Management; a representative from the Field Office Managers; and a representative from the lab M&O contractor group.

  One of the LOB's early efforts illustrates the enterprise-wide impact of the group: the LOB led a first-ever enterprise-wide assessment of general purpose infrastructure across all 17 National Laboratories and NNSA sites and plants, using newly-established metrics to provide a uniform assessment of infrastructure such as utilities, HVAC systems, and office buildings. This initiative provided the basis for an additional $106 million requested by DOE, and funded by Congress in the Fiscal Year (FY) 2016 appropriations, targeted for general purpose infrastructure projects. Since then, the LOB has led DOE on other operations and management issues such as leading the Department's implementation of its response to the recommendations from the CRENEL. It also oversaw the task force which developed innovative modifications to the existing M&O contract model to reduce transactional oversight and duplicative requirements.

  The LPC and LOB have proven to be successful partnership forums where issues can be raised and solutions can be debated with relevant stakeholders engaged. In reviewing the DOE-laboratory relationship, CRENEL's October 2015 report recognized that "there is significant improvement being made in this area … which has resulted in much more open and effective collaboration between DOE and its laboratories in areas such as strategic planning and overall management. Likewise, the LOB and other forums for collaboration of various groups within DOE and the laboratories is having very positive results. It is important that these continue."

- The ***Energy Council***, chaired by the Secretary, serves as a forum for Department-wide consideration of energy issues - a tool to work across the diverse DOE mission areas and promote coordination across program offices. The Council, made up of senior leaders from across the Department's energy programs, provides advice to, and receives direction from the

Secretary and Deputy Secretary on issues of Department-wide applicability, including but not limited to strategic directions in energy policy; Department-wide energy RDD&D portfolio; coordination of strategies to address issues that may have cross-Departmental implications, including development of energy markets and business models; state, local, and tribal engagement and energy policy development; geopolitics of energy and the implications for the Department; and energy infrastructure, security, and resilience. The Energy Council meets monthly or as called by the Secretary. An Executive Committee of the Council sets the agenda.

The Energy Council has served as a forum for discussions, including: identifying strategies for modernizing transmission networks; developing a more systematic approach to how DOE interacts with state, local, regional, and tribal governments, particularly as it relates to energy and climate policy; highlighting the growing importance of energy-water issues and DOE's role; expanding capital and lowering the cost of energy technology; safeguarding infrastructure against specific cyber, physical, and climate-related threats; examining the implications of nuclear power plant retirements; achieving the President's goal of doubling energy productivity by 2030; planning future policy for low-growth energy markets; establishing models for STEM-related workforce development programs; and preparing the Quadrennial Technology Review.

- The ***Energy Jobs Strategy Council (EJSC)*** is a cross-cutting initiative that integrates the research, technology, and economic resources of the Department to respond to the economic and workforce development needs of the energy industry. The mission of the EJSC is to accelerate the growth of and access to jobs in all sectors of the United States energy economy. Comprised of senior leaders from across the Department, the Council reports to the Secretary and Deputy Secretary. The Council is chaired by the Secretary or his/her designee. Given the critical nature of the work performed by the Council, DOE's 2017 budget request includes funding to establish the Office of Energy Jobs Development, a permanent office to manage this important effort.

  EJSC activities are concentrated in three areas, including:

  - *Energy and Employment Data Collection*. The EJSC is responsible for conducting an annual national supplemental survey of employers in energy, energy efficiency, manufacturing and transportation industries and issuing the U.S. Energy and Employment Report (USEER), which tracks the relationship between energy technologies and employment growth in these key sectors of the United States economy.

  - *Workforce Development Activities in Energy and Advanced Manufacturing Technologies.* The EJSC also administers the Energy and Advanced Manufacturing Workforce Initiative composed of DOE Program Offices, the National Lab Directors' Council (NLDC) Committee on Workforce Development, and five other federal agencies: Departments of Labor, Education, Commerce, and Defense, and the National Science Foundation. This initiative is charged with coordinating the workforce development activities of these partners with a particular focus on the community college system and disadvantaged communities. It also sponsors a monthly Workforce Development Forum inside DOE for

DOE Program Offices and National Laboratories.

- *Integrating DOE Technical Assistance Programs*. The EJSC administers cross-cutting energy and manufacturing-related technical assistance programs through place-based initiatives with state, local, and regional partners and NGOs designed to maximize job creation while creating replicable models. Examples include projects to model 21st Century infrastructure with the City of Pittsburgh, low income solar financing with the City of Baltimore and the Maryland Clean Energy Center, energy and manufacturing with the City of Brownsville, development of an energy blueprint with the State of Montana, and energy modeling with a group of national labor organizations.

- The ***Nuclear Policy Council***, chaired by the Secretary, serves as a forum for Department-wide consideration of cross-cutting nuclear issues. The Council, made up of senior leaders from across the Department, advises, and receives direction from the Secretary and Deputy Secretary on key nuclear policy topics that transcend individual DOE program offices. The Council provides a means to address a range of cross-cutting nuclear issues, including nuclear energy, nuclear waste, and nuclear proliferation or nuclear terrorism, or other issues that the Secretary or Deputy Secretary have identified as priority matters requiring special attention or coordination. The Council was established, in part, to address a recommendation by SEAB that the Department should "ensure the effectiveness of an organizational structure that provides for integration within DOE of all aspects of nuclear policy (including nuclear weapons, nuclear nonproliferation, nuclear energy, nuclear waste, emergency response, and nuclear counter-terrorism)." The Council meets quarterly in full session or as needed at the discretion of the Chair or Vice Chair.

- The ***Cyber Council***, chaired by the Deputy Secretary, is the principal forum for coordination of cyber-related activities across the Department and serves as an advisory body to the Deputy Secretary. DOE is engaged in three categories of cyber-related activities: (1) protecting the DOE enterprise – including government-owned, contractor-operated sites and facilities – from a range of cyber threats that can adversely impact mission capabilities; (2) bolstering the United States Government's capabilities to address cyber threats; and (3) supporting energy sector efforts to strengthen cybersecurity. Membership includes senior leadership with responsibilities for cyber security. The Council meets every six weeks or as required by the Chair. The Cyber Steering Committee helps the Deputy Secretary set the agenda and prioritize the issues facing the Council.

  The Council streamlined cyber governance for the Department, with Council membership being fully inclusive of all DOE entities. The Council oversaw the development of the DOE Cyber Strategy and its implementation, furthered Federal Information Technology Acquisition Reform Act implementation, and accelerated implementation of key cybersecurity measures resulting from lessons learned from the 2015 Office of Personnel Management breach. The Council also guided the evolution of DOE cyber operations centers to create the Integrated Joint Cybersecurity Coordination Center, which provides a collaborative, intelligence-driven, distributed approach to cybersecurity operations and response that engages DOE's full capabilities.

- The ***Energy Systems Acquisition Advisory Board*** (ESAAB), chaired by the Deputy Secretary, supports the Department's objective of achieving and maintaining excellence in project management, advises the Secretary on enterprise-wide project management policy and issues, and assists on critical decision milestones for major projects. As part of the Secretary and Deputy Secretary's ongoing efforts to improve the management of DOE's projects, the ESAAB has been revitalized and transitioned from a static process to an active and dynamic body. Previously, the ESAAB had no regular meetings and was only convened to approve milestones. The ESAAB now reviews projects regularly to raise awareness of problems and solutions. It also now reviews all capital asset projects with a total project cost of $100 million or greater, compared to the $750 million threshold previously required. An integral part of the improved ESAAB is the support it receives from a committee established in 2014 called the ***Project Management Risk Committee (PMRC)***. The PMRC, which is chaired by the Associate Deputy Secretary, provides enterprise-wide project management risk assessment and expert advice to the Secretary, the Deputy Secretary, Departmental Project Management Executives, and the ESAAB.

- The ***Emergency and Incident Management Council (EIMC)***, chaired by the Deputy Secretary, serves as a forum to increase cooperation and coordination across the Department to prepare for, mitigate, respond to, and recover from nuclear incidents, major disruptions to energy systems and respond to all-hazard emergencies. The Council, made up of senior leaders from across the Department, addresses strategic-level aspects of the emergency management enterprise and identifies department-wide capabilities that can be utilized, as appropriate, in response, consultation, and technical assistance and restoration activities. The Council is the authorizing body to the Unified Command Structure.

- The ***Credit Review Board (CRB)***, chaired by the Deputy Secretary, is charged with ensuring full consideration of credit management, debt collection, and policy issues, to make recommendations to the Secretary of Energy prior to the Secretary's granting final approval for any conditional commitment for a loan guarantee or loan, and to participate in the oversight of the Loan Programs portfolio. The CRB seeks to confirm the commercial viability of a project receiving a loan or loan guarantee; thoroughly examine the project or activities benefitting from the program in light of DOE's objectives, including the portfolio objectives for the program; and oversee the development of a strategy for managing risks taken on by the Department in association with its loans, loan guarantee, and portfolio.

DOE's Cross-Cutting and Interagency Initiatives

The energy, national security, and governance challenges that DOE faces often exceed in complexity what a single office or lab can address. Therefore, DOE ensures that work on important challenges is properly matrixed to include multiple offices with expertise, equities, and experience. Examples of significant cross-cutting initiatives include:

Strategic Initiatives

- ***Climate Action Plan:*** Under the President's 2013 Climate Action Plan (CAP), the Department undertook an effort to reduce GHG emissions and to invest in future emissions reductions. As a result of the collaboration of multiple DOE departments and offices, DOE

has completed almost all of its commitments in this area, including releasing the first installment of the QER.

- ***Quadrennial Energy Review (QER)***: A January Presidential Memorandum established the QER to provide policy makers with a deep and broad analysis of the complex and interdependent elements that comprise the Nation's energy systems. The QER is led by the White House Office of Science Technology Policy and Domestic Policy Council, and supported by DOE EPSA who serves as the QER Secretariat and analytical arm of the process. DOE also coordinates with 22 Federal agencies and conducts extensive outreach with state and local governments as well as key stakeholders around the country. The QER has been and will continue to be a series of installments of analytical, actionable documents designed to provide policymakers, industry, investors, and other stakeholders with unbiased data and information on energy challenges, barriers, needs, requirements, and opportunities. The first installment, released in April 2015, examined the energy transmission, storage and distribution infrastructure. The report has been lauded and used by Congress, state energy officials, industry, and academia. This includes receiving $2 billion from Congress to modernize the distribution capabilities of the Strategic Petroleum Reserve. The next installment of the QER is slated to be finished in this calendar year and examines the electricity system from end-to-end and its impact on national security, economic competitiveness, and environmental responsibility.

- ***Quadrennial Technology Review (QTR):*** In 2015, DOE, under the leadership of the US/SE, developed and released the 2nd QTR, which explores the current state of technologies in key energy sectors and R&D opportunities present. The QTR frames a blueprint for DOE energy technology development and the enabling science for future technology breakthroughs. The QTR examines the most promising RDD&D opportunities across energy technologies to effectively address the nation's energy needs. Specifically, this analysis identifies the important technology RDD&D opportunities across energy supply and end use in working toward a clean energy economy in the United States. The insight gained from this analysis provides essential information for decision makers as they develop funding decisions, approaches to public-private partnerships, and other strategic actions over the next five years. The QTR can be found at: http://www.energy.gov/under-secretary-science-and-energy/quadrennial-technology-review-2015.

- ***Mission Innovation (MI):*** In November 2015, the President met with other world leaders in Paris to launch Mission Innovation, a landmark commitment to dramatically accelerate public and private global clean energy innovation. Through the initiative, 20 countries, including the United States, committed to double their governments' R&D investments in this domain over five years. For the U.S. this increases investment from $6.4 billion in FY 2016 to $12.8 billion in FY 2021. As part of the President's 2017 Budget Request, MI provides $7.7 billion for clean energy R&D distributed across 12 federal agencies. Because DOE is the nation's principal sponsor of clean energy R&D, 76% ($5.865 billion) of the proposed MI funding in the President's FY 2017 budget request would be directed to DOE programs, supporting research, development, and demonstration (RD&D) activities that address a wide range of low carbon technologies. The President's FY 2017 Budget Request includes $110 million for regional clean energy innovation partnerships, envisioned as cost-

shared, public-private partnerships that will develop regional RD&D portfolios tailored to the characteristics of the regions that they serve. DOE's applied energy and basic science research organizations worked together to develop proposals for this important initiative, including Regional Energy Innovation Partnerships that will support regionally.

- ***Portfolio Planning:*** Based on the commitment to double energy R&D funding in the United States over the five years starting with FY 2017, the Secretary Moniz charged the Under Secretary for Science and Energy and the Chief Financial Officer with taking a portfolio approach toward laying out a five-year budget framework. The effort took a holistic look at the broad energy needs from the QTR, explored break-through ideas that could be funded with a large increase in support, and evaluated the impacts from different investments. With this input, the next step is to document the framework that could be used to inform the budgets for FY 2018 and the next several years.

- ***Clean Energy Ministerial (CEM):*** The seventh CEM was held in May 2016, and focused on the launch of "CEM 2.0" framework — a non-binding implementation structure for CEM participation under the International Energy Agency (IEA) umbrella. The framework outlines the CEM mission statement, objectives, membership and guiding principles for its work program and budget and expenditures. It also defines the CEM governance structure, including the roles of CEM ministers, sherpas, external partners, the CEM steering committee, and the CEM Secretariat. As the host of this year's CEM, the United States (led by the Department of Energy) will continue to serve as a co-chair of the CEM Steering Committee in preparation for next year's CEM8 in Beijing, China. These ministerials have been jointly managed by DOE's Office of International Affairs (IA) and the Under Secretary for Science and Energy.

- ***North American Energy Integration:*** In February 2016, the energy ministers from Canada, Mexico and the United States signed a trilateral memorandum of understanding (MOU) on Climate Change and Energy Collaboration. To support the MOU, multiple DOE organizations are collaborating to provide policy analysis, conduct studies and workshops, and develop strategies to accelerate clean energy development to address climate change and energy security with our North American partners. These efforts are building on the analysis and results from the QER.

- ***Workforce Development:*** DOE's Energy Jobs Strategy Council (EJSC) supports the growth of, and access to, jobs in all sectors of the United States energy economy while meeting the goals of the Climate Action Plan. The EJSC accomplishes the mission through a cross-cutting initiative that integrates the research, technology, and economic resources of the Department to respond to the economic and workforce development needs of the energy industry. The Council also cross-collaborates with federal agencies, including the United States Departments of Labor, Education, and Defense, as well as labor unions and other external stakeholders. DOE also recognizes the value that a diverse workforce and inclusive environment has on the success of its mission. To build and maintain a more inclusive workforce, the Department recently launched the OneDOE Diversity and Inclusion (D&I) initiative to help gain leader commitment, establish a support structure, and implement D&I training and education programs.

RD&D Initiatives — Programmatic Cross-Cuts

- ***Grid Modernization:*** Modernizing the grid to better integrate generation, transmission, distribution and loads into a dynamic interactive system that incorporates new controls, information sharing and security beyond its current capability, will provide a critical platform for United States prosperity, competitiveness, and innovation. The key DOE offices involved in the Grid Modernization Initiative include EERE, OE, EPSA, and IE.

- ***Energy-Water Nexus:*** This initiative supports the Nation's transition to more resilient energy-water systems. Given the interdependent nature of our energy and water systems, current trends are increasing the urgency to address the energy-water nexus in an integrated way. Several DOE organizations are, including SC, EE, FE, EPSA, IE and IA, are coordinating to better understanding and develop strategies to address this critical need.

- ***Advanced Materials*:** Affordable, reliable, high performance materials are key enablers to most transformational changes in technology, including critical clean energy applications. As a result, accelerating advanced materials development from discovery through deployment is critical to maintain United States energy technology competitiveness and for United States manufacturing competitiveness. The key DOE offices involved in this cross-cutting working group include SC, EE, FE, NE and NNSA.

- ***Subsurface Science, Technology and Engineering RD&D (Subsurface/SubTER)****:* Subsurface resources constitute the Nation's primary source of energy with over 80 percent of the Nation's current energy supply originating from oil, natural gas, coal and geothermal energy. The Subsurface is also a critical storage medium, with opportunity for large-volume CO2 storage. The Subsurface crosscut addresses common challenges associated with uses of the subsurface, and has strong support from industry, academia and the national labs. The key DOE offices involved in this cross-cutting team include FE, EE, SC, EM, and NE.

- ***Exascale Computing:*** The importance of high performance computing (HPC) simulations is increasing as the United States faces serious and urgent economic, environmental, and national security challenges based on dynamic changes in the energy and climate systems, as well as growing security threats. Providing HPC tools for solving these and future problems requires exascale capabilities. Equally important, a robust domestic computing industry contributes to our nation's security by helping avoid unacceptable cybersecurity and computer supply chain risks. The key DOE offices involved in this cross-cut include SC and NNSA.

- ***Supercritical CO2 Technology***: Demonstrating and developing a power cycle based on sCO2, instead of steam, to produce electricity has the potential to revolutionize electric power generation for a variety of fuels and energy sources (including fossil, concentrating solar, geothermal, nuclear and waste heat). The key DOE offices involved in this cross-cut are FE, EE and NE.

Operational Initiatives

- ***Emergency Response:*** DOE plays a key role in Federal preparedness and response to energy-related emergencies, including: collaborating with infrastructure owners and operators to strengthen the security and resilience of critical infrastructure; serving as the day-to-day Federal interface for the prioritization and coordination of energy sector-specific activities; carrying out incident management responsibilities consistent with statutory authority and other appropriate policies; and providing technical assistance to the energy sector to identify vulnerabilities and help mitigate incidents, as appropriate. DOE has response capability for nuclear accidents or incidents both domestically and internationally. In support of this mission, the Emergency Incident Management Council (EIMC) coordinates enterprise-wide efforts to prepare for, mitigate, respond to, and recover from nuclear incidents, major disruptions to energy systems, and all-hazard emergencies.

- ***Infrastructure:*** One of the most significant challenges facing the Department is the degrading infrastructure at its laboratories and production facilities, the growth of its deferred maintenance backlog, and the large numbers of excess nuclear facilities. Recognizing these challenges, DOE, through the LOB, launched an enterprise-wide initiative to improve infrastructure planning by establishing uniform infrastructure assessments across the complex, ensuring that the deferred maintenance backlog does not increase, prioritizing investments in general purpose infrastructure (meaning the supporting infrastructure such as utilities), and increasing the overall investment in DOE infrastructure. These efforts are led by the Infrastructure Executive Committee, which is a subgroup of the LOB, and consists of line managers and facilities experts from programs, labs, plants, and sites.

- ***Project Management*:** The Department manages some of the world's largest, most complex projects and has faced significant challenges in completing these projects on cost and schedule. In 2013, several actions were taken to integrate and improve project management, including: establishing a Project Assessment Office reporting to each Under Secretary; strengthening the Energy Systems Acquisition Advisory Board, which is chaired by the Deputy Secretary; establishing a Project Management Risk Committee to provide objective analysis of project planning and performance; strengthening the independence of the project peer review process, and clarifying project management requirements.

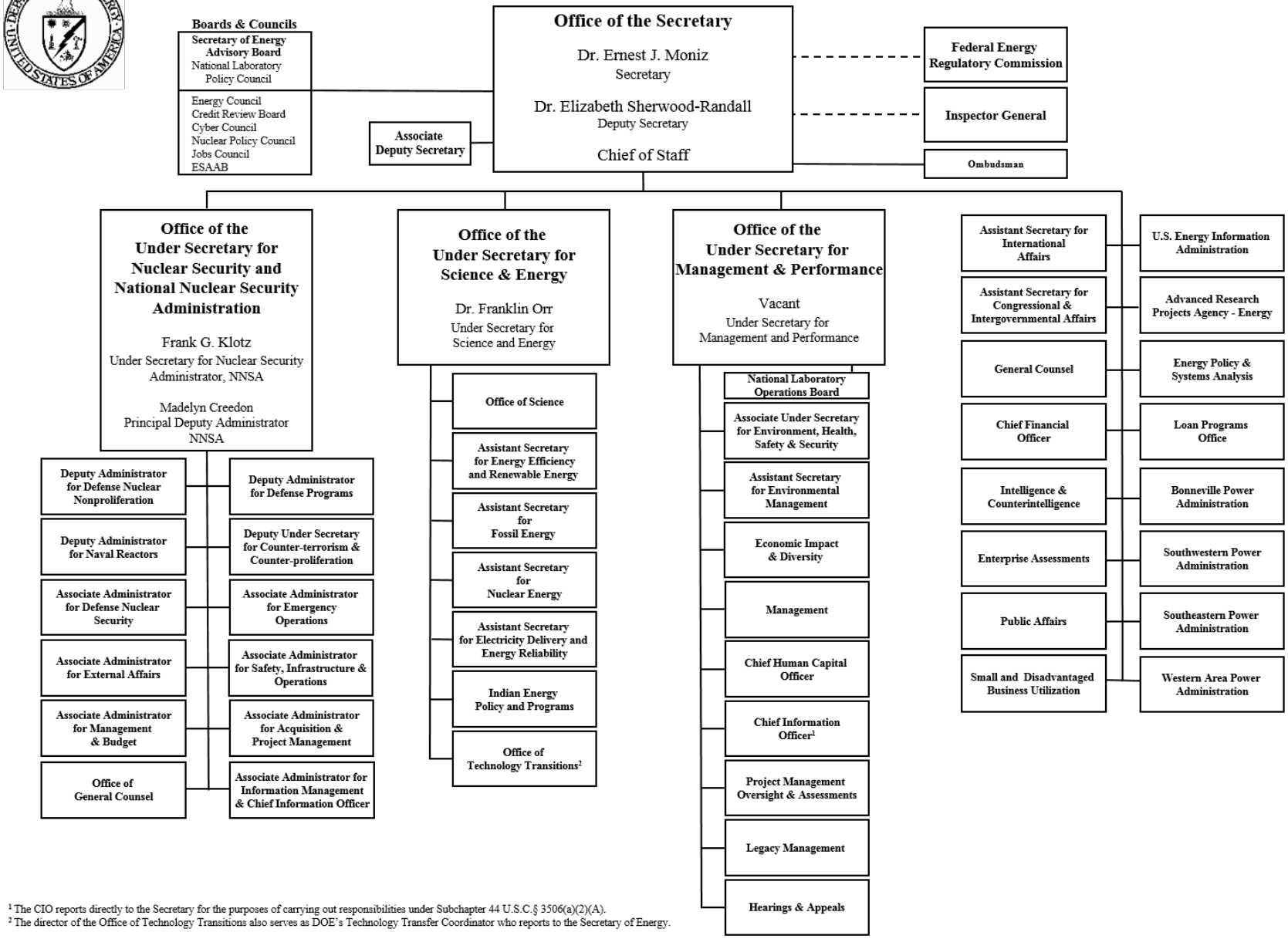
- ***Cyber Security:*** The Department is engaged in two different cyber-related activities: protecting the DOE enterprise from a range of cyber threats and improving cybersecurity in the electric power subsector and the oil and natural gas subsector. The cybersecurity crosscut supports central coordination of the strategic and operational aspects of cybersecurity and facilitates cooperative efforts such as the Joint Cybersecurity Coordination Center (JC3) for incident response and the implementation of Department's Identity, Credentials, and Access Management (ICAM) initiative. In addition, the cyber capabilities at the National Labs provide cutting-edge technical support to the entire Federal enterprise through strategic partnerships.

Conclusion

The Department of Energy is delivering the innovative and transformative scientific and technological solutions to energy, security, economic, and environmental challenges facing the United States in the 21st century. The Science and Energy programs are advancing implementation of the Climate Action Plan to cut carbon pollution and supporting an all-of-the-above energy strategy. The Nuclear Security programs are providing the Nation with a safe, secure and effective nuclear deterrent without explosive testing, strengthening nonproliferation efforts, combating nuclear terrorism, and providing nuclear propulsion for the Navy. The Management and Performance programs are tackling the legal and moral imperative of cleaning up legacy nuclear waste and promoting better management of our programs on behalf of the American people.

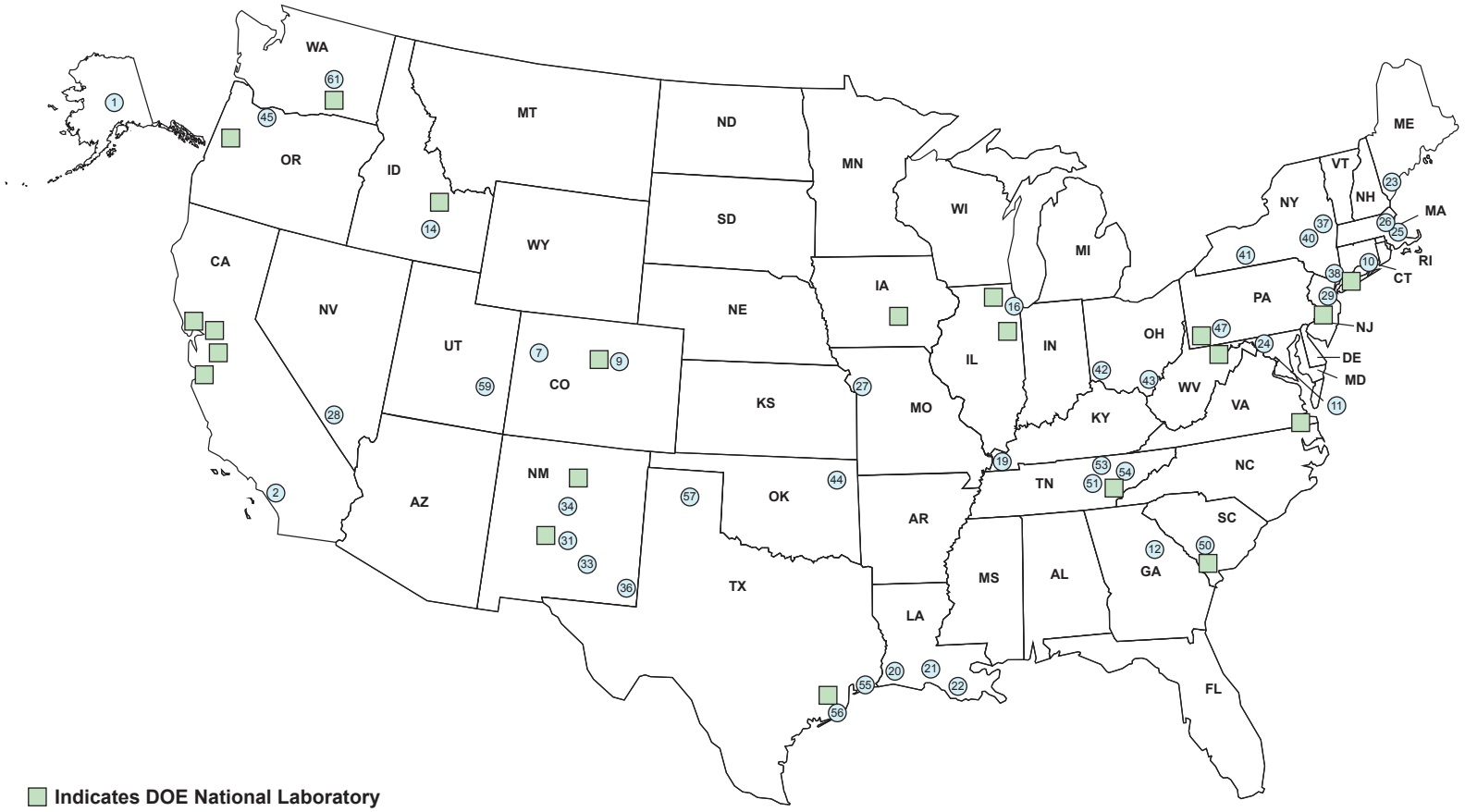
DEPARTMENT OF ENERGY

Figure 1



[1] The CIO reports directly to the Secretary for the purposes of carrying out responsibilities under Subchapter 44 U.S.C.§ 3506(a)(2)(A).
[2] The director of the Office of Technology Transitions also serves as DOE's Technology Transfer Coordinator who reports to the Secretary of Energy.

DOE Laboratories, Plants, and other Field Sites



Indicates DOE National Laboratory

*** Federal Field/ Site Offices are co-located with many of the DOE locations listed**

Alaska
1. Arctic Energy Office

California
2. Energy Technology Engineering Center
3. Lawrence Berkeley National Laboratory
4. Lawrence Livermore National Laboratory
5. Sandia National Laboratories
6. SLAC National Accelerator Laboratory

Colorado
7. Grand Junction Office
8. National Renewable Energy Laboratory
9. Western Area Power Administration

Connecticut
10. Northeast Home Heating Oil Reserves

District of Columbia
11. DOE Headquarters – Forrestal Building

Georgia
12. Southeastern Power Administration

Idaho
13. Idaho National Laboratory
14. Radiological Environmental Sciences Laboratory

Illinois
15. Argonne National Laboratory
16. Chicago Office
17. Fermi National Accelerator Laboratory

Iowa
18. Ames Laboratory

Kentucky
19. Paducah Gaseous Diffusion Plant

Louisiana
20. Strategic Petroleum Reserve - West Hackberry Site
21. Strategic Petroleum Reserve - Bayou Choctaw Site
22. Strategic Petroleum Reserve Project Management Office

Maine
23. Northeast Gasoline Supply Reserve

Maryland
24. DOE Headquarters – Germantown Campus

Massachusetts
25. Northeast Gasoline Supply Reserve
26. Northeast Home Heating Oil Reserve

Missouri
27. Kansas City National Security Campus

Nevada
28. Nevada National Security Site

New Jersey
29. Northeast Home Heating Oil Reserve
30. Princeton Plasma Physics Laboratory

New Mexico
31. Inhalation Toxicology Research Institute
32. Los Alamos National Laboratory
33. National Training Center
34. NNSA Albuquerque Complex
35 Sandia National Laboratory
36. Waste Isolation Pilot Plant

New York
37. Separations Process Research Unit
38. Northeast Gasoline Supply Reserve
39. Brookhaven National Laboratory
40. Knolls Atomic Power Laboratory
41. West Valley Demonstration Project

Ohio
42. EM Consolidated Business Center
43. Portsmouth Gaseous Diffusion Plant

Oklahoma
44. Southwestern Power Administration

Oregon
45. Bonneville Power Administration
46. National Energy Technology Laboratory – Albany

Pennsylvania
47. Bettis Atomic Power Laboratory
48. National Energy Technology Laboratory – Pittsburgh

South Carolina
49. Savannah River National Laboratory
50. Savannah River Site

Tennessee
51. East Tennessee Technology Park
52. Oak Ridge National Laboratory
53. Office Scientific and Technical Information
54. Y-12 Plant

Texas
55. Strategic Petroleum Reserve - Big Hill Site
56. Strategic Petroleum Reserve - Bryan Mound Site
57. Pantex Plant
58. National Energy Technology Laboratory - Sugar Land

Utah
59. Moab UMTRA Project

Virginia
60. Thomas Jefferson National Accelerator Facility

Washington
61. Hanford
62. Pacific Northwest National Laboratory

West Virginia
63 National Energy Technology Laboratory – Morgantown

Department of Energy's Upcoming Critical Decisions and Events

The following includes the Department's high-visibility critical decision points and events, by program, for 2017.

January 2017 (Post-Inauguration)

- *Office of Congressional and Intergovernmental Affairs:* Begins preparing incoming nominees for confirmation hearings, including congressional courtesy visits.
- *Office of Electricity Delivery and Energy Reliability*: Announcement of the award for the new Joint Clean Energy Research and Development Center (JCERDC) in the area of Smart Grids and Energy Storage for Grid Applications. The 5-year project will be funded by DOE and the Government of India, with matching industry cost share for total value of at least $30 million. The awards are expected to be announced in late January/early February.
- *Office of Energy Efficiency and Renewable Energy:* Will prepare the Secretary to potentially participate in the annual Washington, DC, Auto Show (January 27 – February 5), which provides an opportunity to amplify DOE's role in transportation technologies.
- *Energy Information Administration*: Issues the Annual Energy Outlook (AEO), an integrated midterm forecast of the United States energy supply, demand, and process.
- *Office of Environmental Management:* Expects to award a multi-billion dollar, 10-year contract for remediating liquid waste at DOE's Savannah River site between January and March.
- *Office of Fossil Energy:* DOE's Strategic Petroleum Reserve may begin crude oil sales, pending receipt of a Congressional appropriation.
- *Office of International Affairs:* Prepares for possible Secretarial participation in the International Energy Agency Ministerial in Paris, to discuss global energy governance and security issues. (Ministerial will take place in Winter 2017; the date is to be determined.)
- *National Nuclear Security Administration:* Expects to announce that their commercial partner (NorthStar) will receive FDA approval to produce Mo-99 for medical use, which will draw significant Congressional and media interest.
- *National Nuclear Security Administration:* Needs $200 million to transfer facilities in Kansas City to a private developer; delays would result in about $800 million in additional costs.
- *Office of Science:* Deputy Secretary will be expected to make a decision on the estimated cost and schedule for the U.S. ITER First Plasma Subproject of the ITER international fusion facility. If the U.S. Senate's FY17 proposal to zero the budget for ITER prevails, DOE will have current investments and commitments to international partners that must be addressed.

February 2017

- *Advanced Research Projects Agency - Energy:* Will host DOE's Eighth Annual ARPA-E Energy Innovation Summit (February 27-March 1) in the Washington, DC area, at which the Secretary typically presents.
- *Office of the Chief Financial Officer:* Develop DOE FY 2018 budget request based on Administration guidance.
- *Office of Congressional and Intergovernmental Affairs:* Will prepare senior leadership for possible meetings with intergovernmental groups who are scheduled to hold their annual meetings in Washington, DC, in February and March.
- *Office of Environmental Management:* Expects to award a multi-billion dollar, 10-year contract to provide deactivation and remediation services at the Paducah Gaseous Diffusion Plant in Kentucky between February and May.
- *Office of Energy Efficiency and Renewable Energy:* Plans to announce the selection of a Wave Energy Test Facility project that will draw media and Congressional interest.
- *Office of Project Management Oversight and Assessments:* The Government Accountability Office (GAO) will issue its bi-annual High Risk List, which includes Federal government activities considered to be at high-risk. DOE's major projects and contracts (over $750 million) likely will be included on the list, primarily due to significant challenges DOE faces in completing large construction projects.

March 2017

- *Office of Environmental Management:* Will complete retrieval of high-level waste from an underground tank that was discovered in 2012 to have leaked up to 70 gallons of waste.
- *Office of International Affairs*: Prepare for possible Secretarial participation in the U.S. – European Union Energy Council in Brussels to deepen coordination on strategic energy issues of mutual interest, foster cooperation on energy policies, enhance energy security, and further strengthen United States-European Union research collaboration. Secretary of State is also expected to participate. (Will take place in Spring 2017; the date is to be determined.)
- *National Nuclear Security Administration*: The President provides the annual assurance on the safety, security, reliability, and military effectiveness of the nuclear weapons stockpile based on an assessment conducted by DOE and the Department of Defense.
- *Office of Nuclear Energy:* DOE's Nuclear Energy Advisory Committee will complete a review of a study on the need for an advanced test reactor; the review is expected to draw significant Congressional interest.

April 2017

- *Office of Environmental Management:* Expects to award a multi-billion, 10-year contract to continue the legacy cleanup mission at the Los Alamos National Laboratory between April and August.
- *Office of International Affairs*: Prepares for possible Secretarial participation in the Group of Seven (G7) Energy Ministerial in Rome, Italy, to discuss pressing issues related to international energy security, such as innovation, cybersecurity, energy reform in Ukraine, and efficiency. (Will take place in April 2017; the date is to be determined.)
- *National Nuclear Security Administration:* Will support a security exercise that will involve senior level decision makers at the White House and select agencies.
- *Office of Science*: Will host the annual National Science Bowl (NSB), where teams of middle school and high school students across the country compete in NSB Finals. The President, First Lady, and the Secretary are traditionally invited to address students or host at the finals.
- *Office of Technology Transitions:* Awards $20 million in Energy Technology Commercialization matching funds for applied RD&D high-impact commercial applications.

All Other Events in 2017

- *Office of the Chief Financial Officer:*
  - Implements DATA Act through transmission of required files to Treasury Department. (May 2017)
  - Completes initial risk profiles as part of Enterprise Risk Management implementation for submission to OMB. (June 2017)
  - Develops and submits to OMB DOE FY 2019 budget request. (September 2017)
  - Develops and submits updated DOE Strategic Plan. (September 2017)
  - Complete GONE Act requirements and submit required reporting. (November 2017)
  - Complete FY 2017 financial statements to support DOE annual independent audit. (November 2017)
- *Office of Congressional and Intergovernmental Affairs:* Manages DOE's National Lab Day on the Hill. (Late Spring)
- *Office of Electricity Delivery and Energy Reliability*: New Hampshire State siting authority will issue decision on the proposed Northern Pass transmission project, which will draw media interest. (September 2017)
- *Office of Energy Efficiency and Renewable Energy:*
  - Announces selections and awards for several programs, including: Critical Materials Institute Hub Renewal, Advanced Manufacturing Office Incubator Selections, Clean Water Institute/Hub Selection, and Geothermal Down Select. (September 2017)

- Hosts the annual Solar Decathlon, a collegiate competition to design and build solar-powered homes. (October 2017 in Denver, CO)

- *Energy Information Administration:* Sponsors the Annual EIA Energy Conference in Washington DC, which brings together over 1,000 leaders from industry, government, and academia to discuss current and future challenges facing domestic and international energy markets and policymakers. (June 2017)
- *Office of Environmental Management:*
  - Secretarial determination is needed before May 1, 2017 to continue uranium barters that partially fund EM and NNSA programs. (May 2017)
  - Completes demolition of the Plutonium Finishing Plant at Hanford, WA, in accordance with an agreement with State regulators and the EPA. (September 2017)
  - Trial begins on lawsuits filed by Washington State, as well as Hanford Challenge and United Association of Plumbers and Steamfitters Local Union 598, regarding workers concerns about exposure to tank vapors at DOE's Hanford, WA, site. (September 2017)
- *Office of Fossil Energy:* Sponsors the Carbon Sequestration Leadership Forum Ministerial, which is typically led by the Secretary. (November 2017)
- *Office of Indian Energy Policy and Programs:* Will host the annual Tribal Energy Summit in Washington, D.C., which provides a forum to enhance energy security, increase community resiliency, and cultivate sustainable energy on Tribal land. The Secretary and Deputy Secretary have attended in previous years. (May 2017)
- *Office of International Affairs*: Will prepare senior leadership for the below international meetings. The Secretary will be invited to participate in most of these events, with the exception of two events where the Deputy Secretary is expected to participate, as noted below.
  - Mission Innovation Ministerial in China to discuss research and development of innovative clean energy technologies. (May/June 2017)
  - Clean Energy Ministerial 8 Meeting in China to discuss and promote policies and programs that advance clean energy development in support of the NDCs. (May/June 2017)
  - U.S. – China Strategic & Economic Dialogue to discuss and advance work on a range of bilateral energy collaboration activities. (Location/date will be determined, but event is likely to take place in Washington, DC, in Summer 2017.)
  - Energy and Climate Partnership of the Americas in Chile to discuss action on climate and clean energy priorities, and to strengthen collaboration among member countries across in the Americas. (September/October 2017)
  - Conference of the Parties 23, United Nations Framework Convention on Climate Change to advance United States Government climate and clean energy deployment priorities. (Event will be held in Asia, but the country is to be determined.) (November 2017)

- APEC Energy Ministerial in Vietnam to discuss clean energy and energy security issues in the Asia-Pacific region. Deputy Secretary-level meeting. (Fall 2017)

- US-India Energy Dialogue in India to discuss bilateral energy cooperation agenda. (Date is to be determined.)

- US-China Energy Dialogue in China to discuss bilateral energy cooperation agenda. (Date is to be determined.)

- United States – UAE Strategic Energy Dialogue in UAE to discuss bilateral energy cooperation agenda. Deputy Secretary-level meeting. (November 2017)

- United States – Saudi Strategic Energy Dialogue to discuss bilateral energy cooperation agenda. (Event will be held in the United States, but location is to be determined.) (December 2017)

- US-India Energy Dialogue in India to discuss bilateral energy cooperation agenda. (Date is to be determined.)

- US-China Energy Dialogue in China to discuss bilateral energy cooperation agenda. (Date is to be determined.)

- *National Nuclear Security Administration:*
  - Conducts Emerging Threats mock deployment in Panama. (May 2017)
  - Converts the miniature neutron source reactor (MNSR) in Nigeria from highly enriched uranium (HEU) fuel to low-enriched uranium (LEU) fuel. (August 2017)
- *Office of Science*:
  - Will manage DOE participation in a Ministerial-level ITER Council Meeting to secure the support of the ITER Member countries for ITER fusion facility's cost baseline. (Spring 2017)
  - Will reassess its recommendation to Congress that the United States continue to participate in the ITER facility project. (December 2017)

- *Office of Small and Disadvantage Business Utilization*:
  - Will host the 16th Annual DOE Small Business Forum and Exposition, and the FY 2016 Annual Small Business Awards Program in Kansas City, MO. (May 16-19, 2017)
  - The U.S. Small Business Administration will release its 2016 Small Business Scorecard, rating the performance of each agency in meeting small business goals. In 2015, DOE received an "A" rating. (May/June 2017)

- *Office of Technology Transition*: Will conduct the Clean Energy Investment Center Summit, which convenes private sector and strategic investors; philanthropic organizations; and venture capitalists to discuss strategies for developing new public-private partnerships to accelerate investment opportunities in the clean energy sector. (Summer 2017)

Department of Energy Important Issues

Below is a list of issues that will need the attention of the incoming Administration. A brief issue paper on each topic follows. The papers are categorized by science and energy, nuclear security, environmental clean-up, and management.

Category 1: Science and Energy	
Title	**Summary**
Quadrennial Energy Review (QER)	Following publication of the first-ever QER in 2015, the second installment, which is focused on the electricity system, will be published in late 2016 and will provide an opportunity to drive national electricity policy.
DOE Exascale Computing and the National Strategic Computing Initiative	DOE is establishing the Exascale Computing Initiative to deliver capable exascale computing for DOE science, technology, and national security mission needs.
ITER Project	ITER is a large-scale international fusion energy research project that has experienced significant cost issues. In 2016, DOE recommended to Congress that the U.S. continue its participation in the project. Congress expects a second recommendation is December 2017.
Climate Action: Meeting Domestic and International Clean Energy and Climate Commitments	As part of the Agreement of the 21st Conference of the Parties in Paris in 2015, countries representing 98 percent of global greenhouse gas emissions announced their domestic climate and clean energy targets. Significant action is needed to implement these commitments.
International Partnerships	The Secretary and Deputy Secretary of Energy lead a number of bilateral and multilateral efforts with key energy producers and consumers.
Advanced Manufacturing Consortia	DOE is facilitating the establishment of new public-private R&D partnerships to increase U.S. manufacturing competitiveness.
Appliance and Equipment Efficiency Standards	DOE needs to meet legislated schedules to finalize 20 standards over the next four years.
U.S. Offshore Wind	With the first U.S. offshore windfarm commencing operations off Block Island, RI, the U.S. is poised to be a global leader in technology for offshore wind.

Carbon Capture and Storage Major Demonstrations	Over the next several months, three carbon capture and storage demonstration projects funded in part by DOE will initiate commercial operations.
Strategic Petroleum Reserve (SPR) Modernization	DOE is statutorily required to develop an SPR modernization program to make operational improvements to extend the life of the SPR infrastructure.
Liquefied Natural Gas (LNG) Exports	DOE's natural gas export regulatory program is at the center of discussions concerning U.S. natural gas trade policy.
Uranium Management	A Secretarial Determination is needed before May 1, 2017 to continue uranium barters that partially fund NNSA and EM programs.
Siting New Facilities for Storage and Disposal of Spent Nuclear Fuel and High-Level Radioactive Wastes	DOE is designing a phased, adaptive, consent-based approach to siting new nuclear waste facilities.
Grid Modernization	DOE is working in partnership with states and industry to create a modern, secure grid for the future through its Grid Modernization Initiative.
Category 2: Nuclear Security	
Annual Assessment of the Nuclear Weapons Stockpile	DOE and its national laboratories annually assess the nuclear weapons stockpile and certify that it is safe, secure, reliable and militarily effective.
Stockpile Stewardship and Sustainment	NNSA must extend the lifespan of the aging nuclear warhead stockpile and ensure it remains safe, secure, and reliable without underground nuclear testing.
Joint Comprehensive Plan of Action with Iran	DOE/NNSA programs provide critical support to the nuclear deal with Iran that is designed to prevent Iran from acquiring a nuclear weapon.
Emergency Management Programs	DOE/NNSA maintains a wide range of capabilities in the core areas of crisis operations, consequence management, and emergency management.
NNSA Major Capital Projects	NNSA has experienced challenges in completing major construction projects. Success depends on stable predictable funding and Congressional support of the President's Budget.

NNSA Governance and Management Reform	NNSA must closely monitor the effectiveness of specific initiatives to ensure that governance reform stays on course.
Ohio Class Submarine Reactor Plant Replacement	NNSA must replace the capabilities of the OHIO-Class SSBN in order to maintain the nuclear triad.
Naval Reactors Spent Fuel Handling Recapitalization Project	NNSA's Expended Core Facility must be replaced or risk adverse impacts on U.S. fleet operations.
Low Enriched Uranium (LEU) Cores	The Secretaries of Energy and the Navy must make a determination on whether the United States should pursue research and development of an advanced naval nuclear fuel system based on LEU.
Category 3: Environmental Clean-up	
Hanford	DOE's Hanford site in Washington state is DOE's largest clean-up site and poses considerable challenges and opportunities.
Hanford Waste Treatment and Immobilization Plant (WTP)	WTP is DOE's largest, most complex construction project and has experienced significant technical, cost and schedule challenges.
Uranium Enrichment Decontamination and Decommissioning (UEDD)	Without adequate funding to continue cleanup at three former gaseous diffusion uranium enrichment sites, the pace of cleanup activities and related workforce will be affected.
Waste Isolation Pilot Plant (WIPP)	DOE is taking action to reopen this repository for transuranic waste which has been closed since 2014 when two unrelated safety incidents occurred.
Category 4: Management	
Project Management Reform	DOE has experienced significant challenges in completing its major construction and environmental clean-up projects on cost and schedule. DOE has taken aggressive action to improve project management.
Aging DOE Infrastructure and Excess Facilities	DOE's aging, degrading infrastructure must be addressed to maintain DOE capabilities to achieve its mission.
Cybersecurity	DOE has statutory, sector-specific, scientific, and national security missions that contribute to advancing our nation's cybersecurity, and is responsible for its own enterprise.

DOE/Lab Partnership – CRENEL Implementation	DOE has made substantial progress in addressing recommendations made by CRENEL in transforming its relationship with its National Laboratories towards a more strategic partnership.
Safety Culture, Employee Concerns, and Whistleblower Protection	DOE is committed to ensuring safe operations and fostering a work environment where employees can express concerns without fear of retaliation.

Quadrennial Energy Review (QER)

Following the publication of the first-ever installment of the QER in April 2015, the second installment of the QER will be released around December 2016. This installment, which is focused on the electricity system from generation to end use, will provide the new Administration an opportunity to drive national electricity policy by implementing the recommendations laid out in the report.

Summary: A January 2014 Presidential Memorandum[1] established the QER to provide policymakers with a deep and broad analysis of the complex and interdependent elements that comprise the Nation's energy system and how it applies to other sectors in the economy. Rather than conducting a review of the entire energy system, however, DOE—as QER Secretariat—and the Federal interagency structured the QER in installments to focus on discrete components. The first installment of the QER (QER 1.1) was published by the White House and DOE in April 2015, focusing on the Nation's infrastructure for transmission, storage, and distribution. The second installment (QER 1.2) examines the Nation's electricity system from end-to-end, and will provide the new Administration with an opportunity to drive national electricity policy by implementing the recommendations laid out in the report.

Issue

After the initial publication of QER 1.1, Federal and state lawmakers, regulators, industry, and other stakeholders responded positively to the report's findings. The Administration began—and continues to be—actively engaged in the implementation of the QER's 63 recommendations, and many proposals have received bipartisan support on Capitol Hill. Congressional action that supports or authorizes implementation is ongoing and over 20 of the QER's proposals are fully or partially reflected in Federal law. In the *Consolidated Appropriations Act, 2016* (P.L. 114-113), Congress set a requirement for DOE to create an implementation report card to assess the cumulative achievements of Congress, DOE, and its interagency partners to implement recommendations from the QER.

Interest in the second installment is expected to be significant given the past attention to QER 1.1. DOE will need to work with the White House, interagency partners, and Congress to undertake a wide-ranging suite of initiatives for QER 1.2. Using the rollout and implementation work from QER 1.1 as a model, the Department will conduct activities in the following areas:

- *Public Outreach*: Provide overview briefings to state utility commissions, industry, trade associations, other stakeholders, and media and conduct technical assistance and studies with these partners.
- *Legislative Branch Implementation*: Interact with Congressional members and staff to share the report's findings, highlight recommendations, and provide technical expertise during the drafting of legislation. For QER 1.1, Secretary Moniz testified to Congress

[1] The White House. "Presidential Memorandum—Establishing a Quadrennial Energy Review." January 9, 2014. https://www.whitehouse.gov/the-press-office/2014/01/09/presidential-memorandum-establishing-quadrennial-energy-review.

three times regarding the report's recommendations while DOE staff provided over ten briefings to the House and Senate.

- *Executive Branch Implementation:* Coordinate work within DOE as well as between DOE and its interagency partners to begin implementing recommendations which include additional analytical studies, interagency working groups, Administration initiatives and partnerships, etc.

Status

The second installment examines the Nation's electricity system from end-to-end. QER 1.2 will develop a set of findings and policy recommendations to help guide the modernization of the electric grid and ensure its continued reliability, safety, security, affordability, and environmental performance through 2040. Today's U.S. power grid—the world's "largest machine"—is vast and complex. The value of the electricity supply chain (from fuel to generation to transmission to distribution) is about $1 trillion. This drives a $20 trillion GDP and significantly influences global economic activity totaling roughly $80 trillion. The electricity system supports the increased electrification of all of the sectors of the U.S. economy and the convergence of many critical systems within, across, and beyond the electricity systems. How the electricity sector generates, transmits, and delivers power to consumers is changing—enabled by technology, and driven by opportunities for value creation and the environmental imperatives of climate change. The centrality of electricity to national health and well-being in this time of transformation has merited closer examination.

Thus, following its scheduled release around December 2016, the new Administration will have the opportunity to drive national electricity policy by implementing the recommendations in the second QER installment.

Background

On January 9, 2014, President Obama issued a Presidential Memorandum directing the Administration to conduct a Quadrennial Energy Review. Informed by the President's June 2013 "Climate Action Plan" and in response to a 2011 recommendation by the President's Council of Advisors on Science and Technology, the QER enables the Federal Government to translate energy policy goals into a wide set of actions. These include executive actions, legislative proposals, and budget and resource requirements for proposed investments to address the energy challenges and opportunities facing the Nation.

The QER Task Force, comprised of 22 Federal agencies and co-chaired by the White House's Domestic Policy Council and Office of Science and Technology Policy, leads development of the QER. Each installment of the QER is designed to: provide an integrated view of, and recommendations for, Federal energy policy in the context of economic, environmental, occupational, security, and health and safety priorities; review the adequacy of existing executive and legislative actions and recommend additional executive and legislative actions, as appropriate; assess and recommend priorities for research, development, and demonstration programs to support key energy innovation goals; and identify analytical tools and data needed to support further policy development and implementation.

DOE provides support to the Task Force, including support for coordination activities related to policy analysis and modeling; stakeholder engagement; interagency engagement; and preparation of the final QER report. Specific DOE activities include:

- *Analysis and Modeling*

  DOE undertakes an extensive suite of analyses that include scenario modeling, synthesis, and white papers. The Department generates analysis, policy working papers, and public reports in addition to commissioning analyses from DOE National Laboratories and energy firms. Technical workshops that occur with subject matter experts from relevant fields also provide analytical content for use in the QER. DOE analysts review the suite of analytical products, stakeholder comments, and interagency contributions to determine relevant findings and insights that will inform final recommendations.

- *Stakeholder Engagement*

  The Department leads the QER Task Force's work to gather ideas, advice, and suggestions from myriad sources that include state and local governments, tribes, businesses, universities, and nongovernmental entities. Interactions with the public occur in person and via technology. Public stakeholder meetings in locations across the country enable the public to speak directly to the QER Task Force. DOE also maintains an online comment portal that enables individuals to submit comments, studies, reports, data sets, and other relevant materials for review by DOE analysts.

- *Interagency Engagement*

  As Secretariat of the QER Task Force, DOE convenes regular meetings through the White House to work closely with the leadership of relevant Federal agencies to provide content for the QER. Many agencies provide information on topics within their statutory and regulatory jurisdiction in addition to particular areas of expertise.

DOE Exascale Computing and the National Strategic Computing Initiative

DOE's Office of Science (SC) and National Nuclear Security Administration (NNSA) have partnered to establish the Exascale Computing Initiative (ECI) to deliver capable exascale computing for DOE science, technology, and national security mission needs. DOE is one of the Federal leads in the interagency National Strategic Computing Initiative (NSCI) focused on delivering exascale computing to advance U.S. economic competitiveness and national security.

Summary: It is critical to national security and economic competitiveness to maintain the Department of Energy's Exascale Computing Initiative.

- Over the past six decades, U.S. computing capabilities have been maintained through continuous research and the development and deployment of new computing systems with rapidly increasing performance on applications of major significance to government, industry, and academia. Maximizing the benefits of High Performance Computing (HPC) in the coming decades will require an effective national response to increasing demands for computing power; emerging technological challenges and opportunities; and growing economic dependency on and competition with other nations. This national response will require a cohesive, strategic effort within the Federal Government and a close collaboration between the public and private sectors.
- In 2016, DOE initiated research and development activities to deliver an exascale (10^{18} operations per second) computing capability by the mid-2020s. This activity, referred to as the ECI, is a partnership between the DOE Office of Science (SC) and the DOE National Nuclear Security Administration (NNSA) that addresses DOE's science and national security mission requirements.

Issue

Early this summer, China eclipsed the U.S. in scientific supercomputing. This is the first time that the U.S. has not dominated high performance computing since the beginning of the computer era. On June 20, 2016, China unveiled its newest supercomputer, the 125 petaflop Sunway TaihuLight taking the #1 position in the TOP500 ranking, displacing to #2 its Tianhe-2, which had occupied #1 since June 3013. "Flops" (floating point operations per second) are the elementary unit of computational power: one flop corresponds to one calculation. One petaflop is one quadrillion (one thousand trillion or 10^{15}) flops and one exaflop is one thousand (10^{18}) petaflops. More importantly, China overtook the U.S. with the total number of machines on the list and is likely to win the prestigious Gordon Bell Prize in November, based on scientific applications run on the Sunway TaihuLight. By all significant measures – top ranked, total number of supercomputers in the TOP500, aggregate total computing power, and software capable of sustained performance – China now dominates the U.S. in supercomputing. In addition, China is investing heavily in its domestic production capabilities and future computing technologies, such as quantum computing, neuromorphic computing, and artificial intelligence (see definitions below).

Currently, within DOE SC and DOE NNSA, the total leadership computing capability (combined capability of existing DOE high-performance computers) is about 50 petaflops. Upgrades are

under way, and further supported by the FY 2017 budget request will increase DOE's aggregate capability to approximately 500 petaflops by 2018. Recent and ongoing analyses of computing requirements across DOE SC and DOE NNSA establish an aggregate mission need of 2-10 exaflops of capacity by the mid-2020s. There are significant challenges associated with achieving this level of capacity due to the physical limits of existing computing technology and concomitant limitations in software design. Scaling of current high performance computing technologies would result in systems that are untenable in their energy consumption, data storage requirements, latency, and other factors. Unlike previous upgrades to DOE's leadership computing capabilities, an exascale system capable of meeting critical national needs cannot be developed through incremental improvement of existing systems.

In addition to its importance for U.S. competitiveness, HPC is also a critical component of the national security, energy, and science missions of the Department of Energy.

National Security Needs: Stockpile stewardship, which underpins confidence in the U.S. nuclear deterrent, has been successful over the last two decades, largely as a result of HPC-based modeling and simulation tools used in the NNSA Annual Assessment process, as well as solving issues arising from Significant Finding Investigations (SFIs). In the coming decade, the importance and role of HPC at the exascale computing performance level in this area will intensify, and exascale-based modeling and simulation tools will be increasingly called upon to provide required confidence, using robust uncertainty quantification techniques, in lifetime extensions of warheads in the U.S. nuclear weapons stockpile. These tools also will have an increasing role in understanding evolving nuclear threats posed by adversaries, both state and non-state, and in developing national policies to mitigate these threats.

Science: For nearly two decades, the department's Science programs have utilized HPC to accelerate progress in a wide array of disciplines. Recent requirements gathering efforts across the SC program offices indicate an increasing need for advanced computing at the exascale. Examples include: discovery and characterization of next-generation materials; development of reliable earthquake warnings and risk assessment; development of accurate regional impact assessments of climate; systematic understanding and improvement of chemical processes; analysis of the extremely large datasets resulting from the next generation of particle physics experiments; and extraction of knowledge from systems-biology studies of the microbiome. Dramatic improvements in public health may result from the application of exascale capabilities to cancer research, precision medicine and understanding the human brain.

Energy: For the past two years, the Energy programs have formulated strategic plans that rely on advanced computing capabilities at the exascale. Examples include: design of high efficiency, low emission combustion engines and gas turbines; improving the reliability and adaptability of the Nation's power grid; increased efficiency and reduction in costs of turbine wind plants in complex terrains; and acceleration of the design and commercialization of next generation small modular reactors. Advances in applied energy technologies also are dependent on next-generation simulations, notably whole-device modeling in plasma-based fusion systems.

Status

In 2015, the interagency National Strategic Computing Initiative (NSCI)[1] was established by Executive Order to maximize the benefits of HPC for U.S. economic competitiveness, scientific discovery, and national security, and ensure a cohesive, strategic effort within the Federal Government. DOE is one of three lead Federal agencies for the NSCI to deliver capable exascale computing.

DOE established the ECI in the President's FY 2016 Budget Request. The DOE ECI will accelerate the development and deployment of DOE exascale computing systems and is DOE's contribution to the interagency NSCI. Within DOE, the NNSA Office of Advanced Simulation and Computing (ASC) and SC Office of Advanced Scientific Computing Research (ASCR) are the lead organizations and are partners in the ECI. In addition to the NNSA/ASC and SC/ASCR investments, the Department's ECI also includes targeted scientific application development in SC's Office of Basic Energy Sciences and Office of Biological and Environmental Research.

In FY 2016, the ECI was split into the Exascale Computing Project (ECP) and other exascale related activities. The ECP, a multi-lab project with project office at DOE's Oak Ridge National Laboratory, has as its sole focus the delivery of an ecosystem supporting DOE science, energy, and national security applications to run on at least two exascale machines. The ECP will follow the project management approach developed by DOE SC for large multi-lab projects such as the Linac Coherent Light Source and the Spallation Neutron Source[2]. As such, the ECP will be executed within a tailored framework that follows DOE Order (O) 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, and defines critical decision points, overall project management, and requirements for control of a baselined schedule and cost. The first four years of ECP will focus on R&D directed at achieving system performance targets for parallelism, resilience, energy consumption, memory, and storage. The second phase, approximately the last five years of the ECP, will support production-readiness of application and system software, supplement the procurement of exascale computer systems, and start of ECP operations. The other DOE ECI related activities includes domain-specific software development in the Biological and Environmental Research and Basic Energy Sciences programs.

Milestones

The DOE Acquisition Executive (Deputy Secretary) formally approved the Mission Need (Critical Decision 0) for the Exascale Computing Project (ECP) on July 28, 2016. Project milestones will be established when the project is baselined at Critical Decision 2.

Major Decisions/Events

Pursuant to DOE O 413.3B, the next phase of this effort will require the Deputy Secretary as the Acquisition Executive to approve the Alternatives Analysis (Critical Decision 1) by the end of 2016 and the issuance of research and development contracts with competitively selected vendors (Critical Decision 3a).

[1] https://www.whitehouse.gov/the-press-office/2015/07/29/executive-order-creating-national-strategic-computing-initiative

[2] http://science.energy.gov/user-facilities/

Background

Over the past several years, DOE has become aware that future-generation systems will require significant changes in how high performance computers are designed, developed and programmed. Although focused on overcoming the same challenges, industry responses will be aimed at near-term solutions, which are inadequate to advance DOE's scientific, engineering, and national defense missions. Addressing this national challenge requires a significant investment by the Federal government involving strong leadership from DOE headquarters, and close coordination by government, national laboratories, academia, and U.S. industry, including medium and small businesses.

Concurrent R&D investments in applications that will optimally exploit emerging, new exascale computing architectures is a critical component of the Department's effort in exascale computing. These "extreme-scale" applications, i.e., applications designed to exploit exascale computing, must also be representative of applications requirements for the full spectrum of computing, from terascale to exascale. These should include those that support nuclear weapons stockpile stewardship; scientific discovery; energy technology innovation; renewable electrical generation and distribution; nuclear reactor design and longevity; data assimilation and analysis; and climate modeling. SC and NNSA have already initiated R&D efforts in key extreme-scale mission applications.

Four key challenges, identified in previous reports[3,4,5], must be addressed to realize productive, efficient, and economical exascale systems:

Parallelism: Since around 2004, increases in computing performance have resulted primarily from increasing the number of core processors (cores) on a chip. The number of cores, and hence the parallelism, has been increasing exponentially ever since. Today, there are tens of cores per chip. By 2018, there will be hundreds of cores per chip, according to current industry roadmaps. Exascale computers will have parallelism (also termed "concurrency") a thousand-fold greater than today's petascale systems. Today's science applications and system management software are not designed to work at such extreme parallelism. Design and development of the hardware and software for exascale systems to effectively exploit this level of parallelism will require R&D followed by focused deployment. Developing systems and applications software is already challenging on current petascale systems. Increasing concurrency by a thousand-fold will make software development much more difficult. To mitigate this complexity, a portion of the R&D investments will create tools that improve the programmability of exascale computers.

Memory and Storage**:** In past generations of computers, basic arithmetic operations (addition, multiplication, etc.) consumed the greatest amount of computer time required for a simulation. However, in the past decade, as central-processing-unit (CPU) microcircuits have increased in speed, moving data from the computer memory into the CPU now consumes the greatest amount of time. This issue has already surfaced in petascale systems, and it will become a critical issue in exascale systems. R&D is required to develop memory and storage architectures to provide timely access to and storage of information at anticipated computational rates.

Reliability: Exascale computers will contain significantly more electronic components than today's petascale systems. Furthermore, the individual circuit components are expected to have

[3] http://science.energy.gov/~/media/ascr/ascac/pdf/reports/Exascale_subcommittee_report.pdf
[4] http://science.energy.gov/~/media/ascr/ascac/pdf/meetings/20140210/Top10reportFEB14.pdf
[5] http://www.energy.gov/seab/downloads/report-task-force-next-generation-high-performance-computing

feature sizes of about 7 nanometers, which is at the physical limit of how small circuits can be made. The resilience of circuits becomes a serious issue at this size because of quantum effects and cosmic rays that can randomly flip data bits. Achieving system-level reliability will require R&D to enable the exascale ecosystem to dynamically adapt to a constant stream of transient and permanent failures of components. In order to produce accurate results, applications must be designed to be resilient, in spite of system and device failures, in order to produce accurate results.

Energy Consumption: Current 10-20 petaflop computers consume approximately 10 megawatts (MW) of electrical power. Simple extrapolation to the exascale yields power requirements of 500–1,000 MW; at a cost of $1 million per MW-year, the operating cost of an exascale machine built on current technology would be prohibitive. Continuing discussions with computer vendors indicate that engineering improvements have the potential to reduce the required power significantly, such that initial exascale systems could operate on 20–30 MW. Achieving this savings by the mid-2020s will require R&D beyond what current industry roadmaps are projecting.

Definitions

Artificial intelligence: is intelligence exhibited by machines, such as perceiving its environment and taking actions that maximize its chance of success at some goal.

Capable exascale computing: defined as a supercomputer that: can solve science problems 50 times faster (or more complex) than on today's 20-petaflop systems (Titan, Sequoia), in a power envelope of 20-30 Megawatts; is sufficiently resilient that user intervention due to hardware or system faults is on the order of a week on average; and has a software stack that meets the needs of a broad spectrum of scientific applications and workloads.

Gordon Bell Prize: awarded each year by the Association for Computing Machinery (ACM) to recognize outstanding achievement in high-performance computing.

High Performance Computing (HPC): most generally refers to the practice of aggregating computing power in a way that delivers much higher performance than one could get out of a typical workstation or server in order to solve large problems in science, engineering, or business using applications that require high bandwidth, enhanced networking, and very high compute capabilities.

Megawatt: a unit for measuring power that is equivalent to one million watts. One megawatt is equivalent to the energy produced by 10 automobile engines.

Nanometers: is a unit of measurement that is 10^{-9} meter, or one billionth of a meter.

Neuromorphic computing: the study of theoretical computing systems that attempt to mimic the computing abilities of the human brain to achieve faster, more energy efficient computation.

Petaflop: A petaflop is a measure of a computer's processing speed and can be expressed as a thousand trillion floating point operations per second.

Quantum computing: the study of theoretical computing systems that use quantum-mechanical phenomena to perform operations on data. Large-scale quantum computers would theoretically be able to solve certain problems much more quickly than classical computers.

Scientific application: simulates real-world phenomena using mathematics. The most well-known scientific applications are weather prediction models.

Uncertainty Quantification: is the science of quantifying, characterizing, tracing, and managing uncertainty in computational and real world systems.

ITER Project

ITER is a large-scale international fusion energy research facility to demonstrate the scientific feasibility of fusion energy. The U.S. is one of seven members contributing hardware and funds to the ITER facility in France under a binding international agreement. Owing to the significant cost and issue of project management, continued U.S. participation in the ITER project has been a matter of debate for the last several years. Based on significant improvements in project management, in May 2016, the Secretary of Energy made a recommendation that the U.S. should remain in ITER through FY 2018 and should provide a second recommendation to Congress on continuing U.S. participation in December, 2017 to inform the FY 2019 budget.

Summary

ITER is an international research and development (R&D) facility being built in France by the U.S. and six other international member states. ITER remains the best candidate today to demonstrate sustained burning plasma, which is a necessary precursor to demonstrating fusion energy power.

ITER's design objectives are to produce at least 500 MW of fusion power (a power gain factor Q >10) for pulses lasting at least 400 seconds. U.S. participation was authorized by Congress in the Energy Policy Act of 2005, and the internationally binding ITER Agreement was signed by the parties in 2007. As the host party, the EU contributes 45.4% of the construction cost, with the six other partners each providing 9.09%.

Issue

Since the agreement, the costs of the project have risen substantially from a range of $1.45B to $2.2B in costs for the U.S., to a current range of $4B to $6.5B, and the planned first plasma date has slipped from 2019 to no earlier than 2025. Schedule delays have been driven by the conventional construction of the tokomak building, and assembling of the vacuum vessel. Poor project management at the IO, as well as poor IO/member coordination, also contributed to the delays of the project. As a result, continued U.S. participation in the ITER project has been a matter of debate in recent budget cycles, and in FY 2016, Congress directed the Secretary to make a recommendation on future participation. The U.S. cash contributions were not made in FY 2016 due to constraints placed by Congress in the appropriations language. As a result, U.S. has fallen behind in their obligations to pay the cash contribution.

Recent management changes at the IO, including a new Director General, have greatly improved project performance and led to stabilizing the cost and schedule estimates. In May 2016, the Secretary of Energy recommended in a report to Congress that U.S. remain a Member of ITER through FY 2018, and committed DOE to reassess progress and provide a second recommendation in December 2017 regarding continued U.S. participation.

The scientific need for ITER is still valid as ITER remains the best candidate to demonstrate a sustained burning plasma, the condition required to have the plasma release more energy from the fusion of light elements than it takes to produce, heat, and maintain the plasma. However, due to both the technical and organizational complexity of ITER, the project construction costs have increased and the schedule has slipped substantially. The ITER project schedule to achieve First Plasma (FP) has slipped from November 2019 to no sooner than December 2025. The estimated costs for the overall project have increased from an initial estimate of $1.45B to $2.2B of U.S. costs in 2008 to a current estimated U.S. cost range of $4B and $6.5B. The U.S. ITER Project (i.e., the U.S. contribution) achieved Critical Decision 1 (Approve Alternative Selection and Cost Range) in January 2008.

As a result of the project management problems, a new Director General, Bernard Bigot, took over in March of 2015, and since that time, substantial improvements in project management and performance have been seen at ITER. DOE, OMB, and Congress remain concerned about whether the construction progress seen in the past year will continue.

Status

The new ITER Director General began in March 2015, and since that time, project management has greatly improved and the pace of construction has accelerated. The evidence includes ITER management improvements such as a better organizational structure and the hiring of qualified people in key positions; the performance of the ITER project measured against the updated schedule and the defined milestones; and the results from independent reviews of the ITER schedule and the overall management (a biannual Management Assessment that was most recently completed in 2015).

The US ITER project comprises hardware contributions (80%) and monetary contribution, which represent the U.S. portion required to support the central ITER organization functions and responsibilities. The US ITER project has continued to meet its deliveries and key schedule milestones for hardware. As of October 2016, the U.S. contributions including design, manufacturing, and delivery of hardware to be installed for first plasma (FP) is 42% complete, and the overall project through Deuterium-Tritium (D-T) Operations (nuclear operations) is 30% complete.

The US ITER project is requesting approval of a Performance Baseline for FP (Critical Decision-2) and approval for start/continuation of hardware fabrication (Critical Decision-3) during the first Quarter of FY 2017.

Milestones

- In May 2016, the DOE Secretary submitted a report to Congress containing his recommendation that the U.S. remain a Member of ITER through FY 2018.
- As required by Congress in the FY 2016 Appropriations Report language, the DOE delivered a Status Report to Congress in February 2016 and an update in August 2016.
- The Nineteenth ITER Council Meeting will take place with the IO to propose an integrated Baseline plan through D-T Operations, November 2016.
- DOE approval decision at the level of the DOE Deputy Secretary (S2) for US ITER Project First Plasma Subproject Baseline (CD-2) is anticipated -- December 2016/January 2017. A DOE Office of Science Office of Project Assessment review will be part of the baseline process.

Major Decisions / Events

DOE will reassess continued U.S. participation in ITER and provide recommendation to Congress by December 2018 to inform the FY 2019 budget. DOE will base the recommendation on the approval of an updated ITER integrated baseline by a Ministerial meeting in the spring of 2017, the continued project performance as indicated by the completion of milestones, and the continued improvement of the ITER project management and culture.

Major upcoming decisions and events include:

- The President's FY18 Budget Request for ITER, released in the first half of CY 2017.
- The proposed Ministerial-level ITER Council Meeting will take place to secure Member support of the IO Baseline in Spring 2017.
- The DOE/DOE Secretary re-evaluates U.S. continued participation in the ITER project – Q1-Q2 FY2018.
- Planned First Plasma milestone, December 2025.

Background

At the November 1985 Geneva Summit, a Reagan-Gorbachev initiative led to the ITER Conceptual Design Activities (CDA) which began in April 1988 and were successfully completed in December 1990 and carried out jointly by the U.S., the European Union, Japan, and the USSR under IAEA auspices. On July 21, 1992, the European Union (EU), Japan, the Russian Federation and the U.S. signed a 6-year ITER Engineering Design Activities (EDA) Agreement. The U.S. completed its responsibilities under the EDA and did not extend our participation in 1998, effectively withdrawing from ITER.

On January 30, 2003, President Bush announced that the U.S. would join the ongoing ITER negotiations. From that time until the signing of the ITER Joint Implementation Agreement (Agreement) in November of 2006, the negotiators resolved a number of critical issues, including siting of the ITER project in France; management and financial responsibilities and allocation of material (in-kind) contributions; and the creation and staffing of an ITER Organization to manage ITER's construction and operations. The Agreement was signed in November 2006 and went into force on October 24, 2007. The Agreement was ratified as a treaty by the other partners after signature. The U.S. ratified it as a Congressional-Executive Agreement prior to signing under the authority provided by the Energy Policy Act (EPAct) of 2005.

The DOE is lead U.S. Government agency responsible for delivery of U.S. commitments to ITER construction. These commitment include roughly 80% in-kind components (with associated R&D and other costs) as well as 20% monetary contributions to the ITER Organization (IO) to cover common expenses such as personnel, assembly, commissioning, and agreed site infrastructure costs. Once operations commence, the DOE will contribute 13% of the monetary costs of running the ITER research facility in addition to costs of supporting U.S. researchers who are selected to perform experiments at the site.

DOE senior management has leadership responsibility for the project. The Director of FES has day-to-day responsibility for the management of the USITER Project, and provides input to strategic decision making at higher levels of the Department.

The Project is managed at the international level by the IO, which is overseen by the ITER Council (IC). The DOE Head of Delegation to the IC has been the DOE Under Secretary for Science and Energy since 2013 (previously, the Office of Science Director). DOE and State Department officials make up rest of the US ITER council Delegation.

USITER is responsible for delivery of a number of components. Over the past year or so, USITER has delivered drain tanks, part of the tokamak cooling water system, and has designed and is well underway in fabrication of central solenoid magnets – the first of six is in fabrication. USITER has also designed and shipped the bulk of the steady state electrical network, which will supply power for site operations.

Congress, particularly the Senate, has expressed serious concern over the international project management, and the increasing overall project costs and schedule delays, and has twice zeroed the budget request in the Senate Marks. In FY 2016, the report language of FY 2016 Consolidated Appropriations Act requested three reports from the DOE on the status of the ITER Project (February and August 2016 status reports), and the DOE Secretary's recommendation on whether the U.S. should continue to participate in the ITER Project (May 2016).

Climate Action: Meeting Domestic and International Clean Energy and Climate Commitments

DOE initiatives play a critical role in the research, development, demonstration, and deployment of clean energy technologies. DOE activities are essential to meet our domestic and international clean energy technology acceleration and emissions reductions targets. As part of the Paris Agreement, countries representing 98 percent of global GHG emissions announced their domestic climate and clean energy targets, or Nationally Determined Contributions (NDCs). Though these targets are a significant and unprecedented step toward stabilizing the climate, significant action is needed to implement these commitments and to further increase ambition over time. If all countries achieve their commitments and continue a similar rate of change in the future, worldwide temperatures have an 8 percent chance of staying under 2 degrees until 2100.[1]

SUMMARY

The United States and the Department of Energy (DOE) are committed to accelerating the global transition to clean energy. As part of the Agreement of the 21st Conference of the Parties (COP21) in Paris in 2015, the United States, China, and over 185 other governments agreed:

- to a long-term goal of keeping the increase in global average temperature to **well below 2°C** above pre-industrial levels;
- to aim to limit the increase to **1.5°C**, since this would significantly reduce risks and the impacts of climate change;
- on the need for **global emissions to peak as soon as possible**, recognizing that this will take longer for developing countries; and,
- to undertake **rapid reductions thereafter** in accordance with the best available science.

The U.S. formally entered into the Paris Agreement on September 3, 2016, and the agreement passed the threshold to take effect on October 5, 2016. As a result, the Paris Agreement will enter into force on November 4, 2016.

As part of the Paris Agreement, the United States committed to an economy-wide target of reducing GHG emissions by 26-28% below 2005 levels in 2025, and by 17% below 2005 levels by 2020. We have continued work both domestically and internationally to follow-through on existing commitments and identify future opportunities for emissions reductions. In support of the U.S. commitment, Department of Energy domestic activities include enabling reductions of energy-related GHG emissions and providing analysis of emissions reductions achievements and opportunities. DOE has been an active contributor to the U.S. Climate Action Plan and has a lead role to play in achieving planned U.S. greenhouse gas emissions reductions in the 2025 to 2050 timeframe.

U.S. leadership in international efforts to accelerate development and deployment of clean energy technology is also a pillar of the 2015 Climate Action Plan and critical to the successful implementation of the COP21 Agreement. DOE will also continue to lead and facilitate global collaboration to reduce energy-related GHG emissions in the near-term and post-2020. DOE couples action at home with leadership internationally by working to accelerate:

1) global deployment of currently available technologies; and
2) the pace of innovation through research, development, demonstration, and deployment (RDD&D).

Internationally, this work is carried out primarily through two multilateral initiatives: (1) the Clean Energy Ministerial (CEM) and (2) Mission Innovation (MI), respectively.

(1) The CEM is a **global forum** to promote policies and share best practices to accelerate the global transition to clean energy. CEM initiatives help **reduce emissions, improve energy security, provide energy access, and sustain economic growth.** Please see: http://www.cleanenergyministerial.org/.

(2) The United States is a partner in MI, a landmark commitment to accelerate global clean energy innovation as a means of addressing climate change, making clean energy affordable to consumers, and creating jobs and commercial opportunities. Each of the Mission Innovation partners—20 nations and the European Union—has made a commitment to seek to double its investment in clean energy research and development (R&D) over five years. This increases investment from $6.4 billion in FY2016 to $12.8 billion in FY2021. As part of the President's Budget Request, MI provides $7.7 billion in FY 2017 for clean energy R&D distributed across 12 federal agencies.

Because DOE is the nation's principal sponsor of clean energy R&D, 76% ($5.865 billion) of the proposed Mission Innovation funding in the President's FY2017 budget request would be directed to DOE programs, supporting research, development, and demonstration (RD&D) activities that address a wide range of low carbon technologies. The President's FY2017 Budget Request includes $110 million for regional clean energy innovation partnerships (RCEIPs), envisioned as cost-shared, public-private partnerships that will develop regional RD&D portfolios tailored to the characteristics of the regions that they serve. As Secretary of Energy Ernest Moniz stated during a March 2016 Senate hearing on the Department's budget request, "The goal of these partnerships is to accelerate the pace of innovation in clean energy technologies and to address clean energy challenges specific to regional energy resources, customer needs, and innovation capabilities."

ISSUE

As part of the Paris Agreement, countries representing 98 percent of global GHG emissions announced their domestic climate and clean energy targets, or Nationally Determined Contributions (NDCs). Though these targets are a significant and unprecedented step toward stabilizing the climate, significant action is needed to implement these commitments and to further increase ambition over time. If all countries achieve their commitments and continue a

similar rate of change in the future, worldwide temperatures have an 8 percent chance of staying under 2 degrees until 2100.[1]

Enabling and achieving reductions of U.S. energy-related GHG emissions
DOE invests in a suite of Research, Development, Demonstration, and Deployment programs that advance technology objectives and provide the co-benefit of reduced emissions or the potential to reduce emissions. Early stage technology progress sets the stage for future emissions reductions. For example, algae research could enable sequestration of CO_2. Later stage technology progress and deployment activities facilitate current and future emissions reductions. For example, the appliance and equipment standards designed to reduce energy use, in effect since 1987, have reduced CO_2 emissions 7.3 billion tons and saved consumers nearly $2 trillion.[2] Appliance and equipment standards are one of DOE's few regulatory functions and have achieved significant emissions reductions.

DOE also works with other entities that leverage DOE energy expertise. For example, DOE is part of the Interagency Strategy to Reduce Methane Emissions[3] and conducts RDD&D on methane sensing technologies and to help improve official estimates of emissions from the oil and natural gas sectors. Similarly, DOE provides state, local, and tribal technical assistance (doe.gov/ta) related to energy technologies and systems. Technical assistance can take the form of data and analysis, education and training, or expert consultations.

Along with emissions mitigation, resilience to climate change (also called adaptation) is also a priority. For example, DOE hosts a Partnership for Energy Sector Climate Resilience which facilitates information sharing across electric utilities.[4] DOE has begun exploring ways to integrate resilience into program planning.

Providing analysis of U.S. emissions reductions achievements and opportunities
DOE supports government-wide efforts to track and analyze emissions reductions, for example development of the U.S. NDC. As part of the agreement achieved at COP18, each developed country submits a biennial report to the UN summarizing progress in achieving emission reductions. The United States submitted our second biennial report in January 2016. DOE provided information and analyses of DOE activities. DOE also analyzed energy sector achieved and potential emissions reductions using EPSA-NEMS, an integrated energy system model.

Similarly, DOE's data and analysis, supported by extensive technology expertise, are important inputs to rulemaking by other agencies. For example, in the power and transportation sector, DOE maintains data on current and future technology costs and performance; this type of information is used directly in rulemakings. DOE also maintains extensive energy-economic modeling capabilities which directly inform policy formulation and analysis.

Accelerating the global deployment of clean energy

[1] http://science.sciencemag.org/content/350/6265/1168
[2] http://energy.gov/eere/buildings/appliance-and-equipment-standards-program
[3] https://www.whitehouse.gov/sites/default/files/strategy_to_reduce_methane_emissions_2014-03-28_final.pdf
[4] http://energy.gov/epsa/partnership-energy-sector-climate-resilience

DOE leads or co-leads a suite of global initiatives to facilitate transformative clean energy and climate solutions to achieve deep decarbonization by mid-century. With a focus on wide-scale deployment of clean energy technologies available today, DOE supports efforts to advance innovative policy, build capacity, remove technical and other barriers, and catalyze markets.

These deployment efforts are principally carried forward through the CEM, a high-level forum of 24 countries and the European Commission that represent about 90 percent of global clean energy investment and 75 percent of global GHG emissions. The CEM was launched in 2010 to promote policies and share best practices that accelerate the global transition to clean energy. CEM pairs the engagement of high-level policy makers, technical staff, and non-governmental entities with year-round technical- and policy-focused programs. The CEM is a key implementation forum to help countries achieve their NDCs, particularly in the pre-2020 timeframe. The United States hosted the last CEM meeting (CEM7) in June 2016 where 21 countries, the European Union, nearly 60 companies and non-governmental organizations, and 10 subnational governments announced more than $1.5 billion in commitments to accelerate the deployment of clean energy technologies and increase energy access.

CEM activities include DOE-led initiatives on appliance efficiency, power system transformation, energy management, smart grids, energy access, women's engagement and leadership in the clean energy sector, clean energy finance, and cross-cutting technical and policy assistance. These activities are DOE HQ-led, principally funded by the State Department, and are supported extensively by the National Laboratories and other operating agents and partners.

Accelerating the clean energy revolution through enhanced RD&D

Global coordination on RD&D efforts are principally carried forward through MI under which more than 20 member governments seek to double their investment in clean energy R&D in five years. The MI initiative recognizes the importance of transformative breakthroughs in clean energy innovation and feeding the innovation pipeline for private investors and companies. It aims to set the stage for significant cost reductions over time and making clean energy widely affordable.

DOE hosted the inaugural MI Ministerial in June 2016 where member governments identified a collective baseline investment of nearly $15 billion per year in clean energy R&D. MI members committed to double their funding to a combined $30 billion per year by 2021. Each government determines its own innovation strategy based on national resources, needs, and circumstances. MI members are encouraged to pursue mutually-beneficial engagement with other governments, businesses and investors (such as the Bill Gates-led Breakthrough Energy Coalition, among others), where appropriate.

Membership of the CEM and MI overlap almost exactly. The two forums are distinct, but highly complementary, with CEM focusing on deployment of available technologies and MI focusing on future innovation. Together, U.S. domestic efforts, CEM, and MI provide a path to help realize the short- and long-term goals of the Paris Agreement, as well as facilitating the ratcheting up of ambition over time.

Status

Domestic Action
U.S. greenhouse gas emissions increased 7.4% from 1990 to 2014 but decreased 6.9% from 2005 to 2014. The U.S. remains the largest cumulative emitter, and U.S. per capita emissions are more than three times the global average. DOE serves an active role in implementing the U.S. Climate Action Plan, for example through implementing fossil energy projects, appliance and equipment standards, and the Quadrennial Energy Review. See the other transition materials for detail on several domestic energy activities that also provide emissions reductions.

International Action
Over its first six years, the CEM has achieved significant results. For example, through the Super-efficient Equipment and Appliance Deployment (SEAD) initiative member countries and the European Union have implemented energy efficiency standards projected to save 704 terawatt hours (TWh) of electricity and 563 petajoules (PJ) of oil and gas in 2030, equivalent to roughly 235 fewer power plants and taking over 8 million cars off the road in the next 15 years. While SEAD and the other CEM initiatives have delivered results, a scale-up of effort and ambition is needed to meet our global goals. Since the CEM was launched in 2010, the DOE has served as its Secretariat. To fully multi-lateralize its functions and provide the support and expertise needed to scale-up the CEM's initiatives and campaigns, a new Secretariat will be established at the International Energy Agency. The transition is currently underway and is expected to be complete by CEM8 in summer 2017.

MI governments are pursuing their respective strategies for enhancing R&D, with some ramping-up investments on a path toward their 2021 doubling targets while others remain in the early planning stages. Domestic MI activities continue at the current funding level ($6.4 billion for existing clean energy innovation activities identified across the U.S. government) pending FY17 (and out-year) appropriations. An MI steering committee provides strategic guidance on the overall direction of the initiative. Volunteers from member MI governments are developing optional cooperative activities that governments may wish to jointly pursue, and a DOE-led interim Secretariat is facilitating the overall administration of the initiative.

Major Decisions/Events

- November 2016: COP 22 will be in Marrakech, Morocco November 7-18. The U.S. will release the Midcentury Strategy and hold high level CEM and MI events.
- February 2017: CEM and MI Preparatory Meetings (Brussels TBC)
- May/June 2017: CEM and MI Ministerials (Beijing TBC)
- January 2018: The United States will submit the third Biennial Report
- 2020: Countries are expected to update and strengthen their NDCs; the United States should explore a 2030 emissions reductions target ahead of the 2020 timeframe.
- 2021: Countries are expected to revisit their Midcentury Strategy every five years.

International Partnerships

The Secretary and Deputy Secretary of Energy, with support from the Office of International Affairs, lead a number of bilateral and multilateral efforts with key energy producers and consumers.

Issue

At the request of the White House and counterpart ministers of energy, the Secretary and Deputy Secretary of Energy lead multiple bilateral meetings with counterpart energy ministers in a number of countries, including Argentina, Brazil, Canada, China, India, Iraq, Japan, Kazakhstan, Mexico, Saudi Arabia, South Africa, South Korea, the United Arab Emirates, others. Multilaterally, the Secretary or Deputy represents the United States at the International Energy Agency Ministerial, the International Energy Forum Ministerial, the G-7 Energy Ministers Meeting, the G-20 Energy Ministerial, the APEC Energy Ministers meeting, the Energy and Climate Partnership of the Americas, the U.S-EU Energy Council (co-lead with the Secretary of State) and others. These meetings, and other bilateral work efforts undertaken at the sub-minister level, such as in Colombia, Israel, Indonesia, Pakistan and Ukraine, provide a framework for joint efforts on policy planning and technologies to meet U.S. international energy goals.

Status

Consistent with the DOE Organization Act, DOE has ongoing efforts with key partner nations to pursue diverse energy resource development and utilization of technologies and markets to meet U.S. energy, economic, environmental and security goals. DOE efforts include a focus on:

- Energy Efficiency
- Energy Markets
- Global Energy Governance
- Clean Energy Technologies
- Energy Planning and Policy
- Energy Cyber Security
- Energy Security
- Civil Nuclear Energy

In addition, the National Nuclear Security Administration (NNSA) has significant cooperation with more than 120 partner countries and international organizations to advance its broad nuclear security mission. For further information, please see the Defense Nuclear Nonproliferation, Emergency Operations, and Counterterrorism and Counterproliferation transition papers.

Milestones

- **In the Middle East,** DOE has Memorandums of Understanding (MOUs) in place formalizing Strategic Energy Dialogues (SEDs) with Saudi Arabia and the United

Arab Emirates (UAE). Cooperation is active in areas including energy efficiency, renewable energy, carbon capture utilization and storage, and information sharing on global energy markets and other topics. DOE also has an energy cooperation agreement with Israel that focuses on energy and water infrastructure, biomass-to-liquid fuels technologies, and joint projects between government research institutes, including DOE's National Laboratories.

- **In the Americas,** DOE cooperates bilaterally and trilaterally with Canada and Mexico on a range of energy-related matters, including data sharing; electricity grid resilience; promoting responsible development of unconventional oil and gas resources; reducing methane emissions in the oil and gas sectors, and more. Mechanisms for cooperation include the North American Energy Ministerial, the North American Leaders' Summit, the U.S. - Mexico High-Level Economic Dialogue, the U.S.-Mexico Task Force on Clean Energy and Climate Policy, a bilateral MOU with Canada, and a trilateral MOU with Canada and Mexico. DOE works with partners around the Western Hemisphere through the Energy and Climate Partnership of the Americas (ECPA) to promote cooperation focusing on energy efficiency and renewable energy, energy infrastructure, climate change, among other topics. Bilateral cooperation is carried out under MOUs with Argentina, Brazil, Chile, and Jamaica DOE also supports the Vice President's Caribbean Energy Security Initiative through participation in the United States-Caribbean-Central American Energy Security Task Force, and under MOUs with CARICOM, the Inter-American Development Bank, and the Caribbean Development Bank (IDB).
- **In Asia,** DOE and partner agencies engage in extensive bilateral energy cooperation with India through the DOE-led U.S.-India Energy Dialogue; the U.S.-India Partnership to Advance Clean Energy (PACE), which focuses on research, deployment, and energy access. The U.S. engages China in a number of bilateral platforms including the U.S.-China Clean Energy Research Center (CERC), the Energy Efficiency Action Plan (EEAP), the Climate Change Working Group, the Oil and Gas Industry Forum, the Clean Coal Industry Forum, among many others.
    - DOE has flagship clean energy research centers with both China (CERC) and India (PACE-R). These programs pair top researchers from the United States with researchers from China and India to accelerate development and deployment of critical technologies for clean energy in all three countries. The mission of these programs is to generate a diversified portfolio of technologies needed for transition to an efficient and low-carbon economic future, while mitigating the threat of climate change. The CERC initiative has five tracks – advanced coal technology, buildings energy efficiency, clean vehicles, water-energy technologies and medium- and heavy-duty truck efficiency technologies. PACE-R has research underway in three tracks – solar energy, buildings energy efficiency, and advanced biofuels – and is launching a new track in smart grid and grid storage.
- **In Europe,** in coordination with the U.S. State Department and USAID, DOE leads efforts in partnership with the EU and the G-7 to build energy resiliency and strategic planning capacity in the face of Russian pressure. Through a series of workshops, trainings, and technical assistance programs, DOE supported efforts in

Ukraine and the Baltic states in the areas of cyber security, emergency planning, critical grid infrastructure, and resiliency planning, among other things.

- **In Africa,** DOE is actively involved in all aspects of Power Africa, an initiative coordinated by USAID that seeks to add 30,000 MW of electricity and 60 million new connections in sub-Saharan Africa by 2030. DOE is a member of the interagency Power Africa Working Group (PAWG) and with USAID funding, is leading the implementation of multiple capacity-building efforts in Africa's energy sector. DOE also maintains deep energy engagement including a bilateral energy dialogue with a focus on energy efficiency with the South African government and its energy institutions. DOE coordinates its Africa-related cooperation through the DOE Africa Task Force with goals in four strategic areas: climate change mitigation and adaptation; emerging oil and gas production; electrification; and energy security.
- **International Energy Security:** Secretary Moniz chaired the 2015 International Energy Agency's (IEA) ministerial meeting under the leadership of IEA Executive Director Fatih Birol. As well, DOE's engagement through the IEA, IEF, G-7, G-20, and APEC processes are focused on strengthening global energy security through clean energy technology deployment and energy efficiency.

Major Decisions/Events

3-month events (November 2016 – January 2017)

- U.S.- UAE Strategic Energy Dialogue-Washington- October 2016
- COP 22- Marrakesh- November 2016
- IAEA Nuclear Security Ministerial- Vienna- December 2016
- U.S. – Saudi Economic Dialogue- Riyadh- December 2016
- Atlantic Council Global Energy Summit- Abu Dhabi- December 2016

6-month events (February 2017 – April 2017)

- U.S.-Israel Energy Dialogue, Winter TBD
- CEM8 Preparatory Meeting – European Union TBD, February TBD
- U.S.-India Energy Dialogue – New Delhi, Spring TBD

Background

The DOE Office of International Affairs was established as part of the 1977 Energy Organization Act, which established the Department, with the following responsibilities: "to establish and implement through the Department, in coordination with the Secretaries of State, Treasury, and Defense, policies regarding international energy issues that have a direct impact on research, development, utilization, supply, and conservation of energy in the United States and to undertake activities involving the integration of domestic and foreign policy relating to energy, including provision of independent technical advice to the President on international negotiations involving energy resources, energy technologies, or nuclear weapons issues…"

Advanced Manufacturing Consortia

EERE's Advanced Manufacturing Office (AMO) is leading a growing number of new R&D consortia – public-private-partnerships – to increase U.S. manufacturing competitiveness, addressing critical opportunity spaces described in DOE's QTR. These consortia engage DOE, national labs, academia, and industry and offer new models for accelerating progress in manufacturing-relevant, high-value opportunities. They also have new risk management challenges. DOE leadership for the consortia approach is needed to successfully establish additional consortia to further enhance clean energy manufacturing.

Summary: Securing U.S. leadership in clean energy manufacturing requires employing the assets and capabilities of both the public and private sectors. AMO uses consortia that bring together U.S. industry, universities, and national labs. AMO employs various types of consortia approaches suited to each technology challenge, and targeted RD&D investments help drive regional ecosystem development through place-based innovation. In addition to addressing issue areas like Rare Earth-based materials, carbon fiber composites, and smart manufacturing, AMO has identified additional areas through extensive stakeholder outreach that would be uniquely addressed through the consortia approach such as the proposed *Clean Water Energy Innovation Hub.*

Issue

Solving critical RD&D challenges in the clean energy space requires scaling-up precompetitive clean energy and energy efficiency technologies that can be commercialized by the private sector. Crossing this so-called "valley of death" requires strategic, focused, collaborative RD&D efforts by industry and the public sector working together. AMO consortia not only develop technologies breakthroughs, but facilitate the transition of these technologies from the precompetitive stage to commercialization via industry partners.

Current AMO consortia have made significant impact, including:

- The Manufacturing Demonstration Facility (MDF) at Oak Ridge National Lab is an open-door facility where industry partners can collaborate on R&D projects around additive manufacturing ("3d printing"). The MDF is a key cog driving an advanced manufacturing ecosystem that has attracted companies like Local Motors, Arcam, Leisure Pools, LeMond Bicycles, and others to move to eastern Tennessee.
- The Critical Materials Institute (CMI) focuses on the development of technologies that make better use of critical and Rare Earth materials and eliminate the need for materials that are subject to supply disruptions. With 19 current partners (9 private sector), CMI is in its fourth year of operation and requires a 20% cost-share from for-profit members. CMI recently announced its second licensing agreement for a process designed to recover rare earth magnets from used computer hard drives.

- As part of the broader National Network for Manufacturing Innovation (NNMI) program, AMO manages three current manufacturing innovation institutes, with two more under merit review. Each Institute receives $70 million in federal funding over five years with the goal of self-sustainability after year five. To date, the three current Institutes we launched with a combined $320 million in non-federal cost-share and have over 350 combined non-federal partners. DoE works closely with DoD, DoC, OSTP, and NEC in supporting the broader network.
- The High Performance Computing for Manufacturing (HPC4M) program, launched in early 2015, brings the nation's supercomputing capabilities to bear on industry-defined manufacturing challenges. The program has funded 29 projects to date—each with an industry partner.

Public-private consortia are adaptable funding models capable of addressing a range of challenges in a manner that ultimately encourages private sector-led solutions while developing regional innovation ecosystems. As an example, AMO has identified manufacturing challenges facing cost-effective clean water production as a high-priority area for near-term support through newly formed consortia.

Clean Water Energy Innovation Hub[1]: Vast amounts of untapped water resources could be utilized across the economy as clean water if key technical challenges are addressed to process and purify it at "pipe parity." The Hub spans three primary boundaries—where the water comes from, how the water will be used, and the relevant technical challenges in each case. In each case, manufacturing RD&D challenges are key to lowering cost and energy consumption, including but not limited to novel, cost-effective anti-corrosion materials; durable and robust membranes; integration of smart manufacturing techniques; and development of low cost catalysts. The Hub would be funded at $25 million per year over five years.

Additional topics for potential AMO consortia have been identified through efforts such as the Advanced Manufacturing Partnership (AMP) and may be considered as current consortia move off federal support.

Background

A consortia approach—where both public and private partners identify key research challenges and invest shared resources—leverages the world-class R&D capabilities of the federal government through assets like the national labs, while focusing joint efforts on those challenges most important to industry partners. The Department has statutory authority to utilize consortia to address challenges where market failures require a diverse group of stakeholders to work together on common challenges within a technology focus area.[2] AMO consortia are guided in partnership with industry and align with DOE framing documents like the 2015 Quadrennial Technology Review, as well as the DOE and EERE Strategic Plans.

Each consortium may be structured differently and focus on a range of Technology Readiness Levels (TRL) depending on the unique challenges within a given technology focus area. AMO has adopted three consortia modalities:

[1] This was referred to in the FY16 request as a Desalination Hub. There is no change in scope between the FY16 "Desalination Hub" and the Hub described here.

[2] Statutory authority to create and manage consortia can be found in 42 U.S. Code § 16353 – Energy Policy Act of 2005.

- **Institutes**—Through shared resources and facilities, institutes serve as a regional hub in their area, bridging the gap between applied research and product development with a focus in key technology areas that encourage investment and production in their region and in the United States. Institutes focus on activities in the TRL 4-7 range, and are generally led by nonprofit organizations (however this is not required in the FOA).

  AMO currently manages three Institutes.[3] Technical focus areas for each Institute were determined after extensive public engagement with industry and other stakeholders, including the Advanced Manufacturing Partnership under the President's Council of Advisors on Science and Technology.[4,5] Institutes receive $70 million in federal funding over five years—with the explicit goal of being self-sustaining after the initial funding period—and must be matched by a minimum of 1:1 cost share by non-federal sources by the selected team. Applications for Institutes must be consortia-driven and undergo rigorous open and competitive merit review prior to selection.

  Launched in January of 2015, *PowerAmerica*—focused on wide bandgap manufacturing for power electronics—is led by NC State University in Raleigh, NC. With 34 current members (25 industry, 9 university), the Institute was launched with $70 million in matching funds. Launched in June of 2015, the *Institute for Advanced Composite Manufacturing Innovation (IACMI)* is located in Oak Ridge, TN, with regional satellites in and state funding commitments from Ohio, Michigan, Colorado, Kentucky, and Indiana. IACMI launched with $180 million in non-federal funding, representing more than 2.5:1 cost share. The third Institute—with nearly 200 partners and a 1:1 cost share—the *Clean Energy Smart Manufacturing Innovation Institute* (CESMII), announced by President Obama in June 2016, focuses on the advancement of smart manufacturing process and technologies across the manufacturing sector. The fourth and fifth Institutes—*Modular Chemical Process Intensification* and *Reducing Embedded Energy and Emissions in Materials*—are currently under merit review and focus on chemical manufacturing and recycling and remanufacturing technologies, respectively.

- **Hubs[6]—**The Energy Department's Energy Innovation Hubs are integrated research centers that combine basic and applied research with engineering to accelerate scientific discovery that addresses critical energy issues. Hubs focus on TRL 1-7 activities and may be led by various types of organizations. As mentioned, CMI is an Energy Innovation Hub currently managed by AMO.

- **Lab-based Demonstration Facility (LDF)**—A collaborative manufacturing community sharing a common RD&D infrastructure that provides affordable access to advanced physical and virtual tools for rapidly demonstrating new manufacturing technologies and optimizing critical processes. LDFs are organized to foster an open exchange of pre-competitive manufacturing best-practices and know-how while protecting a company's proprietary intellectual property. LDF's focus on TRL 2-7 activities and are led by

[3] In the Department's budget request, these Institutes are referred to as *Clean Energy Manufacturing Innovation (CEMI)* Institutes. They also represent DOE's component of the National Network for Manufacturing Innovation (NNMI) program, which consists of 15 total Institutes across the federal government.

[4] https://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_amp_steering_committee_report_final_july_27_2012.pdf

[5] https://www.whitehouse.gov/sites/default/files/microsites/ostp/PCAST/amp20_report_final.pdf

[6] http://www.energy.gov/science-innovation/innovation/hubs

national labs. Current LDFs managed by AMO include the Manufacturing Demonstration Facility and HPC for Manufacturing efforts described above.

Appliance and Equipment Efficiency Standards

The Appliance standards program needs to meet legislated schedules to finalize 20 final standards over the next four years which will offer consumers billions in energy savings while avoiding millions of tons of CO2 emissions; lacking steady progress by DOE risks lawsuits and court ordered deadlines as seen in the early 2000's.

Summary: DOE is authorized by the Energy Policy and Conservation Act, as amended, to establish energy conservation standards to address the efficiency gap between products sold in the market and the maximum product efficiency that is both technologically feasible and economically justified for U.S. consumers. DOE has a statutory obligation to promulgate and enforce energy conservation standards and test procedures through a public rulemaking process. The Program is comprised of interrelated efforts:

- Development of test procedures that manufacturers must follow to measure a product's energy efficiency and/or energy use for purposes of assessing the products' eligibility for sale in the U.S. where standards are in place, and for making representations regarding the energy use of the product, which sets a level playing field for manufacturers. Establishment of the national minimum energy efficiency requirements based on the prescribed test procedures which, by law, are set at the maximum level of energy efficiency that is technically feasible and economically justified.
- Enforcement of the energy conservation standards, whereby DOE can assess civil penalties against manufacturers and private labelers that sold noncompliant products.[1]
- Support for the Federal Trade Commission's (FTC's) EnergyGuide labeling program with test procedure calculations, which translates to transparent market information and consistency when manufacturers file ratings for each appliance with the FTC.
- Test procedure development and some testing and verification for the ENERGY STAR program, in coordination with EPA.

The elements of the Program also entail working with a broad range of stakeholders to successfully engage market players, including manufacturers, states, utilities, energy efficiency advocates, and others in each rulemaking to fulfill its statutory responsibilities. The rulemaking process provides opportunities for stakeholder review and comment, and the Program has established the Appliance Standards and Rulemaking Federal Advisory Committee (ASRAC) as means of facilitating stakeholder engagement by allowing for negotiated rulemakings under the guidelines set forth in the Federal Advisory Committee Act.

[1] Enforcement information is located at http://energy.gov/gc/enforcement, including information about every case closed with a penalty or a finding of noncompliance as well as important resources for manufacturers and importers.

Issue

Energy conservation standards, a regulatory function administered by the Office of Energy Efficiency and Renewable Energy, have resulted in huge savings for the nation – in energy and water consumed; pollution and greenhouse gases avoided; and dollars saved.

The Appliance Standards Program determines the impact of each new standard and regularly calculates their cumulative impact. Standards promulgated since 1987 saved American consumers $63 billion annually on their utility bills in 2015, which amounts to nearly $320 on average per household per year in energy bill savings. By 2030, the cumulative operating cost savings to consumers resulting from standards in effect since 1987 are estimated to grow to nearly $2 trillion. Further, these standards completed to date are expected to save 70 quadrillion British thermal units (quads) of energy by 2020, which will increase to 132 quads through 2030. This is equivalent to more than one year's worth of the entire nation's total energy use. For consumers and commercial businesses, this also means improved appliances and equipment, often with better features and operation in addition to increased efficiency. For example, new refrigerators not only use less electricity than they did a generation ago, but are much more likely to have additional features such as pass-through water and ice dispensers; new residential clothes washers today use 70 percent less energy than in 1990; and these savings will only increase as old equipment is replaced by new equipment and appliances.

The environmental benefits to combat climate change are also substantial. Appliance standards have helped avoid emissions of 2.6 billion tons of carbon dioxide (CO2) based on cumulative standards to date in 2015. Annual CO2 savings will reach an estimated 300 million metric tons by 2020, and will grow to 7.3 billion metric tons by 2030—equivalent to the annual greenhouse gas emissions of 1.5 billion automobiles. Not only is the Program highly effective for achieving major bang-for-the-buck national savings, energy conservation standards provide accompanying benefits including spurring of innovation and market competition, creation of jobs, and contributions to U.S. energy security.

To ensure energy savings and associated benefits are realized, and that all manufacturers are treated fairly, the Appliance Standards Program also enforces existing standards. Since 2010, DOE has vigorously enforced its standards and has assessed nearly $19 million in penalties on manufacturers for various violations. This enforcement helps to protect industry competitiveness and lowers risk for industry to invest in energy-efficient technologies.

Status

The Appliance Standards Program develops energy conservation standards that satisfy legislative directives and are technologically feasible and economically justified. The Program, which is part of DOE Office of Energy Efficiency and Renewable Energy's Building Technologies Office, publishes a semi-annual report to Congress that reports its progress with respect to rulemaking actions regarding the implementation of energy conservation standards and test procedures. These reports provide extensive information related to current activities and future dates of expected issuance of key rulemaking documents.

In the current administration alone, the Program has issued a total of 42 energy conservation standard final rules including a variety of products and Federal Building Codes. DOE is making solid progress in meeting aggressive objectives—standards already adopted during this

administration will reduce carbon emissions by over 2.3 billion metric tons with more savings in the pipeline.

Milestones

Appliance and equipment standards have become a cornerstone of U.S. energy and environmental strategy and a high priority in the President's Climate Action Plan (CAP).[2] The Obama administration tasked DOE to reduce carbon pollution by at least 3 billion metric tons cumulatively by 2030. Efficiency rulemakings (including model building codes) set during Obama's first and second terms, combined and to date, have reduced carbon emissions by 2.3 billion metric tons through appliance and equipment standards alone. The estimated cumulative utility bill savings to consumers from appliance and equipment standards issued just since January 2009 amount to $543 billion through 2030.

The Appliance Standards Program's current priority focus is the administration's goal for the U.S. to double energy productivity by 2030 relative to 2010 levels. As part of achieving this ambitious energy productivity goal, the CAP requires the issuance of new or updated standards, between the years 2009 and 2016, that will reduce carbon pollution by at least 3 billion metric tons cumulatively by 2030 and will continue to reduce consumers' energy bills.

The Appliance Standards Program has set internal targets to achieve this goal including those expected to be published in 2016:

- 2014-2016: Complete 34 standards rulemakings, covering 43 products
- 2017-2020: Complete 20 standards rulemakings, covering 21 products

Despite the substantial energy and monetary savings already achieved by Appliance Standards, the U.S. can achieve significant additional savings in the next several years in this area. Technologies are constantly evolving related to equipment performance and cost, and with new innovations and features entering product portfolios on a regular basis, which means the "technologically feasible and economically justified" energy conservation standard levels must be periodically revised. Consistent with this progression, DOE is required by law to undertake regular reviews of existing energy conservation standards and test procedure at intervals of six and seven years, respectively. Specific products or equipment types may be subject to additional statutory requirements that mandate review of energy conservation standards at more frequent intervals. For example, if the standards within ASHRAE standard 90.1 are updated by that organization, DOE is compelled by statute to initiate rulemakings, which review the appropriateness of those standards.

As DOE completed its obligations under the consent decree[3] in 2012, it was able to schedule rulemakings for standards beyond those required by statutory deadlines, expanding the reach of

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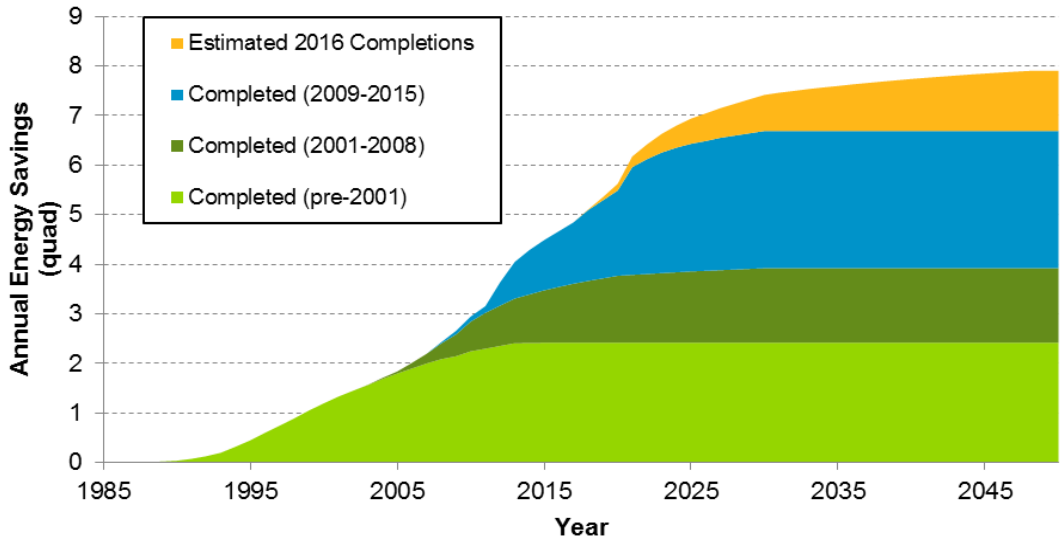
[2] Executive Office of the President. *The President's Climate Action Plan*. Washington, D.C.: Executive Office of the President, 2013. https://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf

[3] In the Energy Policy Act of 2005 (EPACT), the Congress directed the DOE to develop a plan to issue expeditiously efficiency standards for those products with respect to which the Department had not yet met the deadlines specified in the EPCA. In 2005, 14 States and various other entities brought suit alleging that the DOE had failed to comply with deadlines and other requirements in the EPCA. In November 2006, the DOE entered into a consent decree under which the DOE agreed to publish final rules regarding 22 product categories by specific deadlines.

the program into new products. For products that do not have statutorily mandated deadlines—such as those products DOE has added using its discretionary coverage authority—DOE prioritizes completing those rulemakings that deliver the highest level of energy savings and CO2 reductions. The Office will continue to identify for possible coverage, energy-consuming products for which the development of new national energy conservation standards is appropriate and include these to the multi-year schedule.

The figure below shows the energy savings resulting from standards that have been issued since the establishment of the first energy conservation standards, and how those savings continue to accrue over time, on a cumulative basis. The figure also indicates the savings resulting from standards rulemakings expected to be completed through 2016 (most of which require compliance by 2020 or before) and statutory standards that require compliance through 2020.

Substantial additional savings, not depicted, will result from the issuance of both mandated and discretionary standards expected to be completed after 2016, most of which will not require compliance until after 2020. Key milestones after 2016 and during the next administration will continue to build upon and increase the cumulative savings.



Background

For over three decades, policy actions have contributed to the substantial record of national savings and benefits, through both congressional and administrative means. The Energy Policy and Conservation Act of 1975 (EPCA) initially provided the federal statutory authority for product testing and labeling, which DOE was charged to continually update. Yet it was the late 1980s, after several states began establishing their own state-specific energy conservation standards, that the first federal standards were established. Laws enacted with broad bipartisan support led to the National Appliance Energy Conservation Act of 1987 and later the Energy Policy Act (EPAct) of 1992, which amended EPCA. Since then, EPCA has been modified by multiple legislative amendments requiring increasingly aggressive schedules for updates and adding of new products to be covered under DOE regulations. The Energy Independence and Security Act (EISA) of 2007 considerably elevated the level of activity, requiring new product

test procedures and standards, and expanding its coverage of energy use in residential, commercial, and industrial buildings. The Program also works within its authority to proactively expand the range of products held to minimum efficiency standard, such as the direct final rule miscellaneous refrigeration products that set energy conservation standards for a newly covered product.

Most recently, the CAP set goals which require the Program to develop and amend test procedures and standards at an unprecedented rate, including for products not previously covered (e.g., portable air conditioners), while also expanding its role in developing test procedures for the ENERGY STAR program. The Appliance Standards Program has had and continues to have significant impact on energy demand and consumer energy costs since the 1970s and offers large compounding benefits for many years to come.

For more information, please visit the Appliance and Equipment Standards website - http://www.energy.gov/eere/buildings/appliance-and-equipment-standards-program.

U.S. Offshore Wind

The U.S. generates more electricity from land-based wind than any other country. In contrast, there are no offshore wind turbines operating the U.S. even though the U.S. potential offshore capacity is large and other countries have installed offshore wind cost effectively. However, the first such windfarm should begin commercial operation off Block Island, Rhode Island by the end of 2016 and the U.S. is poised to be a global leader in FLOATING technology for offshore wind. To that end, DOE is supporting three offshore wind demonstrations projects that must meet near-term milestones to move to the next phase of development.

Summary:

Offshore wind energy holds the promise of significant environmental and economic benefits for the United States. It is an abundant, low-carbon, domestic energy resource. It is located close to major coastal load centers, providing an alternative to long-distance transmission or development of electricity generation in these land-constrained regions. Once built, offshore wind farms could produce energy at low, long-term fixed costs, which can reduce electricity prices and improve energy security by providing a hedge against fossil fuel price volatility.

By the end of 2015, the U.S. Department of the Interior awarded 11 commercial leases for offshore wind development that could support a total of 14.6 gigawatts of capacity. In May 2016, the U.S. Department of Energy identified three innovative demonstration projects that have made significant progress toward producing power. The first commercial offshore wind energy facility in the United States—the Block Island Wind Farm—is expected to begin commercial operation before the close of 2016.

With almost 80% of U.S. electricity demand located in coastal states and total offshore wind energy technical potential equal to about double the nation's demand for electricity, offshore wind energy has the potential to contribute significantly to a clean, affordable, and secure national energy mix. Realizing these benefits will require overcoming critical challenges in three strategic areas: 1) reducing the costs and technical risks; 2) supporting stewardship of U.S. waters through regulatory certainty and understanding and mitigating environmental risks; and 3) increasing understanding of the benefits and costs of offshore wind energy.

Issue

Though the United States generates more electricity from land-based wind than any other country, there are presently no offshore wind turbines operating in U.S. waters. The first U.S. project is expected to commence operation offshore Block Island, Rhode Island, in late 2016, and several more could be operational before 2020. By comparison, the offshore wind market is maturing quickly in Europe and Asia. The cost reduction has been particularly aggressive in Europe, falling from $180-200/MWh in 2011, to nearly half of that in 2016. This decrease in the cost of energy is mainly due to the increase in turbine size, from approximately 3 MW turbines to 6+ MW turbines, and a highly-developed supply chain that can serve the entire North Sea.

Much of the cost-reduction progress seen in Europe can translate to the U.S. as developers leverage European technologies and adapt them to the unique conditions of the U.S. However, Europe has a significant amount of offshore wind space that is in shallow water. For example, the UK will not need to develop offshore wind in deep waters that require floating technologies in order to reach its 2020 offshore wind goal of 20 GW. Nearly 60% of the U.S. offshore wind potential is in water deeper than 60 meters, where floating technologies are required. Further, Jones Act requires that U.S. built and flagged vessels be used to install offshore systems, which may impact the ability to optimize vessel strategies as has been done in Europe. Nonetheless, these factors mean the U.S. is poised to be a global leader in floating wind.

Realizing the substantial benefits of offshore wind in the U.S., will require overcoming a number of key technological, regulatory, environmental, and market challenges. The National Offshore Wind Strategy has outlined the following strategic areas that need to be addressed in order to facilitate offshore wind development in the U.S.:

- Reducing Costs and Technology Risks: *Current cost of offshore wind energy is too high to compete in U.S. markets without subsidies.*
- Supporting Effective Stewardship: *Effective stewardship is required for the development of a sustainable offshore wind industry in the United States.*
- Increasing Understanding of the Benefits and Costs of Offshore Wind: *Building understanding of the impacts of offshore wind on the electricity grid, unique electricity market costs and benefits, and environmental externalities can help create the conditions needed for near-term deployment.*

Milestones

In September, 2016, Secretaries Moniz and Jewell released the *National Offshore Wind Strategy*. This strategy was a culmination of a year and a half effort between the Department of Energy and Interior, resulting in a robust plan for Federal action in developing offshore wind in the U.S.

Three Offshore Wind Advanced Technology Demonstration Projects will continue to make progress. Fishermen's Energy, University of Maine, and LEEDCo are in phase 2 of 5 phases, and must complete specific criteria in order to move into the next phase. All three of these projects are expected to be installed and commissioned before 2020.

Major Decisions/Events

Currently, there is significant momentum in the U.S. offshore wind industry. The 30 MW Block Island Wind Farm off of Block Island, Rhode Island, should begin supplying power to the grid in November. This 5 turbine project uses GE 6 MW turbines and traditional four-legged jackets.

By the end of the 2016, BOEM expects to complete the auction for the New York Wind Energy Area; further, they are doing public outreach and scoping for wind energy areas in North Carolina and South Carolina. They are also forming an intergovernmental Renewable Energy Task Force in California to examine opportunities for offshore renewable energy development, which will have its first meeting in Q1FY17.

Over the next year, it is expected that both Massachusetts and New York will be demonstrating their support of offshore wind. On August 12, 2016, Governor Baker signed into law a bill

requiring the purchase of 1,600 MW of offshore wind by Massachusetts energy suppliers. All 1,600MW of contracts must be enacted by June 30, 2027.

New York State needs renewable energy to meet the Clean Energy Standard, which ensures 50% of New York State's electricity must come from renewable resources by 2030. The State will release its Offshore Wind Master Plan by the end of 2017, as a comprehensive strategy for developing offshore wind resources in New York State. Additionally, it is expected that the Long Island Power Authority (LIPA) will be approving the 90 MW Deepwater Wind Project off of the South Fork of Long Island by the end of 2016, with construction starting as soon as 2019.

Background

Additional details can be found in the National Offshore Wind Strategy.

Carbon Capture and Storage Major Demonstrations

Carbon Capture and Storage (CCS) can play a critical role as part of an economically sustainable route to emissions reductions. The expected commencement of commercial operations of three DOE supported carbon capture and storage major demonstration projects will provide insights to help reduce the cost of CCS. Cost reductions will be essential to the expanded deployment of CCS.

Summary:

Over the next six months, three carbon capture and storage major demonstration projects funded in part by the Department of Energy are expected to commence commercial operations. The demonstration phase of these projects marks the completion of two significant Office of Fossil Energy (FE) initiatives: the Clean Coal Power Initiative (CCPI) and the Industrial Carbon Capture and Storage (ICCS) program.

Through the CCPI and ICCS programs, FE has made significant investments in deploying CCS technologies at commercial scale. Currently, no U.S. power plants are operating with CCS. Once complete, the Kemper County Energy Facility in Mississippi and the Petra Nova project in Texas will be the first two power plants operating with CCS in the U.S; and the project at the Archer Daniels Midland (ADM) facility in Illinois plans to capture 1 million metric tons of carbon dioxide (CO_2) as a by-product of the ethanol biofuels production process and store it in a deep saline reservoir.

Issue: There is international consensus that CCS will play a critical role as part of an economically sustainable route to the emissions reductions needed to limit global warming to 2°C. In 2014, the Intergovernmental Panel on Climate Change (IPCC) concluded that without CCS, the costs of climate change mitigation could increase by 138%; and that further, realizing a 2°C scenario may not even be possible without CCS technologies.

The construction and demonstration of CCS technologies at these plants and facilities supported by DOE will provide insights to help reduce the cost of CCS. Cost reductions will be essential to the expanded deployment of CCS.

Several major demonstration projects have received scrutiny from elected officials, the press, the U.S. Government Accountability Office, the Department of Energy's Office of the Inspector General, and the public. This scrutiny has focused on cost overruns and schedule delays, along with the inability of some projects to advance beyond the planning phase to construction and operation.

Status:

The CCPI Program sought applications for projects to demonstrate advanced coal-based technologies that capture and store, or put to a beneficial use, CO_2 emissions. In 2009 and 2010, FE selected six projects to demonstrate CCS technologies at commercial scale as part of Round 3. Of those six projects, one is expected to reach commercial operations in January 2017 – Petra Nova; the other five projects were either withdrawn or discontinued. An additional Round 2

CCPI project is also expected to reach commercial operations of its CCS technology in November 2016 – the Kemper County Energy Facility project.

The ICCS program has funded projects that capture and store CO_2 emissions from industrial sources, for design, construction, and operation. One project, a hydrogen production facility, commenced CCS operations in 2013 and continues to operate – Air Products & Chemicals in Port Arthur, Texas. A second project, an ethanol plant, is expected to begin operations in the second quarter (Q2) of calendar year 2017 – Archer Daniels Midland Company in Decatur, Illinois.

The table below summarizes these four major demonstration projects, and additional detail on each follows in the paper below.

Program	Project	Location	Description	Operations Begin
CCPI	Kemper	Kemper County, Mississippi	Integrated gasification combined cycle power plant with CCS	*Nov. 2016*
	Petra Nova	Thompsons, Texas	Retrofit post-combustion CCS on coal-fired power plant	*Jan. 2017*
ICCS	Air Products	Port Arthur, Texas	CCS on existing hydrogen production facility	2013
	Archer Daniels Midland	Decatur, Illinois	CCS on existing ethanol plant	*Q2 2017**

**calendar year*

Background

Clean Coal Power Initiative (CCPI)
The CCPI is a cost-shared collaboration between the government and industry to demonstrate advanced coal-based power generation technologies at the commercial scale. The ongoing CCPI program is a central part of FE's Clean Coal Research Program (CCRP). CCPI accelerates technology adoption by the private sector, filling a crucial gap between small-scale R&D and subsequent commercial deployment. Candidate technologies are demonstrated at a scale sufficient to ensure proof of operation prior to commercialization, and to establish overall process integration.

The status of the major demonstration projects is provided below.

- Kemper County Energy Facility (Kemper) – This electric power plant is a 582-megawatt integrated gasification combined cycle (IGCC). The gasification process is designed to convert coal into synthesis gas ("syngas" for short). Before combustion, the syngas goes through a reaction that produces a concentrated stream of CO_2 to be captured. The Transport Integrated Gasification (TRIG) technology to be used at Kemper was developed jointly by the DOE, Southern Company, Kellogg, Brown, and Root.

  Kemper is being developed by Southern Company Services, Inc. It will be owned and operated by Mississippi Power. The plant has been producing power using natural gas since August 2014. Kemper is situated in close proximity to an estimated 4 billion tons of mineable Mississippi lignite, which will fuel the power plant.

Sixty five percent of the plant's carbon dioxide emissions (around three million metric tons per year) will be captured and shipped to depleted oil fields in the Gulf coast region, owned by Denbury Resources Inc. Denbury is contracted to receive 100 percent of the captured CO_2 and use the CO_2 for Enhanced Oil Recovery (EOR) in depleted oil fields.

EOR is a technique used to produce additional oil from oil fields where much of the easy-to-produce oil has already been recovered. In the context of CCS, the captured CO_2 can be transported to an oil field for injection into the reservoir. The CO_2 expands in the reservoir to push additional oil to the production well. Using the CO_2 for EOR enhances the overall economics of the project by capturing the value of the incremental barrels of oil produced through EOR.

While CCS technologies are successfully being deployed in this country and around the world, the development of any new technology is a difficult endeavor. Businesses face significant challenges as they work to introduce innovative energy technologies to markets. Due to the unprecedented technical nature and size of these first-of-a-kind plants, overall system integration is complex and can require changes to plan and schedule. As a result, some projects have seen cost-overruns.

In the case of the Kemper project, cost overruns have resulted from

- Unanticipated labor costs, labor availability and productivity issues;
- Technology issues associated with equipment (e.g. pumps, pipes, valves, etc.);
- Delays in the delivery of key equipment and equipment rework; and
- Weather related delays.

Finally, a complex control system is incorporated into the plant design. The significant interdependence between the various plant systems will ultimately make Kemper more efficient, but will require careful monitoring and testing.

- Petra Nova – A joint venture between NRG Energy and JX Nippon Oil and Gas Exploration, this project will retrofit a CO_2 capture plant on an existing coal-fired power plant located in Thompsons, Texas (near Houston). The project will demonstrate the ability of the CO_2 capture technology supplied by Mitsubishi Heavy Industries to capture 90% of the CO_2 emitted from a 240-megawatt flue gas stream. The project is designed to capture and store 1.4 million tonnes of CO_2 per year. This will be the largest post-combustion CO_2 capture project installed on an existing coal-fueled power plant. The captured CO_2 will be used to enhance oil production at the West Ranch Oil Field in Jackson County, Texas, where it will remain sequestered underground as a result of EOR operations.

  Construction is nearly complete for the Petra Nova project, and NRG expects the plant will commence commercial operations by January 2017.

Industrial Carbon Capture and Storage Program (ICCS)

The status of the major demonstration projects is provided below.

- Air Products – Air Products has designed, constructed, and is operating a state-of-the-art system to capture the CO_2 emitted from two large steam methane reformers. The reformers are located in Port Arthur, Texas and used by Air Products for large-scale hydrogen production. Air Products is working with Denbury Resources, Inc. to transport the captured gas via pipeline to oil fields in eastern Texas where it is used for EOR and thereby sequestered.

  The project commenced operation in 2013 and has captured over three million metric tons of CO_2 to date.

- Archer Daniels Midland – The Archer Daniels Midland (ADM) major demonstration project in Decatur, Illinois is planned to capture 1 million metric tons of CO_2 as a by-product of the ethanol biofuels production process and store it in a deep saline reservoir. When in operation, it will be the first ever CCS project to use the new Environmental Protection Agency (EPA) Underground Injection Class VI well permit in the United States that is specifically designed for CO_2 storage. The project is currently pending final authorization from EPA to inject the CO_2.

Strategic Petroleum Reserve (SPR) Modernization

Section 404 of the Bipartisan Budget Act of 2015 directs DOE to develop an SPR Modernization program to make operational improvements to extend the useful life of SPR surface and subsurface infrastructure, maintain cavern storage integrity, and make additions to infrastructure and facilities to optimize incremental distribution capability. Section 404 authorizes the sale of up to $2 billion of crude oil over four years to fund this program.

Summary: The mission of the Strategic Petroleum Reserve (SPR) is to protect the United States (U.S.) from severe petroleum supply interruption through acquisition, storage, distribution, and management of emergency petroleum stocks and to carry out U.S. obligations under the International Energy Program.

The April 2015 *Quadrennial Energy Review: Energy Transmission, Storage, and Distribution Infrastructure* (QER) contained a number of findings and recommendations regarding the SPR. The QER recommended that DOE invest to optimize the SPR's emergency response capability. The recommendation anticipated that $1.5–$2 billion is needed to increase the incremental distribution capability of the SPR by adding dedicated marine terminal capacity to the SPR distribution system, as well as undertaking a life extension program for key SPR infrastructure components.

The Bipartisan Budget Act of 2015 (the Act) was enacted into law in November 2015. Section 404 of the Act directs the Secretary to develop an SPR Modernization program to protect the U.S. economy from the impacts of emergency supply disruptions. The program may include operational improvements to extend the useful life of surface and subsurface infrastructure; maintenance of cavern storage integrity; and addition of infrastructure and facilities to optimize the drawdown and incremental distribution capacity of the SPR. Section 404 also authorizes the Secretary, subject to prior appropriation, to sell crude oil from the SPR in an amount up to $2 billion for the purpose of carrying out an SPR modernization program.

Issue: DOE has identified two specific projects that will comprise the SPR Modernization program – the Life Extension II project and the Marine Terminal Distribution Capability Enhancements project. The Life Extension II project will modernize aging SPR infrastructure through recapitalization and replacement of surface and subsurface infrastructure to ensure that the Reserve is able to meet its mission requirements and maintain operational readiness for the next several decades. The Marine Terminal Distribution Capability Enhancements project will enhance DOE's ability to add incremental barrels of oil from the Reserve to the energy market in a crisis through the addition of dedicated marine terminals and associated facilities in each of the SPR's three distribution systems.

Status:

Current status of the Life Extension II project is:

- Critical Decision-0 (CD-0), Mission Need, was approved in October 2015.
- Approval of Critical Decision-1, Alternative Selection and Cost Range, is anticipated to occur in November 2016.

Current status of the Marine Terminal Distribution Capability Enhancements project is:

- CD-0, Mission Need, was approved in August 2016.

Major Decisions/Events:

- Receipt of a Congressional appropriation for each FY of crude oil sales.
- Each Critical Decision required by the project management for acquisition of capital assets process is a major decision.

Background:

Life Extension II Project - the estimated cost for this project is approximately $900 million.

SPR infrastructure underwent its first (and only) life extension project in the late 1990s. At a cost of $324 million, this project addressed the essential improvements necessary to ensure continued drawdown capability, and standardized systems and equipment across the four SPR storage sites. The project did not address the need for replacement or upgrade of a significant amount of equipment across multiple systems. Consequently, this equipment today is near, at, or beyond the end of its design life. In addition to this equipment, other equipment that was replaced during the first life extension project is also approaching its 25-year design life, and will also need replacement.

Additionally, with crude oil sales mandated by the Bipartisan Budget Act of 2015 and the FAST Act, DOE anticipates that it will have to sell more than 124 million barrels of crude oil from the SPR beginning in FY 2017 through FY 2025. These sales will pose an additional challenge to the reliability of existing equipment, as the operations required by such sales necessarily impact the useful life of equipment.

Marine Terminal Distribution Capability Enhancements Project - the estimated cost for this project is approximately $1.1 billion.

To optimize the impact and value of the SPR in the event of an emergency, the SPR's three distribution systems—the Seaway, Texoma, and Capline systems of pipelines, refineries, and terminals—in the Gulf of Mexico need to be able to both deliver oil to Gulf Coast refineries, as well as load crude oil onto marine vessels for further distribution. If DOE is unable to implement crude oil distribution from the SPR without disrupting commercial movements, SPR sales could be offset by a corresponding decrease in domestic crude oil shipments. The construction and availability of dedicated marine terminals and associated facilities for loading SPR crude oil will enhance DOE's ability to add incremental barrels of oil from the Reserve to the energy market in a crisis.

Liquefied Natural Gas (LNG) Exports

Hydraulic fracturing and horizontal drilling have unlocked abundant domestic shale gas resources that have had game-changing implications to the United States' and global energy markets. DOE's natural gas export regulatory program is at the center of discussions about U.S. natural gas trade policy involving many groups including industry, Congress, and the international and environmental communities.

Summary: The Department of Energy has responsibilities under the Natural Gas Act to regulate liquefied natural gas (LNG) exports. To date, the Department has authorized exports of 15 billion cubic feet per day (Bcf/d) (about 20% of current U.S. production) to non-free trade agreement (non-FTA) countries, and continues to evaluate the public interest of pending LNG export applications to non-FTA countries. Exports to free trade agreement countries are automatically granted.

Potential exporters, natural gas industry interests, and others favor quick approvals, and pending legislation could expedite DOE review of export applications. However, other Members of Congress have urged DOE to slow down its approval of exports, citing potential harm to U.S. customers and industry. Environmental interests oppose LNG exports, at least partly as a way to slow or halt hydraulic fracturing in natural gas production. DOE has found that the United States would experience net economic benefits from increased LNG exports, which would also provide both economic and strategic benefits to our allies.

Issues:

1) ***Pending Legislation on Pace of Application Review:*** Congress has proposed an expedited DOE LNG application processing timeline for LNG exports to non-FTA countries. While DOE has stated that it can meet the timeline, DOE has also stated it does not think this is necessary. Currently, DOE evaluates non-FTA applications promptly after a project completes its siting authorization, usually carried out by the Federal Energy Regulatory Commission. Proposals would require DOE action before that process is completed, creating regulatory uncertainty. Conversely, some Members of Congress have the opposite view and are encouraging DOE to slow its approval process. A dozen Senators have written to the Secretary in September 2016 expressing concern about LNG export approvals and requesting a slowing of the review process to enable additional evaluation.
2) ***Opposition/Litigation from Environmental Groups***: DOE is being sued in the U.S. Court of Appeals for the District of Columbia Circuit in several cases over its decisions to authorize LNG exports to non-FTA countries. Among other arguments, groups opposed to LNG exports contend that DOE failed to take a hard look under the National Environmental Policy Act (NEPA) at greenhouse gas emissions and other impacts that might result from increased domestic natural gas production and from foreign consumption of U.S.-exported LNG.

3) ***Timing and Destination of LNG Exports:*** Presently, only one large scale lower-48 states liquefaction facility is exporting LNG, and only two of its six planned liquefaction trains have been completed. Three other major LNG export facilities are expected to begin operation in 2018. There has been significant interest internationally on the destination of LNG cargoes due the new source of supply and contract provisions that U.S. LNG offers to other countries. By the end of June 2016, 16 cargoes of LNG had been exported to destinations around the world including Brazil, Argentina, China, Portugal, and Kuwait. In fact, the first LNG to transit the newly expanded Panama Canal in August 2016 was U.S. LNG bound for China.

Status:

At present, DOE is continuing to process pending applications to export LNG to non-FTA (as well as FTA) countries and to monitor developments in the issues identified above.

Milestones:

See **Issues**

Major Decisions/Events:

See **Issues**

Background:

Technological advances in hydraulic fracturing and horizontal drilling have unlocked abundant domestic shale gas resources and lowered the production cost of natural gas. This new, low-cost supply of U.S. natural gas has prompted numerous companies to seek DOE authorization to export liquefied natural gas (LNG). Under the Natural Gas Act, DOE has responsibilities to regulate imports and exports of natural gas, including the export of LNG.

The United States has typically relied on natural gas imports in order to satisfy domestic demand. As recently as 2007, net imports of natural gas via pipeline from Canada as well as LNG imported into the United States from other countries met 16% of total U.S. natural gas demand. With recent growth in domestic production, net imports of natural gas were only 3% of U.S. demand in 2015. DOE obtained its first application to export LNG produced in the lower-48 states to non-FTA countries in 2010 and several of the LNG terminals originally designed for imports are being reconfigured for exports. Modest exports of less than one Bcf/d of LNG began in early 2016 and are expected to rise to the point that the United States becomes a net exporter of natural gas for the first time by late 2017. Exports reaching the 15.22 Bcf/d currently authorized by DOE are not expected until beyond 2030, according to the Energy Information Administration's 2016 Annual Energy Outlook.

For DOE's regulatory responsibilities, the Natural Gas Act (NGA) has two different application review processes.

- ***Free Trade Agreement (FTA) Applications:*** By law, applications to export LNG to free trade agreement (FTA) countries must be approved by DOE without modification or delay.
- ***Non-Free Trade Agreement (non-FTA) Applications:*** Applications to export LNG to non-FTA countries, (which constitute the majority of demand for LNG), must be approved by DOE unless, after review, DOE finds the exports are not consistent with the

public interest. To conduct DOE's public interest review and an environmental review of the exports, DOE has:

- Commissioned macroeconomic studies of the impact of LNG exports, most recently evaluating LNG export levels from 12 to 20 billion cubic feet per day (Bcf/d) of natural gas.
- Commissioned two environmental studies that considered the upstream impact and lifecycle greenhouse gas (GHG) emissions of producing natural gas for export.

As of October 3, 2016, the Department has issued final authorizations for exports of lower-48 natural gas to non-FTA countries totaling 15.22 Bcf/d. This amount represents approximately 20% of current daily U.S. production. Nearly 30 Bcf/d of non-FTA applications are pending.

This cumulative authorized non-FTA LNG export volume (15.22 Bcf/d) is primarily spread across six major LNG export terminals in various stages of planning and/or construction. It is likely that large scale LNG export facilities will only be built with both FTA and non-FTA export authorizations. Only one of the six major export terminals with non-FTA DOE authorization, Cheniere Energy's Sabine Pass, (Cameron Parish, LA), is in operation. How much LNG will actually be exported, even once all of these facilities are operational, is uncertain. Even where contracts are in place, market forces will determine the amount of LNG exported.

Uranium Management

A new Secretarial Determination is needed before May 1, 2017, to continue uranium transfers that partially fund NNSA and EM programs.

Summary: A new Secretarial Determination is needed before May 1, 2017, to enable the National Nuclear Security Administration (NNSA) and the Office of Environmental Management (EM) to continue uranium transfers that partially fund their programs.

The Department of Energy (DOE) transfers its excess uranium in various transactions that are consistent with the laws governing DOE's management of its uranium inventory. The most significant transfers are:

- transfers of natural uranium hexafluoride by EM in exchange for cleanup services at DOE's Portsmouth Gaseous Diffusion Plant ($134 million value in FY2016), and
- transfers of low enriched uranium (LEU) that have been down-blended from stocks of highly enriched uranium (HEU) ($35 million value in FY2016). NNSA partially funds down-blending activities by transferring derived LEU to the down-blending contractor, and the transferred material also supports production of tritium production in TVA reactors.

- Section 3112(d) of the USEC Privatization Act requires that the Secretary make a Determination that, among other things, certain transfers of uranium will have no adverse material impact on the uranium conversion and enrichment industries.
- The FY 2015 Omnibus Appropriations Act limits the validity of these Secretarial Determinations to two calendar years.
- In preparing each Secretarial Determination, the Department considers, among other inputs, its nuclear defense and cleanup missions, significant input from the public, and current market conditions.
- The May 1, 2015, Secretarial Determination authorized uranium transfers up to the equivalent of 2,100 metric tons of uranium (MTU) in 2016 (approximately 500 MTU allocated for downblending and 1,600 MTU for cleanup.

Issue

A new Secretarial Determination is needed before May 1, 2017, to enable NNSA and EM to continue uranium transfers that partially fund their programs.

Impact of Not Issuing Determination

If a determination is not issued by May 1, 2017, transfers would cease.

If so, NNSA will have to default on the contract with WesDyne to deliver HEU from Y-12 to Nuclear Fuel Services (NFS) for down-blending and NFS would shut down the commercial down-blending line, resulting in immediate layoffs of the operators and staff. Most importantly, losing this capability would negate the Department's only option for tritium production until the Department's domestic uranium enrichment capabilities are operational. The Department will

need to spend billions of dollars sooner than currently planned in order to stand up domestic uranium enrichment quicker and provide unobligated uranium for tritium production.

If uranium transfers cease, EM would have to "reprogram" approximately $96 million from other mission areas to support the cleanup at Portsmouth or reduce the pace of cleanup which will result in layoffs of approximately 600 workers at current levels.

Status

On July 19, 2016, the Department published a Request for Information (RFI) in the *Federal Register* that solicits information from the public about the uranium markets and domestic uranium industries; the potential effects of DOE transfers in the uranium markets and possible consequences for the domestic uranium mining; conversion and enrichment industries. The RFI established an August 18, 2016 deadline for the submission of written comments. On August 8, 2016, the comment period was extended until September 19, 2016. The RFI provided notice to all interested persons that the Department is initiating the process of preparing for a potential new Secretarial Determination.

The Department contracted with Energy Resources International, Inc., (ERI) to prepare an analysis of the potential effects on the domestic uranium mining, conversion, and enrichment industries of sales or transfers of DOE excess uranium inventory in various forms and quantities anticipated to take place during Calendar Years 2017 through 2026. This independent analysis is expected to be completed in November 2016. This analysis will help inform the Secretarial Determination.

Milestones

- September 19, 2016 – RFI public comment period closes.
- November 2016 – DOE expects to receive ERI analysis of the potential effects of DOE excess uranium transfers on the domestic uranium conversion and enrichment industries.
- December 2016/January 2017 – DOE to seek public comment on the ERI analysis.
- No later than May 1, 2017 – Decision on new Secretarial determination supporting future uranium transfers needed.

Major Decisions/Events

- Whether the Department will issue a new determination to enable NNSA and EM to continue the uranium transfers that partially fund their programs.
- What rate of uranium transfer any determination would permit.
- When to issue any determination. A new determination is needed no later than May 1, 2017 to allow uranium transfers to continue uninterrupted.

Sensitivities

DOE's uranium transfers continue to garner significant Congressional attention from uranium-producing states, primarily in the West. The President's FY 2017 Budget proposal included legislation to access alternative sources of financing to pay for D&D costs at the three former uranium enrichment facilities. In response to a May 23, 2016 letter from 17 Members of Congress asking DOE to cease uranium bartering, Secretary Moniz reiterated his interest in finding alternative financing sources for the D&D work. The FY 2016 Consolidated

Appropriations Act Explanatory Statement directs the Department to provide the Committees on Appropriations of both Houses of Congress recommendations to minimize the impact of uranium transfers on the domestic uranium mining, conversion, and enrichment industries. Those recommendations are being prepared.

Siting New Facilities for Storage and Disposal Of Spent Nuclear Fuel and High-Level Radioactive Wastes

DOE is designing a phased, adaptive, consent-based approach to siting new nuclear waste facilities as part of an integrated waste management system, for the safe management of spent fuel and high-level radioactive wastes.

Summary: The use of nuclear technology for commercial electricity production or for national defense activities results in the generation of radioactive wastes. Among the most radioactive of these wastes are used (or "spent") nuclear fuel from nuclear power plants, naval nuclear vessels, and nuclear production or test reactors, and also the high-level radioactive wastes (HLW) left over from the processing of nuclear materials for nuclear weapons production.

Under the Nuclear Waste Policy Act (NWPA), DOE is responsible for providing for the safe and permanent disposal of spent nuclear fuel (SNF) and HLW. DOE has agreements with the states of Idaho, South Carolina, and Washington regarding the cleanup of HLW from former defense sites. And per the NWPA, DOE was to begin accepting commercial SNF and removing it from generator sites by 1998.

Following the 1982 passage of the NWPA, DOE studied several possible sites for a disposal facility (or "repository") for SNF and HLW, until Congress passed the 1987 Amendments to NWPA, directing DOE to evaluate only Yucca Mountain[1] in Nevada. In 2009, DOE determined that siting a geologic repository at Yucca Mountain was an unworkable solution.

DOE is now starting to implement a new, phased, and adaptive integrated strategy for management and disposal of SNF and HLW. This strategy includes use of a consent-based process to site new facilities for storage and disposal of SNF and HLW. A long-term strategy for managing SNF and HLW is needed for many reasons: to safeguard public health and the environment; to mitigate security and proliferation risks; to protect taxpayers from ballooning financial liability as nuclear utilities seek compensation for the federal government's failure to meet its waste acceptance obligations; and—not least—to avoid burdening future generations with nuclear waste they had no part in creating.

Issue

DOE is designing a consent-based siting process to establish an integrated waste management system (IWMS) to transport, store, and dispose of SNF and HLW. DOE has solicited input from communities, tribal governments, and states across the country to develop a process to site future nuclear consolidated interim storage facilities and geologic repositories. In practical terms, this means communities, states, and tribes can begin a dialogue with DOE to see if they would like to become a willing and informed host of a future nuclear management facility. This would likely be done in expectation of yet to be negotiated benefits and the economic activity that would result from the siting, construction, and operation of such a facility in their jurisdictions. The Department is doing what it can within existing authority to advance the consent-based siting initiative as Congress considers this together with other options for nuclear waste storage and

[1] The Office of Legacy Management (LM) assumed responsibility for the preservation of physical records and more than 20 information systems containing more than 96 terabytes of data that document the science and information accumulated during the active life of the Yucca Mountain Project.

disposal including the potential role of private spent nuclear fuel storage initiatives, Yucca Mountain, and a defense repository for high-level radioactive waste.

Status

In fiscal year (FY) 2016, the Department launched an effort to solicit input from the public and interested parties on what elements to consider when designing a fair and effective consent-based siting process. DOE issued an Invitation for Public Comment in December 2015 and held a series of public meetings across the country to solicit feedback from communities, states, Tribes, and other interested stakeholders on elements to consider in the design of a consent-based siting process. Comments received throughout the Invitation for Public Comment and public meetings were summarized in a draft report "Designing a Consent-Based Siting Process: Summary of Public Input" along with a preview of the next steps for consent-based siting. By the end of calendar year 2016, the Department will issue a number of documents for public comment and discussion including a draft consent-based siting process. DOE has requested FY 2017 appropriations from Congress for a grants program to help communities, states, and tribes engage in the consent-based siting process. Meeting materials and transcripts can be found at energy.gov/consent based siting

Milestones

- Issue Request for Information for Private Initiatives, Date: October 2016
- Issue Defense Waste Repository Plan for public comment, November 2016.
- Issue Final Draft of "Designing a Consent-Based Siting Process: Summary of Public Input" December 2016.
- Issue Draft Consent-based Siting Process, December 2016.
- Issue Funding Opportunity Announcement (FOA) to enable community involvement in consent-based siting, date TBD (pending Congressional support/appropriations).
- Conduct citizen forums to seek public perspectives on nuclear waste and consent-based siting, Winter/Spring 2017.

Major Decisions/Events

The next phase of this effort, pending Congressional approval, would entail the award of grants to communities, states, and tribal governments, and potentially others, for them to learn more about what it would take to possibly host a future nuclear waste facility and what benefits could result from their playing a role in solving this national challenge. Understanding that the Department is seeking a willing and informed host, the Department would like to place resources in the hands of communities for them investigate the topic further and to see if they would like to consider hosting a future nuclear waste management facility.

Background

In 2009, the Administration concluded that the Yucca Mountain project was unworkable, due to the lack of support from the host state Nevada, and in 2010 formed the Blue Ribbon Commission on America's Nuclear Future to recommend a new strategy for nuclear waste management. The 2012 report of the Blue Ribbon Commission recommended a new approach to siting that differs in fundamental respects from the prescribed, "top-down" approach that has characterized the

U.S. repository program since the NWPA Amendments Act of 1987 limited DOE's consideration of potential repository sites to a single location, at Yucca Mountain in Nevada. Based on a review of past experience with siting nuclear waste facilities in the United States and overseas, the Blue Ribbon Commission concluded that success would be more likely with an approach to siting that was consent-based – in the sense that affected communities have an opportunity to decide whether to accept facility siting decisions.

In 2013, the Administration released its Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste. This Strategy envisions an integrated waste management system consisting of a set of nuclear waste facilities, each serving a specific purpose, to address the challenges of safely managing both SNF and HLW. These nuclear waste facilities could include:

- A pilot interim storage facility with limited capacity capable of accepting SNF and HLW and initially focused on serving shutdown reactor sites;
- A larger, consolidated interim storage facility, potentially co-located with the pilot facility and/or with a geologic repository, that provides needed flexibility in the waste management system and allows for important near-term progress in implementing the federal commitment;
- Deep borehole disposal, which could be an option for disposal of smaller and more compact waste forms currently stored at Department of Energy sites;
- A permanent geologic repository for the disposal of defense HLW and, potentially, some DOE-managed SNF, which would be generally less radioactive, cooler, and easier to handle, enabling a simpler design and earlier availability; and
- A permanent geologic repository for the disposal of commercial SNF.

DOE is working to design a consent-based siting process for nuclear waste management facilities as part of an IWMS.

- Nuclear technology has been used in the United States for national defense, research and development, and electric power generation. These activities produced a large quantity of SNF and HLW.
- The largest inventory of SNF comes from commercial electricity generation: approximately 75,000 metric tons of uranium (MTU) at the end of 2015 with potential growth to 140,000 MTU with the current reactor fleet. Nearly all the existing commercial SNF is being stored at the reactor sites where it was generated. Of the 74 commercial reactor sites, 13 sites no longer have an operating reactor.
- DOE also manages roughly 90 million gallons of liquids, sludges, and solids, all being managed as HLW, most of which were generated for defense related nuclear activities. These wastes are mainly stored at DOE's Hanford, Savannah River, and Idaho sites.
- SNF and HLW pose a disposal challenge because these materials remain radioactive and therefore require isolation from the public for long periods of time. The expert consensus is that disposal in a deep geological repository offers the best practical solution for achieving long-term isolation. Many locations around the country offer potentially suitable conditions for a disposal repository. However, the challenge to date has been

siting facilities. State (and sometimes local) opposition has thus far stymied all historical efforts to move forward with either a repository or consolidated storage site.

- The Nuclear Waste Policy Act, originally enacted in 1982, was amended in 1987 to limit the continued evaluations of three sites down to one (the Yucca Mountain site in Nevada). Nevada viewed this as an unfair decision that took advantage of its small electorate, and this view fueled a determined effort to fight the project. The failure to win public support led to the 2009 conclusion that Yucca Mountain is not a workable solution to the nation's nuclear waste challenges.
- Building on the recommendations of the Blue Ribbon Commission for America's Nuclear Future and the Administration's Strategy (2013), DOE is working to design and implement a phased, adaptive, consent-based approach to siting nuclear waste management facilities (subject to appropriate authorizations from Congress).

Congress has supported the Administration's position on Yucca Mountain since 2011 and has not appropriated any new funding to continue the project. However, there are members of Congress who believe the Yucca Mountain NRC repository licensing process should be resumed and, at a minimum, completed to demonstrate that a disposal facility could successfully demonstrate its safety and obtain an authorization from NRC to begin construction (even if it is never constructed).

Grid Modernization

The power grid has fueled the nation's growth since the early 1900s; however, the grid we have today must evolve to meet the demands of the 21st century and beyond. DOE's crosscutting Grid Modernization Initiative (GMI) works in partnership with states and industry to create a modern, secure grid for the future prosperity of the Nation. The introduction of innovative technology, policy, and regulatory changes are necessary for continued national prosperity and security. This topic has garnered the attention of the Department's stakeholders and the Nation. In fact, the QER 1.2 addresses maximizing the value of the Nation's electric grid. As one of the Department crosscutting initiatives, stakeholders keep a keen eye on its progress. DOE will conduct its first peer review of the GMI awards in April of 2017.

Summary: The United States has one of the world's most reliable, affordable, and increasingly clean electric systems. Virtually every sector of our modern economy, including all of our critical infrastructure, depends on electricity. The U.S. electric system is, however, at a strategic inflection point—a time of significant changes in a system that has been relatively stable for nearly a century.

Innovative technologies and services, including those supported by DOE, are being introduced to the system at a rapid rate. In sum, they are increasing efficiency, reliability, consumer choice, and improving environmental performance, but also injecting uncertainty into grid operations, traditional regulatory structures, and utility business models. The electricity system is nearly equal to the transportation system as the largest contributor of carbon pollution. Changes in technologies, business plans, and policies – together referred to as grid modernization - are required for continued economic prosperity, security, and the needed deep reductions in carbon emissions economy wide.

DOE's Grid Modernization Initiative (GMI) represents a crosscutting research, development, demonstration, and deployment effort to help shape the future of our nation's grid and solve the challenges of integrating conventional and renewable sources with energy storage, smart buildings, and end use devices, while ensuring that the grid is resilient and secure to withstand growing physical, cyber security, and extreme weather events. Specifically, DOE's efforts focus on the development of technologies that measure, analyze, predict, protect, and control the grid of the future. Maintaining momentum on the work we are doing in collaboration with industry and states to build the grid of the future is critical to the national prosperity and security. Proactive, coordinated, and innovative steps are needed to address several critical challenges:

- Changes in demand driven by population growth and adoption of more energy efficient technologies (which have led to low load growth), and broader electrification;
- Changes in the supply mix (such as increasing renewable energy deployment; retirements of coal and nuclear power facilities; and growing use of natural gas for power generation) and location (centralized, distributed, and offshore) of the Nation's generation portfolio;

- Increasing variability and uncertainty from both supply and demand, including integration of variable renewables, more active consumer participation, and accommodating new (potentially disruptive) technologies and techniques;
- Increasing challenges to the reliability and security of the electric infrastructure (such as more frequent and intense extreme weather events; climate change; cyber and physical attacks; aging infrastructure; and interdependencies with natural gas and water); and
- Evolving state and national environmental and energy policies requiring jurisdictional cooperation between Federal, State, and local levels.

Recognizing the state of urgency to address these critical challenges, a few key areas stand out as we drive towards grid modernization.

1. Cybersecurity for the Energy infrastructure – The Energy Sector cybersecurity environment continues to experience dramatic increases in sophisticated cyber attacks which level threats to the economic engine of the U.S. economy.
2. Energy Storage – Accelerating the development and deployment of advanced energy storage technologies can enable the stability, resiliency, and reliability of the future grid.
3. Transformer Resiliency – More than 90 percent of consumed power passes through high-voltage transformers at some point. These transformers, however, face a number of challenges that make them one of the most vulnerable components on the grid
4. Integration of High Levels of Renewable Energy – As states continue to increase their Renewable Portfolio Standards, considerable additions of renewable energy will need to be incorporated into the power grid in a manner that does not jeopardize affordability, security, reliability, and resiliency.
5. Information Technologies and Data Flow and Control With the Grid – As the grid is expected to handle information and data flow in orders of magnitude (1,000-10,000 times current levels), the system must be reconfigured to control and operate effectively.
6. Valuation – New, lower cost distributed generation, distributed storage, and demand response technologies, together with increased consideration of end-use energy efficiency as a resource by regulators and utilities, is changing the role of consumers, enabling many to become suppliers of services to the supply system, posing new challenges for ratemaking and consumer protection, and new opportunities for grid management.
7. Demonstration of Integrated Systems – To reduce risk and added costs to states and utilities, the multi-technologies developed for grid modernization must be tested and proven to work.

Status

The Department completed a **Multi-Year Program Plan (MYPP)** for grid modernization in December 2015 which lays out a blueprint for the Department's grid research, development, and demonstration agenda, building on concepts and recommendations from DOE's Quadrennial Energy Review (QER) and Quadrennial Technology Review. This was done with input from many sources: state agencies including Public Utility Commissions, utilities, suppliers, universities, and national laboratories.

As part of this initiative, the Department **announced** funding in January 2016 of up to $220 million over three years for DOE's National Labs and partners through the framework of the **Grid Modernization Laboratory Consortium** (GMLC). The funding supports critical research and development in advanced storage systems; clean energy integration; standards and test procedures; advanced control systems; integration of distributed energy resources and a number of other key grid modernization areas. In addition to projects that address the needs of incorporating individual grid technologies like solar or energy storage, this effort supports crosscutting projects that have impact across multiple technologies including sensing and grid control devices.

DOE has also identified and planned Integrated Regional Demonstrations, which will provide an important opportunity to integrate the advancements developed in the lab call and other funding opportunities in a widespread deployment. States and utilities are relying on such demonstrations to mitigate operational and investment risk to the ratepayers.

In addition, DOE will release the second installment of the QER (QER 1.2) in November 2016. QER 1.2 analyzes the entire electricity system: from generation, through transmission and distribution, to end use. QER 1.2 will consider the roles and activities of major actors, industries, and institutions integral to the electricity system, as well as technologies; fuel choices; physical and cyber vulnerabilities; jurisdictional authorities; markets; and finance. QER 1.2 will make findings and recommendations for policymakers.

DOE Leadership and Coordination

Within the Department, the Office of Electricity Delivery and Energy Reliability (OE) has the overall mission responsibility for the reliability, resiliency, and security of the grid. The Office of Energy Efficiency and Renewable Energy (EERE) has considerable work in renewable and end-use integration. The Office of Energy Policy and State Assistance (EPSA) covers overall energy policy for the Department. These three offices work on the grid crosscut. The Under Secretary for Energy and Science leads an executive committee – including the heads of OE, EERE, and EPSA – that oversees the GMI. Coordination and companion research is also provided by ARPA-E, the Office of Science, and other DOE offices in critical areas surrounding high performance computing, energy modeling, materials, and storage.

Externally, critical coordination with many partners including states and regions, private industry, universities, and other Federal agencies is targeted at advancing grid modernization for all parties. Over 100 partners are involved in the GMLC awards, representing state agencies, regional entities, utilities, suppliers, and others. Many other entities are partners in the grid related work across the department.

Major Decisions/Events

DOE will be conducting a Peer Review in April 2017 to assess the contribution of each of the twenty-nine (29) Foundational projects selected from the January 2016 laboratory call.

DOE will host the Electric Sector Coordinating Council Meetings (26 Electric Sector CEO's) - March, June, and Sept 2017 (Hurricane season is June 1 to November 30 2017).

Background

OE was created in 2005 to ensure a resilient, reliable, and flexible electricity system through a mix of technology and policy solutions.

The American Recovery and Reinvestment Act of 2009, (Recovery Act) provided DOE with $4.5 billion to modernize the electric power grid, including the deployment of millions of smart meters nationwide.

In July 2014, the Grid Tech Team, other DOE Tech Teams, and national laboratories met at the Big Ideas Summit to address the Secretaries priorities. The Grid Modernization Technology Team was created to identify challenges of the current grid, key attributes, and main technical focuses important to a modernized grid. Under the GMI umbrella, the GMLC was created to align DOE and national laboratory grid activities.

Recognizing a modernized grid involves integrated advancements across multiple technologies which would involve multiple technologies and program offices, in 2015, DOE moved to centralize the Department's grid developments and investments under the Grid Modernization Initiative.

Annual Assessment of the Nuclear Weapons Stockpile

The Department of Energy's (DOE) National Nuclear Security Administration (NNSA) and its national laboratories must annually assess the nuclear weapons stockpile and certify that it is safe, secure, reliable, and militarily effective without nuclear explosive testing.

Summary: The annual assessment process provides assurance to the President of the United States that the U.S. nuclear weapons stockpile is safe, secure, reliable, and militarily effective. The Departments of Energy and Defense undertake this cycle annually to assess each warhead's existing certification basis in light of new information generated by the Stockpile Stewardship Program in the past year. This process provides the ability to maintain a credible nuclear deterrent without nuclear explosive testing. Each year, the directors of the national security laboratories and the Commander, United States Strategic Command (USSTRATCOM), provide a comprehensive written assessment on the state of each warhead in the nuclear weapons stockpile. The National Nuclear Security Administration (NNSA) laboratory directors then provide the Secretary of Energy with their independent assessments as part of an Annual Assessment Review. To complete the cycle, the Nuclear Weapons Council (NWC) prepares a joint memorandum, the Report on Stockpile Assessments (ROSA), for the Secretaries of Energy and Defense to sign and submit to the President. The ROSA combines each laboratory's report (without change), any comments that the Secretaries individually or jointly consider appropriate with respect to each report, and the conclusions that the Secretaries individually or jointly reach as to the safety, reliability, performance, and military effectiveness of the nuclear weapons stockpile of the United States.

Issue: U.S. law requires that the Secretaries of Energy and Defense provide a joint Memorandum to the President on the state of the stockpile and potential need for nuclear weapons testing.

Status: The Deputy Administrator for Defense Programs issued the 2016 (Cycle 21) Annual Assessment Review on January 7, 2016. This plan provided the necessary requirements and milestones to complete the Annual Assessment Review process to the Secretary of Energy:

Milestones:

	Due Date
Annual assessment reports published and distributed	Aug 1, 2016
Laboratory directors sign Annual Assessment Letters	Sep 30, 2016
Laboratory directors participate in Annual Assessment Review - brief the following: ▪ Deputy Administrator for Defense Programs ▪ NNSA Administrator ▪ Secretary of Energy	Nov 10, 2016

STRATCOM Commander provides Annual Assessment Letter	Dec 1, 2016
ROSA submitted to the to the President	Feb 1, 2017
President forwards the ROSA to Congress	Mar 15, 2017

Major Decisions/Events: Notwithstanding this schedule, the Secretaries of Defense and Energy decided to complete the annual review process and submit the ROSA to the President by December 31, 2016. The Secretary of Energy will be briefed on the results of the 2016 Cycle by the three national security laboratory directors and select DOD members of the NWC (i.e., Commander USSTRATCOM, Vice Chairman of the Joint Chiefs of Staff, Director of Policy, Chairman of the NWC), on November 10, 2016.

Background: The science-based Stockpile Stewardship Program has allowed the Secretaries of Energy and Defense to certify to the President for the past 21 years that the U.S. nuclear weapons stockpile remains safe, secure, reliable, and militarily effective without the need for underground nuclear explosive testing.

The annual stockpile assessment review process is not an annual re-certification of the warheads in the stockpile. It is an assessment of each warhead's existing certification basis in light of new information generated by the Stockpile Stewardship Program in the past year.

On an annual basis, the directors of the three DOE national security laboratories—Los Alamos National Laboratory (LANL), Lawrence Livermore National Laboratory (LLNL), and Sandia National Laboratories (SNL)—are required to assess the safety, security, and reliability of each weapon system in the stockpile. In addition, the Commander of USSTRATCOM provides an assessment of the military effectiveness of the stockpile. Core surveillance, non-nuclear hydrodynamic tests, subcritical experiments, materials evaluation, enhanced surveillance, and modeling and simulation contribute to the analysis. Much of this information is generated through the execution of the programs in the Directed Stockpile Work (DSW) and Research, Development, Test, and Evaluation (RDT&E) budget categories.

Stockpile Stewardship and Sustainment

NNSA must extend the lifespan of the aging nuclear warhead stockpile and ensure it remains safe, secure, and reliable without underground nuclear testing.

Summary: One of Department of Energy's (DOE) National Nuclear Security Administration's (NNSA) core missions is to maintain a safe, secure, and effective stockpile without nuclear explosive testing. To execute this mission, NNSA pursues a science based Stockpile Stewardship Program (SSP) and is replacing or refurbishing the enterprise's aging infrastructure to provide a hedge against technical and geopolitical surprise, and provide a more capable and improved work environment, while continuing to reduce the overall size of the U.S. nuclear weapon stockpile. In order to maintain the deterrent without nuclear explosive testing, NNSA fields a suite of innovative experimental capabilities, diagnostic equipment, high-performance computers, and modern computational codes that build on past nuclear explosive test data to simulate the dynamics of nuclear weapons, and test non-nuclear components. NNSA also engages in critical efforts for stockpile sustainment through life extension programs (LEPs), alterations (Alts), and modifications (Mods), which address aging and performance issues, enhance safety features, and improve security in the nuclear weapons stockpile.

Issue: The scope, budgets, and schedules of the LEPs and the Department of Defense's nuclear delivery systems have been fully integrated through coordination within the Nuclear Weapons Council (NWC). These programs are the foundation of the United States' ability to maintain today's deterrent as we prepare for the uncertain security environment of the future. NNSA must ensure a safe, secure and effective nuclear deterrent without nuclear explosive testing through continued investment in the Stockpile Stewardship Program and the enterprise workforce and infrastructure that makes stockpile stewardship possible.

Status: As agreed by the NWC, NNSA will remain focused on delivering these four programs: the submarine-launched ballistic missile systems, the W76-1 LEP and the W88 Alt 370, (including refreshment of the conventional high-explosive [CHE] main charge) for the U.S. Navy; and the B61-12 gravity bomb LEP and the W80-4 LEP for the cruise missile for the U.S. Air Force.

Major Decisions/Events:

- NNSA expects to complete production of the W76-1 on schedule in 2019. The W76-1 will provide the Navy with a life-extended warhead for its ballistic missile submarine fleet that will last for at least another 30 years. Production of the W76-1 LEP will enable a 50 percent reduction of W76 warheads.
- The B61-12 LEP remains on track for a first production unit (FPU) in March 2020, the date agreed to by the NWC and supported by the President's FY 2017 budget request. The B61-12 LEP will consolidate four families of the B61 bomb into one, and improve both the safety and security of the oldest weapon system in the U.S. arsenal. Timely execution of the B61-12 LEP will enable retirement of the B83-1 – the last megaton-class weapon in the U.S. arsenal.

- NNSA is accelerating all planning activities associated with conventional high explosive refresh and will combine them into a single W88 Alt 370 program by February 2017. Congress approved a $25 million reprogramming request to meet this milestone and maintain a FPU of December 2019.
- The *FY 2015 National Defense Authorization Act* requires the Secretary of Energy to deliver the FPU of a life-extended W80 warhead for the Long-Range Standoff missile by 2025. NNSA is early in this effort but is on track to meet that timeline.

Background: LEPs involve modifications that refurbish warheads by replacing aged components to extend the service life of the weapon. Alts involve limited scope changes that typically affect the assembly, testing, maintenance, and/or storage of weapons. Mods are more comprehensive programs that increase safety, improve security, extend limited-life component life cycles, and/or address identified defects and component obsolescence.

The Joint Comprehensive Plan of Action with Iran

The Department of Energy's (DOE) National Nuclear Security Administration (NNSA) programs provide critical support to the nuclear deal with Iran that is designed to prevent Iran from acquiring a nuclear weapon.

Summary: The Joint Comprehensive Plan of Action (JCPOA), also known as the "Iran Deal," provides verification to ensure that Iran's nuclear program is exclusively peaceful in nature by blocking the four potential pathways to a nuclear bomb:

DOE's expertise in the nuclear fuel cycle, nuclear safeguards and security, and nuclear materials play a critical role in helping to ensure that Iran is meeting its key commitments under the JCPOA. There are three main areas where DOE provides technical support:

1. The Procurement Working Group
2. The Arak Modernization Project
3. The International Atomic Energy Agency's (IAEA) monitoring and verification activities

Issue: The Department of Energy and its national laboratories are providing technical support and analysis throughout implementation of the JCPOA to help ensure that Iran carries out its commitments.

Joint Commission Procurement Working Group (PWG): The JCPOA and United Nations Security Council Resolution 2231 established a procurement channel to oversee all proposed sales, supply, or transfers of export-controlled items. The UN Security Council will make decisions about proposed transfers based on the recommendations of the PWG. The working group is composed of representatives of the P5+1, European Union (EU), and Iran, with the EU representative serving as Coordinator. DOE/NNSA participates in a U.S. interagency working group that supports the U.S. role in the JCPOA procurement channel by evaluating proposed nuclear-related transfers to Iran's nuclear and non-nuclear civilian industries.

Arak Modernization Project: The JCPOA calls for a working group to facilitate the Arak redesign and reconstruction project. DOE co-chairs this working group with China. DOE will provide technical support and review of the modernized reactor design, as well as analysis of fuel design and safety standards, to ensure it conforms to the key attributes and characteristics of the modernized reactor as set forth in the JCPOA.

IAEA Support: DOE/NNSA provide extensive technical expertise, equipment, and training to support the IAEA's ability to monitor implementation of the JCPOA. DOE/NNSA will also continue its longstanding and comprehensive support for the IAEA's broader safeguards mission around the world.

Status: Since January 16, 2016, the IAEA has monitored and verified Iran's implementation of its nuclear-related commitments under the JCPOA.

Milestones

IAEA Report: As requested by United Nations Security Council Resolution 2231 (2015), the IAEA provides regular updates to the IAEA Board of Governors on Iran's implementation of its commitments under the JCPOA.

Iran Nuclear Agreement Review Act (INARA) Certification: Requires that the U.S. President certify, at least every 90 days, that Iran is fully implementing the agreement, has not committed a material breach, and has not taken any action that could significantly advance its nuclear weapons program.

Iran Nuclear Agreement Review Act (INARA) Semiannual Report: Requires that the U.S. President submit a report every 180 calendar days on Iran's nuclear program and Iran's compliance with the agreement during the period covered by the report.

Background: On July 14, 2015, the P5+1 (China, France, Germany, Russia, the United Kingdom, and the United States), the EU, and Iran agreed upon a JCPOA that limits Iran's nuclear program to exclusively peaceful activities. The JCPOA cuts off all of Iran's pathways to a nuclear weapon; provides for sanctions to snap back into place if Iran violates the deal; and includes the most comprehensive nuclear verification measures ever negotiated.

On January 16, 2016, the IAEA verified that Iran completed the necessary steps under the JCPOA to ensure Iran's nuclear program is and remains will be exclusively peaceful to bring the agreement into effect. Iran's nuclear program is now significantly reduced and restrained. Iran has disconnected and removed two-thirds of its installed centrifuge capacity for uranium enrichment, going from over 19,000 before the JCPOA to 5,060 operating today. This includes the termination of all uranium enrichment and the removal of all nuclear material from Fordow. Iran also reduced its stockpile of enriched uranium from roughly 12,000 kilograms, where it was when we reached the deal, to no more than 300 kilograms of up to 3.67 percent enriched uranium today, where it must stay. Iran has removed the core of the Arak reactor, which when operational could have produced weapons grade plutonium, and filled it with concrete so that it is no longer usable. The reactor will be redesigned to minimize the production of plutonium and not to produce significant amounts of weapons grade plutonium.

Before this deal, Iran's breakout time -- or the time it would have taken for Iran to gather enough fissile material to build a weapon -- was only two to three months. Now, because of the JCPOA, it would take Iran 12 months or more if they decided to pursue a nuclear weapons program.

Today the IAEA has in place the nuclear-related transparency measures specified in the JCPOA, including continuous monitoring of all Iran's declared nuclear facilities. Iran is now applying the provisions of its IAEA Additional Protocol, allowing access to any site in Iran requested by the IAEA, and is fully implementing the requirement of early notification of construction of any new nuclear facilities.

DOE Emergency Management Programs

DOE/NNSA maintains a wide range of capabilities in the core areas of crisis operations, consequence management, and emergency management.

Summary:
The Department of Energy (DOE) is responsible for several critically important emergency management missions. DOE's National Nuclear Security Administration (NNSA) is charged with coordinating the Department's Emergency Management Enterprise for all-hazard response. Also, NNSA's Office of Counterterrorism and Counterproliferation (NA-80) is responsible for responding to nuclear and radiological events that occur within the United States and abroad. DOE's Office of Electricity Delivery and Energy Reliability (OE) is responsible for facilitating responses impacting the Nation's energy infrastructure and assisting public and private partners with expediting restoration of energy infrastructure following major disasters. Both the NNSA and OE team coordinate to share resources and expertise to meet each of their respective missions.

Issue**:** DOE has three critically important emergency management missions:

- **Emergency Management Enterprise Response to All-Hazards.** DOE/NNSA is responsible for the safety and security of its personnel, facilities and environment throughout the nation. To ensure preparation for a response to any situation, the Deputy Secretary, through the Emergency and Incident Management Council, charged NNSA's Office of Emergency Operations (NA-40) with the creation and implementation of a response organization that would include the capabilities of the entire department, to include its field sites and laboratories. Functioning out of a central location, the response organization, when fully matured, will ensure DOE's flexible and scalable response to any situation.
- **Responding to Nuclear and Radiological Events.** NNSA has more than 60 years of experience responding to nuclear and radiological incidents and emergencies. NA-80 staffs, trains, and equips nuclear incident response teams of highly trained technical experts from DOE national laboratories, plants, and sites which are supported by home teams staffed with additional scientists and engineers. In the event of an incident involving a nuclear weapon or terrorist nuclear device, the Secretary of Energy has a critical coordination role with the Attorney General or the Secretary of Defense to inform the President and to provide assessments based on device design principles.
- **Securing the Nation's Energy Infrastructure.** Under the National Response Framework, DOE serves as the lead agency for Emergency Support Function 12 (ESF-12), which is responsible for maintaining and restoring our Nation's energy supplies. In addition, DOE is the "Sector Specific Agency" for energy infrastructure and resilience under Presidential Policy Directive (PPD-21). To meet these responsibilities, the Infrastructure Security and Energy Restoration (ISER) team, within DOE/OE, works closely with public and private sector stakeholders to secure the U.S. energy infrastructure against all hazards, reduce the impact of disruptive events, and respond to and facilitate recovery from major energy disruptions that affect both the electricity and oil & natural gas subsectors.

Status: Over the past two years, DOE has strengthened its emergency management program to ensure that the various DOE offices work together internally to respond to a variety of incidents, and that DOE coordinates effectively with partners in government and industry during emergencies.

- **Established the Emergency & Incident Management Council (EIMC).** In July 2015, Secretary Moniz approved the EIMC, which serves as the primary strategic coordination mechanism for senior Department leadership during significant emergencies that require the coordinated efforts of several sites or programs.
- **Developed the Unified Command Structure (UCS).** In December 2015, DOE adopted a UCS to increase cooperation and coordination across the Department as it prepares for, mitigates, responds to, and recovers from the full spectrum of "all-hazard" emergencies, including natural to manmade events. This structure directs the operational activities of DOE's multiple emergency operations components.
- **Overhauled the Disaster Exercise Program.** At the Deputy Secretary's direction, DOE has increased the use of disaster exercises to test and evaluate its capabilities for responding to energy sector emergencies.
- **Strengthened DOE's Partnership with the Energy Sector.** In 2015 and 2016, the Deputy Secretary led the Department's effort to strengthen our emergency management partnership the energy sector. Her efforts included close collaboration with the National Petroleum Council (NPC) and regular engagements with the Electricity Subsector Coordination Council (ESCC) and the Oil & Natural Gas Subsector Coordinating Council (ONG SCC).

Major decisions/events:

- **Provide Introductory Leadership Briefings.** As part of the transition process, briefings for the new DOE and NNSA leadership teams will be required to outline the Secretary's responsibilities in the event of a nuclear incident or major disaster impacting the nation's energy infrastructure.
- **Continue the Development of Plans for a Consolidated Emergency Operations Center (CEOC).** DOE has proposed the creation of a CEOC to allow the UCS to operate in a single facility. The CEOC would eliminate DOE's fragmented emergency operations center system and provide an all-hazards, unified, inclusive, and effective emergency management enterprise modeled on best practices in the federal government. NNSA's NA-40 team is pursuing a near-term effort to modify the 24/7/365 existing watch office space in support of an initial operational capability by December 2016, until a longer term solution can be put in place.
- **Continue to Strengthen Emergency Management Processes and Procedures.** NA-40 is addressing recent findings from the Defense Nuclear Facilities Safety Board (DNFSB), which recommended that the Department improve emergency management processes and procedures at DOE/NNSA facilities. DOE Order 151.1D, *Comprehensive Emergency Management System*, was revised on 15 July 2016 to standardize and enforce DOE's management and administration of the Emergency Management System complex wide.

- **Further Expand DOE's Exercise Program.** In 2017, there will be several opportunities to build-upon the recent improvements in DOE's exercise program. For instance, the fifth installment of DOE's "Clear Path" exercise is scheduled for next year.

Background:

Energy Infrastructure Incidents. The increase in natural and man-made threats in recent years has served to highlight the current vulnerabilities of the Nation's energy infrastructure. To address these threats, the U.S. Government has developed a number of policy directives and authorities to ensure that the nation's critical infrastructure can withstand adverse events and rapidly recover when disasters occur. Under these authorities, the Department has been assigned the following responsibilities:

- Prepare for disasters and energy emergencies.
- Provide situational awareness during energy-related emergencies.
- Facilitate the restoration of damaged energy infrastructure.

NNSA Major Capital Projects:
Uranium Processing Facility (UPF)
Mixed Oxide Fuel Facility (MFFF)
Chemistry and Metallurgy Research Building Replacement (CMRR)

Success on major NNSA capital projects is contingent upon stable and predictable funding and Congressional support of the President's Budget.

Overview: The Department of Energy's (DOE) National Nuclear Security Administration (NNSA) is currently managing three major capital projects--the Uranium Processing Facility (UPF) at Y-12, the Chemistry and Metallurgy Research Replacement (CMRR) Facility at Los Alamos National Laboratory, and the Mixed Oxide Fuel Fabrication Facility (MOX) at the Savannah River Site. Success on the first two of these major projects is contingent upon stable and predictable funding profiles and the Congressional support of the President's Budget. The FY 2017 Budget Request sought termination of the MOX project. If this request is approved MOX will transition from construction to close out.

NNSA has recently made major improvements in project management. For projects that fall below $750 million, all NNSA projects were removed from the Government Accountability Office's high risk list. Since 2011, NNSA has also delivered five percent of NNSA's total project portfolio under original budget.

Issue/Status:

UPF

The UPF Project will provide a new uranium processing facility needed to support the Nation's nuclear weapons stockpile, downblending enriched uranium for nuclear nonproliferation activities, and providing uranium as feedstock for fuel for naval reactors. In 2012, the Administration committed to cease programmatic operations in the aging Building 9212 and deliver the UPF Project for $6.5 billion by 2025.

The current funding profile for the UPF Project must be adjusted to meet the goal of project completion by 2025 and stay within the $6.5 billion goal. The FY 2018 President's Budget Request must make the necessary funding adjustments to support the UPF strategy and protect the project from further scope change, while maintaining the current codes and standards used in design as the project moves into construction.

The focus for FY 2017 is completing the UPF design. Several subprojects have completed their design phase and are authorized to start or have started construction. Consistent with NNSA's increased emphasis on project management rigor and Department policy, subproject Total Project Costs (TPCs) and baseline schedules will not be approved until the designs are sufficiently mature to support a credible cost and schedule estimate. NNSA will not set a performance baseline for nuclear subprojects until the buildings' designs are 90 percent complete. Two subprojects have achieved this level of design.

CMRR

The CMRR Project will ensure continuity in enduring plutonium analysis capabilities for the

NNSA's actinide-based missions in support of stockpile stewardship. NNSA currently conducts the plutonium analysis necessary to certify the stockpile in the Chemistry and Metallurgy Research (CMR) Facility. Continued use of the aged CMR facility is not sustainable; the facility began operations in 1952, and sits on a seismic fault line. Using the Department's best practices, the CMRR Project was restructured into smaller more manageable subprojects, significantly reducing project delivery risk.

The CMRR Acquisition Strategy is based on procurement strategies specific to each major component of the CMRR project in order to mitigate overall technical and schedule risk. The performance baselines for each subproject within CMRR will be established when 90 percent design is reached to allow credible cost estimates to be developed. NNSA has committed to cease programmatic operations in the CMR Facility by 2019. The first two subprojects have established cost and schedule baselines.

MOX

The MOX Project was designed to support NNSA's commitment to dispose of 34 metric tons of surplus weapons-useable plutonium, pursuant to the Plutonium Management and Disposition Agreement (PMDA) with the Russian Federation. Despite Russia's suspension of the PMDA, the United States remains fully committed to verifiably disposing of our surplus plutonium. The Administration proposed terminating the MOX Project in the FY 2017 President's Budget Request after determining that the MOX fuel approach will be significantly more expensive than anticipated and take decades longer to implement. The United States is pursuing an alternative disposition method that can be implemented decades sooner than the MOX fuel approach at a much lower cost and with fewer risks—dilute and dispose.

MOX facility construction began in 2007 and was baselined at a cost of $4.86 billion with a completion date of October 2016. Based on a FY 2017 U.S. Army Corps of Engineers estimate, at a current funding level of $500 million per year, the project is approximately 30-40 percent complete.

Numerous reviews have concluded that the lifecycle costs of the MOX fuel approach will be $50 billion or higher, and will require approximately $800 million to $1 billion annually for decades through the life of the program including construction and operations costs. In accordance with DOE Order 413.3B, a performance baseline deviation occurs when the approved total project cost, completion date, or performance and scope parameters cannot be met. Under this authority, the Department has determined that the completion date cannot be met, and has proposed starting MOX project termination procedures. At this time, the Department has not terminated the MOX program as Congress has not approved the request to terminate. The project does not have a current contract and performance measurement baseline for an effective management control. Any decision to terminate will be in accordance with future statutory requirements.

The State of South Carolina has sued the Department to enforce provisions of previous National Defense Authorization Acts that require the Department to begin removing plutonium intended for MOX, or pay fines to the State of South Carolina of up to $100 million per year, beginning in FY 2016.

MAJOR DECISIONS/EVENTS/MILESTONES

UPF MILESTONES IN FY 2017

Approval of Performance Baseline/Approval of Start of Construction - Main Process Building Subproject	1Q FY 2017
Approval of Performance Baseline/Approval of Start of Construction - Salvage and Accountability Building Subproject	4Q FY 2017
Approval of Performance Baseline/Approval of Start of Construction - Mechanical Electrical Building Subproject	2Q FY 2017
Approval of Performance Baseline/Approval of Start of Construction - Process Support Facility Subproject	3Q FY 2017
Approve Performance Baseline	4Q FY 2017

CMRR Milestones in FY 2017

Approval of Performance Baseline/Approval of Start of Construction - RLUOB Equipment Installation Phase 2	4Q FY 2017
Approval of Performance Baseline/Approval of Start of Construction - PF-4 Equipment Installation Phase 1	4Q FY 2017

MOX

In the event of a final decision to terminate the MOX program, the Department will direct the MOX prime contractor to develop a plan to terminate the project and begin to secure information, materials, and equipment at the job site to protect government assets and ensure the safety of workers. In general, the MOX prime contractor would begin termination of sub-contracts and leases. Where cost effective, the MOX prime contractor would be directed to complete existing sub-contracts and leases, but refrain from beginning any new procurements without government approval. The Department would also begin discussions to negotiate the final costs to terminate the contract. Notification of personnel actions would be made as required by applicable law.

Governance and Management Reform

NNSA must closely monitor the effectiveness of specific initiatives to ensure that governance reform stays on course.

Summary: DOE/NNSA's Governance and Management (G&M) Implementation Plan was developed in response to a range of recommendations from the Congressional Advisory Panel on the Governance of the Nuclear Security Enterprise (Governance Panel), the Commission to Review the Effectiveness of the National Energy Laboratories (CRENEL), and other external reviews. This plan catalogs the progress the Department has already made to improve the stewardship of the enterprise and details planned initiatives to further enhance performance. In 2014, the Governance Panel recommended to Congress that NNSA be moved away from the semi-autonomous structure established in the NNSA Act and reintegrated into DOE. Congress did not endorse this recommendation, but did direct NNSA to submit semi-annual reports on the status of the G&M Implementation Plan.

Issue: The Governance Panel report and other external reviews determined that significant and wide-reaching reform was needed to correct systemic problems in NNSA's management practices and culture, including building a cooperative partnership between NNSA and the Management and Operating (M&O) contractors that manage the NNSA site's on the Government's behalf. The G&M Implementation Plan identifies 41 specific initiatives to improve governance and management of NNSA's nuclear security enterprise. Although the majority of these initiatives will be fully implemented in early calendar year 2017, their effectiveness in improving governance and implementing the desired changes in NNSA's culture is already visible; nevertheless, progress should be assessed in the future.

Status: The G&M Implementation Plan outlines the management systems and 41 specific initiatives developed to track the completion of corrective actions and gauge their effectiveness. These initiatives were assigned to career federal managers for action, and the status is tracked monthly through the NNSA Management Council. As of mid-October, all actions are on schedule. As required by the *National Defense Authorization Act for FY 2016* (*FY 16 NDAA*), NNSA entered into an agreement with the National Academy of Sciences (NAS) and the National Academy of Public Administration (NAPA) to establish an Independent Assessment Panel (IAP) tasked to track NNSA's implementation of its governance and management reforms and assess the effectiveness of these reforms through 2020. The IAP will report to Congress starting in February 2017 and semi-annually thereafter on their observations regarding progress being made to clarify authorities and responsibilities, simplify oversight requirements, adopt best practices, and make NNSA laboratory expertise available to other government agencies and the private sector.

Major Decisions/Events:

- NNSA will have to maintain close alignment and integration with the IAP to ensure common understanding of the state of NNSA's governance improvements to inform the IAP's semi-annual communications with Congress (starting in February 2017).
- The new Administration should continue to participate in the crosscutting network of councils, boards, and working groups within DOE as this is a key component of improved coordination between DOE and NNSA.

Background: The *FY 2016 NDAA* mandated that the G&M Implementation Plan be prepared to identify needed improvements to the governance of the nuclear security enterprise. The G&M Implementation Plan meets NNSA's need for a comprehensive framework to improve governance and management. The plan describes NNSA's recent achievements and identifies 41 new initiatives that should be completed in early calendar year 2017.

The implementation plan was developed after fully analyzing the recommendations of three significant reports:

1. Governance Panel Report. Final Report of the Congressional Advisory Panel on the Governance of the Nuclear Security Enterprise, November 2014. (Governance Panel, or "Mies-Augustine," after Adm. Rich Mies and Norm Augustine, the panel's co-chairs) http://cdn.knoxblogs.com/atomiccity/wp-content/uploads/sites/11/2014/12/Governance.pdf

   NNSA Response: NNSA Comments: Final Report of the Congressional Advisory Panel on the Governance of the Nuclear Security Enterprise, May 2015. https://nnsa.energy.gov/response-on-governance-report

2. CRENEL Report. Final Report of the Commission to Review the Effectiveness of the National Energy Laboratories, October 2015. http://energy.gov/labcommission/downloads/final-report-commission-review-effectiveness-national-energy-laboratories

   DOE Response: Departmental Response to the Final Report of the Commission to Review the Effectiveness of the National Energy Laboratories, Report to Congress, February 2016. http://energy.gov/labcommission/downloads/departmental-response-final-report-commission-review-effectiveness-national

3. SEAB Lab Task Force Report. Report of the Secretary of Energy Advisory Board Task Force on DOE Laboratories, June 2015.

   DOE Response: Departmental Response: Assessment of the Report of the SEAB Task Force on National Laboratories. http://energy.gov/seab/downloads/interim-report-task-force-doe-national-laboratories

DOE's response to these three reports and their recommendations were integrated into common themes that were then used to develop the outline for the G&M Implementation Plan. Recommendations that were directed to other Government entities (e.g., President, Congress) were excluded unless there was an action that DOE could take to address the underlying concern. All recommendations were considered and the underlying intent of most were addressed in the plan.

While all 41 initiatives in the implementation plan are important for strengthening mission-driven management culture, the NNSA Administrator identified five initiatives within the list of 41 that were considered "core" to transforming NNSA into a highly effective organization:

1. Improving contract structures and incentives
2. Implementing effective and efficient oversight of the M&Os by the field offices;
3. Improving the stewardship and long term strategic planning for NNSA laboratories;
4. Improving NNSA policy administration; and,
5. Improving coordination of site reviews and site visits.

All NNSA initiatives are on track to be fully implemented by early calendar year 2017. As the Governance Panel points out, cultural change focused on restoring trust takes time, persistence, and follow-up. The new Administration will need to continue to evaluate and verify these initiatives to assure their effectiveness in reforming NNSA governance, and make any changes as necessary.

Ohio Class Submarine Reactor Plant Replacement

DOE/NNSA must replace the capabilities of the OHIO-Class SSBN in order to maintain the nuclear triad.

Summary: The OHIO-Class ballistic missile submarine (SSBN), which provides the sea-based leg of the nation's nuclear triad, is approaching the end of its useful life. As the most survivable leg of the triad, SSBNs play a critical role in the deterrence mission and will continue to do so for the foreseeable future. It is imperative that the Navy replace OHIO-class SSBN capabilities to ensure continuous and credible strategic deterrence. The Department of Energy's (DOE) National Nuclear Security Administration's (NNSA) Office of Naval Reactors is developing a reactor plant with a life-of-ship core and an electric drive propulsion plant to support the OHIO Replacement submarine.

Issue: Work to support the OHIO-Class Replacement submarine is tightly synchronized between Navy and DOE-funded propulsion plant work. The current OHIO-Class fleet has already been extended from a service life of 30 years to the current life of 42 years; the OHIO-Class cannot be extended further and will begin to retire in 2027 at a rate of one submarine per year.

Status: The first OHIO-Class Replacement must be delivered to the Navy in 2028 and deployed on strategic patrol by 2031 to ensure the SSBN force has enough operational ships to support U.S. Strategic Command (USSTRATCOM) requirements. During the initial introduction of the OHIO-Class Replacement, fewer than 12 SSBNs will be available to support operational requirements, with the full force level of 12 being realized by 2042.

Milestones: To meet increased operational availability, stealth, and energy requirements for the OHIO Replacement, design and development work must continue to support reactor plant core and component procurement in 2019 and ship construction start in 2021.

Milestone	Due Date
OR core/component procurement	2019
Start of lead ship construction	2021
Delivery of lead ship to the Navy	2028

Major Decisions/Events: The President's FY 2017 DOE and Navy Budget requests fully support the project's requirements. Maintaining support is critical to meeting the schedule and supporting USSTRATCOM requirements.

Background: One of the most significant requirements for the OHIO-Class Replacement is the life-of-ship (40+ years) core, which requires new reactor core technology. Naval Reactors is constructing a Technology Demonstration Core (TDC) for its land-based S8G prototype reactor at the Kesselring Site in West Milton, New York. TDC mitigates technical, cost, and schedule risks to the OHIO-Class Replacement ship construction program. The prototype refueling effort will also maintain vital research and testing capabilities while enabling Naval Reactors to continue training nuclear operators for the Fleet. The S8G Prototype must begin refueling overhaul in 2018, with a return to operations in 2021, in order to support the OHIO-Class

Replacement schedule. The S8G Prototype Refueling is also fully supported in the President's FY 2017 DOE Budget requests.

Naval Reactors Spent Fuel Handling Recapitalization Project

The Expended Core Facility must be replaced or risk adverse impacts on U.S. fleet operations.

Summary: The Expended Core Facility, located at the Naval Reactors Facility in Idaho, is the only facility in the country with the capabilities to receive naval spent nuclear fuel shipping containers and process naval spent nuclear fuel. Any disruption to these capabilities would require costly and time-consuming workarounds that would directly impact the ability of the U.S. Navy to complete its mission. Although the Expended Core Facility continues to be operated safely, its infrastructure and equipment is over 55 years old, it is deteriorating, and does not meet current standards for seismic design and water retention. The Spent Fuel Handling Recapitalization Project will replace the capabilities to receive, prepare and package naval spent nuclear fuel currently provided by the Expended Core Facility with a newly constructed facility.

Issue: Naval Reactors maintains total responsibility for all aspects of the U.S. Navy's nuclear propulsion systems, including research, design, construction, testing, operation, maintenance, and disposal. At the end of reactor service life, Naval Reactors transports naval spent nuclear fuel from its origin (i.e., naval spent nuclear fuel from servicing shipyards and naval training platforms) to the Expended Core Facility, located at the Naval Reactors Facility in Idaho. The Expended Core Facility is the only facility with the capabilities to receive naval spent nuclear fuel shipping containers and process naval spent nuclear fuel. The infrastructure and equipment at the Expended Core Facility does not meet current standards and must be replaced. The corrent facility is also incapable of receiving full-length aircraft carrier naval spent nuclear fuel, which is required to support aircraft carrier refuelings.

The magnitude of required sustainment efforts and incremental infrastructure upgrades poses substantial risk to continued processing of naval spent nuclear fuel for long term storage. An interruption of refueling and defueling schedules for nuclear-powered vessels, as required by existing maintenance schedules, would adversely affect the operational availability of the nuclear fleet. Interruptions extending over long periods would negatively affect the Navy's ability to sustain fleet operations.

Status: The Spent Fuel Handling Recapitalization Project will begin construction in FY 2019 and has an estimated total project cost of $1.65 billion. The Project began preliminary design work in FY 2015 and is focused on completing major facility design requirements to complete the preliminary design in the first quarter of FY 2018.

Milestones

Milestones	**Actual/Planned Dates**
Establish the Performance Baseline	Q1 FY 2018
Approval to Start Construction	Q4 FY 2018
Approval to Start Initial Operations	Q3 FY 2024
Approval to Start Remaining Operations	Q3 FY 2025

Major Decisions/Events: In addition to the above milestones, the following represent key decision points and events for the project.

- In late FY 2016, the Project published the *Final National Environmental Policy Act* Environmental Impact Statement
    - Early FY 2017, the Project will publish the *National Environmental Policy Act* Record of Decision
- Early FY 2017, the Project will start long lead material procurements
    - Late FY 2017, the Project will start site preparation for construction
    - Late FY 2024, the first M-290 shipping container with aircraft carrier spent nuclear fuel will be unloaded into the facility
    - Late FY 2025, the facility will be fully operational

Background: All naval spent nuclear fuel is shipped to the Expended Core Facility for examination and packaging for dry storage. In order to meet the Navy's refueling and defueling schedules, Naval Reactors began loading full-length aircraft carrier spent nuclear fuel into larger M-290 shipping containers in 2015. The current facility cannot support the receipt, preparation, and packaging of this full-length spent nuclear fuel. Additionally, per the 1995 Settlement Agreement, as amended in 2008, among the State of Idaho, the Department of Energy, and the Department of the Navy concerning management of naval spent nuclear fuel, naval spent nuclear fuel at the Naval Reactors Facility must be processed and placed into dry storage in a timely manner. Compliance with this agreement and Naval Reactors' ability to continue supporting fleet refueling and defueling schedules is dependent on a viable, efficient spent nuclear fuel handling infrastructure.

Low Enriched Uranium Cores

The Secretaries of Energy and the Navy must make a determination on whether the United States should pursue R&D of an advanced naval nuclear fuel system based on LEU.

Summary: Naval Reactors delivered a report to Congress, *Conceptual Research and Development Plan for Low-Enriched Uranium Naval Fuel*, dated July 2016, in response to a congressional request. In that report, Naval Reactors concluded that an advanced naval fuel development program would provide multiple benefits to the Department of Energy (DOE) and the Department of the Navy. A decision to pursue this type of R&D could advance fuel technology and sustain the cadre of highly specialized naval fuel experts and unique test infrastructure that are vital to naval nuclear propulsion operations. As a possible alternative to highly enriched uranium (HEU) reactors, a low enriched uranium (LEU) fuel system would also have positive national security implications. The proposed LEU fuel development program would span 15 years and is projected to cost approximately $1 billion in FY 2016 dollars.

Issue: Section 3118(c) of the *National Defense Authorization Act (NDAA), Fiscal Year 2016,* directs the Secretary of Energy and the Secretary of the Navy to jointly submit a determination on whether the United States should pursue R&D of an advanced naval nuclear fuel system based on LEU. If the determination is to pursue development immediately, funding to support additional staff and facilities would need to be requested beginning in the President's FY 2018 DOE Budget.

Status: The Secretaries of Energy and the Navy must make a determination on whether the United States should pursue R&D of an advanced naval nuclear fuel system based on LEU. This decision must come before Naval Reactors can request funding to begin research and development. Naval Reactors' resources are currently dedicated to supporting the existing Fleet and new design projects. Existing projects must continue without compromise or delay from any developmental work on LEU fuel. Costs for LEU fuel cannot be offset from existing NR or other NNSA funding sources.

Milestones: Irradiation testing programs will be used to determine whether to continue further research and development. The capacity of test infrastructure is likely to control the schedule. Below are some key milestones:

Milestone	Due Date
Identify if further pursuit is warranted with LEU fuel and identify laboratory infrastructure modifications	2021
Initial LEU irradiation test results and laboratory scale fabrication trials for 1st and 2nd LEU specimen	2027
Final results from the first LEU test and subsets of data from the second and third LEU tests	2032

Major Decisions/Events: The Secretaries of Energy and the Navy must make a determination on whether the United States should pursue R&D of an advanced naval nuclear fuel system based on LEU.

Background: Section 3118 of the *National Defense Authorization Act (NDAA), Fiscal Year 2016* and Division D Explanatory Statement accompanying the *Consolidated Appropriations Act, Fiscal Year 2016* directed the Deputy Administrator for Naval Reactors to submit a conceptual program plan for R&D of an advanced naval nuclear fuel system based on LEU. Section 3118(c) of the same NDAA directed the Secretary of Energy and the Secretary of the Navy to jointly submit a determination on whether the United States should pursue R&D of an advanced naval nuclear fuel system based on LEU. If the Secretaries issue a determination to pursue R&D, Department of Energy funding would need to be appropriately augmented.

Fuel research and development is expected to span at least 15 years. While success is not assured, this development has the potential to deliver a fuel that might enable an aircraft carrier reactor fueled with LEU in the 2040's, aligned to FORD class aircraft carrier procurement. This fuel is unlikely to enable converting current life-of-ship submarine reactors to LEU.

Hanford

The Hanford site in Washington state is the largest and most complex of EM's remaining cleanup sites. As a result, EM has to balance funding and priorities between Hanford and other EM sites. EM also has to balance priorities between the two offices that oversee work at Hanford – the Richland Operations Office and the Office of River Protection – at a time when budget needs are expected to significantly increase for the tank waste remediation mission.

Summary

- The Hanford site in Washington state measures 580 square miles and was used to produce plutonium for U.S nuclear weapons from the Manhattan Project through the Cold War. Production activities came to an end in 1989. Cleanup activities began that year and are currently projected to be completed in 2090.
- Cleanup activities at Hanford are managed by two EM offices – the Richland Operations Office (RL) and the Office of River Protection (ORP). RL is responsible for cleanup activities along the Columbia River corridor at Hanford, which have largely been completed; at Hanford's Central Plateau, which has considerable cleanup work remaining; and is responsible for the site's infrastructure and security. ORP is responsible for managing the cleanup of the 177 underground high-level waste tanks at Hanford, including construction of the Waste Treatment and Immobilization Plant.
- EM's work at Hanford is governed by the Tri-Party Agreement among DOE, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency; and the federal court-ordered 2016 Amended Consent Decree between DOE and Washington state. While both documents contain enforceable milestones for completing cleanup activities, the Consent Decree is primarily focused on the tank waste cleanup mission. The TPA contains enforceable milestones for both RL and ORP.
- EM's total annual budget for cleanup activities at Hanford is approximately $2.4 billion, or approximately one-third of the entire annual EM budget. Hanford's remaining cleanup costs through FY 2090 are estimated to be approximately $107.7 billion, of which RL workscope accounts for approximately $52 billion and ORP workscope accounts for approximately $55 billion.

Issues

EM needs to balance priorities and funding to continue to make progress in the cleanup activities overseen by the Richland Operations Office, while facing significant increasing costs for ORP for completing the Hanford Waste Treatment and Immobilization Plant. EM may need to further balance funding for the growing cleanup costs at Hanford with funding for the other remaining cleanup sites across the country.

EM will need to compete a new set of cleanup contracts at Hanford, to replace those set to expire post-FY 2018. These acquisitions are being coordinated between Richland and the Office of

River Protection and will primarily focus on cleaning up the Central Plateau of the Hanford Site and operations related to the high-level waste tanks. These new contracts are expected to be worth a total of several billion dollars and will be of heavy interest to the contractor community.

EM is also working to address concerns over potential exposure to chemical vapors from Hanford's underground high-level waste tanks.

Status

In late 2015, DOE completed the bulk of the cleanup activities in the 220-square mile Columbia River Corridor region at Hanford. This resulted in:

- Six of the nine former production reactors being placed in an interim safe storage condition known as "cocooning";
- One former production reactor (B Reactor) preserved as part of the Manhattan Project National Historical Park;
- Approximately 16 million tons of waste removed;
- More than 1,200 waste sites remediated; and
- More than 500 facilities demolished.

The remaining cleanup activities in the River Corridor region include:

- Addressing highly contaminated soil under Building 324 and demolition of the building itself;
- Completing remediation of the 618-10 burial ground and associated waste sites; and
- The K Basins sludge project, which involves packaging and transfering radioactive sludge currently stored at the K West Basin to T Plant for eventual treatment for off-site disposal.
- Following the removal of radioactive sludge from the K West Basin, remediating the remaining facilities and waste sites in the K Reactors Area, including "cocooning" of both K Reactors; and
- Continued operation of five pump-and-treat facilities to continue groundwater remediation efforts.

With the River Corridor work largely completed, RL is shifting focus toward cleanup activities at the Central Plateau region of Hanford using its 2020 Vision. In the fall of 2016, RL began demolition of the main facilities at the Plutonium Finishing Plant (PFP), which produced hockey puck-sized plutonium "buttons" for use in nuclear weapons production. The PFP was once known as one of the most dangerous buildings in the DOE complex, and demolition of the plant to the slab level is expected to take approximately one year to complete. Once demolition of PFP is completed, remaining work at PFP will focus on remediation of pipelines; waste sites and waste water discharge ditches; and cribs (waste disposal structure similar to a septic system drain field but for liquid effluent from low level radioactive waste operations). Work to remediate the PFP subgrade items is scheduled to start in FY 2024, funding dependent, and continue through FY 2035.

Over the next decade, RL plans to begin tackling a number of remaining cleanup projects, including:

- Completing the transfer of more than 1,900 cesium and strontium capsules (representing more than 40% of the radioactivity at Hanford) from wet storage to dry storage;
- Remediating thousands of waste sites and demolishing hundreds of contaminated facilities;
- Completing key infrastructure upgrades to support future cleanup work on the Central Plateau;
- Treating billions of gallons of contaminated groundwater;
- Retrieving and treating large qunatities of contact- and remote-handled transuranic waste for eventual off-site shipment;
- Initiating disposition of Hanford's former "canyons," the facilities where plutonium was removed from spent nuclear fuel for processing at the Plutonium Finishing Plant (PFP); and
- Transitioning the Manhattan Project National Historical Park to stand-alone Park operations.

At ORP, cleanup activities are focused on retrieving waste from Hanford's aging single-shell tanks and transferring the material to the more-robust (but also aging) double-shell tanks for storage prior to treatment for final disposal, and design and construction of the Waste Treatment and Immobilization Plant, which will vitrify tank waste for final disposal.

To date, ORP has completed retrieval activities at 16 of the 149 single-shell tanks. Retrieval activities are currently underway at single-shell tank C-105, which had a total of 122,000 gallons to be removed. C-105 is the last single-shell tank in the C Tank Farm to undergo waste retrieval activities. In FY 2017, ORP plans to initiate waste retrieval activities from single-shell tanks in the AX tank farm.

Retrieval activities are also underway at double-shell tank AY-102. In 2012, a small amount of waste was discovered leaking from the primary shell into the annulus, the space between the inner and outer shells. Extensive monitoring shows no indication any waste has leaked to the environment from this tank. In September 2014, after an administrative order from the Washington State Department of Ecology, DOE reached an agreement with the state of Washington, creating a path forward to remove the waste from AY-102. The agreement requires DOE to complete waste retrieval no later than March 4, 2017. As of September 2016, approximately 95 percent of the material from AY-102 has been retrieved and transferred to another Hanford double-shell tank.

One factor that has complicated tank waste retrieval activities is concerns over potential exposure to chemical vapors from the Hanford tanks. In 2014, after two dozen workers reported potential chemical vapor exposure, tank operations contractor Washington River Protection Solutions (WRPS) chartered an independent review of the matter by national experts, led by Savannah River National Laboratory. The Tank Vapor Assessment Team (TVAT) identified 10 overarching recommendations and 47 specific recommendations to prevent or mitigate exposures, which DOE and WRPS are addressing.

In September 2015, the State of Washington, and separately, the United Association of Steamfitters and Plumbers, Local 598, and the watchdog group Hanford Challenge, filed lawsuits in federal court against DOE and WRPS over the tank vapor issue. The suits are still in active litigation. In the spring of 2016, more than 55 workers reported stronger than normal odors or associated symptoms, or were workers in the vicinity of those who reported odors or symptoms. After undergoing the required medical evaluations, all of those workers were cleared to return to work.

Ongoing monitoring and sampling conducted to date within worker breathing zones indicate that the chemical components in any vapors are well below Occupational Exposure Limits (OELs), and below the more stringent administrative limits the Department has set. Based on the available data and the safety measures WRPS has implemented, DOE believes workers are safe while at the worksite at Hanford. However, DOE understands workers are concerned and is working to better understand the circumstances and reduce concerns of potential vapor exposure.

Over the last two years, WRPS has taken significant steps to enhance the tank farm industrial hygiene program, including hiring an additional 150 industrial hygiene professionals; improving industrial hygiene and worker training; and increasing worker communications. DOE is investing tens of millions of dollars into research, development, and bench and field testing of new detection devices, analyses methodologies, and monitoring technologies.

DOE and WRPS are currently adapting and deploying a comprehensive and integrated test array of state of the art chemical monitoring technology for use at the tank farms. This includes infrared cameras; portable area sensors; in-stack and area vapor detection equipment; and portable meteorological stations to help monitor weather conditions. Bench-scale testing of the equipment array was completed this spring, and a large pilot-scale testing of these technologies at Hanford's A, AX, and AP tank farm began late this summer.

Milestones

Significant Upcoming TPA Milestones

- Complete PFP demolition by Sept. 30, 2017.
- Complete 105-KW sludge transfer equipment installation by Sept. 30, 2017.
- Complete 300 Area remedial actions including the 618- 10 burial ground.
- By Sept. 30, 2019, complete remote excavation of the waste site under Building 324 (300-296) in accordance with an approved Remedial Design/Remedial Action (RD/RA)Work Plan.
- Begin sludge removal from 105-KW Fuel Storage Basin by Sept. 30, 2018.
- Complete sludge removal from 105-KW Fuel Storage Basin by Dec. 31, 2019.
- Initiate deactivation of 105-KW Fuel Storage Basin by Dec. 31, 2019.
- By Sept. 30, 2021, complete remedial actions for the waste site under Building 324 (300-296) in accordance with RD/RA Work Plan for 300-FF-2 Soils (DOE/RL-2014-13-ADD1) and disposition for the 324 Building and Ancillary Buildings in accordance with the Removal Action Work Plan (DOE/RL-2004-77).

- By Sept. 30, 2024, complete U Plant canyon (221 U Facility) demolition in accordance with the RD/RAWork Plan.

Upcoming 2016 Amended Consent Decree Hanford Tank Farm Milestones

- Retrieval of five single-shell tanks by Dec. 31, 2020.
- Retrieval of 19 identified single-shell tanks by March 31, 2024.

Major Decisions/Events

DOE is developing an acquisition strategy to replace the Hanford cleanup contracts set to expire post-FY 2018. These contracts are worth tens of billions of dollars and are expected to be of significant interest to the DOE contracting community, local community, Congress, and others.

This fall, pending the results on testing currently underway, DOE and WRPS will decide whether to propose moving to use of cartridge respirators, which could reduce or eliminate the need for the heavy bottles of air required when using supplied air. Also, implementation of the Phase 2 actions from the TVAT assessment may begin.

Background

The Hanford Site sits on 580-square-miles of shrub-steppe desert in southeastern Washington State. Beginning in 1943, the site was used to produce plutonium for the bomb that brought an end to World War II. After a short lull, production was ramped up in 1947 to meet the challenges of the Cold War and continued until 1989 when production at the Plutonium Finishing Plant ended. Weapons production processes left solid and liquid wastes that posed a risk to the local environment including the Columbia River. In 1989, the U.S. Department of Energy (DOE), Environmental Protection Agency (EPA), and Washington State Department of Ecology entered into a legally binding accord, the Tri-Party Agreement (TPA), to clean up the Hanford Site.

The Richland Operations Office (RL) is responsible for overseeing the cleanup along the Columbia River Corridor and at Hanford's Central Plateau, as well as overseeing groundwater remediation efforts. The 220-square mile River Corridor region included the former fuel fabrication facilities at Hanford's 300 Area, just north of the city of Richland, WA, and nine former plutonium production reactors along the Columbia River. Among the fomer production reactors is B Reactor, which was the first-large scale nuclear reactor ever constructed. B Reactor is now part of the Manhattan Project National Historical Park.

Hanford's Central Plateau region contains former plutonium fuel processing facilities, waste disposal areas, and industrial-sized facilities that once refined plutonium fuel into its final product. Within the Central Plateau are five Canyon Facilties; the Plutonium Finishing Plant; waste storage and processing areas; and numerous burial grounds and waste sites. Also located in the Central Plateau region is Hanford's on-site disposal facility for low-level waste, known as the Environmental Restoration Disposal Facility (EDRF). ERDF marked 20 years of successful operations in July 2016, and is seen as one of the major factors in the successful completion of the bulk of the cleanup in the River Corridor region.

The groundwater treatment project includes a number of injection and extraction wells feeding five pump-and-treat facilities in the River Corridor 100 Area near the reactors, as well as a state-of-the-art groundwater pump-and-treat facility in the Central Plateau 200 West area, which has a maximum capacity to treat up to 2,500 gallons of water per minute. Since the first pump-and-

treat systems began in the 1990s, several billion gallons of contaminated groundwater have been treated. The primary focus of the project today is a 60-square-mile area containing billions of gallons of contaminated groundwater. The aim is to remove a number of chemical and radiological contaminants, including cesium, hexavalent chromium, and carbon tetrachloride, among others.

RL's set of contractors includes:

- CH2M HILL Plateau Remediaiton Co. (CHPRC), responsible for the remaining River Corridor cleanup activities and for cleanup work in the Central Plateau region. CHPRC's contract expires in September 2018.
- Mission Support Alliance, LLC (MSA), responsible for site-wide services. MSA's contract is currently set to expire in May 2017. One two-year option period is available to be exercised.
- HPM Corporation (HPMC), responsible for occupational health services. HPMC's contract is currently set to expire in September 2017. One one-year option period is available to be exercised.

The Office of River Protection (ORP) is responsible for the retrieval, treatment, and disposal of high-level radioactive tank waste at Hanford that resulted from plutonium processing activities. ORP was established through legislation sponsored by then-Congressman Doc Hastings to place an additional focus on the tank waste mission at Hanford. ORP's authorization has been extended to 2019.

There is approximately 56 million gallons of waste stored in a total of 177 underground tanks. Of the 177 tanks, 149 are single-shell tanks built between 1943 and 1964, of which 67 are known or are suspected to have leaked into the underlying soil. The remaining 28 are double-shell tanks built between 1968 and 1986. DOE has completed the removal of all pumpable liquid from the single-shell tanks and has transferred the material to the double-shell tanks for more robust interim storage prior to beginning waste treatment for final disposition. ORP is currently working to retrieve semi-solid waste from the single-shell tanks to transfer to the double-shell tanks pending final treatment and disposition. To date, ORP has completed retrieval activities at 16 single-shell tanks.

Workers at the Hanford tank farms have, over the years, periodically reported health and safety concerns related to potential chemical vapors from the underground waste tanks. The tank waste generates hydrogen, which needs to be vented to the atmosphere to prevent potentially flammable concentrations of gases in the tanks.

Hanford tank farms contractor Washington River Protection Solutions has made several modifications to reduce tank vapor hazards and provide long-term protection, including identifying fugitive leak sources around all 149 single-shell tanks, sealing those locations with foam, thereby stopping vapors from escaping through unfiltered pathways; increasing the height of ventilation system exhaust stacks; and increasing the speed of the exhaust through the stacks.

DOE is in the midst of constructing the Hanford Waste Treatment and Immobilization Plant (WTP) to vitrify the Hanford tank waste for final disposition, either on-site at Hanford or in a national geological repository. The WTP consists of five sections—the Low Activity Waste Facility, the High-Level Waste Facility, the Pretreatment Facility, the Analytical Laboratory and

a colleciton of about 20 support facilities known collectively as Balance of Facilities. The WTP is the subject of a separate issue paper.

ORP's set of cleanup contractors includes:

- Washington River Protection Solutions (WRPS), responsible for the Hanford tank farms and retrieval of waste from the single-shell tanks. The WRPS contract expires in September 2018.
- Bechtel National Inc. (BNI), which is responsible for design and construction of the WTP. This is a completion contract.
- Wastren Advantage Inc. (WAI), responsible for analysis and testing services at the 222-S Laboratory. WAI's contract is currently set to expire in September 2017. Three one-year option periods are available to be exercised.

Hanford Waste Treatment and Immobilization Plant (WTP)

The WTP is the Department of Energy's largest, most complex and most expensive single project. While EM has taken steps to improve management and oversight of the project, it continues to face significant technical, cost and schedule challenges completing and operating the plant. The facility is essential for the completion of the Hanford tank waste disposition mission.

Summary:

- Hanford's Waste Treatment & Immobilization Plant (WTP) is being designed and built to vitrify (convert into glass) the waste currently stored in 177 aging underground tanks.
- Since 2013, EM has been pursuing an approach to commissioning and starting up sections of the WTP intended to begin actual waste treatment as soon as 2022, while the technical issues are fully resolved at other sections of the plant. This approach also requires the addition of a Low-Activity Waste Pretreatment System (LAWPS) facility.
- EM currently faces court ordered milestones to complete commissioning of the WTP Low Activity Waste (LAW) Facility by December 31, 2023; and to have the WTP fully operational by 2036.
- The states of Washington and Oregon have put considerable political and legal pressure on DOE to complete the Hanford facility cleanup and disposition legacy nuclear waste soonest.

Issue

The WTP is a design-build project that is being built to immobilize the legacy nuclear waste stored in 177 aging underground tanks, putting the material in a glass form for disposal. WTP includes three primary nuclear and chemical processing facilities – the LAW Facility, High-Level Waste (HLW) Facility and Pretreatment (PT) Facility. The Analytical Laboratory and about 20 facilities (known as the Balance of Facilities (BOF) are also part of the WTP.

In 2012, due to the extent of remaining technical issues, the Department suspended production engineering and construction on the PT Facility, and production engineering on the HLW Facility, limiting construction to those areas not impacted by technical issues, to focus on resolving remaining technical issues; and shifted design and construction focus to other facilities. In order to resolve the remaining complex technical issues, full scale vessel testing (FSVT) was also initiated. FSVT is expected to be completed by the end of FY2018.

In 2013, the Secretary announced a phased approach to Hanford's tank waste treatment, including a strategy that would allow low activity waste to be directly fed to the LAW Facility for vitrification, by-passing the PT Facility. This direct feed low activity waste (DFLAW) strategy would facilitate commencing the treatment of low activity as soon as December 2022.

The DFLAW stategy requires the construction of a stand-alone interim pretreatment system – known as the Low-Activity Waste Pretreatment System (LAWPS). LAWPS is being designed

under the tank operations contract, and will use mature technologies to provide the waste separation capability to support DFLAW. Located between the tank farms and the LAW Facility, LAWPS will be used to remove the solids and cesium from the liquid waste stream, returning them to the tanks and feeding the resulting LAW to the LAW Facility for treatment. In addition to supporting the DFLAW initiative, LAWPS creates secondary separation capabilities that will provide future operational flexibility to continue waste treatment if the PT Facility is taken out of service.

Status

Significant progress has been made on the sections of the WTP necessary to achieve DFLAW. As of the end of August 2016, the LAW Facility is more than 80 percent complete, and construction is expected to be completed in 2018. The Analytical Laboratory is more than 94 percent complete. Construction of the Balance of Facilities is more than 88 percent complete, including the Switchgear Building that will be before the end of 2016, representing a major step toward providing electricity directly to the WTP site.

In addition, WTP workers have started implementing the modifications necessary to support DFLAW, including the design and beginning of construction of the Effluent Management Facility (EMF), where evaporator systems are being relocated from the PT Facility to be closer to DFLAW operations; and several support facilities are nearing completion. The LAWPS designis more than 30 percent complete.

Design and construction activities at the HLW and PT facilities were largely halted in 2012 due to the need to resolve remaining technical issues. These issues involve:

- Pulse-Jet mixing and control mechanisms;
- Hydrogen gas buildup and release from vessel solids;
- Criticality in Pretreatment Facility Vessels;
- Hydrogen gas accumulation in piping and ancillary vessels;
- Erosion and localized corrosion in vessels and piping;
- Design redundancy in black cells/in-service inspection;
- Black cell vessel structural integrity;
- Facility ventilation; and
- Waste feed preconditioning requirements.

EM has made significant progress in working to address these technical issues, and all eight are expected to be fully resolved by the end of FY2018.

Milestones

On March 11, 2016, the Court issued an Amended Consent Decree, extending the dates for the original remaining WTP milestones. These included requiring substantial completion of the LAW Facility by Dec. 31, 2020; start of LAW Facility cold commissioning by Dec. 31, 2022; and completion of LAW hot commissioning by Dec. 31, 2023. The Court also extending the milestone for all WTP plant operations to be initiated by December 31, 2036 – 14 years beyond the previous milestone for full plant operations.

Major Decisions/Events

As soon as FY-18, EM will need to request additional funds for the WTP to support work necessary to begin LAW Facility hot commissioning by the December 31, 2023 milestone, as well as to proceed with work in other areas of the plant as needed to meet the 2033 milestone for hot commissioning of the PT and HLW facilities, and the 2036 milestone for initial operations of the full WTP.

Background

The WTP is intended to treat the radioactive waste stored in 177 aging underground storage tanks for disposition. As initially contracted, all of the WTP facilities would be commissioning in parallel, with all tank waste fed directly to the PT Facility, where it would be separated into two waste streams (HLW and LAW), and subsequently fed to either the HLW or LAW facility for vitrification.

The LAW containers would be disposed of onsite, while the HLW canisters would stored until eventually be shipped offsite for disposal at a geological repository. The WTP analytical laboratory is intended to provide necessary sampling analysis, while the BOF includes various infrastructure and support facilities for the WTP.

The Department awarded the design-build contract to BNI in December 2000. The contract required BNI to assume an incomplete conceptual design for a pilot scale facility, while advancing the design in parallel with construction, to be completed in 2007, when the entire project would be simultaneously commissioned. The total project cost was $4.35 billion.

Over the course of the project's development, the design and execution strategy significantly evolved to reflect changing technical understanding of the waste streams and risk mitigation strategies. DOE's engineering, procurement, and commissioning contract with BNI similarly evolved to align the scope of work and required activities with the updated strategy, resulting in several contract modifications. This evolution included significant design changes, melter reconfiguration, plant capacity increases, and commissioning strategy changes.

In the summer of 2012, the Department directed BNI to suspend production engineering and construction on the PT Facility, and to limit construction activities on the HLW Facility to those areas not impacted by technical issues.

There are nine technical issues currently under resolution, of which three are expected to be closed by the end of 2016. Resolution of these three technical issues facilitates resumption of full production engineering and construction for the HLW Facility. The Department anticipates the remaining six technical issues will be closed by the end of 2018.

Because the WTP design had anticipated that all waste would be first processed through the PT Facility, and the construction of this facility is delayed, DOE developed an alternative approach intended to begin low activity waste treatment as soon as practicable while simultaneously completing resolution of the remaining technical issues associated with the PT, and to a lesser degree HLW, facilities. This alternative approach, DFLAW, may be able to begin low activity waste treatment as soon as December 2022.

DFLAW is expected to provide a number of significant benefits, including beginning actual waste treatment as soon as 2022, approximately 14 years before the rest of the WTP is operational; significantly aids in management of available double-shell tank space; provides

operational expertise that will benefit the commissioning and startup of the PT and HLW facilities; and creates secondary separation capabilities that will allow future operational flexibility to continue waste treatment if one system is taken out of service.

Uranium Enrichment
Decontamination and Decommissioning (UED&D) Account

Without adequate funding to continue EM cleanup at the three former gaseous diffusion uranium enrichment sites, the pace of cleanup activities and related workforce will be affected.

Summary
Funding for the EM cleanup at the three former gaseous diffusion uranium enrichment sites (Oak Ridge, TN; Portsmouth, OH; and Paducah, KY) has been constrained despite the use of both funds from annual appropriations as well as the transfer of excess natural uranium.

Issue
With the decline of price of uranium over the last several years, barter proceeds have also declined, resulting in required increases in discretionary appropriations to fund UED&D cleanup at the three sites. With the expected depletion of DOE's excess natural uranium by 2020, significant increases in appropriated funds would be required to sustain clean-up efforts beyond 2020.

Status

The FY2017 Congressional Budget Request included the following funding request for the cleanup of the former gaseous diffusion facilities: Oak Ridge, TN - $178 million; Portsmouth, OH - $258 million and Paducah, KY - $208 million.

DOE has also funded a portion of the cleanup at Portsmouth with natural uranium transfers from its excess natural uranium stockpile. The amount of natural uranium transferred each year is planned to remain constant at approximately 1,600 metric tons. The quantity of natural uranium remaining in the stockpile will permit the transfer to continue through the middle of FY 2020. The spot price of uranium has fallen by 40 percent this year, thus significantly affecting the pace of cleanup afforded with this budget .

The cleanup estimates for future work are: Oak Ridge - $1.4 billion with a current projected completion of FY 2024; Portsmouth - $11.1 to $11.9 billion with a current projected completion of FY 2044; and Paducah - $9.5 to $10.5 billion with a current projected completion of FY 2040.

Recognizing that the barter funding will not continue after the middle of 2020 at the latest and cleanup at the sites is expected to continue over a much longer period, DOE developed a funding alternative. The FY 2017 Budget Request proposed use of mandatory funding from the USEC Privatization Fund instead of discretionary appropriations for UED&D cleanup activities but the House and Senate Energy and Water Development Appropriations bills continued to provide only discretionary funding for the sites.

Major Decisions/Events
A long-term strategy for continuing cleanup amid funding and uranium barter issues needs to be addressed in the development of the FY 2018 Budget Request.

Background
A. Funding Alternatives
The following funding considerations affect the availability of funding for cleanup of the former gaseous dissusion sites in FY 2017.

1. Uranium Transfer Program

The transfer of excess uranium for services has supplemented appropriated funds to support programs for downblending of highly-enriched uranium (HEU) to low-enriched uranium (LEU) for the National Nuclear Security Administration (NNSA) and the cleanup of the Portsmouth Gaseous Diffusion Plant for EM. In FY2016, the barter of LEU downblended from HEU provided $21.5 million for the downblending operation and the barter of natural uranium provided $134 million for cleanup services at Portsmouth. In accordance with the USEC Privatization Act, for certain uranium transfers to proceed it is required that the Secretary determine the transfers "will not have an adverse material impact on the domestic uranium mining, conversion or enrichment industry, taking into account the sales of uranium under the Russian HEU Agreement and the Suspension Agreement." DOE issued its most recent determination on May 1, 2015, which covers transfers to be conducted over the following two-year period. See separate transition paper on the need for a new Secretarial Determination by May 1, 2017.

2. Availability of Appropriations Funding

The Bipartisan Budget Acts (BBA) of 2015 established government-wide discretionary spending caps for FY 2017 that approximate the FY 2016 level, making it difficult to substantially increase FY 2017 appropriations for UED&D cleanup activities. During Congressional deliberations on the FY 2017 Congressional Budget Request, modest increases were proposed for the Oak Ridge and Portsmouth sites.

3. Additional Funding Sources

The FY 2017 Budget Request proposed additional funding sources available to Congress to support UED&D cleanup in a manner that would augment current funding sources. The Treasury currently holds nearly $5 billion in three separate funds:

- The UED&D Fund current balance is $ 2.525 billion.
- The Uranium Supply and Enrichment account current balance is $0.86 billion in unappropriated receipts.
- The USEC Fund, current balance is $1.6 billion, which can be accessed legislatively outside the BBA caps.

Use of either of the first two funds requires additional appropriations, which would score against the BBA caps. The President's FY2017 Budget proposed legislation to authorize the Department to access these three funds; however, the Congress has not been supportive.

4. Proposals to Reauthorize Utility Assessments

The FY 2017 and previous budget requests proposed to reauthorize the collection of utility assessments that expired in 2007. Reauthorization of the industry assessments could provide $200 million annually, credited as discretionary collections. Over the last seven years, Congressional interest in this proposal has been mixed, but in FY 2017, both the House and Senate bills excluded this proposal.

Waste Isolation Pilot Plant (WIPP)

Disposal of transuranic waste at WIPP - the nation's only geologic repository for permanent disposal of transuranic waste from the nation's nuclear defense program - has been suspended since 2014, when two unrelated incidents occurred. DOE estimates the resumption of emplacement operations as early as the end of 2016, but additional time may be needed to assure the facility can safely resume emplacement operations.

Summary:

- The Waste Isolation Pilot Plant (WIPP), located near Carlsbad, New Mexico is the nation's only geologic repository for permanent disposal of nuclear waste known as transuranic waste.[1] The repository, constructed in the 1980's for disposal of defense-generated transuranic waste, has been disposing of transuranic waste since 1999.

- Transuranic waste is long lived and has to be isolated to protect public health and the environment. Deep geologic disposal in salt beds was chosen because the salt is free of flowing water, easily mined, impermeable, and geologically stable. Salt rock also naturally seals fractures and closes openings.

  In February 2014, two unrelated incidents led to the suspension of transuranic waste receipt and emplacement activities at WIPP: a salt haul truck fire in the underground and a radiological release from waste in the repository.
- The Accident Investigation Boards identified multifaceted corrective actions that must be addressed before WIPP can resume operations. DOE is completing recovery efforts to resume waste operations in coordination with regulatory agencies and stakeholders.

- The corrective actions include robust upgrades to nuclear safety, fire protection, radiological controls, emergency management, procedure review and updates, federal oversight, training, and validation of certified TRU waste in storage to ensure it meets more stringent waste acceptance criteria for chemical compatibility and other requirements.

- If WIPP resumption occurs as early as the end of 2016, the total estimated cost of the recovery effort is approximately $244 million. This includes activities such as facility program enhancements; revision of the WIPP Documented Safety Analysis (DSA) which establishes the facility's safe operating envelope; underground habitability and ground control; facility upgrades such as interim and supplemental ventilation systems; fire protection systems. The two line item capital asset projects, Safety Significant Confinement Ventilation System and Exhaust Shaft, are not included in this cost, but are necessary to

[1] Transuranic waste (or TRU) consists of clothing, tools, rags, residues, debris, soil and other items contaminated with small amounts of plutonium and other man-made radioactive elements.

achieve full operational capacity in the 2021-2022 timeframe. This also does not include activities that occur under WIPP's base operations (e.g., waste characterization and certification, waste transportation, waste disposal, facility projects, environmental compliance, administrative programs).

- DOE is implementing new and enhanced oversight of federal and contractor activities to prevent a recurrence of the 2014 events and ensure safe and sustainable long-term operations.

- The suspension of waste receipts for disposal at WIPP has created challenges for waste generator sites to meet regulatory compliance milestones and commitments. For example, the Idaho Settlement Agreement requires all legacy TRU waste to be removed from Idaho by December 31, 2018.

- In March 2016, the Department issued a Record of Decision for the Disposition of Non-Pit Plutonium for the Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement. The Record of Decision outlined DOE's path forward to prepare and process six metric tons of surplus non-pit plutonium at the Savannah River Site for disposal at WIPP. After the material is diluted at the Savannah River Site, the plutonium will be disposed using a proven process that has been used in emplacing surplus plutonium currently at WIPP.

Issue
The goal for resumption of waste emplacement operations at WIPP is December 2016. This schedule has no remaining contingency.

Status
The activities prior to resuming waste emplacement are: complete corrective actions from the Contractor Operational Readiness Review (ORR), perform DOE ORR, and complete corrective actions from the DOE ORR.

Safety is the DOE's highest priority, and ground control is paramount to ensuring the safety of workers underground. Ground control – ensuring the stability of the mine area – consists of installing roof bolts and removing unstable salt rock through scaling and mining to ensure the ground in the mine is stable. There have been several roof falls in late September/early October in the underground. They have occurred either in prohibited areas of the underground where no personnel are allowed or as a result of ground control operations in a manner that ensured worker safety. The Department is beginning the process of drafting a plan to close the far south end of the mine. The decision to do this was made after balancing worker safety issues, overall issues related to rock bolting and ground control in contaminated areas, efficient use of resources, and long term integrity of the underground. Ground control activities will take priority over all other operations. DOE will only resume waste operations when it is safe to do so.

Milestones
The WIPP contactor's integrated performance measurement baseline established December 2016 as the goal for resuming WIPP operations. There is no remaining schedule contingency should

delay(s) result from the need to address corrective actions identified during the two operational readiness reviews or from ground control activities to ensure the safety of the WIPP underground.

The existing ventilation system was modified in 2016 to include additional filter units and increased air flow capacity to support occupancy and operation of underground equipment. A supplemental ventilation system was installed to provide even more air flow to support interim operations.

Completion of two capital asset projects for the new permanent ventilation system and exhaust shaft are required to achieve full ventilation flow to allow simultaneous waste disposal and mining operations and hence the return to pre-incident waste emplacement rate (approximately 17 shipments per week). The new ventilation system is estimated to be operational in the 2021-2022 timeframe. (An interim ventilation system was installed and went into operation in September 2016, which doubled the airflow over what was available since the two incidents.) After the radiological event in February 2014, the system had been operating in the HEPA filtration mode at a reduced ventilation capacity. Increasing ventilation capacity supports worker safety, mining, and waste emplacement.

Following the completion of the pre-start findings from the Contractor ORR and completion of the DOE ORR and the resolution of all pre-start findings, the field office will serve as the approval authority for resuming emplacement operations. It is anticipated that priority will be given to emplacement of waste currently stored above ground at WIPP, with shipments to WIPP to begin after waste stored above ground is emplaced. New shipments are anticipated to be based initially on an estimated emplacement rate of up to five shipments per week.

Major Decisions/Events

DOE is working on a schedule for future waste receipts. The rate of waste receipts will be limited until the permanent ventilation system is operational. Regulatory agencies and stakeholders are highly interested in the shipping priorities.

DOE-Carlsbad Field Office (CBFO) issued the WIPP Waste Acceptance Criteria (WAC), Revision 8.0, effective July 5, 2016, incorporating corrective actions from the Accident Investigation Board Reports and from the revised WIPP DSA (Revision 5). The following activities are ongoing to ensure that TRU waste received at WIPP in the future is safe and compliant:

- There is a substantial backlog of already packaged and previously certified TRU waste that requires validation against the revised WIPP WAC requirements in order to ship after waste emplacement operations resume. The Idaho Site has the largest volume of TRU waste in backlog.

- There is a temporary suspension of future TRU waste certification activities at generator sites until the site programs are upgraded in accordance with the requirements in the newly revised WIPP DSA and WIPP WAC. The site program upgrades will be verified through recertification audits conducted by DOE and generator site program reviews conducted by DOE and the WIPP management and operating contractor.

Background
During the February 5, 2014, fire event, 86 workers were in the mine (underground) when the fire occurred. All workers were safely evacuated.

During the February 14, 2014, radiological release incident, no personnel were determined to have received external contamination; however, 21 WIPP personnel were identified through bioassay to have initially tested positive for low level amounts of internal contamination with no adverse health effects. Trace amounts of americium and plutonium were detected off-site well below a level hazardous to the public or environment.

The direct cause of the radiological release incident was determined to be an exothermic reaction of incompatible materials in a LANL waste drum that led to thermal runaway, which resulted in over-pressurization of the drum, breach of the drum, and release of a portion of the drums contents (combustible gases, waste, and wheat-based absorbent) into the WIPP underground. Specifically, LANL's use of organic, wheat-based absorbent instead of the directed inorganic absorbent in the glovebox operations procedure for nitrate salts resulted in the generation, shipment, and emplacement of noncompliant, ignitable waste form.

CBFO is responsible for ensuring that all TRU wastes coming to the WIPP site meet the requirements for safe disposal. CBFO achieves this objective through the review and approval of TRU waste packaging, characterization, and certification programs that operate at the TRU waste generator sites. The Central Characterization Program operating at all of the TRU waste generator sites certify TRU waste for disposal at WIPP. (Idaho is an exception; it has a program that certifies the waste to CBFO requirements.)

In response to corrective actions required by DOE's Accident Investigation Board's Phase 2 report on the February 2014 radiological release at WIPP, changes to the National TRU Program (NTP) waste packaging, characterization and certification requirements were made and must be implemented before generator sites can resume shipments of newly certified waste to WIPP. A revised WIPP DSA was approved by DOE on April 29, 2016, and implemented on May 30, 2016. Chapter 18 of the revised WIPP DSA outlines conditions and limitations on waste acceptance at WIPP that required changes to the WIPP WAC. Revisions made to the WIPP WAC (Revision 8) to improve the NTP characterization, chemical compatibility evaluations, waste certification, documentation and oversight at WIPP and the waste generator sites include:

- Enhanced Acceptable Knowledge requirements - detailed verification of source documentation and processes involved in generating, treating, and packaging the waste. The enhancements include:
    - Chemical Compatibility Evaluations – identification of the range of possible chemical combinations and potential reactions that could occur in each waste stream using EPA approved methodology to ensure any chemical incompatibilities have been mitigated.

    - Basis of Knowledge for Oxidizing Chemicals – development of a guidance report through high quality laboratory testing to better understand the interactions between oxidizers and absorbents and prescribe adequate treatment methods when warranted.

- Conduct of Generator Site Technical Reviews: performed by CBFO and the WIPP management and operating (M&O) contractor to verify generator site programs implementing waste packaging and treatment activities are compliant with applicable DOE requirements such as conduct of operations, contractor oversight, and radioactive waste management before shipping of previously certified waste can resume.

- Quality Assurance Recertification Audits of Generator Site Programs: performed by CBFO to ensure that waste packaging, treatment, characterization, and certification activities are compliant with the revised WIPP WAC before shipping can resume.

Project Management Reform

The Department has historically experienced significant challenges in completing its major construction and environmental clean-up projects on cost and, in some cases, in accordance with schedules agreed to with State regulators. As a result, the Department has taken aggressive action to improve its performance on these projects.

Summary:

The Department is taking the necessary steps to improve efficiency and effectiveness of its project management processes.

- Improving management of ongoing major projects.
- Preparing cost estimates in a manner consistent with methods and best practices identified by U.S. Government Accountability Office (GAO).
- Conducting analyses of alternatives in a manner consistent with methods and best practices identified by GAO to provide unbiased, rigorously analyzed results.

Issue and Background

The Department is the largest civilian contracting agency in the federal Government and spends approximately 90% of its annual budget on contracts to operate its scientific laboratories; engineering and production facilities; and environmental restoration sites; to acquire capital assets; and to perform our mission. DOE sites and laboratories perform critical missions that include maintaining the nuclear weapons stockpile, cleaning up radioactive and hazardous waste resulting from the development and manufacturing of nuclear weapons, and conducting some of the world's most sophisticated basic and applied energy and scientific research activities. To conduct these missions, the Department has established some of the largest, most complex capital asset projects in either the public or private sector. The Department has been challenged to improve the efficiency and effectiveness of its project management processes.

The GAO has identified concerns regarding DOE contract and project management to include: (1) management of ongoing major projects; (2) cost estimating for projects and programs; and (3) analysis of alternatives, the process to select a preferred project alternative to acquire a capital asset.

Over the past three decades, the Department has successfully delivered many of its capital asset projects on time and within budget; however, far too many have breached their performance baseline. This lack of consistent performance has harmed the Department's credibility and eroded congressional support. As a result, beginning in 1990, the GAO included "DOE Contract (Project) Management" on their High-Risk List citing concerns about inadequate management and oversight of contractors and failure to hold contractors accountable.

In January 2009, GAO narrowed the focus of its high-risk designation to two DOE program elements—the Office of Environmental Management (EM) and the National Nuclear Security Administration (NNSA), in large part, due to the actions outlined in the Department's Root

Cause Analysis (RCA) Corrective Action Plan (CAP). In its February 2013 High-Risk List update, GAO acknowledged the Department's continuing improvement in contract and project management by narrowing the focus of DOE's high-risk designation to major contracts and projects executed by EM and NNSA with values of $750 million or greater. This focus continued in GAO's update in February 2015.

Status

In May 2016, the Deputy Secretary signed the update to DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, which institutionalized recent Secretarial policies to strengthen project execution, including: expanding the role of the Energy Systems Acquisition Advisory Board (ESAAB) in overseeing projects; establishing the Project Management Risk Committee (PMRC); improving upfront planning such as design maturity and technology readiness; preparing cost estimates and conducting analysis of alternatives using industry best practices; enhancing project management controls using best practices equivalent to those implemented in the Department of Defense; and improving project peer review processes. The changes were noted as areas for improvement by the GAO in recent reports or by DOE project management experts or were recommended in the Improving Project Management Report, which was developed in-house by project management experts in November 2014.

The Department's project management success metric is to deliver projects to completion at the original scope with no greater than a 10% cost increase. During the most recent reporting period covering FYs 2014 through 2016, it is projected that 83% of DOE's projects will be completed successfully. For the first time, the Department achieved a PM success rate of 91% for construction projects, exceeding the 90% target established in 2008. DOE continues to explore strategies for improving performance.

Ongoing Major Projects. DOE is addressing specific GAO concerns on the following major projects: (a) Waste Treatment and Immobilization Plant (WTP) Project; (b) Mixed Oxide (MOX) Fuel Fabrication Facility; (c) Uranium Processing Facility (UPF); and (d) Chemistry and Metallurgy Research Replacement (CMRR) Facility. Updates on these projects will be provided to the ESAAB, chaired by the Deputy Secretary, within the first year. As a direct result of recent reforms, the Department's contract and project management culture has changed dramatically. For example, projects such as UPF will not be baselined until the design is sufficiently mature, independent cost estimates are developed, risks are understood, and the Department is confident we can complete project scope within cost and schedule commitments.

Cost Estimating. DOE has taken actions to improve requirements for developing more reliable cost estimates for capital asset projects. In May 2016, DOE Order 413.3B was updated mandating that cost estimates be developed, maintained, and documented in a manner consistent with methods and best practices identified in GAO-09-3SP, *GAO Cost Estimating and Assessment Guide*. DOE is updating its *Cost Estimating Guide* (DOE G 413.3-21) to align it with the newly revised Order, and expects the Guide to be issued in December 2016. This guide emphasizes the use of established methods and best practices to develop, maintain, monitor, and communicate comprehensive, well-documented, accurate, credible, and defensible cost estimates. NNSA has also issued complementary policy direction.

Analysis of Alternatives (AoA). DOE has taken actions to improve requirements for completing a thorough AoA for capital asset projects. In May 2016, DOE Order 413.3B was updated, requiring that responsible program offices conduct an AoA that is independent of the contractor

organization responsible for managing the construction or constructing the capital asset project. It requires that the AoA be consistent with GAO published best practices and refers the reader to GAO-15-37, *DOE and NNSA Project Management: Analysis of Alternatives Could be Improved by Incorporating Best Practices*. The Order also requires that AoAs be conducted for projects with an estimated total project cost greater than or equal to the minor construction (or General Plant Project) threshold, which is currently $10 million, prior to approval of Critical Decision (CD)-1, Approve Alternative Selection and Cost Range. In March 2016, NNSA's Business Operating Procedure (BOP)-03.07, *Analysis of Alternatives*, was signed. It establishes oversight from both the project management executive and independent offices within NNSA to ensure a disciplined approach to the conduct of AoAs. DOE's draft AoA Guide (DOE G 413.3-22) is under review.

Some strategies for improvement to Project Management going forward include:

- Reinforcing Senior Leadership Active Engagement and Ownership: Continue active, ongoing PMRC and ESAAB meetings to keep a broad swath of knowledgeable senior managers and project management experts aware of technical, cost ,and schedule issues regarding projects that are $100M or greater; Under Secretaries and Assistant Secretaries carrying out Quarterly Project Reviews; and assigning project owners.
- Up-front Planning and Design Maturity: Ensuring that scope and requirements are well-defined and documented, and that design and technologies are sufficiently mature before baselining a project (committing to scope, cost, and schedule targets). Insufficient front-end planning consistently contributes to cost increases and schedule delays.
- Enhance the Contract and Project Management Workforce: Developing tools to help programs assess and determine the appropriate staff size and required skill sets for each capital asset project and enhancing the Project Management Career Development Program (PMCDP) and the Acquisition Career Management Program to improve the training and qualifications of contract and project management personnel. Particularly for project management work, make use of temporary duty assignments to support projects, augment federal personnel with support service contractors, and temporarily acquire federal personnel resources from other federal agencies, including the U.S. Army Corps of Engineers.
- Capital Asset Project Fiscal Affordability: Identify clear project priorities within Programs and the Department, and aligning budgets with the priorities. Focus available dollars on the critical few projects rather than providing limited funding on many to avoid protracted funding which results in cost and schedule expansion. Include adequate budget contingency to cover risk in real time. Having funding stability, and accurate stable project scope, cost, and schedule estimates are key considerations in the funding process. Inadequate funding has often led to projects failing to meet initial baselines.
- Improving Cost Estimates: Providing independent cost estimates and reviews at the various critical decision milestones, such as critical decision (CD)-2 (approve performance baseline), for projects greater than $100 million.
- Project Controls: Improving project management controls in Earned Value Management Systems (EVMS) across the complex. Too often project cost and schedule information are deficient and do not accurately reflect current project status or provide acceptable

forecasts, so effective project management and oversight is impaired. Continue enhancing the workforce through a certification program that includes training, experience, continuous learning, on-the-job experiential learning, demonstrated performance, and equivalency considerations. Strengthen the Project Controls Fellowship Program and community. Ensure a uniform approach to EVMS certification through policy, guidance, and automation for consistency of expectations, implementation and assessment.

- Independent Project and Contract Oversight: Provide leadership realistic, unbiased assessments of the project and contract status through independent oversight and project assessments. Project teams tend to have an optimism bias. Independent reviews ensure that the contract and project scope as well as cost and schedule estimates are valid and credible, as well as minimizes undue influence from program sponsors and/or chain of command. For optimum advice and counsel organizational independence of the review team is advisable. Each Under Secretary office should maintain its own independent project assessment office.
- Driving Consistent Implementation: Policies and procedures are in place; hold people accountable, both contractors and Feds, to ensure proper, consistent implementation.

Milestones

- None

Major Decisions/Events

- GAO's biennial High-Risk Series Report will be released January/February 2017.

Aging DOE Infrastructure and Excess Facilities

DOE is facing a significant challenge of degrading infrastructure at its laboratories and production facilities and has limited resources for needed improvements. Similarly, the number of aging excess facilities is increasing and DOE has limited resources to deactivate, decontaminate, decommission, and demolish them.

Summary: DOE's capability to achieve its mission objectives is dependent upon safe and reliable infrastructure. That infrastructure must be operated safely while being modernized to meet mission needs now and in the future. One of the most significant challenges facing the Department is the degrading infrastructure at its laboratories and production facilities, including the growth of its deferred maintenance backlog and the large numbers of excess nuclear facilities. In recent years, the Department has conducted enterprise-wide assessments to better define the issue and identify areas for targeted investments to begin to address this substantial challenge.

Issue: DOE is responsible for a vast portfolio of world-leading scientific and production assets, as well as the general purpose infrastructure that enables the Department to operate and use those assets. While the Department has made significant investments in its world class mission facilities, much of the supporting, or "general purpose" infrastructure (e.g. utilities, office space, general laboratory spaces, maintenance shops, etc.) that enables the mission and forms the backbone of the laboratory and production plant sites is aging and is in need of greater attention.

Based on Department-wide facility assessments and data analyses, the Department is facing a systemic challenge of degrading infrastructure due to the age of the DOE complex – which dates back to the Manhattan project – and levels of deferred maintenance that have been increasing. At the end of FY2015, DOE's total level of deferred maintenance for operational facilities was $5.4 billion; of this, the National Nuclear Security Administration (NNSA) deferred maintenance total at the end of FY2015 for operational facilities was approximately $3.5 billion (adding non-operational facilities, this total for NNSA was approximately $3.7 billion).

In addition to a degrading infrastructure, excess contaminated facilities are a drain on DOE's resources, and can pose a risk to safety, security, and programmatic objectives. The Department faces a significant challenge with the number of aging excess facilities throughout the complex and the limited resources to deactivate, decontaminate, decommission, and demolish (D&D) those facilities in the near term. The Office of Environmental Management (EM) is responsible for the D&D of excess contaminated facilities. However, due to budget constraints and competing regulatory and other compliance obligations, EM is unable to D&D all of the excess facilities transferred to EM in a timely manner, or accept additional aging excess contaminated facilities from other DOE programs in the foreseeable future.

Status. In 2013, the Secretary of Energy formed the Laboratory Operations Board (LOB) to provide an enterprise-wide forum to engage the Laboratories and DOE's programs in a joint effort to identify opportunities to improve effectiveness and efficiency. As one of its key initiatives, the LOB led a first-ever enterprise-wide assessment of general purpose infrastructure across all 17 labs and NNSA sites and plants, using newly-established uniform metrics. The effort revealed that

approximately half of the assessed infrastructure is rated as not "adequate" to meet the current mission needs.

Using this data, the Department established an enterprise-wide set of priorities for general purpose infrastructure, focusing on the goals of reducing deferred maintenance, increasing reliability, reducing facility footprint, and reducing risk to safety and to mission. This LOB-led initiative provided the basis for an additional $106M requested and appropriated in FY2016 targeted for prioritized general purpose infrastructure projects. The Administration's FY2017 budget request includes additional funding to address infrastructure challenges, including a 36% increase over the Department's FY2016 request for General Plant Projects (GPP) for general purpose infrastructure.

As a key part of this effort, beginning with the FY2016 budget, Secretary Moniz directed that each program's annual proposed investments in infrastructure should halt the growth of deferred maintenance. Within NNSA, investments in FY2016 will halt the growth of deferred maintenance, and assuming that funding levels continue to increase, the total will likely begin to decline.

With respect to the challenges posed by excess contaminated facilities, in early 2015 the Secretary directed the establishment of an Excess Contaminated Facilities Working Group, which is a subgroup of the LOB. The working group developed and executed an enterprise-wide data collection effort to obtain updated cost and risk assessments to deactivate, decontaminate, decommission, and demolish excess facilities. The updated data from the working group was used to define the scope of the challenge and to identify options for how DOE may better prioritize excess facilities. The group is developing policies to institutionalize a corporate approach, and updating and validating data gathered by the working group's efforts. The group also is finalizing a report on its work, to be issued in 2016.

In addition, within individual program offices infrastructure activities are now an integral part of the annual laboratory and evaluation process. Lab plans include proposals for potential construction of new facilities to maintain the labs as the nation's science and technology powerhouse; reduction of deferred maintenance; removal of excess facilities; and consideration of innovative financing approaches where appropriate. As part of these efforts, new planning tools have been developed. For example, NNSA's new Master Asset Plan (MAP) will prioritize and sequence all NNSA major capital investment needs, including construction, disposition, recapitalization, and maintenance to support mission requirements.

Milestones. To ensure that the enterprise-wide focus on revitalizing infrastructure continues, and to assess whether DOE is making measurable progress, DOE will publish two documents on infrastructure on a recurring basis, beginning in 2016:

- Annual State of General Purpose Infrastructure Report. This report is developed by the Infrastructure Executive Committee, which is a subgroup of the LOB and consists of senior line managers and facilities experts from across the complex. The inaugural report will be issued in 2016, and it will be issued on an annual basis by the end of each Fiscal Year.
- Biannual Excess Facilities Report (Plan for Deactivation and Decommissioning of Nonoperational Defense Nuclear Facilities). This report is developed by the Excess Contaminated Facilities Working Group, a subgroup of the LOB. This is a biannual report

to Congress, in response to a requirement of the FY2016 National Defense Authorization Act.

Background. DOE's real property inventory spans over 2 million acres of land and over 115 million square feet of buildings, the fourth largest inventory of real property in the Federal government by square footage. The portfolio includes seventeen DOE National Laboratories, NNSA plants, and Environmental Management cleanup sites. This portfolio of land, facilities, and other assets is the foundation of DOE's ability to conduct its mission, and represents one of America's premier assets for science, technology, innovation, and security.

However, modernization of DOE's infrastructure has not kept up in all areas with evolving mission needs in science and technology. This infrastructure portfolio has been developed over the past 70 years. The average age of DOE's facilities is 36 years and its support structures (utilities, roads, etc.) is 39 years. Within NNSA, more than half of NNSA facilities are over 40 years old, nearly 30 percent date back to the Manhattan Project era, and 12 percent are excess.

In early 2015, both the DOE Inspector General (IG) and the Government Accountability Office (GAO) issued reports raising concerns with DOE's management of high-risk excess facilities, particularly those awaiting transition to EM. These reports describe what the IG characterized as increasing levels of risk assumed by DOE due to delays in the cleanup and disposition of contaminated excess facilities. As noted in these reports, DOE's progress in disposing of excess facilities, while substantial, has not included all of the relatively higher risk excess facilities. According to the reports, additional attention, improved strategic direction, and better prioritization would help maximize the use of available resources to address these issues. The Department's Excess Contaminated Facilities Working Group was established in January 2015 and, as noted above, will issue to Congress in 2016 the first biannual report on excess facilities.

Cybersecurity

The Department of Energy (DOE) has statutory, sector-specific, scientific, and national security missions that contribute to advancing our Nation's cybersecurity. DOE is responsible for its own enterprise cybersecurity as well as supporting the energy sector's efforts to strengthen cybersecurity.

Enterprise Cybersecurity

DOE uses a fully-inclusive enterprise-wide approach to meet its cybersecurity goals. These efforts are guided by the DOE Cyber Strategy and corresponding implementation plan. In the last 18 months we have established an innovative enterprise-wide cyber governance structure involving our headquarters, 17 National Laboratories, and multiple sites across the country. This collaborative approach has enabled DOE to make substantial progress on cyber information sharing and safeguarding priorities. A critical priority currently under implementation, DOE's Enterprise Cyber Distributed Shared Risk Management Framework is designed to provide enterprise-wide cyber situational awareness to support cyber risk decisions on investments, policy, capabilities, and operations.

Energy Sector Cybersecurity

DOE is the only statutorily-defined sector-specific agency for cybersecurity and the Secretary has authority to issue an order to protect or restore the reliability of critical electric infrastructure or of defense critical electric infrastructure during an attack on the grid. . DOE leverages its deep technical expertise in its work with industry – which owns and operates 90 percent of the Nation's power infrastructure – to counter cyber threats to critical energy infrastructure. DOE also is an owner and operator of critical energy infrastructure and manages cyber threats that affect the transmission and marketing of Federal hydropower by our four Power Marketing Administrations. The December 2015 cyber attack on Ukraine's utilities has increased the need for securing domestic electric infrastructure.

DOE is directly investing in collaborative cybersecurity research and development projects with industry, universities, and our Labs to support energy systems cybersecurity for control systems. Further, in the past two years we have developed an increasingly robust exercise and assessment program evaluate cyber risk and maturity as well as test whole-of-Nation responses to the full spectrum of potential energy infrastructure emergencies, including both natural and manmade events. Cybersecurity is a priority in our intensive collaboration on emergency preparedness and response with the Electricity Subsector Coordinating Council (which includes 21 utility CEOs and leaders of electricity trade associations), and is a leading example of government-industry partnerships.

Issue: DOE is establishing a coordination center, the Integrated Joint Cyber Coordination Center (iJC3), that unifies cyber expertise across the DOE enterprise, and provides a collaborative, intelligence-driven, distributed approach to cyber operations and response that engages the full capabilities of the Department and protects the full DOE cyber-attack surface.
Status: iJC3 achieved initial operating capability in August 2016 and plans to reach full operating capability in FY18.

Issue: DOE is implementing the DOE Enterprise Cyber Distributed Shared Risk Management Framework; a significant shift for DOE to develop enterprise-wide cyber situational awareness to support cyber risk decisions on investments, policy, capabilities, and operations. This is a cybersecurity best practice widely adopted throughout industry and government.
Status: While the Framework will be implemented by the end of the year, continued pressure will be required to ensure full transparency through aggregation of DOE entity level cyber situational awareness and availability of resulting analysis.

Issue: DOE energy sector cybersecurity cross-cut efforts are currently limited largely to one program in the department. OE has traditionally led the vast majority of control systems cybersecurity innovation to support energy infrastructure protection. However, growing attention to cyber threats to control systems requires expanded efforts across the Department to ensure energy generation, delivery and end-use efforts address cybersecurity at the earliest stages.
Status: OE is currently investing $62 million (FY16 enacted) in cybersecurity activities. EERE is working to address cybersecurity in its Solar, Buildings, and Vehicles programs and is collaborating with OE to further understand cybersecurity impacts. NE launched a nuclear energy cybersecurity R&D program 2 years ago currently investing $3 million per year with aspirations of growing upwards of $10 million per year. IN and NNSA are supporting research and development in this area as well.

Issue: In June 2015, the Office of Management and Budget directed all Federal departments and agencies to accelerate implementation of strong Multifactor Authentication (MFA) for 100% of privileged and standard user accounts by September 30 following the OPM breach.
Status: The Department has 100% accountability of all user accounts, meaning all accounts are either complete, under an approved exception with compensating controls, or under a remediation strategy. DOE is on target to meet OMB's goal by December 31, 2016.

Milestones

- Exercised draft DOE Cyber Incident Response Plan in September 2016
- Reached iJC3 initial operating capability in August 2016
- Implemented Federal Information Technology Acquisition Reform Act in May 2016
- Notice of Proposed Rulemaking for Secretary Authority, November/December 2016
- Liberty Eclipse Exercise, Newport, Rhode Island, December 8-9, 2016

Major Decisions/Events

- Nov 29, 2016: Electricity Subsector Coordinating Council Meeting
- February 2017: Oil and Natural Gas Coordinating Council Meeting
- iJC3 full operating capability (FOC) in FY18

Additional Background

DOE's 17 National Laboratories address a broad range of science and technology challenges, including cybersecurity. This expertise originated in our no-fail mission to ensure the reliability of the nuclear deterrent, including the hardening of its components to cyber threats. Multiple Federal departments and agencies use DOE Lab resources to solve their cybersecurity challenges, investing more than $500 million annually in cyber research and development. DOE's unique capabilities include deep and specialized expertise in strategic computing, control systems, and extensive test bed capabilities for conducting experiments at scale (such as the grid-scale test bed for SCADA systems at our Idaho National Lab). DOE is a world leader in computational capability: 4 of the 10 fastest supercomputers in the world are found in DOE's Labs, and DOE is leading interagency efforts to accelerate delivery of an exascale-capable system in the early 2020s. We are leveraging this strength to redefine prediction through the integration of machine learning/artificial intelligence, big data analytics, and high performance computing at the processor level. As we prepare to handle the ever-increasing richness of available data, this has strong intersections with tools development for analyzing cyber threat information and information contained in data sets so large that no other institution can currently process them. DOE is also accomplishing groundbreaking work that ensures we have the ability to "out-innovate" our adversaries and stay ahead of advanced persistent threats. For example, Lawrence Berkeley National Lab developed "BRO" – a powerful intrusion detection tool that is now used by leading companies such as Apple, Amazon, Cisco, General Electric, and Yahoo.

DOE provides a niche strength in industrial control systems cybersecurity expertise on which the Federal government and industry rely. This includes DHS's Industrial Control Systems Cyber Emergency Response Team, which is staffed largely by DOE Lab talent. On the educational front, our Labs recruit top academic talent starting from high school summer cyber programs through post-doctoral positions. The Cyber Defenders program and the Cyber Engineering Research Lab at Sandia National Laboratory are examples of how our Laboratories tap into both national and local talent pools. Our Labs also lead the Cyber Forensics Incident Response Exercise (FIRE) series of immersive cyber training and exercise events. These events provide DOE and other USG agencies with intensive, hands-on experience solving complex cybersecurity challenges. In addition, DOE's pioneering Minority Serving Institution Partnership Program (MSIPP) enables us to engage underrepresented communities and invest in the next generation of cybersecurity professionals with a focus on improving workforce diversity. We are creating talent pipelines from Minority Serving Institutions (including Historically Black Colleges and Universities, Tribal Colleges and Universities, and Hispanic Serving Institutions) to DOE Labs, sites, and other Federal agencies and industrial partners.

DOE/Lab Partnership - CRENEL Implementation

DOE has made substantial progress in addressing recommendations made by CRENEL, an independent, Congressionally-chartered commission, in transforming its relationship with DOE Laboratories towards a more strategic partnership.

Summary: A key priority for the Department has been to reset the relationship between DOE and its 17 National Laboratories, which serve as a science and technology powerhouse for the Nation. Independent reports issued over the past few years – including the Congressionally-mandated Commission to Review the Effectiveness of the National Energy Laboratories (CRENEL) – have indicated that DOE oversight of the laboratories has become increasingly transactional rather than strategically mission-driven. The Department has made substantial progress in implementing fundamental changes to the DOE-laboratory relationship, but has a number of ongoing items to implement to fulfill the commitments it made in its response to CRENEL and to further strengthen the partnership between DOE and the National Laboratories.

Issue: Congress, through Section 319 of the Consolidated Appropriations Act, 2014, directed the Secretary of Energy to establish an independent commission to review the effectiveness of the DOE National Laboratories. The Secretary established this commission in May 2014 and CRENEL issued its Final Report in October 2015.

In its report, CRENEL concluded that the DOE laboratories are "a unique scientific resource and national security asset, providing a vital experimental infrastructure to the Nation's research community and sustaining the nuclear weapons expertise crucial to modern American security" and are "a national treasure with the potential to serve the nation now and well into the future." The CRENEL report noted that, while the DOE laboratories serve the Nation well, they could be even more effective and efficient if they and DOE improve their relationship, focusing on the principles of stewardship, accountability, competition, and partnership inherent in the fundamental model of Federally Funded Research and Development Centers (FFRDC).

DOE issued a response in a February 2016 report to Congress, organized around the six themes articulated by CRENEL: (1) recognizing value, (2) rebuilding trust, (3) maintaining alignment and quality, (4) maximizing impact, (5) managing effectiveness and efficiency, and (6) ensuring lasting change. The DOE response details those actions that DOE was engaged in, and those that DOE committed to execute, to improve the DOE/lab relationship in each of these six areas.

Status. Since DOE issued its response, it has made substantial advances in CRENEL implementation, and in transforming its relationship with the Laboratories towards a more strategic partnership. While many actions are complete, others are in progress or are ongoing commitments intended to strengthen the DOE-Laboratory partnership. The status of these actions is monitored by the Laboratory Operations Board (LOB), which is the primary Departmental

entity responsible for tracking the Department's CRENEL implementation efforts. A few key areas of progress include:

- ***Reduced transactional oversight*** by collaborating with the laboratories to identify and minimize overly burdensome oversight and to reform the system used to develop requirements (the DOE Directives system).

- ***Improved infrastructure planning*** in collaboration with the laboratories by establishing uniform infrastructure assessments, ensuring that the deferred maintenance backlog does not increase, prioritizing investments in general purpose infrastructure, and increasing the overall investment in DOE infrastructure.

- ***Piloting streamlined contract approaches,*** including a new contract with SLAC National Accelerator Laboratory which promotes a more tailored lab-specific approach to partnering and oversight.

- Expanded ***Contractor Assurance Systems*** beyond the environment, safety, security, and health areas to include business and financial systems, and emphasized through a new policy the importance of establishing and maintaining productive relationships between laboratory, Federal, and corporate parent personnel.

- Strengthening ***Laboratory Planning*** efforts to establish a more uniform process throughout the Department, to engage the laboratories in strategic planning for the future, and to focus on cross-cutting initiatives.

- Instituted a ***Leadership Development Rotational Program*** offering DOE Federal and laboratory mid-level and senior employees opportunities to rotate to laboratory or Federal sites to build greater understanding of the entire DOE enterprise.

- Developed an ***Annual State of the Laboratories*** report for Congress, to discuss the role and value of the National Laboratory system, and to identify the actions being pursued to enhance the vitality of the Laboratory system to help ensure that it continues to provide best-in-class science and technology research and solutions to meet the near-term and long-term missions of the Department.

- Enhanced efforts to support ***technology transfer***, including a new Technology Commercialization Fund for laboratory collaboration with the private sector.

Milestones. Ensuring Lasting Change. The last theme of the CRENEL report was "ensuring lasting change." The report points out that over 50 commissions, panels, reviews and studies of the National Laboratories have been conducted over the past four decades, and notes that none of those reports led to the comprehensive change necessary to address persistent challenges. Recognizing the importance of institutionalizing ongoing and new efforts identified in the DOE response, DOE committed to tracking implementation of these commitments. This effort has been guided by the overarching objectives the DOE response (rebuilding trust, maximizing

impact, etc.), so that DOE can assess not only whether the specific action was taken, but also whether it had the intended consequence and effectively resulted in substantive change.

The LOB is responsible for tracking the Department's implementation of the commitments made in its February 2016 response. The LOB monitors progress on a monthly basis and provides reports to the Laboratory Policy Council (chaired by the Secretary) and the Secretary of Energy Advisory Board (SEAB) Lab Task Force.

The SEAB Lab Task Force provides the independent oversight of the Department's CRENEL implementation. This Task Force has been charged with overseeing the implementation of the Department's response to CRENEL from an independent perspective. The Task Force reports its findings to SEAB and SEAB provides reports on the status of Departmental CRENEL implementation efforts at its public meetings.

In addition, the Department committed in its CRENEL response that the LOB will conduct a review of the effectiveness of CRENEL Implementation before February 2018 (a two year review) to determine whether the actions have had their desired impact.

Background. CRENEL is one of three recent reports which provided recommendations to the Department regarding its relationship with the Laboratories. These reports are:

1. CRENEL. Report: Final Report of the Commission to Review the Effectiveness of the National Energy Laboratories, October 2015. http://energy.gov/labcommission/downloads/final-report-commission-review-effectiveness-national-energy-laboratories DOE Response: Departmental Response to the Final Report of the Commission to Review the Effectiveness of the National Energy Laboratories, Report to Congress, February 2016. http://energy.gov/labcommission/downloads/departmental-response-final-report-commission-review-effectiveness-national
2. Mies-Augustine. Report. Final Report of the Congressional Advisory Panel on the Governance of the Nuclear Security Enterprise, November 2014. (Governance Panel, or "Mies-Augustine," as Adm. Rich Mies and Norm Augustine served as the co-chairs of this Panel) http://cdn.knoxblogs.com/atomiccity/wp-content/uploads/sites/11/2014/12/Governance.pdf NNSA Response. NNSA Comments: Final Report of the Congressional Advisory Panel on the Governance of the Nuclear Security Enterprise, May 2015. https://nnsa.energy.gov/response-on-governance-report
3. SEAB Lab Task Force. Report. Report of the Secretary of Energy Advisory Board Task Force on DOE Laboratories, June 2015. DOE Response: Departmental Response: Assessment of the Report of the SEAB Task Force on National Laboratories. http://energy.gov/seab/downloads/interim-report-task-force-doe-national-laboratories

The Department's response to these three reports has been integrated such that the CRENEL implementation efforts incorporate actions being taken to address similar recommendations from the other reports. The NNSA Governance and Management Implementation Plan (described in a separate Issue Paper) identifies the actions NNSA is taking to address the Department's CRENEL

implementation commitments as they pertain to NNSA, but also it contains additional NNSA specific-items that respond to the Mies-Augustine report, which was focused on NNSA.

Safety Culture, Employee Concerns, and Whistleblower Protection

A strong safety culture, including effective processes for addressing employee concerns and protecting whistleblowers, is key to ensuring safe operations at DOE.

Summary

DOE is responsible for the safe operations of its wide array of facilities, including high-hazard facilities needed to meet its nuclear waste cleanup and nuclear weapon surety missions. Lack of a strong safety culture threatens the timely and cost effective accomplishment of DOE missions. DOE has a number of systems in place to ensure that employees have multiple avenues to express safety concerns, but multiple reviews over the past five years have found deficiencies in the safety culture at DOE sites. In addressing these deficiencies, it is clear that safety culture requires constant work and attention by all levels of DOE management.

In 2011, concerns were raised by the Defense Nuclear Facilities Safety Board (DNFSB) that DOE did not have a safety culture where employees felt that they could raise safety concerns that would be addressed without fear of retaliation, and major improvements were recommended. Further, in July 2016 the Government Accountability Office (GAO) issued a report, *Department of Energy Whistleblower Protections Need Strengthening*, which identified weaknesses in DOE's Employee Concerns Program (ECP) and its whistleblower protection efforts. Effective resolution of employee concerns and protection of whistleblowers are important components of a strong safety culture.

DOE has taken significant actions to evaluate and improve its safety culture; however, a large amount of work remains. DOE is also taking actions to strengthen its ECP and to improve its requirements for and oversight of DOE whistleblower protections. DOE is frequently called upon to respond to questions from members of Congress and their staff on these issues.

Issue

Sound safety culture depends on continued visible senior leadership support, as well as robust ECP and whistleblower protections. Management of these issues requires internal oversight, and support for training and workshops that promote best practices across the DOE complex.

Status

DOE has taken several recent actions to improve safety culture, including:

- establishing a Safety Culture Improvement Panel chartered by the Deputy Secretary,
- performing safety culture assessments across the DOE complex, and conducting safety conscious work environment training for senior managers.
- DOE has also taken actions to strengthen its ECP, including: transferring ECP to the Office of Environment, Health, Safety and Security (AU); drafting a revision to the DOE ECP Order; and developing training for ECP Managers.In August 2016, DOE issued detailed guidance to Federal personnel responsible for entering into and administering contracts that makes clear if and when the Department will reimburse legal costs in whistleblower cases.

- DOE also issued a proposed rulemaking clarifying that the Department can assess civil penalties against contractors and subcontractors for retaliating against any employee who raises concerns relating to nuclear safety.

Milestones

To further ensure DOE's safety culture goals are understood and practiced by its supervisors and employees, DOE's National Training Center will be completing two culture courses in 2017, i.e.:

- *Safety Culture for Front Line Leaders*
- *Safety Culture for Employees*

By the summer of 2017, the Safety Culture Improvement Panel will establish a safety culture website which will inform the public and DOE's other stakeholders of the Department's activities to promote a strong safety culture.

Major Decisions/Events

DOE's new senior leadership can continue to support the strengthening of DOE's safety culture by demonstrating their personal commitment to health and safety through leadership, employee engagement, and organizational learning—DOE's three key foundational elements for a strong safety culture. Opportunities in this regard include:

- Visible support or attendance by the Secretary or Deputy Secretary and other leaders in the Safety Culture Improvement Panel's next annual meeting in May 2017 (which is held during a workshop that is attended by many of the DOE safety professionals). This would send a strong message of the importance that DOE's new leadership team places on safety culture.
- Incoming DOE senior leaders taking the *Safety Culture for Senior Leaders* course in 2017.

The DOE ECP Order is scheduled to be revised by June 30, 2017. In parallel, DOE is developing a formal training program for ECP Managers and a DOE-wide database to track, and analyze DOE trends in ECP reporting to support continued ECP improvement.

DOE is currently reviewing comments on a proposed whistleblower protection rule and hopes to issue the final rule in the near term.

Background

Safety Culture

DOE defines safety culture as "an organization's values and behaviors modeled by its leaders and internalized by its members, which serve to make safe performance of work the overriding priority to protect the workers, public, and the environment."

In 2011, the Defense Nuclear Facilities Safety Board found that the safety culture at the Waste Treatment Plant at the Hanford site needed improvement and that a chilled work environment existed. DOE conducted a series of extent of condition reviews as part of the response to the Board's recommendation. The Department found evidence that other projects and programs also needed improvement in establishing a strong safety culture. The Department recognized that in areas where a significant percentage of workers do not feel they can raise their safety concerns without fear of reprisal, information essential to the safe operations of its facilities would likely

be suppressed. It also realized that without a safety conscious work environment where workers felt safe in raising their concerns without fear of retaliation, the timely and safe accomplishment of DOE mission-related work could be negatively impacted.

The Safety Culture Improvement Panel is a key resource for senior leadership—and the Department as a whole—to support the continuous improvement of DOE's safety culture. DOE knows from experience that a chilled work atmosphere adverse to safety or a workplace that suppresses technical dissent can impede the timely and cost-effective completion of major projects (e.g., DOE's Waste Treatment and Immobilization Plant at the Hanford Site).

Employee Concerns Program (ECP)

In an October 5, 2014 memorandum, Secretary Moniz stated that DOE federal and contractor employees serve as the principal source for the discovery of conditions that could negatively affect the quality or safety of operations. And while he encouraged employees to discuss their concerns with their immediate supervisor or any level of management, he stated that the DOE ECP provides an important alternative forum where these concerns could be raised.

In its July 2016 report, the GAO raised a number of concerns regarding DOE's ECP. In its "Recommendations for Executive Action," it stated the following:

> To help ensure that the organizational placement and practices of DOE- and contractor-provided Employee Concerns Programs (ECP) do not inhibit contractor employees from raising safety and other concerns, we recommend that the Secretary of Energy revise DOE's ECP order and guidance to (1) require that the organizational placement and practices of contractor ECP's do not compromise or impair their independence, (2) clarify the circumstances under which DOE's ECP is permitted to transfer and refer concerns to contractors, and notify or require approval of the contractor employee raising the concern, and (3) provide criteria for overseeing and evaluating the effectiveness and independence of contractor-provided ECPs.

The ECP provides a voluntary, independent, and formal avenue to report concerns, and ensures prompt identification, reporting, evaluation, investigation, and response. All DOE Federal employees have access to ECP managers either at their site or through a multi-site shared ECP arrangement. Most DOE site contractors have an ECP for their own employees, however, contractor employees also have access to site ECP Managers where circumstances warrant it.

More generally, DOE provides a variety of formal and informal services for addressing conflict and issues in the workplace (including a Differing Professional Opinion process and an Office of the Ombudsman). The Department strives to resolve issues at the lowest possible level, and employees are encouraged to involve their supervisors first, if they are comfortable doing so. If they are not comfortable approaching their supervisor with an issue, DOE has developed a Resolution Services website to direct employees to the office best suited to address their concerns.

Whistleblower Protection

DOE is strongly committed to a workplace where all workers—both federal and contractor employees —are free to speak out, voice concerns, or lodge complaints without fear of retaliation. In particular, contractors are statutorily and contractually bound not to retaliate against employees for protected whistleblower conduct.

Employees of DOE contractors can access multiple processes to raise claims of whistleblower retaliation. These include:

- The whistleblower protection provision of the Energy Reorganization Act, which offers an avenue for contractor employees who believe that they have experienced retaliation for, among other things, reporting alleged violations of nuclear safety laws or regulations.[1] An employee initiates an action by filing a complaint with the Department of Labor. If the Department of Labor does not issue a decision on the complaint within one year, an employee may file a complaint in the United States District Court.
- DOE regulations, contained in 10 C.F.R. Part 708, which establishes a process to resolve complaints by DOE contractor employees alleging retaliation by their employers for protected conduct. DOE's Office of Hearings and Appeals investigates and adjudicates these claim.

The contractor employee can choose which process or, in some cases, processes to use to raise their concerns. If one of these processes results in a finding that there has been whistleblower retaliation, a variety of remedies may be directed for the benefit of the affected employee. The remedies vary slightly according to the process that rendered the finding but generally include: reinstatement; back pay; and attorney's fees.

[1] 42 U.S.C. § 5851.