U.S. DEPARTMENT OF ENERGY

Transition 2020

Issue Papers

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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 sector's efforts to strengthen cybersecurity.

Cyber Threat

Cyber threats to the energy sector are growing in number and sophistication. The Intelligence Community's 2019 Worldwide Threat Assessment stated: "China, Russia, Iran, and North Korea increasingly use cyber operations to threaten both minds and machines in an expanding number of ways—to steal information, to influence our citizens, or to disrupt critical infrastructure. China has the ability to launch cyber-attacks that cause localized, temporary disruptive effects on critical infrastructure—such as disruption of a natural gas pipeline for days to weeks—in the United States. Russia has the ability to execute cyber-attacks in the United States that generate localized, temporary disruptive effects on critical infrastructure—such as disrupting an electrical distribution network for at least a few hours—similar to those demonstrated in Ukraine in 2015 and 2016. Moscow is mapping our critical infrastructure with the long-term goal of being able to cause substantial damage."

In recognition of the emerging cyber threat from China, Russia, Iran and North Korea, and the increasing importance of cybersecurity for the energy sector, DOE created the Office of Cybersecurity, Energy Security and Emergency Response (CESER) in 2018. The creation of CESER fulfilled a dual purpose: to work with industry to increase cybersecurity protections across multiple energy subsectors and interdependent sectors of critical infrastructure, and to coordinate the cybersecurity mission among multiple stakeholders within the department. DOE's enterprise-wide approach to cybersecurity is guided by the 2018-2020 DOE Cyber Strategy and corresponding implementation plan. 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.

Energy Sector Cybersecurity

As the sector specific agency for the energy sector, CESER leverages deep technical expertise in its work with industry – which owns and operates 80 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. Additionally, CESER directly invests in collaborative cybersecurity research and development projects with industry, universities, and DOE's Labs to support energy systems cybersecurity for control systems and operational technology. CESER hosts and supports numerous cyber exercises involving multiple energy sector stakeholders, as well as several innovative assessment programs that evaluate cyber risk and maturity and test whole-of-Nation responses to cyber incidents.

Issue(s)

Cybersecurity Mission Growth

In August, CESER completed a new plan to strategically evolve the cybersecurity mission at DOE, to include building new capabilities to perform cyber discovery and pursuit functions; cyber threat intelligence sharing and situational awareness; cyber modeling and simulation; and fostering cyber protections for emerging technologies in energy sector systems. All of these functions will be undertaken in collaboration with the DOE Offices of Electricity, Chief Information Officer, and Intelligence and Counterintelligence, in support of DOE-operated utilities such as the Power Management Authorities, and in partnership with external stakeholders in industry and all levels of government.

New Cybersecurity Engagement with Industry

Pursuant to direction in Section 5726 of the FY2020 National Defense Authorization Act, CESER launched a 2-year pilot Securing Energy Infrastructure

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Executive Task Force (SEIETF) to partner with digital component manufacturers and asset owners to address cybersecurity in sector supply chains. The SEIETF convenes a broad set of stakeholders from across government, industry, academia, and the DOE Labs to: 1) evaluate technology and standards to isolate and defend critical industrial control systems (ICS) from cybersecurity vulnerabilities and exploits; 2) develop a national cyber-informed engineering strategy to isolate and defend critical ICS from cybersecurity vulnerabilities and exploits; and 3) identify new classes of security vulnerabilities of critical ICS.

Supply Chain Risk Management

CESER manages DOE's premier cyber vulnerability testing program for industrial control system (ICS) digital components: the Cyber Testing for Resilient ICS (CyTRICS) program. CyTRICS partners across stakeholders to identify high priority operational technology (OT) components, perform expert testing, share information about vulnerabilities in the digital supply chain, and inform improvements in component design and manufacturing. The program leverages best-in-class test facilities and analytic capabilities at four DOE Labs and strategic partnerships with key stakeholders including technology developers; manufacturers; asset owners and operators; and interagency partners.

Energy Sector Pathfinder Program

The Energy Sector Pathfinder is led by DOE and the Department of Homeland Security (DHS), and is supported by the Department of Defense (DoD) and FBI. The overall purpose of the Pathfinder is to coordinate among government and critical industry partners in the energy sector to pilot cybersecurity projects, collect best practices and lessons learned, and identify opportunities for scaling up findings.

Federal partners signed an MOU launching the program in February 2020. Pursuant to the MOU, the Pathfinder focuses on three core objectives: 1) Advance Threat-Information Sharing and Analysis; 2) Improve Energy Sector-Specific Knowledge Within the U.S. Government; and 3) Develop Joint Operational Preparedness and Response Procedures.

Cyber Threat Information Sharing

The energy sector has housed the premier cyber threat intelligence platform for over a decade. This program, known as the Cybersecurity Risk Information Sharing Program (CRISP), is a public-private partnership, co-funded by DOE and industry and managed by the Electricity Information Sharing and Analysis Center (E-ISAC). CRISP collaborates with energy sector partners to facilitate the timely bi-directional sharing of unclassified and classified threat information and to develop situational awareness tools that enhance the sector's ability to identify, prioritize, and coordinate the protection of critical infrastructure and key resources. CRISP leverages advanced sensors and threat analysis techniques developed by DOE along with DOE's expertise as part of the nation's Intelligence Community to better inform the energy sector of the high-level cyber risks. Current CRISP participants provide power to over 75 percent of the total number of continental U.S. electricity subsector customers.

Status

Cybersecurity Mission Growth

CESER's plan is reflected in DOE's FY2022 budget request. Internally, the implementation of new cybersecurity functions began ramping up at the beginning of FY2021. Cybersecurity will feature prominently in the new DOE Integrated Security Center (DISC) located in Denver. DISC will, among other functions, provide secure space for a team of cybersecurity analysts to develop and provide critical information to the sector and to coordinate with DOE's Office of Intelligence and Counterintelligence. Initial cybersecurity personnel are targeted for on boarding in Denver in the 3rd Quarter of FY2021.

New Cybersecurity Engagement with Industry

The SEIETF launched in October 2020 and is chartered as a three-tiered structure that includes senior technology policy leaders, senior technical leaders, and joint project teams comprised of technical experts. The SEIETF will deliver an interim report to Congress in mid-December and final progress report in Mid-June 2021, and is scheduled to complete the three deliverables noted above in June 2022.

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Supply Chain Risk Management

CyTRICS completed proof-of-concept testing in 2018 and developed multi-Lab program processes in 2019. During FY2020, CESER began signing agreements with major manufacturers and asset owners to provide digital components for testing. CyTRICS will complete a full pilot test of program processes in the fall of 2020. Concurrent with pilot testing, CESER is gathering input from industry stakeholders on key CyTRICS processes including test operations, reporting formats, design requirements for the results repository, advanced analytics, and a coordinated vulnerability disclosure process. Through the program pilot and industry input, CESER will refine and finalize CyTRICS program processes and move to initial operating capability in early 2021.

CyTRICS cyber vulnerability testing will support testing needs under the Bulk Power Executive Order (E.O. 13920), as well as testing needs for other energy subsectors including oil and natural gas, renewables; and hydroelectrics. CyTRICS will leverage the new Securing Energy Infrastructure Executive Task Force for technical feedback on the program, and will brief findings to CESER's existing sector engagement forums to ensure transparency and coordination with industry partners.

Energy Sector Pathfinder Program

Initial work to identify and coordinate existing federal stakeholder cyber activities in the energy sector was completed in FY2020. Proposals for new pilot projects will be submitted for federal leadership consensus in the first quarter of FY2021, and will be subsequently presented to critical energy sector companies for participation. New pilots are anticipated to begin in the 3rd quarter of FY2021.

Cyber Threat Information Sharing

CRISP is extending its footprint of participants to include utilities that support Defense Critical Energy Infrastructure facilities. The "+ 30 Initiative" provides funding for critical electric sector companies to participate for a period of three years, working together with the E-ISAC and Pacific Northwest National Laboratory. Additionally, CRISP is launching pilot efforts in FY2021 to extend participation to select entities in the oil and natural gas sector, and to collect and integrate operational technology data into its current information technology data holdings.

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Energy Sector All-Hazards Emergency Response

The Department of Energy (DOE) is the coordinating agency for Emergency Support Function (ESF) #12, under the National Response Framework, and the Sector Specific Agency (SSA) for the energy sector, pursuant to Presidential Policy Directive (PPD) 21, PPD 41, Executive Order 13636, and the FAST Act. Within DOE, these responsibilities are managed by the Infrastructure Security and Energy Restoration (ISER) division of the Office of Cybersecurity, Energy Security, and Emergency Response (CESER), which supports preparedness and response efforts in the energy sector across federal, state, local, territorial, and tribal governments, private industry, trade associations, and non-governmental organizations.

Summary

During an incident requiring a coordinated federal response, CESER activates the Energy Response Organization (ERO) to manage ESF #12 activities, including deployment of DOE ESF #12 responders and sector engagement. As the lead for ESF #12, CESER works with Energy Sector partners to:

Assess the impacts of a disaster on local and regional energy infrastructure.

Provide situational awareness updates to Federal, state, and private sector partners.

Facilitate legal and regulatory waivers to accelerate restoration of damaged energy systems.

Provide technical expertise on energy damage assessment, restoration, and logistical assistance.

To fulfill DOE's ESF #12 responsibilities, CESER trains and manages a cadre of volunteer ESF #12 responders, from DOE sites across the Nation. Upon activation of ESF #12 by the Federal Emergency Management Agency (FEMA) or at the request from a State, DOE deploys responders to the FEMA National Response Coordination Center, FEMA Regional Response Coordination Centers, and/or FEMA Joint Field Offices and State Emergency Operations Centers. Each FEMA Region is represented by an ESF #12 Regional Coordinator, who maintains regular contact and supports planning efforts with regional and State counterparts. Additionally, a subset of ESF #12 responders are part of the ESF #12 Catastrophic Incident Response Team (CIRT) to respond to catastrophic incidents and remote locations. CIRT members are experienced responders, mainly from the Power Marketing Administrations, who can be deployed when DOE needs to provide in-depth expertise to support damage assessments and restoration planning. For incidents that do not require a full coordinated Federal response, DOE supports and coordinates with industry as the sector-specific agency (SSA).

Energy Sector Cyber Incident Response Coordination

CESER also coordinates DOE's response to cyber incidents impacting or potentially impacting the Energy Sector. Per PPD 41 and the National Cyber Incident Response Plan (NCIRP), there are four key lines of effort during a coordinated federal cyber response:

Threat Response led by the Federal Bureau of Investigation (FBI)

Asset Response led by the Department of Homeland Security (DHS)

Intelligence Support led by the Office of the Director of National Intelligence (ODNI)

SSA Coordination

For an Energy Sector cyber incident that requires a coordinated response, CESER will activate the DOE Cyber Crisis Action Team (Cyber CAT), with support from the Office of Electricity (OE); Office of Intelligence and Counterintelligence (IN); and the Office of the Chief Information Officer (OCIO). The Cyber CAT also coordinates with the interagency partners, including a Unified Command Group

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convened per PPD-41. CESER serves as DOE's representative to the Cyber Response Group.

Sector Specific Agency

As the SSA for the Energy Sector, DOE executes responsibilities through a system outlined in the National Infrastructure Protection Plan (NIPP), which facilitates interaction and cooperation between government and industry partners. Under the NIPP, each of the 16 critical infrastructure sectors has a Government Coordinating Council (GCC), consisting of government entities with responsibilities for the sector, and a Sector Coordinating Council (SCC)—a self-organized and self-governed group comprised of sector industry representatives and their designated trade associations. The Electricity Subsector Coordinating Council (ESCC) and Oil and Natural Gas Subsector Coordinating Council (ONGSCC) provide a mechanism for industry-government coordination during emergency response based on steady state relationships, joint response preparation activities, and critical infrastructure security and resilience coordination and planning.

DOE Emergency and Incident Management Council

The DOE Emergency and Incident Management Council (EIMC), serves as the principal forum for DOE senior leadership to provide strategic guidance and priorities for all-hazards incident coordination and unity of effort across DOE. The EIMC is chaired by the Deputy Secretary of Energy. Primary members of the EIMC include principals from each office in the DOE Emergency Management Enterprise, including components of the National Nuclear Security Administration. Advisory members of the EIMC are included as needed and are comprised of the relevant support offices.

DOE Primary Mission Essential Function #3

DOE is responsible for three Primary Mission Essential Functions (PMEFs) in support of the eight National Essential Functions (NEFs). DOE PMEF #3 is to "continuously monitor and manage the National Energy Infrastructure and execute incident management responsibilities under the National Response Framework, to include responding to energy infrastructure disruptions, to ensure rapid recovery of energy supplies."

DOE PMEF #3 is supported by six DOE Mission Essential Functions (MEFs) managed by CESER, OE, the Office of Fossil Energy (FE), and the Energy Information Administration (EIA), in coordination with IN and other DOE offices, as well as interagency and industry partners, as appropriate. The Office of Electricity is the lead for PMEF#3.

In response to COVID-19, DOE PMEF #3 established a unified Incident Command Structure (ICS) to ensure coordinated actions across the supporting offices, and to ensure unity of effort during DOE incident response.

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Role in Executing the "Sector-Specific Agency" Responsibilities for Energy Infrastructure Protection and Coordination with Government and Industry

The U.S. Department of Energy (DOE) is designated as the sector specific agency (SSA) for strengthening and securing critical infrastructure against both physical and cyber threats in the energy sector under Presidential Policy Directive (PPD) 21. The Office of Cybersecurity, Energy Security, and Emergency Response (CESER) manages these responsibilities, building trusted partnerships with relevant Federal agencies, states and local governments, and the private sector.

Summary

Energy infrastructure serves as the backbone of the nation's economy, security, and health. Any disruption or destruction to these vital assets, systems, or networks can have a debilitating effect on national security. The U.S. Department of Energy (DOE) is designated as the sector-specific agency (SSA) for strengthening and securing the Energy Sector against both physical and cyber threats under Presidential Policy Directive (PPD) 21. The Office of Cybersecurity, Energy Security, and Emergency Response (CESER) manages these responsibilities, building trusted partnerships with relevant Federal agencies; states and local governments; and the private sector. By harmonizing collective defense, resilience, and response across industry and government, CESER advances a national unity of effort towards a secure, functioning, and resilient Energy Sector.

Issue(s)

The Energy Sector is comprised of geographically dispersed electricity, oil, and natural gas assets and the transmission infrastructure, pipelines, and other systems and networks that connect them. Without a stable energy supply, the Nation's collective health and welfare are threatened, and the U.S. economy cannot function. More than 80 percent of the country's energy infrastructure is owned by the private sector, supplying fuels to the transportation industry; electricity to households and businesses; and other sources of energy that are integral to growth and production across the nation. An integrated risk-management approach and close collaboration between multiple levels of government and the private sector will enable national security.

Background

In February 2013, President Obama signed Presidential Policy Directive (PPD) 21, outlining a national effort to strengthen and secure critical infrastructure against physical and cyber threats. Under PPD-21, DOE is designated as the SSA for the Energy Sector along with SSAs designated for each of the other 15 critical infrastructure sectors. CESER implements the responsibilities which include serving as the Federal interface for the sector; identifying vulnerabilities and encouraging risk management; facilitating threat information sharing, potential protective measures, and promising practices; executing incident management; and providing sector-specific critical infrastructure information on an annual basis.

DOE and other SSAs execute their responsibilities through the National Infrastructure Protection Plan (NIPP), which facilitates interaction and cooperation between government and industry. Each of the 16 sectors has a Government Coordinating Council (GCC) and a Sector Coordinating Council (SCC) to collaborate across government and private sector

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owners and operators for critical infrastructure security and resilience coordination and planning, as well as a range of sector-specific activities and issues.

The CESER Assistant Secretary chairs the Energy Government Coordinating Council (EGCC), and the Director of the U.S. Department of Homeland Security (DHS) Cybersecurity and Infrastructure Security Agency (CISA) serves as the co-chair. The EGCC includes representatives from several federal agencies; the Federal Power Marketing Administrations (PMAs); state energy and regulatory associations; and the Canadian government.

The Energy Sector has two subsector councils: the Electricity Subsector Coordinating Council (ESCC) and the Oil & Natural Gas Subsector Coordinating Council (ONG SCC), which each meet jointly with the EGCC two to three times per year at DOE. The SCCs inform and engage with CESER on energy and cyber security programs on a regular basis. The joint meetings occur under rules established by the Secretary of Homeland Security in 2006 for the Critical Infrastructure Partnership Advisory Council (CIPAC), which exempt them from the Federal Advisory Committee Act (FACA). The joint council meetings usually include a SECRET classified briefing. CESER manages the nomination and processing of clearances for energy sector owners and operators under the Private Sector Clearance Program.

Status

DOE and its sector partners are currently engaged in a number of initiatives designed to increase the resilience of the Nation's energy infrastructure. These initiatives include the following:

COVID-19 Recovery and Return-to-Work Guidance

In addition to coordinating response efforts, CESER engaged in drafting recovery and return-to-work guidance with the subsectors. The "Oil and Natural Gas Responsible Recovery Compendium" and the "ESCC Resource Guide – Assessing and Mitigating the Novel Coronavirus (COVID-19)" were updated as the COVID situation evolved and both have been lauded as a resource for other critical infrastructure sectors. DOE supported the DHS essential critical infrastructure workers (ECIW) guidance, as well, with letters to the Governors.

NDAA Section 5726 Securing Energy Infrastructure (SEI) Task Force

Three representatives from the ESCC were selected to participate on an executive task force that is based on the Section 5726 of the National Defense Authorization Act (NDAA) for Fiscal Year 2020 requirement that the Secretary of Energy establish a working group to advise a two year pilot program to identify new classes of security vulnerabilities and evaluate technology and standards to isolate and defend industrial control systems within energy infrastructure from security vulnerabilities and exploits.

Bulk Power System Executive Order (BPS EO) Task Force

Under the BPS EO, a Task Force on Federal Energy Infrastructure Procurement Policies will coordinate Federal Government procurement of energy infrastructure and the sharing of risk information and risk management practices. The new task force will be chaired by the Deputy Secretary of Energy and will consult with the energy industry through the ESCC and the ONG SCC to develop recommendations that it will pass on to the Federal Acquisition Regulation Council.

National Infrastructure Protection Plan (NIPP) Refresh

Two representatives from both the ESCC and the ONG SCC are engaged in the NIPP refresh, which will focus on removing obsolete information, refining existing language, and adding new information and policy references since publication.

Section 9 Data Call from DHS

In 2013, DOE contributed to the DHS-maintained list of critical infrastructure entities that meet the criteria specified by Section 9 of Executive Order (EO) 13636, *Improving Critical Infrastructure Cybersecurity,* where a "cybersecurity incident could reasonably result in catastrophic regional or national effects on public health or safety, economic security, or national security." DHS released a data call in August for SSAs to confirm the existing energy sector companies and propose new companies, if needed. DOE responded in October. The Section 9 list is used by DHS and other Federal agencies to provide the entities with threat intelligence and support.

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ESCC Grid Security Emergency Working Group

Section 61003 of the FAST Act defined a "grid security emergency" and authorized the Secretary of Energy to order emergency measures following a Presidential declaration of a grid security emergency (GSE). A GSE could result from a physical attack, a cyber-attack, an electromagnetic pulse (EMP), or a geomagnetic storm event. The ESCC established a group to work with CESER in planning for and issuance of GSE orders.

ESCC Wildfire Coordination

The ESCC, CESER, and the Office of Electricity (OE) hosted a meeting on wildfires in May 2020 to discuss land management, technology and information sharing, and restoration and recovery.

ESCC Coordination with States

Representatives from the ESCC, the federal government, National Governors Association, National Association of State Energy Officials, and National Association of Regulatory Utility Commissions have formed a working group to discuss how the electric power sector, state officials, federal partners, and regulators can align resources and priorities, unify their message, and enhance overall awareness of incident management and resilience planning.

Major Decisions/Events

ESCC-EGCC Meetings in 2021

The ESCC is focused on Spring 2021 for the next Joint Meeting. The Deputy Secretary of Energy typically provides opening remarks. The agenda will be developed in the March timeframe and typically includes presentations from CESER, OE, DHS CISA, and the Federal Energy Regulatory Commission, along with updates from the ESCC co-chairs.

ONG SCC-EGCC Meeting

The ONG SCC is assessing dates in 2021 for three Joint Meetings with the EGCC in March, July, and October.

"Sector-Specific Agency" Responsibilities with State, Local, Tribal, and Territory Governments and Efforts to Advance Their Energy Security, Cybersecurity, and Emergency Response Capabilities

The Office of Cybersecurity, Energy Security and Emergency Response (CESER) engages daily at an operational, technical, and policy level with partners from across the energy and cybersecurity sectors, and state, local, tribal, and territory (SLTT) governments under the Sector Specific Agency (SSA) role codified by the 2013 Fixing America's Surface Transportation (FAST) Act and Presidential Policy Directive 21.

Summary

CESER engages daily at an operational, technical, and policy level to enhance cybersecurity with partners from across the Energy Sector, and state, local, tribal, and territory (SLTT) governments under the Sector Specific Agency (SSA) role under Presidential Policy Directive (PPD) 21 and the FAST Act. Through this engagement, CESER builds energy security capabilities, enables information sharing, and enhances cybersecurity knowledge at the SLTT level to sustain and improve the nation's energy security and resilience. These efforts and partnerships help to advance a national unity of effort that will strengthen and maintain a secure, functioning, and resilient Energy Sector.

SLTT governments play a critical role in energy security planning and emergency response. These governments have operational, tactical, and policy development roles and responsibilities that can have a wide-reaching impact beyond the Energy Sector. Supporting SLTT advancement results in a more secure and resilient Energy Sector that is able to better prevent, mitigate, withstand, respond, and recover from disruptions. CESER encourages energy security planning that is risk-based, operationally-focused, and cross-jurisdictional, and seeks to build SLTT capacity to serve national security interests for cybersecurity, energy security, and emergency response.

CESER supports Governors and their energy advisors; state energy office directors and staff; public utility commissioners and staff; state legislators and their staff; emergency managers; and public power owners and operators through cooperative agreements with their representative groups—National Governor's Association (NGA), National Association of State Energy Officers (NASEO), National Association of Regulatory Utility Commissioners (NARUC), National Conference of State Legislature (NCSL), National Electrical Manufacturer's Association (NEMA), and American Public Power Association (APPA)—and also through direct engagement with state governments. CESER enhances SLTT preparedness and response efforts through a suite of analytical tools, training, workshops, and exercises. These resources and technical assistance advance SLTT energy security planning, risk awareness, policy and investment decisions, and mitigation strategies. CESER engages regularly with the SLTT associations through monthly calls, daily interactions on project activities, and participation in national/regional conferences, webinars, calls, and training workshops.

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Issue(s)

SLTT energy officials face a myriad of challenges including limited resources, high staff turnover, tight budgets, and gaps in energy knowledge. Decisions regarding how to secure and invest in our Nation's energy infrastructure are often complex and cross jurisdictional. There is a need to maintain continual foundational energy education for new officials to build upon and to develop advanced resources for experienced officials to utilize. With threats to the energy sector increasing and evolving, it is imperative that SLTT officials stay well-informed and coordinate with DOE and other Energy Sector partners. To address these needs, CESER is actively creating resources and activities that are user friendly, tailorable, replicable, and scalable.

Background

CESER's work with states is informed and authorized by several directives and legislation. Presidential Policy Directive (PPD) 21 identifies CESER as the SSA for energy, as well as the lead agency for Emergency Support Function (ESF) #12. The National Security Presidential Directive 51 and Homeland Security Directive 20 provide guidance for State, local, territorial, and tribal governments in order to ensure a comprehensive and integrated national continuity program that will enhance the credibility of our national security posture and enable a more rapid and effective response to and recovery from a national emergency. Finally, Presidential Policy Directive 41 (PPD-41) sets forth principles governing the Federal Government's response to any cyber incident. Under the PPD-41 framework, the Department of Energy (DOE) works in collaboration with other agencies and private sector organizations, including the designated Federal lead agencies for coordinating the response to significant cyber incidents.

DOE executes its SSA responsibilities through a framework outlined in the National Infrastructure Protection Plan (NIPP), which facilitates government-industry cooperation. Under the NIPP, each of the 16 sectors has a Government Coordinating Council (GCC) and a Sector Coordinating Council (SCC). The Councils serve as the principal points of collaboration for critical infrastructure security and resilience coordination and planning. CESER oversees the Energy Government Coordinating Council (EGCC) which includes representatives from state energy and regulatory associations

Status

Below are a few examples of initiatives that CESER and its SLTT partners are currently engaged in to increase the resilience of the Nation's energy infrastructure.

COVID-19 Response and Recovery

CESER participated in multiple COVID-19 calls and webinars with Governors and their advisors; state legislators; state and local energy officials; and tribal leaders. CESER has also participated in NASEO's COVID-19 calls with State Energy Office officials since late March.

National Defense Authorization Act (NDAA) Section 5726 Securing Energy Infrastructure Task Force (SEITF)

The SEITF will convene stakeholders to:

- evaluate technology and standards to isolate and defend critical industrial control systems (ICS) from cybersecurity vulnerabilities and exploits;
- develop a national cyber-informed engineering strategy to isolate and defend critical ICS from cybersecurity vulnerabilities and exploits; and
- identify new classes of security vulnerabilities of critical ICS.

NDAA Section 5726 requires participation of a State or regional energy agency.

NARUC Task Force on Emergency Preparedness, Recovery, and Resiliency

In response to recent extreme weather and COVID-19, NARUC launched a Presidential Resilience Task Force focused on protecting the reliability of our vulnerable energy systems and creating a more resilient infrastructure to enable the nation to better respond to future large-scale and catastrophic events. Membership includes a diverse private and public sector group, including CESER's Deputy Assistant Secretary.

State and Regional Energy Risk Profiles

CESER developed risk profiles that examine the relative magnitude of risks at a regional and state level, highlighting energy infrastructure trends and impacts. The profiles present both natural and

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man-made hazards with the potential to disrupt electric, petroleum, and natural gas infrastructure. The profiles are used by states to inform decisions about investments, resilience, and hardening strategies and asset management. CESER, in collaboration with Argonne National Laboratory, is currently updating these profiles.

SLTT Online Energy Security Training

CESER is seeking to institutionalize the fundamentals of energy assurance planning through an online training platform. The platform will address a training gap for new and existing energy officials and allow supplemental exercises, workshops, and resources to address more advanced and dynamic issues in the energy sector. The nation's security and resilience posture will improve with an educated and knowledgeable cadre of state energy officials who are prepared to mitigate and respond to energy disruptions, regardless of the threat.

State Emergency Response Training

CESER, in partnership with our commercial training provider HAMMER, is expanding their federal Emergency Support Function (ESF-12) training to State ESF-12 responders for the first time in FY 2021. This integration will enhance Federal and State ESF-12 coordination and response capabilities to ensure Federal, Regional, and State preparedness for events affecting the energy systems.

In addition to these initiatives, CESER's SLTT Program is currently preparing a variety of other resources and activities—ranging from cybersecurity training to threat briefings and preparedness exercises—for FY 2021.

Major Decisions/Events

State Association Conferences

The state member associations—NASEO, NARUC and NGA—typically hold annual meetings in D.C. in February that include DOE leadership. While these events will likely be virtual in 2021, CESER anticipates invitations will be extended for participation in energy security-focused panels and keynotes. Other major conferences and regional events are held in the spring, summer, and fall in various locations.

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Advanced Research on Integrated Energy Systems (ARIES)

ARIES is a research platform that addresses the fundamental challenges of integrated energy systems at scale including technologies of variable physical sizes, securely controlling large numbers of interconnected devices, and integrating diverse energy technologies.

Summary

Advanced Research on Integrated Energy Systems (ARIES) is a research platform at the National Renewable Energy Laboratory (NREL) that can match the complexity of the modern energy system and conduct integrated research to support the development of groundbreaking new energy technologies. ARIES represents a substantial scale-up in experimentation capability from existing research platforms, allowing for research at the 20-MW level. The scale of the platform is amplified by a virtual emulation environment powered by NREL's 8-petaflop supercomputer.

ARIES will make it possible to understand the impact and get the most value from the millions of new devices—such as electric vehicles, renewable generation, hydrogen, energy storage, and grid-interactive efficient buildings—that are being connected to the grid daily. The scale of the platform will also make it possible to consider opportunities and risks with the growing interdependencies between the power system and other infrastructure like natural gas, transportation, water, and telecommunications.

ARIES unites research capabilities at multiple scales and across sectors to create a platform for understanding the full impact of energy systems integration. ARIES addresses the risks and opportunities of widescale integration across five research areas: energy storage, power electronics, hybrid energy systems, future electric infrastructure, and cybersecurity.

Energy Storage

ARIES connects multiple individual energy storage applications with a system-level perspective. The coupling of at-scale storage technologies—such as batteries + thermal, or batteries + hydrogen—will support essential steps toward validating energy system models and controls. As storage technologies graduate from the laboratory to the multi-megawatt level, ARIES will help systems stay ahead of performance and interfacing challenges associated with scaling.

Power Electronics

The continued growth in power electronics is creating a new paradigm in power system operation. ARIES helps address the fundamental differences between power electronic-based equipment and traditional devices and the limits that must be overcome to enable higher levels of renewable generation. By integrating new power electronic technologies and system architectures, ARIES will support a future grid with resilient and flexible operation.

Hybrid Energy Systems

With future energy systems expected to incorporate millions of distributed energy assets, the ARIES research platform is uniquely able to reproduce the diverse time scales, physical scales, and technologies of these hybrid energy systems. ARIES introduces a near-real-world environment with high-fidelity, physics-based, real-time models that facilitate the connection between hundreds of real hardware devices and tens of millions of simulated devices. This research area will advance the foundational science for real-time optimization and control of large-scale energy systems.

Future Energy Infrastructure

ARIES supports the innovation necessary for next-generation energy infrastructure solutions. The future energy infrastructure research area involves transmission and delivery networks on a variety of advanced fuel types and infrastructures, which undergird the power, transportation, buildings, and industrial sectors. ARIES will enable testing on grid designs that span from the level of microgrids up

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to high-voltage direct current transmission grids. Testing will also include management and control systems that optimally integrate power delivery for diverse fuel and technology types.

Cybersecurity

ARIES helps close the system-level security gaps that emerge from distinct hardware and software becoming integrated. The ARIES platform involves visualization, monitoring, and data processing for ARIES research assets and the connections between them. By creating a digital twin of clusters of research hardware, ARIES has the ability to simulate and detect attacks on communications and control systems that are still evolving, with an effect of reducing overall vulnerabilities in energy systems.

Issue(s)

The pace of innovation is occurring faster than the pace of grid modernization. Providing the energy industry with a place to conduct research and development on integrated energy systems at real-world scale and innovate new methods to monitor and control the growing number of diverse technologies that will interact with the grid is essential.

ARIES will enable the development of advanced energy solutions from generation, storage, and efficient, dynamic loads to serve as a foundation for the future bi-directional grid network, and their potential benefits are captured and valued. ARIES will provide data and results to simulate, validate, and enable integrative solutions for the transformational grid.

ARIES capabilities will support integration research that addresses the physical size and the growing number of interconnected devices as well as integration at the interface between the bulk and distribution power levels. ARIES will integrate emulation (e.g., representing dynamic building loads) with actual experimental hardware and use controllable grid interface equipment to inject faults and anomalies to test how equipment responds

Status

Building off seven years of successful research and development at the Energy System Integration Facility (ESIF), the Office of Energy Efficiency and Renewable Energy (EERE) is in the process of finalizing a research and development plan for ARIES based on feedback from a Request for Information (RFI) posted in February 2020. Secretary Dan Brouillette officially announced the opening of ARIES in August 2020, and NREL and EERE followed up on the announcement by holding an industry workshop in September 2020. More than 330 industry representatives participated in that workshop. Based on feedback from the kickoff meeting, NREL plans to hold a meeting specifically addressing energy storage.

Milestone(s)

- ARIES Request for Information: This was sent out to stakeholders for comment in February 2020.
- ARIES Kickoff: Secretary Brouillette announced the kickoff of ARIES in August 2020.
- ARIES Industry Workshop: Over 330 stakeholders attended the first ARIES industry workshop in September 2020.
- Finalizing an ARIES R&D plan: This is planned for completion in October 2020.

Background

ARIES is a new initiative that will leverage capabilities at NREL's Energy Systems Integration Facility (ESIF)[1], the Integrated Energy Systems at Scale (IESS) capabilities at the Flatirons Campus,[2] and a virtual emulation environment, matching those not physically existing as such but made by software to appear to do so. This will support hardware-in-the-loop (HIL) experimentation with up to millions of virtual power grid and cyber infrastructure devices.

ARIES aims to build on the capabilities at the ESIF by linking ESIF research assets to those at NREL's Flatirons Campus. Research at the ESIF can go up to 2 MW, which covers distribution-level testing.

1 NREL's South Table Mountain Campus in Golden, Colorado, is home to the Energy Systems Integration Facility (ESIF). The ESIF is a state-of-the-art research facility which provides a unique contained and controlled platform on which partners and users can identify and resolve the technical, operational, and financial risks of integrating emerging energy technologies into today's environment.

2 NREL's recently renamed Flatirons Campus is located near Boulder, Colorado. The campus is also home to the National Wind Technology Center (NWTC) that provides unique capabilities that support experiments, innovation and technology validation that advances U.S. leadership in wind technology.

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NREL is developing its Flatirons Campus to allow for research at the 20 MW scale and beyond, representing the interface between the distribution and bulk-power levels.

Technologies to be investigated through partnerships between DOE, NREL, and industry will include storage technologies with new battery chemistries; innovative thermal storage systems such as phase-change materials; innovative electrolyzer and hydrogen storage technologies; extreme fast charging of multiple vehicles simultaneously; new medium voltage power electronics with wide band gap semiconductors; and a whole host of other emerging technologies that will need to be validated at-scale.

Using a 100 Gbps fiber optic link as its backbone, researchers can leverage capabilities at the Flatirons Campus and ESIF, including high-performance computing. This communications link will make it possible to explore breakthrough solutions for optimizing the integration of renewables, buildings, energy storage, and transportation—helping to modernize our energy systems and ensure a secure and resilient grid. A virtual emulation environment between the two campus sites will virtually connect with other research laboratories and industry to enable further leverage of research and capabilities. Network connectivity and fiber-optic connections will further enable data transfer from field experiments and provide data communications and dynamic closed-loop experimentation among the IESS component systems, ESIF, and other National Laboratories to enable experiments involving local and remote hardware, with machine-learning being an integral piece.

Appliance Standards

DOE continually strives to meet its legal obligations under the Appliance Standards Program, while ensuring that meaningful improvements are proposed and published through a robust public process.

Summary

DOE is authorized by the Energy Policy and Conservation Act (EPCA), as amended, to establish energy conservation standards that are 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 product's eligibility for sale in the U.S. where standards are in place, and for making representations regarding the energy use of the product. Establishment of the national minimum energy efficiency requirements based on the prescribed test procedures which, by law, must result in a significant conservation of energy and be 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. 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 a means of facilitating stakeholder engagement by allowing for negotiated rulemakings under the guidelines set forth in the Federal Advisory Committee Act.

Issue(s)

Since 1989, in more than 60 rulemakings subject to statutory deadlines, the Department has issued the required rule on time as required by the statute only six times. During that same time period, the Department has had, on average, nearly 15 outstanding deadlines each year. Over the 32 years starting in 1989 through 2020, only four years had fewer than five outstanding deadlines, and three of those years were 1989-1991. In calendar year 2020, DOE is at about the annual average for outstanding deadlines.

DOE is subject to two kinds of statutory deadlines. The first are those in which Congress sets an initial standard in law and directs the Department to review that standard, usually three to five years after the statutory standard is enacted. Second, DOE is required by statute to consider whether to amend the existing standards for a given product at least once every six years. The EPCA also generally requires a three to five-year compliance lead time after DOE publishes a final rule setting a new standard under this six-year lookback requirement.

The standards rulemaking process requires that data be collected and analyzed to determine whether a new standard is justified and, if so, what that standard might be. Typically, there are no new data available until the market has adjusted to the previous rulemaking. Given the statutorily prescribed three to five-year lead-time period before compliance with a new standard is required, market adjustment to the previous standard generally does not happen until many years after issuance of the last rulemaking. The problem is that the data gathering and analysis required for DOE to consider whether new standards

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.

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are justified, as well as the public participation requirements specified in EPCA for the promulgation of a rule that DOE has found are invaluable to the standards development process, simply cannot fit within a statutory timeframe for rulemaking that requires a decision to be made before the data are available. As a result, the Department struggles to meet statutory deadlines so long as the law requires that decision in six years or less, as historical precedent shows.

Nevertheless, DOE is conscious of the requirements and continually strives to responsibly undertake the required rulemakings, while ensuring that meaningful improvements are proposed and published through a robust public process. The Department dedicates substantial resources to this goal.

Status

While DOE has historically been hampered by the conflict between the statute and the data gathering and public process necessary to make decisions, DOE is striving to meet its legal obligations under the Appliance Standards Program and has made substantial progress to address missed deadlines. In fact, recently DOE's progress on energy conservation standards has accelerated:

- Since December 2018, DOE has completed 9 final rules pertaining to energy conservation standards, including standards for commercial air compressors, commercial packaged boilers, external power supplies, general service incandescent lamps, general service lamps, portable air conditioners, process improvement rule, procedures for evaluating statutory factors for use in new or revised energy conservation standard, and uninterruptible power supplies.
- Since December 2018, DOE has completed 2 final rules pertaining to energy conservation test procedures, including cooking tops and fluorescent lamp ballasts.
- Furthermore, DOE has ongoing efforts to meet energy conservation standards obligations for 50 additional products.

Milestone(s)

To address the timing problem (to the extent possible within the existing law), DOE issued a final rule that would streamline and modernize its process for setting energy efficiency standards and test procedures. The so-called "Process Rule" improves the internal framework used by DOE's Office of Energy Efficiency and Renewable Energy for establishing new energy efficiency regulations, with the goal of increasing transparency, accountability, and certainty for stakeholders. The Process Rule updates the agency's methodology for setting energy efficiency standards and test procedures for residential appliances and commercial equipment. Among other things, the changes include:

- Establishing a threshold for "significant" energy savings at 0.3 quads of site energy over 30 years or, if less than that amount, a 10 percent improvement over existing standards. Congress requires DOE to regulate only where doing so would save significant energy, but this term is not currently defined by Congress. DOE established the 0.3 quads threshold after conducting an analysis which found that over the last three decades, 60% of standards were projected to save 0.3 quads or more over 30 years, and those 60% of standards accounted for 96% of total energy savings. The other 40% of standards, projected to save less than 0.3 quads, accounted for just 4% of total energy savings. Establishing a threshold of significant energy savings at 0.3 quads or, if less than that amount, a 10 percent improvement will allow DOE to focus on standards projected to provide by far the largest return on investment for the American people.
- Requiring that DOE establish final test procedures 180 days before proposing a new energy conservation standard rulemaking. In public comments, stakeholders expressed concern when DOE regulates the efficiency of products before specifying how energy use will be measured via test procedure. This provision ensures that all parties involved in a standards rulemaking will know the engineering basis upon which the standards decision will be made.
- Clarifying that DOE will codify private sector consensus standards for test procedures, as described in the original Process Rule. When DOE-recognized, consensus-based bodies comprised of industry, advocates, and other stakeholders reach consensus on a test procedure that meets statutory requirements, the Process Rule requires DOE to adopt that consensus procedure as the DOE test procedure. This change provides enhanced certainty to stakeholders and allows manufacturers to test their products at lower cost than when DOE takes time to create an agency-specific testing metric.

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Critical Minerals

Addressing challenges with critical mineral supply chains is essential to the energy, economic, and national security of the United States. DOE is engaged across the enterprise in R&D and international collaborations.

Summary

Critical materials are used in many products important to the U.S. economy and national security. The assured supply of critical materials and the resiliency of their supply chains are essential to the economic prosperity and national defense of the United States. Of the 35 mineral commodities identified as critical on the list[1] published in the Federal Register by the Secretary of the Interior, the United States lacks domestic production for 14,[2] and is more than 50% import-reliant for 31.[3] This dependence puts supply chains and U.S. companies and material users at increased risk.

On December 20, 2017, President Donald J. Trump issued Executive Order (EO) 13817, A *Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals,* which identified actions to reduce our Nation's reliance on imports, preserve our leadership in technological innovation, support job creation, and improve national security and the balance of trade. The Department of Commerce was directed to submit a report on critical minerals to the President once the Department of the Interior had published a list of critical minerals. The Department of Commerce published this report on June 4, 2019. [4]

On September 30, 2020, President Trump issued EO 13953 on Addressing the Threat to the Domestic Supply Chain from Reliance on Critical Minerals from Foreign Adversaries. This directed agencies to examine potential authorities and prepare agency-specific plans to improve the mining, processing and manufacturing of critical minerals.

DOE is the agency authorized by Congress to work R&D around mining, processing, and manufacturing of critical minerals (as well as other minerals). When the United States Bureau of Mines was closed in 1996, Congress transferred to DOE the research on the extraction, processing, use, and disposal of mineral substances, and functions pertaining to mineral reclamation industries and the development of methods for the disposal, control, prevention, and reclamation of mineral waste products. See Pub. L. No. 104-134, 110 Stat. 1321-167 (1996).

The Department of Energy (DOE) is engaged in achieving the goals in the Executive Orders through a crosscut of our entire enterprise. DOE's strategy for addressing critical materials has three pillars: diversify supply, develop substitutes, and improve reuse and recycling. The Department was a key agency in the development of the Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals and serves as the co-chair of the National Science & Technology Council (NSTC) Critical Minerals Subcommittee. DOE has forged a strong working relationship with other agencies (Department of Defense, Department of the Interior, Department of Commerce, Department of State) as well as with Canada, Australia, the European Union, and Japan.

1 Aluminum (bauxite), antimony, arsenic, barite, beryllium, bismuth, cesium, chromium, cobalt, fluorspar, gallium, germanium, graphite (natural), hafnium, helium, indium, lithium, magnesium, manganese, niobium, platinum group metals, potash, the rare earth elements group, rhenium, rubidium, scandium, strontium, tantalum, tellurium, tin, titanium, tungsten, uranium, vanadium, and zirconium

2 U.S. Geological Survey, "Mineral Commodity Summaries 2018," 2018, https://doi.org/10.3133/70194932

3 U.S. Department of the Interior, "Final List of Critical Minerals 2018," 83 Fed. Reg. 23295; 2018, https://www.federalregister.gov/documents/2018/05/18/2018-10667/final-list-of-critical-minerals-2018

4 U.S. Department of Commerce. https://www.commerce.gov/news/reports/2019/06/federal-strategy-ensure-secure-and-reliable-supplies-critical-minerals

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Issue(s)

The United States is more than 50% import-reliant on foreign sources for 31 of the 35 minerals deemed critical by the Department of the Interior. The United States not only lacks the mining for many of these materials, we also lack downstream domestic processing and manufacturing capabilities for critical materials like neodymium for magnets. Ores and other raw materials mined or produced in the United States have to be exported for further processing into more value-added products. This makes the United States vulnerable to supply disruption. Without investing in downstream supply chain activities like processing and manufacturing in parallel with increased domestic production, we simply shift the risk down the supply chain.

For example, rare earth elements are essential for the manufacturing of high strength magnets used in electric vehicle motors and offshore wind turbine generators. Lithium and cobalt are vital to the manufacturing of lithium-ion batteries used for electric vehicles and grid energy storage.

In order to develop a sustainable and robust supply chain here in the United States, we have to innovate to reduce the costs of the materials and reduce the environmental impacts of production. We also have to develop cost-effective substitutes and improve the recycling and reuse of critical materials.

Status

In support of Executive Order 13817, multiple DOE offices are addressing key parts of the critical minerals supply chain.[5] For example, the Office of Fossil Energy (FE) is focused on diversifying supply, with the goal of producing market-ready rare earth elements from primarily coal resources. Research and development (R&D) includes resource characterization, extraction and separation, process and systems modeling and techno-economic analysis. For FY 2020, FE is soliciting pre-feasibility studies for the development of systems that can produce one to three tons per day of mixed rare earth oxides or rare earth salts (REOs/RESs). The FY 2020 solicitation builds on previously completed small-scale (bench-pilot) projects. The FY 2020 work focuses on researching processes for scale-up, optimization, and efficiency improvements for Rare Earth Elements (REEs) and critical materials recovery from coal refuse, acid mine drainage, and fly ash. FE has conducted 20 early stage R&D projects looking at transformational methods to identify, extract, recover and process critical minerals.[6]

The Office of Energy Efficiency and Renewable Energy also funds substantial R&D into critical minerals. In FY 2020, EERE has a variety of efforts related to critical minerals and rare earth elements: Critical Materials Institute (CMI); ReCell Lithium Battery Recycling R&D Center at Argonne National Laboratory; Lithium-Ion Battery Recycling Prize; Commercialization of Electric Vehicle Batteries; and recovering critical minerals from geothermal brines and seawater.

CMI is an Energy Innovation Hub, funded by the Advanced Manufacturing Office (AMO) and led by Ames Laboratory, that leverages decades of these DOE investments. CMI brings together facilities and complementary expertise located at 18 U.S. corporations, 13 universities, and four DOE national laboratories (Ames Laboratory, Idaho National Laboratory, Lawrence Livermore National Laboratory, and Oak Ridge National Laboratory).

CMI, with its partners, focuses on R&D towards DOE's three pillars: diversifying supply, developing substitutes, and recycling. CMI's efforts have largely been on rare earth elements (for magnets and lighting) and lithium. New efforts on cobalt, graphite, indium, and gallium are also underway. As of October 2020, CMI has issued 137 invention disclosures, received 19 patents, created three open-source software packages, and won four R&D awards.[7] It has licensed 10 technologies to U.S. companies.

5 The Department of the Interior and Related Agencies Appropriations Act of 1996 generally supports DOE research and development activities related to extraction, separation, and processing technologies. When the United States Bureau of Mines (BoM) was closed in 1996, Congress transferred certain BoM functions to DOE including research of the extraction, processing, use and disposal of mineral substances, and functions pertaining to mineral reclamation industries and the development of methods for the disposal, control, prevention, and reclamation of mineral waste products. See Pub. L. No. 104-134, 110 Stat. 1321-167 (1996).

6 U.S. Department of Energy, National Energy Technology Laboratory, Office of Fossil Energy, "Feasibility of Recovering Rare Earth Elements", https://www.netl.doe.gov/coal/rare-earth-elements

7 Critical Materials Institute. (n.d.). About CMI. Retrieved October 19, 2020, from https://www.ameslab.gov/cmi/about-critical-materials-institute

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In FY 2020, AMO released a $30M Funding Opportunity Announcement for research and development that focuses on field validation and demonstration, as well as next-generation extraction, separation, and processing technologies for critical materials. Selections are expected in late 2020.

EERE's Vehicle Technologies Office (VTO) has established the ReCell Lithium Battery Recycling R&D Center at Argonne National Laboratory to develop innovative, efficient recycling technologies for current and future battery chemistries. ReCell funds R&D across four research areas: design for recycling; recovery of other materials; direct recycling or cathode-to-cathode recovery; and modeling and analysis (including reintroduction of recycled materials).

In January 2019, the Department (through EERE's VTO and AMO) announced the launch of a Lithium-Ion Battery Recycling Prize to incentivize American entrepreneurs to create cost-effective, disruptive solutions to collect, sort, store, and transport 90% of spent or discarded lithium-ion batteries for eventual recycling. Phase I winners have been announced with Phase II winners expected to be announced in November 2020.[8]

EERE's VTO is pursuing several R&D paths to mitigate the potential issues associated with the supply of cobalt including: (1) funding R&D to reduce cobalt content in the battery cathode to less than 5% by weight in the mid-term by increasing nickel content or substituting manganese, aluminum, or other earth abundant metals; and (2) funding high risk research completely eliminating the need for cobalt in the long term, such as lithium sulfur, solid state, and lithium metal battery technology.

Long-term investments by the Office of Science (SC) set the stage for applied R&D. Current Basic Energy Sciences critical materials research includes advancing the understanding of the role of rare earth materials and other critical materials in determining the properties of materials at length scales ranging from electronic interaction distances to atomic and microstructural scales. A key aspect of basic research in this field is identifying methodologies to reduce or replace rare earth elements in materials used in electronic and magnetic applications as well as alternatives to elements such as lithium and cobalt in batteries and platinum in catalytic reactions. In FY 2021, SC plans to increase R&D to advance the understanding of rare earth elements and other critical materials at atomic and microstructure scales; develop synthesis approaches and materials discovery; and research the chemistry of rare earth elements.

Milestone(s)

As a result of the report published by the Department of Commerce, *A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals,* the National Science & Technology Council (NSTC) Critical Minerals Subcommittee (CMS) requested DOE to take the lead for coordinating interagency activities to advance transformational research, development, and deployment across critical minerals supply chains, including development of an R&D roadmap to identify key needs. DOE also has a key role in other aspects of the Federal Strategy, including to increase international exchanges with partner nations; enable commodity specific mitigation strategies; and encourage the use of secondary and unconventional sources of critical materials.
In EO 13953, DOE is responsible for:

- Within 30 days of the date of the order, developing and publishing guidance clarifying the extent to which projects that support domestic supply chains for minerals are eligible for loan guarantees pursuant to Title XVII of the Energy Policy Act of 2005, as amended; and funding awards and loans pursuant to the Advanced Technology Vehicles Manufacturing (ATVM) incentive program established by section 136 of the Energy Independence and Security Act of 2007, as amended.
- Within 30 days of the date of the order, reviewing its regulations (including any preambles thereto) interpreting Title XVII and the ATVM statute, including the regulations published at 81 Fed. Reg. 90,699 (Dec. 15, 2016) and 73 Fed. Reg. 66,721 (Nov. 12, 2008); and identifying all such regulations that may warrant revision or reconsideration in order to expand and protect the domestic supply chain for minerals (including the development of new supply chains and the

8 Battery Prize Rules and Scoring Criteria. (2020, March 25). "Important Dates". https://americanmadechallenges.org/batteryrecycling/battery-recycling-prize-rules-and-scoring-criteria.pdf

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processing, remediation, and reuse of materials already in interstate commerce or otherwise available domestically).

- Within 90 days of the date of the order, proposing for notice and comment a rule or rules to revise or reconsider any such regulations for this purpose, as appropriate and consistent with applicable law.
- Examining available DOE authorities and identifying any such authorities that could be used to accelerate and encourage the development and reuse of historic coal waste areas, materials on historic mining sites, and abandoned mining sites for the recovery of critical minerals.

Energy Efficiency and Renewable Energy Staffing

The Office of Energy Efficiency and Renewable Energy (EERE) has prioritized hiring, with an effort to staff EERE to 675 Full-Time Equivalents. EERE recognizes qualified and sufficient staff is necessary to efficiently and effectively execute the mission.

Summary

EERE and DOE's Office of the Chief Human Capital Officer (HC) have developed a strategy to increase recruiting and hiring capabilities, allowing EERE to bring on new talent. Over the past three years, EERE's attrition rate (~10%) has outpaced the hiring rate, resulting in a reduced workforce, totaling 589 at the end of September 2020.

Concern around EERE's ability to efficiently execute increasing enacted budgets was also raised by Congress, leading to the following language being included in the FY 2020 appropriations report: "The Department is directed to report to the Committees on Appropriations of both Houses of Congress not later than 30 days after enactment of this Act with a plan for reaching a staffing level of 675 to 700 full-time equivalents (FTEs) by the end of fiscal year 2020".

As a result, EERE developed a staffing plan with the goal of reaching 675 FTEs. The plan identifies a full mapping of positions for each technology and operations office (e.g., Solar, Buildings, Vehicles, etc.), including a plan on how each position will be backfilled upon vacancy. The staffing plan accounts for a total of 715[1] positions, allowing EERE to manage to a minimum of 675 employees on board, at all times (accounting for attrition and time-to-hire, and assuming 35 positions in some stage of the recruitment process at all times). This increase in positions will provide for a more balanced workload across staff and address employee concerns about overload.

Issue(s)

As with many government agencies, it is challenging for EERE to recruit and retain the best staff. The federal hiring process is extensive with more than 100 steps. The average time-to-hire for EERE positions completed in FY 2020 was 158 days from the start of the HC process to the date an employee was on-boarded. The internal approval process for the position was in addition to that timeline.

HC has developed more than 100 standardized position descriptions (PDs) and created continuous open announcements to accelerate the hiring efforts for technical staff in scientific and engineering positions. EERE was one of the first offices within DOE to make use of the government-wide STEM direct hiring authority.

EERE's staffing plan was recently approved, providing a plan for a total of 715[2] positions across EERE. The plan identifies a full mapping of positions for each technology and operations office, including a plan on how each position will be backfilled upon vacancy. The approval of this plan significantly streamlines the internal approval timeline, as backfill plans for any new vacancies have already been identified and approved. The final approved staffing plan balances grade distribution, supports career pathways and succession planning, and builds technical and project management capacity while ensuring an appropriate level of operational expertise across a variety of disciplines.

Status

EERE leadership is committed to ensuring sufficient staff to execute the mission and is actively working with HC to ensure that program offices are fully staffed. In FY 2020, the office on-boarded 82 new employees, and ended the fiscal year with an on-board count of 589[3] and an estimated FTE level of

1 The plan includes a total of 648 EERE positions, 44 reimbursable NETL FTEs directly supporting EERE and 25 'Other' positions in Human Capital and General Counsel providing services to EERE.

2 The plan includes a total of 648 EERE positions, 44 reimbursable NETL FTEs directly supporting EERE and 25 'Other' positions in Human Capital and General Counsel providing services to EERE.

3 OBC includes 38 FTEs at NETL, which EERE funds through a reimbursable agreement. A portion of the 40 FTEs are directly billed to

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561[4]. Table 1 identifies the number of new hires per quarter and illustrates the significant increase in the rate of hiring and on-boarding of new staff as the year progressed.

New External Hires On-boarded – FY 2020			
Q1	Q2	Q3	Q4
13	15	21	33

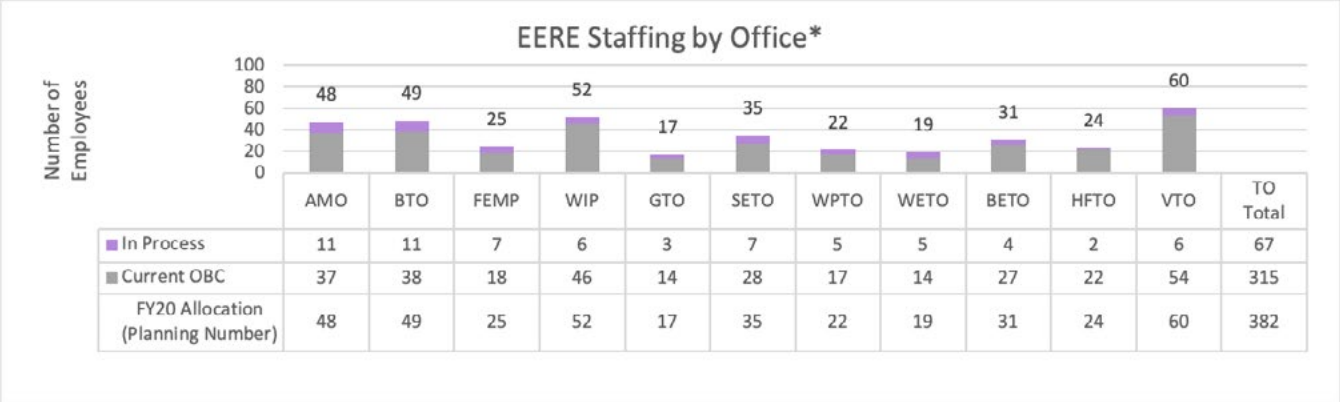
Table 1. Number of new external hires on-boarded in FY 2020.

EERE currently has 127 positions in the recruitment process, and given the increased rate of hiring, the collaborative efforts of EERE and HC are estimated to reach an on-board count of 675 by third quarter, FY 2021. Table 2 provides a snapshot of the status of each technical office recruitment efforts, highlighting both the current staffing levels (on board count) and the approved staffing actions for the technical offices. NETL staff that directly support a technical office are shown as part of the office total.

Background

EERE's previous position target was established at 671, to support an FTE level of 625. The position target assumes EERE's historical attrition rate of 10% and a six to eight month estimation of time from a position becoming vacant to on-boarding a backfill for the position. In order to revise the plan in support of maintaining a 675 FTE level, additional positions were allocated with a greater emphasis on addressing workload concerns in the EERE technology offices.

To determine the office-by-office allocation, EERE reviewed the 2019 position targets, the new FY 2020 enacted budget and an assessment of skill gaps. Additionally, in order to account for operational and administrative functions, EERE aimed to maintain a ratio of appropriations to FTEs ($K/FTE) based on the size of the office. For a larger office, the $K/FTE range targeted was $7-8.5M/FTE versus a range of $5-7M/FTE for smaller offices.



	AMO	BTO	FEMP	WIP	GTO	SETO	WPTO	WETO	BETO	HFTO	VTO	TO Total
In Process	11	11	7	6	3	7	5	5	4	2	6	67
Current OBC	37	38	18	46	14	28	17	14	27	22	54	315
FY20 Allocation (Planning Number)	48	49	25	52	17	35	22	19	31	24	60	382

Table 2. Number of current staff (or incumbents) and approved vacancies by (*technical) office.

EERE Operations (including the Golden Field Office) has an additional 308 positions, 56 of which are currently in the hiring process. The remaining 25 positions are for General Counsel and Human Capital FTEs who provide services to EERE.

Milestone(s)

There are no specific intermittent milestones to report.

Once the targets were established, each EERE office developed a detailed staffing plan to estimate staffing needs with a one to two year outlook. Each office was asked to identify the current grade and position series for each of their vacant positions, as well as the recruitment plan for each of their encumbered positions should they become vacant. These plans were consolidated into the EERE staffing plan which was reviewed and approved by HC, the Under Secretary of Energy, and the Secretary.

EERE payroll and the remainder are indirectly billed, and are not included in EERE's payroll codes. EERE provides PD funds directly to NETL to cover indirectly funded employees, travel, training and other related expenses, consistent with the reimbursable agreement.

4 Final FTE count for FY 2020 will be calculated when final payroll has been processed. Value shown is an estimate, but final number should be within 1 or 2 FTEs.

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Energy Storage Grand Challenge (ESGC)

The mission of the ESGC is to lead globally in energy storage innovation, manufacturing, and utilization.

Summary

The Department of Energy's (DOE) Energy Storage Grand Challenge (ESGC) is a comprehensive program to accelerate the development, commercialization, and utilization of next-generation energy storage technologies and build American global leadership in energy storage. Launched by Secretary Dan Brouillette in January 2020, the ESGC is a cross-cutting effort managed by DOE's Research Technology Investment Committee (RTIC), which is chaired by the Secretary. The RTIC established an Energy Storage Subcommittee to manage the ESGC, and that subcommittee is co-chaired by the Office of Energy Efficiency and Renewable Energy (EERE) and the Office of Electricity (OE). The effort involves 8 DOE offices [EERE, OE, Advanced Research Projects Agency-Energy (ARPA-E), Fossil Energy (FE), Nuclear Energy (NE), Loan Programs Office (LPO), Office of Technology Transitions (OTT), and Science (SC)] and has a Fiscal Year (FY) 2020 budget of $345 million.

Issue(s)

International competition remains fierce in the race to dominate market share in a suite of energy storage technologies for a variety of applications. As the market for energy storage products and services grows domestically and worldwide, U.S. reliance on foreign supplies of raw materials, components, and finished manufactured products creates a national security concern. The key issue is how to plan and coordinate efforts across the Department—as well as with other Federal agencies, states, utilities, industry, and other stakeholders—to achieve the ESGC goal and strengthen U.S. national security and economic competitiveness.

Status

In July 2020, DOE published a Draft Roadmap to guide Departmental efforts on activities that can help achieve the 2030 ESGC mission. DOE is updating the Draft Roadmap based on responses from the public to a Request for Information (RFI), which closed on August 31, 2020. DOE is considering over 2,800 responses from the RFI as it makes edits and updates. DOE is also developing an Energy Storage Market and Cost Projections Report to inform ESGC strategy and assess progress toward ESGC goals. Both the final Roadmap and the market report are scheduled for release in Fall 2020. In September 2020, DOE released a lab call to select a lead ESGC Lab Coordinator. Supported by multiple DOE program offices, the Lab Coordinator will track and coordinate efforts across DOE's lab complex. A core team representing each of the five ESGC "tracks" (see Background) from offices across the Department meets weekly to coordinate ESGC actions.

Milestone(s)

January 2020

Secretary Brouillette announced the ESGC.

Spring 2020

DOE conducted a series of stakeholder outreach sessions.

July 2020

DOE released the Energy Storage Grand Challenge Draft Roadmap and Request for Information.

Fall 2020

DOE updates Draft Roadmap based on stakeholder input. DOE will release a final Roadmap, as well as an Energy Storage Market and Cost Projections Report.

Winter 2021

DOE offices will finalize and begin executing work plans consistent with Roadmap conclusions.

Continuous

DOE releases funding opportunity announcements and supports National Lab research and analysis to advance ESGC objectives. DOE provides updates to the RTIC and receives guidance.

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Background

In FY 2017-2020, DOE invested approximately $1.6 billion into energy storage research and development, an average of $400 million per year. Nonetheless, the Department has never had a comprehensive strategy to address energy storage. After stakeholder consultations, DOE developed a Draft Roadmap that includes five tracks:

The Technology Development Track will align DOE's ongoing and future energy storage research and development (R&D) around user-centric use cases and long-term leadership.

The Manufacturing and Supply Chain Track will develop technologies, approaches, and strategies for U.S. manufacturing that support and strengthen U.S. leadership in innovation and continued at-scale manufacturing.

The Technology Transition Track will work to ensure that DOE's R&D transitions to domestic markets through field validation, demonstration projects, public private partnerships, bankable business model development, and the dissemination of high-quality market data.

The Policy and Valuation Track will provide data, tools, and analysis to support policy decisions and maximize the value of energy storage.

The Workforce Development Track will educate the workforce, who can then research, develop, design, manufacture, and operate energy storage systems.

A system of inter-related metrics across the tracks will be used to establish targets and continuously assess progress. Cost target ranges linked to potential market demand have been developed for each of six use cases. Use case-driven technical performance metrics will help guide R&D activities. Manufacturing metrics and targets link production cost and performance to meet emerging market demand, supporting a commercially competitive energy storage revolution in the U.S. These goals are encapsulated in a "50 by 30" goal: that by 2030, storage technologies should cost-effectively serve 50 percent of the target markets identified in the ESGC use cases.

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Hydrogen Program

Hydrogen is part of a comprehensive energy portfolio that can enable energy security and resiliency and provide economic value and environmental benefits for diverse applications across multiple sectors. The DOE Hydrogen Program is addressing key challenges in core technical and institutional areas including cost, durability, reliability, and performance, hydrogen infrastructure, and other non-technical barriers such as codes, standards, and workforce development. EERE's Hydrogen and Fuel Cell Technologies Office (HFTO) coordinates Hydrogen Program activities across EERE, FE, NE, OE, SC, and ARPA-E.

Summary

Hydrogen, as a versatile energy carrier and chemical feedstock, offers advantages that unite all of our nation's energy resources—renewables, nuclear, and fossil fuels—and enables innovations in energy production, storage, end-uses, and integration across transportation, industry, and power generation sectors.

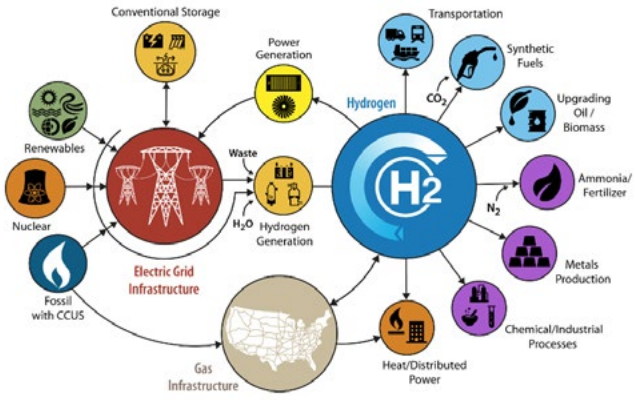

Figure 1. Conceptual H2@Scale energy system

The mission of the DOE Hydrogen Program is to research, develop, and validate transformational hydrogen and related technologies to enable adoption across multiple applications and sectors. H2@Scale,[1] a DOE initiative launched by HFTO in 2016, provides an overarching vision for how hydrogen can enable energy pathways across applications and sectors in an increasingly interconnected energy system. The H2@Scale concept, shown in Figure 1, is based on hydrogen's potential to meet existing and emerging market demands across multiple sectors. It envisions how innovations to produce, store, transport, and utilize hydrogen can help realize that potential and achieve scale to drive revenue opportunities and reduce costs. Hydrogen's versatility as both a chemical feedstock and an energy carrier can serve end-uses in various markets such as transportation applications (e.g., in heavy duty trucks and other vehicles; as a feedstock for synthetic fuels; and to upgrade petroleum and bio-fuels); industrial feedstock (e.g., in steel and cement manufacturing); heat in industrial systems and buildings; power generation (for large-scale power, off-grid distributed power, and back-up or emergency power); and energy storage.

Issue(s)

There are a wide range of applications where the use of hydrogen has the potential for significant future global demand. Industry has projected a potential $2.5 trillion global market for hydrogen technologies by 2050,[2] and investments are ramping up in many countries (e.g. $9 billion in Germany, $7 billion in France, and similar plans in Korea, Japan, and more). To sustain U.S. leadership and widespread commercialization, hydrogen technologies must be competitive in terms of cost, performance and reliability. Hydrogen production as well as delivery/infrastructure and storage are required, and conversion technologies like fuel cells and turbines must be competitive and durable. More Research, Development, and Demonstration (RD&D) is also required in systems development and integration, such as integrating renewables into the grid through hydrogen energy storage. Non-technical barriers need to be addressed, such as developing and harmonizing codes and standards; fostering best practices for safety; and developing

1 U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Hydrogen and Fuel Cell Technologies Office. 2020. "H2@Scale," https://www.energy.gov/eere/fuelcells/h2-scale.

2 Hydrogen Council. November 2017. "Hydrogen Scaling Up. A Sustainable Pathway for the Global Energy Transition." https://hydrogencouncil.com/wp-content/uploads/2017/11/Hydrogen-scaling-up-Hydrogen-Council.pdf.

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a robust supply chain and workforce. A strong, cohesive and well-coordinated effort that leverages activities across DOE offices and other agencies, as well as states and the private sector, is essential to move forward and address the emerging threats from foreign competition. This cohesive, cross-office effort through the Hydrogen Program—coordinated by HFTO and with strong engagement by FE, NE, OE, SC, and ARPA-E—should continue to be strengthened to address the key challenges.

Status

Today, approximately 10 million metric tons of hydrogen are produced in the U.S. each year, about 1/7th of the global supply, mostly from natural gas. Demand is primarily for ammonia production and oil refining; but analyses indicate the potential for 2 to 4x greater demand for hydrogen in various sectors, particularly for transportation, metals refining, and biofuels. The integration of hydrogen production technologies with utility-scale power generation plants is also a concept recently receiving increased interest, due to its potential to improve profitability of these plants while supporting grid resiliency.[3]

Annual shipments of fuel cells have increased 15-fold since 2015, now at over 1 GW,[4] and there are thousands of fuel cells across the U.S. for stationary backup power, vehicles, and niche markets such as forklifts at major company warehouses. Much of this progress was enabled by DOE. For example, HFTO funding has led to over 1,100 U.S.-issued patents, 30 commercial technologies[5] in the market (ranging from components like catalysts and membranes to complete systems such as electrolyzers), and reduced transportation cost by 60% and quadrupled durability in the last 15 years.

Milestone(s)

The Program supports target-driven RD&D efforts that will provide the basis for the near-, mid-, and long-term production, delivery, storage, and use of hydrogen derived from diverse domestic energy sources supporting a wide variety of applications, with varying timeframes for commercial adoption.

One of the mechanisms used is to fund consortia led by national labs with industry and university partners to address quantitative metrics, such as H2NEW and the Million Mile Fuel Cell Truck Consortium launched by HFTO. Key targets include the following: reduce the cost of heavy duty fuel cells by >2X to $80/kW; improve durability by >5X to 25,000 hours by 2030; reduce the cost of electrolyzers by ~3 to 5X to $300/kW to enable $2/kg hydrogen cost; double energy density for onboard hydrogen storage to 1.7 kWh/l; and reduce the cost of hydrogen storage tank cost by > 40% to $9/kWh by 2030. Each office, such as FE and NE, have metrics related to their feedstocks, and depending on the end-use application, the goal is $1/kg or $2/kg hydrogen production cost to be competitive with today's hydrogen from natural gas.

Background

The United States has been at the forefront of hydrogen and fuel cell R&D, from its inception in the space program, to enabling commercialization in transportation, stationary power, and portable-power applications. For the last 15 years, DOE has coordinated hydrogen and related efforts through the DOE Hydrogen Program as shown in Figure 2. HFTO coordinates activities among the DOE offices and meets monthly at a technical level to evaluate progress and strengthen activities. Each office focuses its RD&D activities on their respective energy sources, feedstocks, and target applications. All of these activities are coordinated to achieve a cohesive and strategically managed effort. As a recent example, EERE has been working closely with FE to define a matrix of roles and responsibilities, including, for example, EERE's focus on water-splitting, renewable integration, and distributed-scale storage and utilization; and FE's focus on leveraging fossil resources for hydrogen production and on large-scale utilization, such as combustion.

3 A relevant example is a wind farm or nuclear power plant that produces hydrogen from surplus electricity (via electrolysis) and then either sells or uses the hydrogen for other purposes, or reconverts it to electricity (via a fuel cell or turbine) at times of higher demand.

4 E4 tech. December 2019. "The Fuel Cell Industry Review 2019.".

5 "Progress in Hydrogen and Fuel Cells". (2020 June). Retrieved from https://www.energy.gov/sites/prod/files/2020/10/f79/hfto-progress-fact-sheet-june-2020-2.pdf

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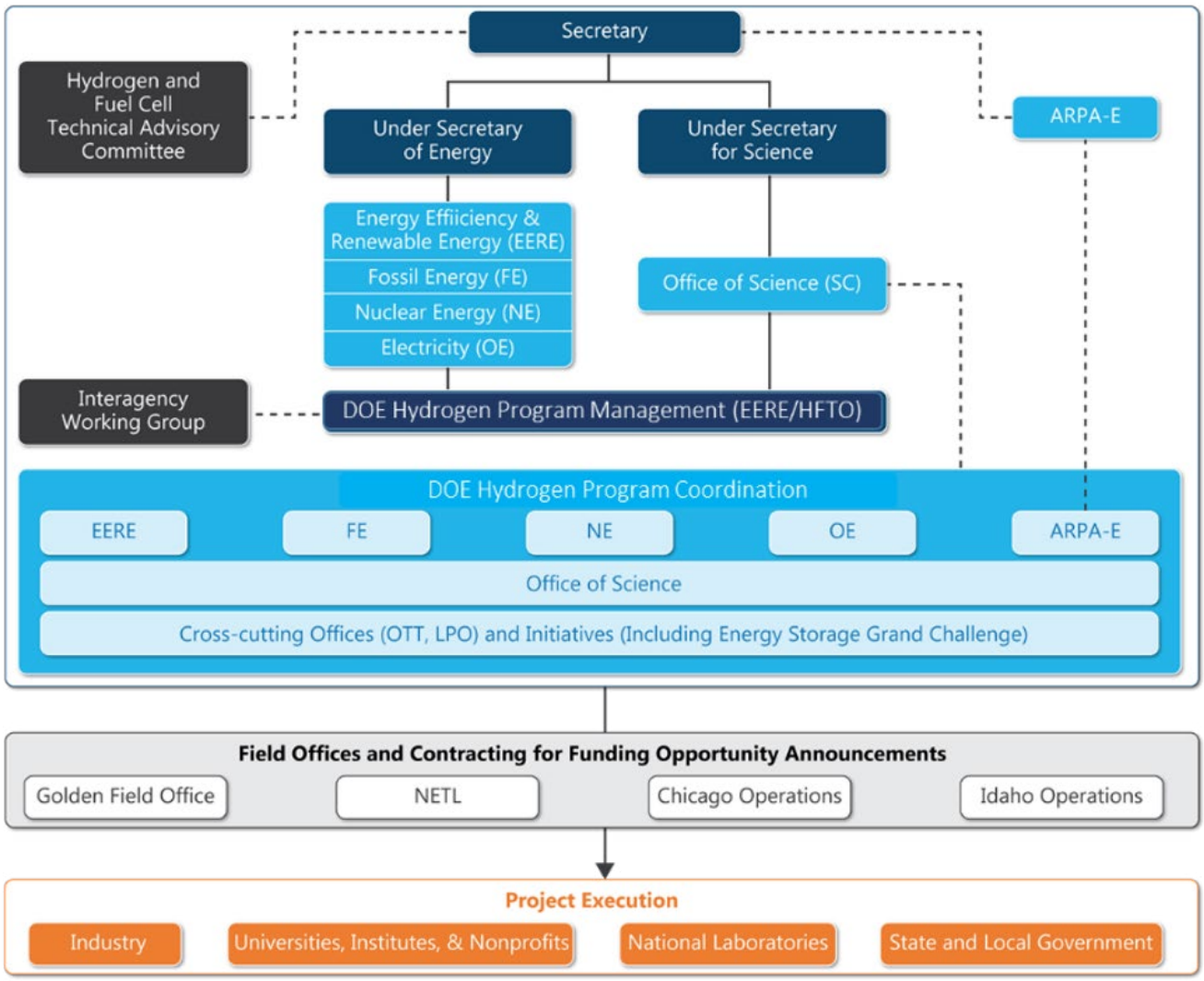

Figure 2. DOE Hydrogen Program organizational structure

HFTO has also served since 2018 as the elected Chair of the *International Partnership for Hydrogen and Fuel Cells in the Economy* (IPHE), which includes 20 countries and the European Commission. IPHE is one of the primary mechanisms through which the HFTO coordinates and collaborates with other new and emerging partnerships such as the *Clean Energy* and *Hydrogen Energy Ministerials*.

Authorizations for the Hydrogen Program in Energy Policy Act of 2005 cover multiple areas, including the following in Title VIII of the U.S. Code:

> Sec. 805 (a) IN GENERAL.—The Secretary, in consultation with other Federal agencies and the private sector, shall conduct a research and development program on technologies relating to the production, purification, distribution, storage, and use of hydrogen energy, fuel cells, and related infrastructure.
> (b) GOAL.—The goal of the program shall be to demonstrate and commercialize the use of hydrogen for transportation (in light duty vehicles and heavy-duty vehicles), utility, industrial, commercial, and residential applications.

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Plastic Innovation Challenge (PIC) and Proposed Energy Materials and Processing at Scale (EMAPS) Facility

DOE launched the Plastic Innovation Challenge (PIC) in 2019 with the goal to develop new technology to allow plastics to be upcycled into higher value products and to be more economically recycled by design. This effort has the potential to deliver both energy savings and environmental benefits.

DOE has proposed a new Energy Materials and Processing at Scale (EMAPS) Facility at the National Renewable Energy Laboratory (NREL) which will integrate and grow our ability to address the scale-up of new materials, including those being developed through the PIC.

Summary

The U.S. is faced with a challenge: can we overcome the vast challenges related to plastic waste, and can we make domestic processing of plastic waste economically attractive and energy efficient? Can we reimagine the overall approach to plastics production and recycling? The Plastics Innovation Challenge, supported by the U.S. Department of Energy (DOE), seeks to develop new and improved plastic materials, and to invest strategically in technologies that will make domestic processing of plastic waste economically viable and energy efficient. These solutions could then also be applied internationally to the global problem of plastic waste.

The Plastics Innovation Challenge, launched in 2019, seeks to position the United States as the world leader in advanced plastic recycling and upcycling technologies. Plastics have become an integral part of modern life and provide tremendous benefits—from safer food and medical equipment, to lighter vehicles and improved energy efficiency. Unfortunately, the vast majority of plastics are never recycled, and a portion ends up in the environment. The challenge is vast.

Consistent with DOE's mission, the Plastics Innovation Challenge emphasizes novel technology development that can tackle plastic waste issues while reducing energy consumption for chemical production, environmental waste problems, and that can make U.S. manufacturing more competitive. Ultimately, the Plastics Innovation Challenge will result in a paradigm shift in which plastic waste is used as a resource to power the economy.

The Plastic Innovation Challenge has five goals:

1. **Develop** collection and sorting technologies to prevent plastics from entering landfills, waterways, and the environment or facilitate its removal.
2. **Create** new chemical and biological pathways to deconstruct plastics efficiently into useful chemical intermediates.
3. **Advance** the scientific and technological foundations that will underpin new technologies for upcycling chemical intermediates from plastics into higher value products.
4. **Design** new plastics that have the properties of today's plastics, are easily upcycled, and can be manufactured at scale domestically.
5. **Support** a domestic plastics supply chain by helping companies scale and deploy new technologies in domestic and global markets.

Current technology limitations, spanning from basic science to manufacturing, underpin each of the Plastics Innovation Challenge goals. DOE is uniquely suited to overcome these challenges, due to National Laboratory capabilities in polymer deconstruction and redesign; chemical and biological catalysis; pilot scale facilities; and technoeconomic and life cycle analyses. Industry and academic research partnerships, sponsored

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through competitive funding opportunities issued by DOE, also support the ability to develop innovative solutions to reimagine plastic materials and plastic waste. The scope of the plastics problem as well as DOE's Plastics Innovation Challenge approach are described below.

Issue(s)

Plastics are used in a vast array of applications, from food and beverage packaging to vehicle components to medical equipment. More than 300 million tons of plastic is produced each year to meet these needs, with half going to single use applications.[1] Plastics provide clear benefits to convenience, safety, and energy efficiency. However, only 14% of the 78 million tons of plastic packaging produced each year is collected for recycling (and only 2% of that collected material is recycled into the same- or similar-quality applications). Of the remaining plastic packaging produced, 14% is incinerated or processed for energy, 40% ends up in landfills and 32% is leaked into the environment, where plastic causes detrimental effects to the environment,[2] human health,[3] and the economy. [4]

Current recycling strategies often do not allow for cost-effective recycling of commonly used plastics. But new and novel upcycling of plastics could transform a plastic feedstock into a more valuable product than its original use, representing an opportunity to provide a real economic incentive for plastic recycling while leading to environmental benefits.

Status

As part of the Plastics Innovation Challenge, extensive intradepartmental coordination has been ongoing amongst the Office of Energy Efficiency and Renewable Energy (EERE); the Office of Science (SC); the Advanced Research Projects Agency–Energy (ARPA-E); and the Office of Fossil Energy (FE). Together, the participating offices have developed a strategy to invest in R&D at all technology readiness levels (TRL) in order to fully support the Plastics Innovation Challenge. These investments are described below by TRL and broken down by DOE office:

- **TRL 1-2**

  SC supported fundamental science research to enable plastic degradation and upcycling in FY 2020. The primary effort was the selection of two new Energy Frontier Research Centers (EFRCs). Selections were the Center for Plastics Innovation ($11.65 million) and the Institute for Cooperative Upcycling of Plastics ($12.8 million). SC has future work planned; Revolutionizing Polymer Upcycling, elucidating the chemical and biological pathways for transforming polymers and synthesizing high-value chemicals or new polymers.

- **TRL 2-4**

  In FY 2020, the Bioenergy Technologies Office (BETO) and Advanced Manufacturing Office (AMO) partnered to co-fund investments to create polymers that are recyclable-by-design, develop efficient deconstruction pathways for plastics and to establish methods to "upcycle" waste plastic to higher value products. ARPA-E has also piloted a new program for plastics conversion to fuels. Investments include:

  - Bio-Optimized Technologies to Keep Thermoplastics out of Landfills and the Environment (BOTTLE) Funding Opportunity Announcement (FOA) ($25 million)
  - Small Business Innovation Research (SBIR) Phase 1 *Novel Utilization Strategies for Ocean Plastic Waste* ($1 million)
  - Seed BOTTLE Consortium at National Labs ($2 million)
  - REUSE Initiative to develop new technologies to convert plastic waste into fuels ($4 million)

- **TRL 2-5**

  BETO has invested in SBIR and FOA topics to develop waste plastic as a feedstock for products and to develop bio-based polymers since 2019. Efforts include:

  - 2019 SBIR Phase 1 Release 2 *Reimagining Plastic Degradation for Upcycling* ($2.2M)

1 Ritchie H and Moser M. (2018). Plastic Pollution. Our World in Data. https://ourworldindata.org/plastic-pollution

2 Ellen MacArthur Foundation. (2017). The New Plastics Economy: Rethinking the Future of Plastics & Catalysing Action. Cowes, United Kingdom: Ellen MacArthur Foundation.

3 Beaumont NJ et al. (2019). Global ecological, social, and economic impacts of marine plastic. Marine Pollution Bulletin; 142:189-195.

4 UNEP. (2014). Valuing Plastic Waste: The business case for measuring, managing, and disclosing plastic use in the consumer goods industry.

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- 2019 FOA Topic *Plastics in the Circular Carbon Economy* (~$10 million)
- 2020 FOA Topic *Urban and Suburban Wastes* (~$10 million)
- 2020 SBIR Phase 2 *Reshaping Plastic Design and Degradation for the Bioeconomy* ($3.3million)

- **TRL 3-7**

  Reducing EMbodied-energy And Decreasing Emissions (REMADE), a Manufacturing USA Institute, launched in 2017 with a $70M investment from the AMO over 5 years. Research funded by the REMADE Institute improves energy efficiency by enabling and increasing the use of many recycled materials, including plastics.

The Plastics Innovation Challenge partner offices have identified a core set of metrics to be reached in order to enable transformative implementation of the Plastics Innovation Challenge goals:

- **Scope**

  Technologies developed to address *recycling for >90%* of plastic polymers

- **Energy**

  Recycling technologies provide ≥*50% energy savings* relative to virgin material production

- **Carbon**

  Recycling technologies provide ≥*75% carbon utilization* from waste plastics

- **Economics**

  Recycling technologies provide ≥ *2x economic incentive* above price of reclaimed materials

Proposed Energy Materials and Processing at Scale (EMAPS) Facility:

Like many other energy challenges, solutions to the plastic waste problem are likely to be multi-faceted and could involve integrated solutions that combine chemical, thermal, and biological methods. The research, development, and deployment of potential solutions is accelerated when multi-disciplinary teams are able to work closely together with access to scale-up facilities. While there are DOE facilities that can scale-up certain processes, the scale-up of new plastic synthesis, and deconstruction and upcycling of waste plastics are not existing capabilities. Furthermore, many DOE facilities are not structured to facilitate the type of interdisciplinary work needed to solve major challenges related to novel energy technology development (e.g. membranes in electrolyzers/fuel cells, polymers in photovoltaics, and processing of novel inorganic-organic hybrid materials such as metal-organic perovskites for solar cells, lighting, etc.).

To address the process integration capability gap, DOE proposes to create an Energy Materials and Processing at Scale (EMAPS) research capability to co-locate and integrate critical scientific and engineering disciplines and capabilities to address and enable novel and hybrid processing for electrolyzers, batteries, structural wind turbine components, and advanced solar cell manufacturing. This multi-disciplined approach will attract a consortia of experts from strategically aligned institutions to tackle critical challenges in rapidly scaling materials, innovations and technologies needed to provide the crucial elements for addressing end-of-life and accelerating them from the lab to markets.

Milestone(s)

The critical decision milestones and schedule for establishment of the EMAPS facility are listed below.

CD-0, Approve Mission Need	12/16/2019
CD-1, Approve Alternative Selection and Cost Range	04/2022
CD-2, Approve Performance Baseline	02/2023
CD-3, Approve Start of Construction/Execution	02/2023
CD-4, Approve Project Completion	12/2024

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Final Energy Security and Infrastructure Modernization Sale

The Energy Security and Infrastructure Modernization Fund supports the Strategic Petroleum Reserves modernization.

Summary

Congress established the Energy Security and Infrastructure Modernization (ESIM) Fund to support modernization of the Strategic Petroleum Reserve (SPR). The Bipartisan Budget Act of 2015, Section 404(e), as amended by Section 14002 of the Coronavirus Aid, Relief, and Economic Security (CARES) Act, authorized appropriations (and drawdowns and sales under subsection (c) in an equal amount) for carrying out subsection (d)(2)(B), $2 billion for the period encompassing fiscal years 2017 through 2022.

The Department responded by creating the Life Extension 2 (LE2) project to modernize the SPR. Congress subsequently approved selling ~$1.4 billion of SPR crude oil to fund the LE2. To date, three crude oil sales (2017, 2018, and 2019) have been conducted, raising $971 million for deposit into the ESIM Fund. A final $450 million sale will bring the ESIM Fund balance to $1.4 billion.

Issue(s)

The Office of Petroleum Reserves (OPR) must raise the final $450 million for the ESIM Fund by FY 2022 and commence the LE2 project.

Status

In February 2020, OPR announced the final Congressionally-mandated sale of crude oil to fund the LE2 project. However, in March 2020, due to the COVID-19-driven collapse of crude oil prices, the sale was postponed. Section 14002 of the CARES Act extended the time for DOE to hold the sale to FY 2022.

Major Decisions

The Department is authorized to conduct the final ESIM sale by the end of FY22 under the CARES Act. Important decisions on the timing of the sale will need to be made. The posting of a Notice of Sale will be required 1 month prior to making any awards.

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International Meetings, Agreements, and Commitments

The Office of Fossil Energy (FE) plays a leadership role internationally to advance U.S. strategic energy interests, including developing a low-carbon economy (hydrogen and CCUS), reducing U.S. critical minerals vulnerabilities, and supporting global energy market stability (LNG and oil).

The Office of Clean Coal and Carbon Management

The Office of Clean Coal and Carbon Management (CCCM) engages with foreign governments, research organizations, and other stakeholders, through both bilateral and multilateral agreements, including research, development, and demonstration (RD&D) cooperation. These international collaborations are designed to ensure coordination, avoid duplication of effort, enhance information accessibility, and address intellectual property issues. Such connections also provide insights on global R&D and technology innovations; deepen understanding of the unique challenges facing clean coal and carbon management in a diversity of countries; and create opportunities to increase awareness of the office's R&D efforts and successes.

CCCM leads policy-focused and technical Carbon Capture, Utilization, and Storage (CCUS) work under numerous multilateral fora:

- Clean Energy Ministerial (CEM): CEM CCUS Initiative
- International Energy Agency (IEA): IEA Working Party on Fossil Energy (WPFE)
- IEA Technology Collaboration Programs: IEA Greenhouse Gas R&D Programme and IEA Clean Coal Centre
- Carbon Sequestration Leadership Forum (CSLF)
- Asia-Pacific Economic Cooperation (APEC): Expert Group on Clean Fossil Energy (EGCFE)
- Accelerating CCS Technologies (ACT) Initiative

CCCM co-leads bilateral relationships to leverage and accelerate DOE's R&D efforts and advance U.S. policy interests. Examples include:

- **Norway:** Memorandum of Understanding (MOU) on energy RD&D; work focused on capture, storage, and enhanced oil recovery (EOR); collaboration at Test Centre Mongstad (TCM).
- **Saudi Arabia:** MOU on CCUS and clean fossil fuels.
- **United Kingdom:** MOU and implementing agreement on fossil energy and energy technology.
- **China:** Historic efforts have been focused on advanced coal technologies and CCUS. Forward progress and collaboration are to be determined.
- **India:** U.S.-India Strategic Economic Dialogue (SEP): Power & Energy Efficiency Pillar; Partnership on Clean Energy Research-Demonstration (PACE-R).
- **Japan:** Memorandum of Cooperation on CCUS; U.S.-Japan Strategic Energy Partnership (JUSEP); U.S.-Japan Energy Cooperation Working Group (ECWG) under the U.S.-Japan Economic Dialogue.

The office also engages with Canada and Mexico through the North American Energy Ministers Trilateral (NAEMT).

The Office of Oil & Gas

The Office of Oil & Gas (O&G) leads technical engagements with numerous countries on oil and gas topics including technologies for unconventional and offshore oil and gas production, natural gas market and infrastructure development, including small scale LNG, methane emissions quantification and mitigation, and more. Examples include:

- **U.S.-China Oil and Gas Industry Forum:** Annual industry-led conference with China's National Energy Administration, now in its 20th year.
- **U.S.-India Strategic Energy Partnership:** Industry-led Gas Task Force addresses India's natural gas market development.

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- **U.S.-Brazil Energy Forum:** Technical engagements with Brazil focused on offshore, unconventional, and natural gas markets.
- **Africa LNG Handbook Initiative:** Workshops for African countries developing natural gas and markets.
- **Small Scale LNG:** Engagement in Caribbean, Central America, and Eastern Europe.
- Many additional technical engagements on irregular bases with other countries.

O&G also has Memoranda of Cooperation on gas hydrate development with India, Japan, and South Korea.

The Office of Petroleum Reserves

The Office of Petroleum Reserves (OPR) engages with foreign governments through bilateral agreements and international meetings for technological and managerial best practices exchanges, and participates in:

- Annual Coordinating Meeting of Entity Stockholders (ACOMES) along with 27 other oil stockpiling nations. ACOMES is held bi-annually to exchange technical information, share experiences, and discuss changes in environmental regulations, legislation, and other issues affecting the maintenance and operations of oil reserves.
- Bi-annual meetings of the International Energy Agency (IEA) Standing Group on Emergency Questions and Standing Group on the Oil Market along with 29 other members of the IEA.

OPR has increased its international engagement posture with various foreign governments for the purpose of bi-lateral information exchange. The following highlights OPR's recent international engagements:

- Major player in the Department's recent Memorandum of Understanding with the Ministry of Petroleum and Natural Gas (MoPNG) of India for cooperation in the following areas:
  - Cooperate in areas of safety, technology development, and management of strategic petroleum reserves.
  - Conduct bilateral site visits to the strategic petroleum reserves of the U.S. and India.
  - Hold symposia to exchange scientific and technical information.
  - Facilitate engagement with U.S. companies, as appropriate, on opportunities to participate in India's Strategic Petroleum Reserve program.
- Meets annually with the Japan Oil, Gas and Metals National Corporation (JOGMEC) for bilateral discussions on the technical and managerial operations of our reserves.
- Major entity in the Department's crude oil storage lease agreement with the Government of Australia which allows for the storage of Australian owned crude oil in the SPR.

Critical Upcoming Decisions (FY21 Q1 and Q2)

None.

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Minerals Sustainability

DOE's new Division of Minerals Sustainability is advancing minerals R&D that will reduce America's severe dependency on foreign critical minerals supply chains and enable a U.S. energy transition. The division may be elevated to a Deputy Assistant Secretary's office level to recognize the importance of these activities.

Summary

The recently established Division of Minerals Sustainability brings a sharper DOE focus on minerals issues, which are essential to supporting a new energy transition and recapturing the critical minerals (CM) supply chain. Under this Division, FY 2021 is the launch year for regional innovation centers. The Division's programs are also funding bench-scale and engineering design work related to discovery, extraction, and processing.

Upcoming Decisions

In order to increase the stature and effectiveness of the program, the Division was planned to be elevated to an Office level and led by a Deputy Assistant Secretary for Minerals Sustainability

Issue(s)

Meeting Exponential Demand

By 2050 the demand for CM and other minerals will grow by 450%.

Ensuring National and Economic Security

- Defense, high-tech, and manufacturing industries are at risk due to their dependency on imports and fewer supply chains for CM and ores.
- As U.S.-based supply chains have contracted in the face of, often subsidized, foreign competition, U.S. industry has lost expertise in advanced mineral processing and extractive metallurgy technologies that produce CM and ores in an efficient and environmentally appropriate manner.
- The loss of expertise in the United States has further strengthened foreign competition and resulted in environmental damage and justice issues in developing countries.

Enabling a 21st Century Energy Transition

- Expanded market penetration of electric vehicles (EVs), renewable energy, power electronics, grid technologies, and conventional generation will create an exponential growth in U.S. demand for minerals.
- A 21st century energy transition is estimated to require 3 billion tons of CM and metals requiring hundreds of billions of tons of raw materials extraction and processing activities.
- It will be necessary to deploy advanced energy technology for electricity generation (renewables, power electronics, grid technologies, and conventional generation) and to support the transportation sectors.

Recycling and Reuse Insufficient (World Bank Report 2020, Bloomberg)

- Example – Without new sources, EV batteries demand for CM will outpace supply, cause regional supply shortages and escalation in price.
- Example of Scale –
  - 1 million EVs in the United States vs. 18 million in the United States by 2030 (Bloomberg).
  - 5 million EVs globally in 2019 vs. 120 million expected in 2030 (McKinsey).
  - By 2022 lithium prices projected to soar 42% as the market bottoms out (Bloomberg).

Unchecked Foreign Sourcing Contributes to Human and Environmental Abuses

- The United States is dependent on CM and metals from other countries, many with human rights violations and inadequate environmental standards.
- Example – Cobalt sourced primarily from Congo through contracts with China.

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The United States is the only industrial country in the developed world without an applied Research & Development (R&D) program for sustainable minerals and ore discovery, extraction, and processing. Creating an Office of Minerals Sustainability and continuing program expansion would rectify this deficiency and address the national need.

R&D Goals

Major advances in technology and computing over the last 20 years have been driving the industry to use advanced technologies for resource recovery, such as drones and robotic drilling; use of precise micro drilling to improve recovery and reduce risks; self-driving machines and ore carriers; improved sensors to enable real time data analytics during operations; and autonomous mining technologies that can support more efficient mining and recovery of resources previously considered unrecoverable. Selected, early R&D goals include:

Assess the regional difference in resource availability in on-shore and off-shore mineral resources and opportunities for the recovery and processing of raw materials.

Develop new technologies for assessment of recoverable resources (drones, real time sensing and analytics, and micro drilling technologies) on and off shore.

Develop advanced mineral extraction technologies to maximize production of mineral feedstocks that advance U.S. competitiveness in energy generation and other industrial sectors.

Develop novel autonomous mining and extraction technologies to enable recovery of CM that are currently not recoverable.

Develop advanced technologies to extract CM feedstocks from abandoned mining residuals while maximizing environmental controls.

Advance mineral processing technologies to enable commercial production while minimizing land disturbance and maximize environmental stewardship.

DOE's Statutory Authorization

As part of its effort to balance the Federal budget, on June 27, 1995, the Appropriations Committee of the U.S. House of Representatives advanced a bill abolishing the U.S. Bureau of Mines (USBM). On April 26, 1996, Congress transferred to, and vested in, the Secretary of Energy three USBM authorities, including "the functions pertaining to the conduct of inquiries, technological investigations[,] and research concerning the extraction, processing, use[,] and disposal of mineral substances . . . ." Pub. L. 104-134, 110 Stat. 1321-167 (Apr. 26, 1996). At that time, the small agency had fewer than 1,900 employees and a proposed budget of $132 million for fiscal year 1996. Consequently, the USBM went through its "orderly closure" in May 1996.

Annual Appropriations Acts from 1996 through 2020 have included the following language in the Fossil Energy Research and Development section, exhibiting Congress' long-held understanding of the Office of Fossil Energy's prominent role at the DOE in conducting R&D concerning mineral extraction, processing, use, and disposal:

> *"including . . . for conducting inquiries, technological investigations and research concerning the extraction, processing, use, and disposal of mineral substances without objectionable social and environmental costs (30 U.S.C. 3, 1602, and 1603)."*

With a renewed national interest in critical minerals and facing a 21st century energy transition, DOE is accelerating its effort in these areas.

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Strategic Petroleum Reserve (SPR) Mission, Upcoming Congressional Sales, and Funding Issues

The SPR is a critical national energy and economic security asset for crude oil supply interruptions or surplus and fulfills U.S. obligations under the International Energy Program.

Summary

The SPR protects the U.S. economy from severe petroleum supply interruptions through the acquisition, storage, distribution, and management of emergency petroleum stocks and carries out U.S. obligations under the International Energy Program. The SPR was created in 1975 pursuant to the Energy Policy and Conservation Act following an oil embargo by the Organization of Arab Petroleum Exporting Countries from October 1973 to March 1974. In FY20, DOE entered into a crude oil storage lease agreement with the Government of Australia, which allows for the storage of Australian owned crude oil in the SPR.

The SPR is funded by two accounts: The SPR Account and the SPR Petroleum Account. The SPR Account funds the program's operational readiness, drawdown capabilities, and management. The SPR Petroleum Account funds activities related to the acquisition, transportation, and injection of petroleum products into the SPR; test sales of petroleum products; and drawdown, sale, and delivery of petroleum products from the SPR.

Over the next several years, the SPR must simultaneously and safely maintain operational readiness and drawdown capabilities, execute a major life extension project (known as LE2), and conduct Congressionally-mandated sales, including Energy Security & Infrastructure Modernization (ESIM) sales, without spilling a drop of oil. The COVID-19 pandemic caused a demand (rather than supply) interruption that created a supply surplus and ushered in a new national need (e.g., to prevent U.S. crude oil producers from having to shut in production) for the SPR that resulted in an emergency storage exchange program and a crude oil purchase.

During COVID-19, small to mid-sized U.S. crude oil producers temporarily stored crude oil in the SPR, which was returned once market conditions improved. In exchange, these companies left behind a percentage of the oil stored (known as "premium barrels") to compensate the U.S. Government for the use of the SPR. This expanded use of the SPR mission amplifies SPR's economic and energy security value.

Congress mandated several sales of SPR crude oil as an offset to various laws requiring additional funding during FY17-FY28 (see table below). These sales will reduce the SPR inventory from nearly 700 million barrels to about 400 million barrels. DOE proposed to disestablish the Northeast Gasoline Supply Reserve (NGSR) in the FY21 budget. As proposed, DOE would draw down and sell one million barrels of refined petroleum product from the NGSR during FY21, with $19 million of the proceeds from the sale to be deposited into the SPR Petroleum Account for Congressionally-mandated crude oil sale logistical/transportation costs. Any proceeds in excess of $19 million collected from the sale shall be deposited into the general fund of the Treasury during FY21 and dedicated to deficit reduction. Congress rejected previous proposals to disestablish the NGSR.

The NGSR was administratively established in 2014 as part of the SPR to ease regional shortages resulting from sudden/unexpected supply interruptions. The NGSR consists of 1 million barrels of gasoline blendstock stored in leased commercial storage terminals located in Maine, Massachusetts, and New Jersey. It represents less than one day of gasoline consumption in the Northeast, and it has never been used for its intended purpose and is not cost efficient or operationally effective.

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Congressionally-Mandated SPR Sales

Drawdown Legislation	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total
Bipartisan Budget Act 2015 (Public Law 114-74 Section 404) ESIM Sale	6.3	4.7	4.2		TBD								15.2+TBD
Bipartisan Budget Act 2015 (Public Law 114-74 Section 403)		5	5	5	5	8	10	10	10				58
Fixing America's Surface Transportation Act (Public Law 114-94)							16	25	25				66
21st Century Cures Act (Public Law 114-255)	9.9	9.2	6										25.1
Tax Cuts and Jobs Act of 2017 (Public Law 115-97)										7			7
Bipartisan Budget Act of 2018 (Public Law 115-123)						30				35	35		100
Consolidated Appropriations Act, 2018 (Public Law 115-141)				4.9	5.1								10
America's Water Infrastructure Act of 2018 (Public Law 115-270)												5	5
Total Annual Drawdown Volume	16.2	18.9	15.2	9.9	10.1+TBD	15.5	33.5	42.5	42.5	38.5	38.5	5	286.3+TBD

TBD: ESIM sales in FY21 will be determined by revenue targets placed in the eventual FY21 appropriation bill.

For purposes of calculating an annual volume, volumes across multiple years are split evenly across those years. In practice, actual sales may not end up being split evenly.

Projected SPR inventory by the beginning of 2029 is about 400 MMB

In FY20, the SPR conducted two Congressionally-mandated, non-emergency oil sales raising ~$567M for deposit into the U.S. Treasury. Due to the negative effects of COVID-19, the SPR executed an Emergency Storage Exchange Program that provided storage for 21.1 million barrels of U.S. produced crude oil from U.S. producers with 1.2 million barrels to remain in SPR as "premium barrels" (~$50M present value). The SPR also executed a crude oil purchase of 124 thousand barrels ($5M) sourced from small/midsize U.S. oil producers to test market conditions and SPR purchase processes.

Status

- The number and volume of sales over this 12-year period is unlike anything the SPR has previously experienced. Congressionally-mandated sales and demand disruption create an added strain on the infrastructure during execution of the LE2 project. The FY21 House Mark provides $195M without support to disestablish NGSR. If the Mark prevails, an additional $20M is required above the request to maintain the NGSR annual lease; otherwise, SPR maintenance programs will be cut during a time maintenance is crucial to ensure requisite infrastructure to safely meet requirements.
- Congress allowed for a delay to the final ESIM sale (marked as TBD in the top row of the sales chart), but did not delay any other sales, so unless Congress delays the FY21 mandated sale of 10.1 million barrels, that sale will proceed in spring 2021.
- The FY21 Budget Request did not include a request for direct appropriation for the SPR Petroleum Account; instead, DOE proposed the sale of the NGSR's one-million barrels of refined petroleum product (gasoline blendstock) and requested authorization to deposit sale proceeds into the SPR Petroleum Account up to $19 million. The House Mark provided $7.5M in the SPR Petroleum Account. To support ~30 million barrel drawdown capability during a supply interruption, SPR historically attempts to maintain ~$15M in the SPR Petroleum Account; readiness to support a ~30 million barrel fill action would require an additional $6M. Due to execution of FY20 unplanned activities in response to the COVID-19 demand destruction, the SPR Petroleum Account resources for emergency drawdown/fill are estimated to be $8.5M which supports ~17 million barrel emergency drawdown. A larger drawdown would require additional funds. The following table reflects FY20 SPR Petroleum Account balances and FY21 requirements based on the House Mark.

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Title	- debit / + credit ($M)	Running Total ($M)
FY20 Balances		$24.4
FY21 Mandatory Sales	-$7.6	$16.8
ESIM Sale	-$7.7	$9.1
Storage Exch. Returns	-$8.1	$1
House Mark	$7.5	$8.5

- Hurricane Laura damaged the West Hackberry site. The initial damage assessment cost range was $25M - $95M. Congress requested to be kept apprised of estimates as they evolve.
- The additional supply surplus mission has not been formalized. A requirements study and a configuration study were in Departmental coordination prior to the new fill mission's identification as a possible Departmental need (not yet formalized). To account for supply surplus use, the requirements and configuration studies are being updated to reflect impacts of the new mission.

Major Decisions

Decisions on whether to seek Congressional relief on the timing of mandated sales, delay the ESIM sale and related LE2 project, formalize an SPR storage mission during demand disruption, and seek Hurricane damage relief are required in FY21.

Milestone(s)

The major milestones for the SPR program are to execute the FY21 mandated oil sale of 10.1 million barrels and the sale to raise $450 million for the ESIM fund by FY22.

United States Nuclear Fuel Working Group (NFWG)

The April 2020 NFWG strategy for *Restoring America's Competitive Nuclear Advantage* recognizes that it is in the Nation's national security interests to preserve the assets and investments of the entire U.S. civil nuclear energy enterprise and to revitalize the sector to regain U.S. global nuclear leadership. The Strategy lays out a series of priority policies and identifies specific recommendations to reinvigorate the domestic nuclear fuel supply industry, accelerate advanced nuclear technology development, and create pathways for American nuclear exports.

Summary

The NFWG Strategy[1] is a holistic approach to address the challenge of restoring America's competitive nuclear advantage, with four strategic priorities:

1. **Provide Immediate Action** to Support U.S. Mining and Restore the Viability of the Entire Front-End of the Nuclear Fuel Cycle.
2. **Revitalize and Strengthen** the Front-End of the Nuclear-Fuel Cycle and Domestic Nuclear Industry.
3. **Lead** the World in Technology and Standards.
4. **Empower** U.S. Export Competitiveness.

These priorities cascade to 18 vetted, supporting recommendation measures, with corresponding implementation activities for each to be led by the appropriate Federal Departments and Agencies. The Strategy provides recommendations that, if fully implemented, will revitalize the domestic nuclear energy industry and reestablish America as the global leader in nuclear technology innovation. In turn, the United States will regain its influence to continue to ensure strong safety, security, and nonproliferation standards for the international nuclear regime, and will be well positioned for future commercial opportunities for large light water reactors, as well as small modular reactors and advanced reactors.

Importantly, the strategy recognizes that a strong nuclear energy industry supports both U.S. commercial and defense needs that the success of the uranium mining industry and of U.S. nuclear technology exports are inextricably linked.

Issue(s)

Pending Appropriations for the FY 2021 Proposed Uranium Reserve

Preventing the near-term collapse of the domestic uranium mining and conversion industries is considered the most immediate concern. If Congressional appropriations are provided for FY 2021, DOE could support and strengthen the front end of the domestic nuclear fuel cycle by establishing a DOE Uranium Reserve and re-establishing active domestic conversion capabilities. By initiating a 10-year program to purchase uranium and conversion services for the Reserve, DOE would support the restart of near-term uranium production and conversion services for that domestic uranium, where the risk of losing these capabilities is most immediate. The Reserve would also provide assurance of availability of uranium in the event of a market disruption, such as intervention by a foreign state, which prevents nuclear utilities from acquiring uranium to refuel their reactors.

Interagency Coordination

Although DOE led the publication of the Strategy, restoring America's competitive nuclear advantage will require a complex, long-term interagency effort over the next 10 years. An interagency NFWG implementation plan would help to maintain alignment with the Strategy intent; incorporate new information; align resource requests and allocations; coordinate communications internally and externally; and inform adjustments, if needed. However, DOE does not have the authority to direct

1 https://www.energy.gov/strategy-restore-american-nuclear-energy-leadership#:~:text=The%20Strategy%20to%20Restore%20American%20Nuclear%20Energy%20Leadership,of%20the%20United%20States%20Nuclear%20Fuel%20Working%20Group.

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how, when, or if other Departments and Agencies implement the Strategy.

Senior Administration Position

The Strategy recommends the designation of a senior Administration official within the Executive Branch who will be tasked with leading nuclear exports in partnership with the private sector and all relevant agencies. DOE envisions a central, coordinated office, led by the senior Administration official, to coordinate nuclear exports and implementation—including promotion of nonproliferation, safety, and security norms—and assist emerging and expanding countries' development and deployment of their nuclear energy programs. The position placement within the Executive branch, whether the official will hold White House authorities, and the specific responsibilities of this position have yet to be determined.

Nuclear Industrial Base Advisory Committee

The Strategy recommends the establishment of a Nuclear Industry Base Advisory Committee charged with making recommendations on the confluence of public and private investment and nuclear supplier base challenges pertaining to the national security considerations provided in the Strategy. DOE envisions an industrial group, modeled after the Defense Industrial Board, who would incorporate supplier needs into their recommendations. It has not yet been determined whether this committee would be related to the existing Nuclear Energy Advisory Committee, who the membership would include, or whether this board would report to DOE, nor at what level it would report.

Advanced Nuclear Technology Innovation, Development, Demonstration, and Export

The Strategy recognizes that innovation in the nuclear technology sector is crucial to the future of U.S. national security. The U.S. currently has zero new nuclear plant builds outside the U.S. while Russia and China currently dominate the nuclear power plant global marketplace for new build nuclear power plants. The new builds currently underway will provide Russia and China with 100-year nuclear technology relationships with many strategic members of the global community. The U.S. must export its innovative nuclear power technology to ensure that U.S. norms for operation, safety, security, and non-proliferation are adopted worldwide.

Status

At present, DOE has drafted the DOE Implementation Plan and a whole-of-government NFWG Implementation Plan, pending formal concurrence within the Department and comment from the interagency, respectively.

Subject to the availability of appropriations, the Strategy calls for DOE to lead the creation of a national Uranium Reserve to provide immediate relief to the U.S. mining and conversion industries. DOE also supports innovative nuclear energy technology, including managing research, development, and/or demonstration programs for advanced nuclear reactors, accident tolerant fuels, and high-assay low enriched uranium. DOE will support the development of small modular reactors and microreactors, the Versatile Test Reactor, and the National Reactor Innovation Center. DOE is also the lead for investigating methods that continue to increase efficiencies in the 10 CFR Part 810 nuclear export process, as well as providing statutorily mandated technical support to the Department of State for the negotiation of 123 agreements.

Other Federal Departments and Agencies have also begun to implement recommendations and activities identified in the Strategy, when consistent with existing appropriations and authorities, which have created visible signals of American commitment to this strategy. The first near-term action by the U.S. International Development Finance Corporation (DFC) was to reverse a legacy policy limitation on financing for nuclear energy projects in emerging markets[2]. As America's development bank, DFC partners with private businesses to support investment in challenging frontier markets. By providing debt and equity financing; insurance; and technical assistance to projects that are unable to obtain sufficient support from private lenders, DFC helps mobilize additional private capital, resulting in projects that are financially viable and built to the highest standards. Together with the DOE's support of innovative reactor technology, this critical policy change will help restore America's global leadership in the civil nuclear sector, while increasing access to

2 https://www.dfc.gov/media/press-releases/dfc-modernizes-nuclear-energy-policy

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a safe and sustainable source of clean energy in the developing world.

Another near-term action was the completion of a Memorandum of Understanding (MOU) between the U.S. Environmental Protection Agency (EPA) and the U.S. Nuclear Regulatory Commission (NRC), "Concerning the Regulation of Uranium in situ Recovery Activities," that entered into force on July 23, 2020. The MOU describes how the NRC and EPA will work with each other to accomplish their responsibilities under Title II of the Uranium Mill Tailings Radiation Control Act (UMTRCA) and supports the goal of re-establishing a robust domestic uranium industry. This MOU follows on to (but does not supersede) a 1992 MOU on general cooperation and, although not legally binding, is intended to support more timely, efficient regulation, and foster opportunities for communication and cooperation between the agencies.

DOE also established the Advanced Reactor Demonstration Program in FY 2020 with the publication of a competitive solicitation and a strong response from industry. This program will enable demonstration of up to two advanced reactor designs through partnerships with industry.

Consistent with the Strategy, the Department of Commerce recently announced a draft amendment to the Agreement Suspending the Antidumping Investigation on Uranium from the Russian Federation ("Russian Suspension Agreement") to extend the Agreement to 2040 and reduce U.S. reliance on Russian enriched uranium[3].

Milestone(s)

See issues.

Major Decisions/Events

See issues.

Background

On July 12, 2019, President Donald J. Trump determined that "the United States uranium industry faces significant challenges in producing uranium domestically and that this is an issue of national security." The President directed "a fuller analysis of national security considerations with respect to the entire fuel supply chain."

The President created the NFWG to study the challenges facing the nuclear fuel supply chain in the United States, including identifying impediments to domestic industry competitiveness, exports, and technical development; strengths that could be enhanced to improve U.S. competitive advantage; and opportunities to reestablish American nuclear energy leadership.

The U.S. government, in consultation with stakeholders, identified a range of recommendations to revitalize and expand the U.S. nuclear enterprise, while maintaining American leadership in the nonproliferation arena.

A reliable supply of domestic uranium in the United States is critical for our national and energy security. The uranium industry has been decimated by reduced demand after the accident at the Fukushima Daiichi nuclear power plant and the low price of uranium in the international market place. State owned and influenced companies did not cut production in response to the reduced demand, over-supplying the international market and driving the price of uranium down to the point that it is unprofitable for U.S. domestic mining, milling, conversion, and enrichment companies to operate.

The United States needs to revitalize its nuclear industry enterprise and enable the sale and export of U.S. nuclear energy technology to compete with state sponsored and funded companies selling outdated technology and fuel at cut rate prices. The next decade is critical to the United States re-establishing its participation in the global nuclear energy marketplace. The alternative is that once the competition has sold and deployed non-U.S. technology and fuel, the U.S. will have missed the procurement and deployment opportunities afforded by the expansion of global energy systems and the U.S. will be functionally excluded from those markets for the next 80 to 100 years. It is imperative that the actions detailed in this implementation plan occur over the next decade to ensure the U.S. is the dominant influencer in the global nuclear energy marketplace.

3 https://www.commerce.gov/news/press-releases/2020/09/us-department-commerce-announces-draft-amendment-suspension-agreement

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American Broadband Initiative

Access to broadband is essential to the economic success of Americans across the United States. Without modern broadband infrastructure, communities and businesses, particularly in rural areas, are being left behind in today's information-driven economy. The Department of Energy's Power Marketing Administrations aim to make federally-owned transmission assets available to expand telecommunications infrastructure across the United States.

Summary

The American Broadband Initiative (ABI) is the current Administration's signature strategy aimed at stimulating increased private investment in broadband infrastructure and services to address broadband connectivity gaps in America, particularly in rural areas. ABI recognizes federally owned assets such as tower facilities, buildings, and land could potentially be made available to lower the cost of broadband buildouts and encourage private-sector companies to expand telecommunications infrastructure. As part of this effort to identify types of federal assets or classes of assets that private-sector companies could use to expand broadband infrastructure in America, the Southwestern Power Administration (SWPA) and Western Area Power Administration (WAPA), in consultation with the Department of Energy's (DOE) Office of Electricity, completed feasibility assessments to determine if SWPA and WAPA's preexisting excess fiber, referred to as "dark fiber," can be leased to their existing customers and broadband service providers.

SWPA and WAPA are two of four federal Power Marketing Administrations (PMAs) that market and deliver wholesale federal hydropower to 33 states. The PMAs operate and maintain over 34,000 miles of high-voltage transmission line, which are used to deliver power from water projects and related hydropower generating facilities owned primarily by Bureau of Reclamation and U.S. Army Corps of Engineers. By law, the PMAs are required to set rates to cover costs including federal investments in dam and transmission infrastructure, plus interest, "at the lowest possible rates to consumers consistent with sound business principles." The other two PMAs (Bonneville Power Administration and Southeastern Power Administration) were outside the scope of this initiative.

SWPA and WAPA have been using fiber optic cable in their telecommunications for the past 20 years. Combined, they currently have an inventory of over 5,500 miles of dark fiber deployed on transmission lines, the majority of which is optical ground wire (OPGW). OPGW is the preferred type of fiber for overhead transmission lines as it is both strong and versatile; it combines the functions of grounding, a telecommunications pathway, and lightning protection all in one single package. Typically, OPGW contains glass optical fibers inside a metal tube structure that is then surrounded by layers of high-strength steel and aluminum wire. This cable has been installed primarily for PMA use in support of power operations, but SWPA and WAPA also have partnerships with other utilities that enable shared use of the cable for the utility partner's power operations use.

Issue(s)

A number of risks were identified in association with leasing available fiber capacity, including possible limitations on existing legal authority, right-of-way issues, cost, non-alignment with the PMAs' missions, security concerns, and lack of benefit to utility operations (or potential interference with those operations). Should SWPA and WAPA move forward with leasing available fiber capacity to third parties in order to provide rural communities with better access to broadband services, they must develop processes and procedures at the PMA level that outline how requests would be made, what entities would be allowed access, and what uses would be permitted. WAPA noted that its current process for fiber usage requests is handled regionally and is based on best practices, though it noted that it plans to move to a PMA-wide process.

The SWPA and WAPA assessments were submitted to DOE and assembled into a consolidated report in July 2020.[1]

1 https://www.energy.gov/sites/prod/files/2020/07/f76/Fiber_Optics_Feasibility_Assessment_25JUNE2020.pdf

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Status

Both SWPA and WAPA completed feasibility assessments in December of 2019 to determine if excess fiber could be leased to customers and broadband service providers. SWPA and WAPA reached different conclusions in their individual assessments. For instance, WAPA stated that, contingent upon full clarification of its existing legal authorities, current law may potentially allow preference power customers to lease available fiber capacity in order to carry broadband internet traffic. WAPA's preference power customers pay back capitalized costs, including those associated with fiber, through the collection of revenues from their ratepayers, and it is possible they may have preference in the commercial use of the fiber under current law. Following clarification, and/or confirmation of legal authorities, WAPA also could potentially lease fiber to commercial broadband providers, which would require significant investment in managing and tracking leased fiber, as well as consideration for capital investment recovery, which in either case would be paid for by the lessee. SWPA allowed for the possibility of leasing more than 100 miles of existing and available fiber capacity once various risk factors have been mitigated.

Background

SWPA

- SWPA identified preexisting available fiber capacity on its system and conducted a technical analysis for the feasibility of leasing that specific fiber.
- SWPA allowed for the possibility of leasing more than 100 miles of existing and available fiber capacity once various risk factors have been mitigated.

WAPA

- WAPA assessed the feasibility of leasing fiber in the abstract (more qualitatively).
- WAPA currently operates and maintains a fiber optic cable inventory consisting of about 5,500 route miles over its 15-state territory. Fiber optic strand counts are 24-fibers or less for 85 percent of WAPA's current inventory.
- WAPA may rely on existing statutory authority to construct, maintain, operate, and share fiber optic cable to perform DOE's power marketing functions relating to electric power. New authority may be needed, but it may be possible for existing statutory authority could allow the use of fiber optic assets for third-party communications unrelated to the operational requirements associated with the marketing and transmitting of electric power if the third party lights the fiber. WAPA already has partnerships for utility use by customers. In addition, land rights pose a potential risk if WAPA fiber is used by third parties, especially for commercial broadband purposes. While some land rights provide for WAPA to string lines of others, it is uncertain whether that type of language would allow third-party use for commercial broadband purposes.
- If WAPA were to begin leasing its available fiber to third parties, all receipts from such agreements might have to be returned to the U.S. Department of Treasury, as provided by current law. Should WAPA decide to establish a third-party leasing program, additional staff would be required.
- Interfacing WAPA fiber with third parties would require special design of interface locations to ensure physical security and cybersecurity. Additionally, a GIS-based fiber management system would need to be implemented to track third-party usage across the WAPA's system.
- Introduction of additional third-party fiber customers would necessitate additional planning and coordination time, along with a more defined and universal procedure across WAPA for repairs during outage conditions, as well as routine maintenance. Should WAPA move forward with allowing its power customers to use its fiber to support rural communities with better access to broadband services, it would develop WAPA-wide processes and procedures to outline how requests would be made, what entities would be allowed to access the dark fiber and what uses would be allowed.
- WAPA conducted customer meetings during the summer of 2019 and the results were incorporated into the final assessment. One key outcome of these meetings was customers emphasized that WAPA should adhere to the "beneficiary pays" construct, which ensures the beneficiary of services is responsible for any related costs.

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Executive Order 13920: Securing the United States Bulk-Power System

Executive Order 13920 declares a national security emergency due to the threat foreign adversaries pose to the U.S. Bulk-Power System and seeks to reduce the risk by prohibiting the procurement of specific components and equipment; pre-qualifying vendors and equipment; mitigating risks posed by components and equipment already on the system; and convening a task force on national security in Federal procurement. The Executive Order provides the Department with the authority to take actions to ensure the security of the BPS.

Summary

The bulk-power system (BPS) is the backbone of the United States (U.S.) electric grid, national security, and economy. Foreign adversaries continue to develop new ways to compromise the BPS, including undermining the supply chain of required critical components (per the 2019 Worldwide Threat Assessment and the 2020-2022 National Counterintelligence Strategy). To confront this increasingly sophisticated threat, President Trump signed Executive Order 13920, "Securing the United States Bulk-Power System," (the EO) on May 1, 2020, authorizing the Secretary of Energy—working with other Federal departments, agencies, and industry—to quickly and proactively protect the BPS. DOE's Office of Electricity (OE) is the office leading the implementation of the EO. Successful implementation will be critical to ensure equipment used on the BPS is secure, both now and into the future.

The authorities established in the EO comprise four "pillars:"

Pillar 1

Prohibition determinations for future procurements.

Pillar 2

Criteria for pre-qualified equipment and vendors.

Pillar 3

Mitigation of existing equipment and components already in the BPS.

Pillar 4

Creation of a Task Force on Federal Energy Infrastructure Procurement Policies Related to National Security.

Status

The Department is taking a thoughtful, deliberate, phased approach that includes input from all stakeholders when implementing the four pillars of the EO. There are numerous lines of effort under each of the four pillars. Some activities have specific timelines whereas others will be longer term engagements where the effort will be dependent on a variety of factors, e.g., funding, equipment testing, support and engagement from DOE Program Offices and industry.

To better inform implementation of the EO and understand existing supply chain risk management practices across the stakeholder community, the Department published a Request for Information (RFI) in the Federal Register (FR) on July 8, 2020, with a 30-day public comment period ending on August 7, 2020. In response to several comments from stakeholders, the Department extended the RFI public comment period by an additional two weeks, and the comment period closed on August 24, 2020.

The RFI responses will be utilized in the ongoing rulemaking effort.

DOE Leadership and Coordination

- Since the EO was signed, OE's Transmission Permitting and Technical Assistance Division (TPTA) holds weekly meetings with OE leadership

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to discuss the EO implementation and discuss key policy decisions.

- TPTA meets on a regular basis with the Office of General Counsel, including weekly rulemaking development meetings with the core rulemaking team.
- DOE leadership, including the Office of the Secretary, is also regularly briefed by OE leadership.
- Updated information on the EO implementation is routinely posted to OE's website: https://www.energy.gov/oe/bulkpowersystemexecutiveorder.
- The docket is being maintained on the Federal eRulemaking Portal: https://www.regulations.gov/docketBrowser?rpp=25&po=0&D=DOE-HQ-2020-0028.

Major Decisions/Events

- NOPR will be published in Federal Register with 30-day public comment period.
- The EO Federal Task Force will be convened.
- BPS EO Final Rule will be published in Federal Register.

Background

The EO declares threats by foreign adversaries to the BPS constitute a national emergency. The EO was issued pursuant to the President's authority under the Constitution and the laws of the U.S., including the International Emergency Economic Powers Act (50 U.S.C. 1701 et seq.) (IEEPA), the National Emergencies Act (50 U.S.C. 1601 et seq.), and section 301 of title 3, U.S. Code.

The BPS provides the electricity that supports the U.S. national defense, our vital emergency services, critical infrastructure, economy, and way of life. The Office of the Director of National Intelligence's (ODNI) National Counterintelligence and Security Center (NCSC) indicates near-peer foreign adversaries (e.g., China and Russia) possess highly advanced cyber programs and that both nations pose a major threat to the U.S. government, including, but not limited to, military, diplomatic, commercial, and critical infrastructure. The BPS is a target of these adversaries' asymmetric cyber and physical plans and operations. A successful attack on the BPS would present significant risks to the U.S. economy, and public health and safety and would render the U.S. less capable of acting in defense of itself and its allies. The Department of Defense's *2018 National Defense Strategy* states the "homeland is no longer a sanctuary" and malicious cyber activity against personal, commercial, and government infrastructure is growing significantly.

According to ODNI's *2019 Worldwide Threat Assessment of the U.S. Intelligence Community,*[1] near-peer foreign adversaries have the capability and integrated plans necessary to launch cyber-attacks causing localized, disruptive effects on critical infrastructure—such as the disruption of a natural gas pipeline and electric infrastructure for days to weeks—in the U.S. These near-peer foreign adversaries continue to map U.S. critical infrastructure with the long-term goal of being able to cause substantial damage. According to the *2020-2022 National Counterintelligence Strategy,*[2] these foreign adversaries are employing innovative combinations of traditional spying, economic espionage, and supply chain and cyber operations to gain access to critical infrastructure. They are also attempting to access our Nation's key supply chains at multiple points—from concept to design, manufacture, integration, deployment, and maintenance—by, among other things, inserting malware into important information technology networks and communications systems.

The EO has four main pillars:

1. **Prohibit** any acquisition, importation, transfer, or installation of BPS electric equipment by any person or with respect to any property to which a foreign adversary or an associated national thereof has any interest that poses an undue risk to the BPS; the security or resiliency of U.S. critical infrastructure or the U.S. economy; or U.S. national security.
2. **Authorize** the Secretary to establish and publish criteria for recognizing particular equipment and vendors in the BPS electric equipment market as "pre-qualified" for future transactions, and to apply these criteria to establish and publish a list of pre-qualified equipment and vendors.

1 https://www.dni.gov/files/ODNI/documents/2019-ATA-SFR---SSCI.pdf

2 https://www.dni.gov/index.php/ncsc-features/2741-the-national-counterintelligence-strategy-of-the-united-states-of-america-2020-2020

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3. **Direct** the Secretary, in consultation with heads of other agencies, to identify existing BPS electric equipment in which a foreign adversary or associated national thereof has an interest that poses an undue risk to the BPS; the security or resiliency of U.S. critical infrastructure or the U.S. economy; or U.S. national security; and develop recommendations to identify, isolate, monitor, or replace this equipment as appropriate.
4. **Establish** a Task Force on Federal Energy Infrastructure Procurement Policies Related to National Security, which will focus on the coordination of Federal Government procurement of energy infrastructure; the sharing of risk information and risk management practices; and the development of recommendations for implementation to the Federal Acquisition Regulatory Council (FAR Council).

The EO directs DOE, in consultation with the heads of several other agencies, to issue regulations implementing the authorities the President delegated to the Secretary of Energy.

The BPS is defined in the EO as: (i) facilities and control systems necessary for operating an interconnected electric energy transmission network (or any portion thereof); and (ii) electric energy from generation facilities needed to maintain transmission reliability. This definition includes transmission lines rated at 69,000 volts (69 kV) or more but does not include facilities used in the local distribution of electric energy.

The EO defines BPS electric equipment as items used in BPS substations, control rooms, or power generating stations, including reactors, capacitors, substation transformers, coupling capacitor potential devices [expressed in the E.O. as current coupling capacitors and coupling capacity voltage transformers], large generators, backup generators, substation voltage regulators, shunt capacitor equipment, automatic circuit reclosers, instrument transformers, protective relaying, metering equipment, high voltage circuit breakers, generation turbines, industrial control systems, distributed control systems, and safety instrumented systems. Items not included in the preceding list and that have broader application of use beyond the BPS are outside the scope.

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Critical Electric Infrastructure Information (CEII) Protection

The protection of Critical Electric Infrastructure Information (CEII) encourages industry to share sensitive information with the Department of Energy and increases DOE's ability to execute responsibilities as the Sector-Specific Agency for Energy.

Summary

The Critical Electric Infrastructure Information (CEII) designation protects and secures critical information about the Nation's electric infrastructure as part of the Department of Energy's (DOE) commitment to improving energy security while ensuring a reliable and resilient flow of energy to America's communities and businesses. In the CEII final rule, DOE established administrative procedures for how the Department will designate, protect, and share CEII. The rule also provides procedures for DOE coordination with other Federal agency partners and industry to facilitate mutual understanding and information sharing as it may relate to CEII.

CEII is a category of controlled unclassified information about a system or asset of the bulk-power system, whether physical or virtual, that if destroyed or incapacitated would negatively affect the United States' national security; economic security; public health or safety; or any combination of such effects. A CEII designation exempts the information about physical and virtual assets of the bulk-power system from public release under the Freedom of Information Act (FOIA) and other laws requiring government disclosure of certain information or records. As a general principle, DOE will not designate information as CEII if it has been made publicly available previously by an owner or generator of the CEII.

Key Points

- The Fixing America's Surface Transportation (FAST) Act added Section 215A to the Federal Power Act, which authorizes both the Secretary of Energy and the Federal Energy Regulatory Commission (FERC) to designate information as CEII. DOE's CEII rule is contained in 10 C.F.R § 1004.13, and FERC's CEII rule is contained in 18 C.F.R. § 388.113 .
- DOE's CEII rule supports and encourages information sharing between government and industry by ensuring the security of CEII. It also provides procedures for DOE coordination with other Federal agency partners (e.g., the Department of Homeland Security, FERC) to facilitate mutual understanding and implementation among Federal information classification programs as it may relate to CEII.
- CEII designation lasts for five years and can be renewed at the Department's discretion. The designation exempts data or information from disclosure under FOIA and other laws requiring government disclosure of certain information or records.
- DOE previously released a Notice of Proposed Rulemaking for the CEII designation on October 29, 2018, and received fourteen sets of comments over a 60-day comment period.
- The CEII final rule became effective on May 15, 2020.
- On April 14, 2020, Public Citizen and the Union of Concerned Scientists filed a petition for rehearing with DOE on five grounds related to: (1) DOE's statutory authority to issue the CEII Final Rule; (2) the CEII Final Rule's alleged inconsistency with the FOIA and Federal Records Act; (3) due process concerns with accessing CEII in the course of DOE proceedings; (4) DOE's justification for the CEII Final Rule under the Administrative Procedure Act (APA); and (5) DOE's alleged failure to provide notice and an opportunity to meaningfully comment during the rulemaking proceeding. The petitioner urged DOE to voluntarily withdraw or revise the CEII final rule to remedy their alleged injuries.
- On July 13, 2020, Secretary of Energy Dan Brouillette issued an order denying the rehearing request.

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- On July 13, 2020, the Union of Concerned Scientists filed a petition for review of the Department's Order on Rehearing and CEII final rule in the U.S. Court of Appeals for the District of Columbia Circuit.
- The U.S. Department of Justice (DOJ) is arguing the case on behalf of DOE. OE, through GC-76, provided a certified index to the administrative record of the CEII final rule to DOJ, which was filed in the D.C. Circuit on August 31, 2020.
- On September 29, 2020, the court issued an initial briefing schedule:

November 9	Petitioner's Brief Due
December 9	Respondent's Brief Due
December 30	Petitioner's Response Brief Due
January 31, 2021	Final Briefs Due

- OE staff continue to work with GC staff and are awaiting the petitioner's brief in the aforementioned lawsuit.
- OE staff are currently working with the Office of the Chief Information Officer to develop an electronic tracking system that will track all CEII requests and designations.
- OE staff are working with DOE's Office of Management to begin the process of developing a Department-wide directive that will instruct all Department staff on how to identify, mark, and protect CEII.

Defense Critical Electric Infrastructure (DCEI)

The protection of Defense Critical Electric Infrastructure (DCEI) fulfills DOE statutory and executive authorities and enables the Department and its public and private sector partners to address energy sector threats to 1) national defense and security missions, and 2) the health and safety of American civilians.

Summary

National security threats against the U.S. energy sector continue to intensify. Our Intelligence Community reports that adversaries are conducting sustained and increasingly sophisticated campaigns against American government and civilian targets and warns to anticipate a debilitating event, or even the devastation of a multiple-threat scenario.

Of particular concern is the threat posed by determined adversaries with advanced cyber and physical hybrid warfare capabilities. For example, Chinese military tactics include "system destruction warfare" designed to cripple an adversary by exploiting vulnerabilities in physical and digital infrastructure. Their goal is to exploit situational awareness capabilities such as satellites, communication systems, and other parts of the military's "nervous system" that enable the "muscles" to project power and defend U.S. interests globally.

The U.S. Departments of Homeland Security (DHS) and State (DOS) have jointly identified lifeline functions and critical infrastructure sectors in the *Guide to Critical Infrastructure Security and Resilience (2019)*. The Energy Lifeline is among the most critical due to its role in enabling all other life-sustaining critical infrastructure sectors to function. Due to the interconnectivity of the grid, a cyberattack targeting energy infrastructure could be detrimental to multiple lifelines. Energy not only powers our nation's military bases but it also provides an essential service to public health and safety by supplying power to civilian hospitals; prisons; cell towers; police and fire stations; water treatment facilities; gas station pumps; and other lifeline functions and critical infrastructure sectors.

Section 215A of the Federal Power Act (FPA) gives the Secretary of Energy the authority to designate critical defense facilities (CDFs) located in the 48 contiguous States and the District of Columbia that are critical to the defense of the U.S. and vulnerable to a disruption of electric supply provided to such facility by an external provider, and identify their associated electric infrastructure as defense critical electric infrastructure (DCEI). The Office of Electricity (OE) leads the Department of Energy's (DOE) efforts to mitigate all man-made and natural threats to the energy system. As such, the Secretary of Energy has delegated the authority to designate CDFs and identify their associated DCEI to the Assistant Secretary for Electricity.[1]

DOE aims to energy-assure priority operational plans for critical defense and security missions by enabling consistently resilient power and fuel supply. Department of Defense (DoD) mission assurance, and by extension U.S. national security, is exposed to risk both "inside" and "outside" defense installations. DoD has the authority to execute risk management "inside the fence" by ensuring on-base energy resilience and emergency generation; whereas, DOE has the authority to manage risk "outside the fence" in partnership with the electric power industry and others. DOE's role is distinct from, complementary to, and in full support of the DoD mission – DOE refers to this role as *energy assurance for mission assurance*

Status

OE is developing activities and capabilities to enable a structured approach to leverage the strengths of DOE and its partners to stay ahead of intensifying threats to DCEI. Key steps OE is taking include:

Maintaining and periodically revising, as necessary, a CDF list on behalf of the Secretary of Energy and in consultation with other appropriate Federal agencies and informing the appropriate

1 See Delegation Order No. 00-001.00H and Redelegation Order No. 00-002.10E.

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owners, users, or operators of infrastructure that may be DCEI.

Differentiating DCEI from the broader energy system and identifying project approaches and funding/financing resources to **execute strategies and investments to harden and protect DCEI.**

Reviewing needs for scoping how DCEI is identified or defined across the energy system (generation, transmission and distribution) including special consideration of:

- Ongoing risk mitigation efforts within installations to support complementary or integrated energy assurance activities on both sides of the fence.
- The extent to which mission assurance may rely on natural gas pipelines and delivered fuels in addition to electric infrastructure.
- Specific components, equipment, and systems that may present higher risk and therefore should receive priority attention.
- Other civilian infrastructure needed for mission assurance that requires power to function (e.g., communications, transportation systems, and water and wastewater systems).

Establishing coordination and collaboration mechanisms with key stakeholders and partners, including:

- DOE's Offices of Cybersecurity, Energy Security, and Emergency Response (CESER); Energy Efficiency and Renewable Energy (EERE); Fossil Energy (FE) and others.
- CDF owners and operators; the utility industry and other DCEI owners and operators.
- Security partners including DHS, the intelligence and law enforcement communities
- Regional and federal energy reliability organizations including the North American Electric Reliability Corporation (NERC) and the Federal Energy Regulatory Commission (FERC).
- State and local governments, to include utility regulators and State, Local, Tribal and Territorial (SLTT) energy offices.
- Technical assistance providers such as DOE's national labs.

Conducting a comprehensive inventory of DOE and partner capabilities that can be leveraged for DCEI program success including:

- Implementation of Executive Order 13920, "Securing the United States Bulk-Power System."
- Coordination with the Power Marketing Administrations (PMAs), which report to the Assistant Secretary for Electricity; and hydropower projects of the Bureau of Reclamation and the U.S. Army Corps of Engineers through:
  - Strengthening operational technology (OT) and industrial control systems (ICS) cybersecurity and resilience.
  - Pursuing mutually beneficial broadband infrastructure and energy technology investment and deployment opportunities for America's rural communities, including exploring the feasibility of providing broadband internet services using PMA preexisting excess fiber optics infrastructure.
- Development of black start, load shedding, grid restoration, and operation activities protecting or restoring the reliability of DCEI.
- Coordination of cybersecurity, critical infrastructure, and emergency response programs and activities led by CESER.
- Facilitation of technical support provided to federal agencies by EERE's Federal Energy Management Program.
- Development of the North American Energy Resilience Model (NAERM).
- Creation of other capabilities in the areas of research, development, and demonstrations; modeling, analysis and exercises; direct technical assistance; education and information sharing; and others.

Guiding and supporting the development of decision support tools uniquely suited to respond to unpredictable and high-consequence resilience events. OE recognizes the critical role Lawrence Berkeley Lab's Interruption Cost Estimate (ICE) Calculator plays in supporting grid reliability improvements based on customer value of lost load surveys. However, the lack of methods and approaches suitable for evaluating DCEI-related investment proposals remains a significant barrier to achieving energy assurance for mission assurance. In order to implement DCEI risk

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mitigation measures on the grid, electricity system decision makers and their stakeholders will need methods to assess the full costs of unpredictable, widespread, long-duration outages and the benefits of improvements that can help avoid disastrous economic and societal consequences should DCEI be left vulnerable to cyber-attacks and other hazards.

DOE Leadership and Coordination

DOE is well-positioned to lead the DCEI initiative as the Sector Specific Agency (SSA) for energy under the framework established by the *Presidential Policy Directive 21 (PPD-21): Critical Infrastructure Security and Resilience.* More specifically, DOE's DCEI-related authorities as established in the FPA enable the identification of DCEI for the purposes of protection, hardening, and enhancement. In addition, Sections 215A and 202(c) of the FPA authorize DOE to order grid restoration and operation activities to meet the needs of a "grid security emergency," including protecting or restoring "the reliability of critical electric infrastructure or of defense critical electric infrastructure." This authority, administered by OE for the Secretary of Energy, can support prioritizing and accelerating restoration of electricity service to CDFs and other critical assets in long duration outages that could last weeks or months. In such extended blackouts, emergency power generators and fuel resupply operations for on-base electric systems are at increasing risk. Sustaining and restoring electric service to these CDFs is therefore vital for national defense and security.

DOE has the mandate, expertise, and electric utility industry relationships to manage risk "outside the fence" of CDFs by leading efforts to harden energy supply paths for DCEI and other mission critical assets on the grid using an **energy assurance for mission assurance** framework.

Major Decisions/Events

The President's FY2021 budget request includes $1.65 million to support foundational technical analysis for the initial year of DOE's DCEI program.

Grid Modernization Initiative

The electricity system we have today must evolve to meet the demands of the 21st century and beyond. The Grid Modernization Initiative (GMI) coordinates electric grid-related research and development (R&D) across the five Department of Energy (DOE) applied energy offices: Fossil Energy (FE); Nuclear Energy (NE); Electricity (OE); Energy Efficiency and Renewable Energy (EERE); and Cybersecurity, Energy Security, and Emergency Response (CESER). Because the technology mission of each of these Offices depends on a reliable, resilient, and secure electric grid, the GMI allows each Office to pursue grid-related R&D while minimizing duplicative effort. Over the past five years, GMI has provided for cross-cutting coordination on over $330 million of DOE research investment; and worked with industry, regulators, policymakers, and other stakeholders to facilitate the widespread adoption of new technologies.

Summary

America's security, economy, and sustained global leadership depend on a reliable, secure, and resilient power grid. GMI works with public and private partners to develop the concepts, tools, and technologies needed to measure, analyze, predict, protect, and control the grid of the future. This requires focus on a fully integrated vision of the energy system from fuel to generation to delivery to load, including interdependent infrastructures (e.g., communications systems, natural gas pipelines). GMI's portfolio of work will help to better integrate all sources of electricity; improve the security of our nation's grid; solve challenges of energy storage and distributed generation; and provide a critical platform for U.S. competitiveness and innovation in a global energy economy.

Five key trends, below, are driving a transformation that challenges the capacity of the grid to provide the services the US needs, but also serve as an opportunity to transform our nation's grid into a platform for greater prosperity, growth, and innovation.

1. Changing mix of types and characteristics of electricity generation.
2. Growing demands for a more resilient and reliable grid, especially due to weather impacts.
3. Growing threat of cyber and physical attacks.
4. Opportunities for customers to provide grid services and participate in electricity markets.
5. Increased use of digital and communication technology in the control of power systems.

Status

Details on the existing research portfolio are available at the Grid Modernization Laboratory Consortium (GMLC) website.[1] Projects from the first two rounds[2] of funding are wrapping up, while the third round of projects are underway, completing their first year of research.[3]

DOE Leadership and Coordination

OE and EERE initially partnered to create the GMI to coordinate and leverage grid-related research efforts, and in 2018 the GMI collaboration began to include the other applied energy offices. These five offices and a steering committee drive activities under the GMI that complement individual investments and programs that each Office implements separately. In addition, the GMI coordinates their activities with DOE's Office of Science, Advanced Research Projects Agency–Energy, and the Artificial Intelligence and Technology Office.

The Grid Modernization Laboratory Consortium (GMLC) is a subset of GMI and was established as a strategic partnership between DOE and

1 See, https://gmlc.doe.gov/projects

2 See, https://www.energy.gov/grid-modernization-initiative-0/doe-grid-modernization-laboratory-consortium-gmlc-awards ; https://www.energy.gov/grid-modernization-initiative-0/resilient-distribution-systems-lab-call-awards

3 See, https://www.energy.gov/2019-grid-modernization-lab-call-awards

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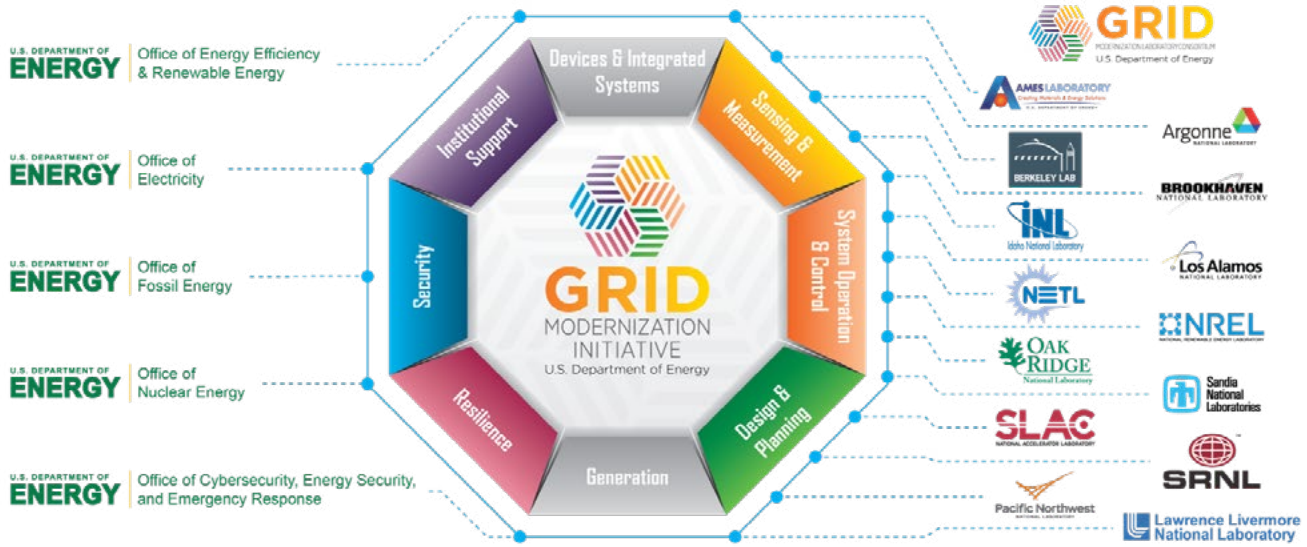
the National Laboratories to bring together leading experts, technologies, and resources to collaborate on the goal of modernizing the Nation's grid. The benefits of the GMLC include more efficient use of resources; shared networks; improving learning and preservation of knowledge; enhanced lab coordination and collaboration; and regional perspective and relationships with local stakeholders and industry.

Externally, over 400 partners are involved in GMLC projects and peer reviews, representing State agencies, regional entities, utilities, suppliers, universities and others.

The GMI/GMLC has been very successful with broad U.S. Congressional support and has served as the model for other DOE crosscutting initiatives.



Structure of the Grid Modernization Initiative and Grid Modernization Laboratory Consortium

Background

The modernized grid will need to balance six attributes, and GMI tailors its efforts to incorporate them:

1. **Resilience.** The ability to recover quickly from any situation and sustain the operation of critical facilities and customers.
2. **Reliability.** Improvement of power quality and fewer power outages.
3. **Security.** Protection at every scale, from components to regions, and in our critical infrastructure.
4. **Affordability.** Maintenance of reasonable costs to all stakeholders.
5. **Flexibility.** Ability to responds to the variability and uncertainty of conditions across a range of timescales, including a range of energy futures.
6. **Environmental Sustainability.** Facilitation of broader deployment of clean generation and efficient end-use technologies and reduces environmental impact of energy-related activities.

Grid Storage Launchpad Project

Grid energy storage is a central element in modernizing the power grid and unlocking a broad array of economic and societal benefits. Further adoption of grid energy storage will require the accelerated development and testing of new energy storage technologies that are more cost-effective, safe, and durable. On November 20, 2018, the Office of Electricity (OE) approved a Mission Need Statement (MNS) that identified the following significant battery research and development (R&D) capability gaps within the Department of Energy (DOE) complex:

- **Capability for independent testing and validation of next generation energy storage materials, devices, and prototype systems under grid operating conditions.**
- **Characterization capabilities focused on technologies with grid applications capabilities.**
- **Integration of existing materials development capabilities and collaboration with industry and universities.**

In August 2019, OE determined that a new facility at Pacific Northwest National Laboratory (PNNL) would optimally address these gaps.[4]

Summary

The Grid Storage Launchpad (GSL) Project will be a new, national grid-scale energy storage R&D facility that includes investments from the State of Washington, Battelle, and PNNL. Through independent testing and validation of grid energy storage technologies, the GSL will develop and promulgate rigorous grid performance standards and requirements that span the entire energy storage research and development (R&D) cycle, from basic materials synthesis to advanced prototyping. The GSL will focus on three outcomes to advance grid energy storage development:

Collaborate

By bringing together DOE, multidisciplinary researchers, and industry under one roof, the GSL will lower the barriers to innovation and deployment of grid-scale energy storage.

Validate

The facility will enable independent testing of next-generation grid energy storage materials and systems under realistic grid operating conditions.

Accelerate

From bench top to systems, the facility will de-risk and speed the development of new technologies by propagating rigorous performance requirements along all phases of R&D.

The facility will be approximately 85,000 gross square feet in size and will include approximately 35 laboratories and 150 workstations. The Total Project Cost of the Project is $77 million. The Project is anticipated to be completed by Quarter 2 of Fiscal Year (FY) 2025, subject to appropriations.

Planning/Design Process

Before acquiring design and construction services, the GSL Project developed detailed performance specifications by touring and benchmarking six nationally-recognized battery testing facilities, including: DNV GL/New York Battery and Energy Storage Technology (NY-BEST); CAR Technologies; General Motors; FM Global; Underwriters Laboratory; and the Naval Surface Warfare Center, Crane Division.

Milestone(s)

As a line item acquisition, the project has been subject to several independent reviews, as noted below:

- Independent analysis of alternatives – completed in June 2019;
- Energy Systems Acquisition Advisory Board (ESAAB); Critical Decision (CD) 1 readiness – completed in August 2019;

4 Critical Decision 1

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- Head of Contracting Activity review of contracting package – May 2020; and
- Independent Project Review for Critical Decision 2/3 ESAAB – December 2020 (est.)

Formal DOE Process

The Project is subject to the requirements of DOE Order 413.3B, Program and Project Management for the Acquisition of Capital Assets.[1] The Order establishes project management principles and processes with the goal of delivering projects within cost and schedule that are fully capable of meeting mission performance, safeguards & security, and environmental, safety, and health requirements. The project lifecycle is organized into project phases which are separated by Critical Decisions, which represent a project's readiness to proceed from one phase to the next.

Major Decisions/Events

The next Critical Decision for the GSL is a combined CD-2/3, the (2) Approval of the Performance Baseline and (3) Start of Construction. Planned for Quarter 2 of FY21, CD-2/3 will accommodate the GSL Project design-build acquisition strategy.

Budget History and Planned Funding Profile

Planned Funding Profile

Fiscal Year	FY2019(d)	FY2020(e)	FY2021	FY2022	FY2023	Total ($M)
OPC(a)	$1.0	$0.0	$0.0	$0.0	$1.0	$2.0
TEC(b)	$0.0	$5.0	$40.0	$30.0	$0.0	$75.0
TPC(c)	**$1.0**	**$5.0**	**$40.0**	**$30.0**	**$1.0**	**$77.0**

a. Other Project Costs (OPC) includes Conceptual Design and Pre-Operations. For the GSL, OPC is funded through PNNL overhead.
b. TEC Construction includes preliminary and final designs, construction, project management, and other costs not captured in OPC.
c. TPC includes TEC Project Engineering and Design, TEC Construction, and OPC.
d. FY2019 and FY2020 numbers reflect actual amounts
e. FY2020 numbers reflect $1m in appropriated funds and $4m in reprogrammed funds

In addition to OE line item funding for the facility acquisition, PNNL and others are committing resources to leverage the DOE investment: $15 million of Laboratory Directed Research and Development (LDRD) for catalysis research, $8 million from the State of Washington for state-of-the-art research equipment, $7 million from PNNL for general research equipment, and $5 million from the Battelle Memorial Institute.

1 Available at, https://www.directives.doe.gov/directives-documents/400-series/0413.3-BOrder-b.

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North American Energy Resilience Model

The North American Energy Resilience Model (NAERM) will provide national-scale energy planning and real-time situational awareness capabilities based on rigorous and quantitative assessment. This effort develops a first-of-its-kind understanding of complex energy delivery interdependencies across multiple infrastructure sectors, while considering a range of large-scale emerging threats, both natural and man-made. By enhancing federal-level intelligence of the energy sector, NAERM can improve the Department of Energy's (DOE) response to energy sector incidents, sponsor strategic level exercises, and gain insight in the planning and operational factors required for a reliable and resilient energy future.

Summary

The reliability of the U.S. electric power system is critical to the Nation's economic vitality, security, and well-being. Today, that reliability is being challenged, as the infrastructure ages and as incidences of severe weather, coordinated cyber-physical attacks, and other threats to the system increase. The electric system must not only be reliable, but also resilient.[2]

Our Nation's bulk-power system will benefit from quantitative modeling tools that will fully integrate and analyze the interdependencies among energy infrastructure such as natural gas pipelines, pump stations, and river levels and flows. Investment in the tools, models, and expertise across infrastructure sectors provide insight gained from simulations and exercises which can enhance preparedness for natural and adversarial events. NAERM is a comprehensive resilience modeling system for North America's energy sector infrastructure, and is being developed from a collaboration between DOE, its National Laboratories, and industry. It is advancing capabilities to model, simulate, and assess the behavior of electric power systems, as well as associated dependencies on natural gas and other critical infrastructures. The modeling approach enables prediction of the impact of a range of large-scale, emerging threats; evaluation and identification of effective mitigation strategies; and coordinated planning, system restoration, and recovery (Figure1).

Status

DOE released its high-level strategy for NAERM in July 2019.[3] The main phases of NAERM address:

- Phase 1: Long-term energy planning using static, offline data;
- Phase 2: National-level situational awareness using real-time streaming data for both infrastructure and threats; and
- Analytic and decision support capabilities to anticipate threats and mitigate their impacts (Figure 2).

In FY2020, NAERM research and development was divided into three sub-areas to expand model features and deliver initial NAERM platform capabilities. As such the NAERM team has thus far:

Real-Time Situational Awareness

Developed an initial tool for visualizing and analyzing layers of infrastructure data, forecasts of load and renewable resources, and graph-based interdependency analytics.

Infrastructure Modeling

Developed a modeling system to perform advanced co-simulation of energy-related infrastructure, leveraging the DOE/Grid Modernization Lab Consortium (GMLC) Hierarchical Engine for Large-scale Infrastructure Co-Simulation (HELICS) software. Capabilities include tools for performing visualization, multi-domain contingency analysis, and initial version for integrated Distributed Energy Resource models.

2 The term "resilience" means the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions. -- Presidential Policy Directive 21 (Feb. 2013)

3 See https://www.energy.gov/sites/prod/files/2019/07/f65/NAERM_Report_public_version_072219_508.pdf

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Software Architecture

Built a secure environment to host and orchestrate the development and deployment of the complex, multi-component NAERM software system.

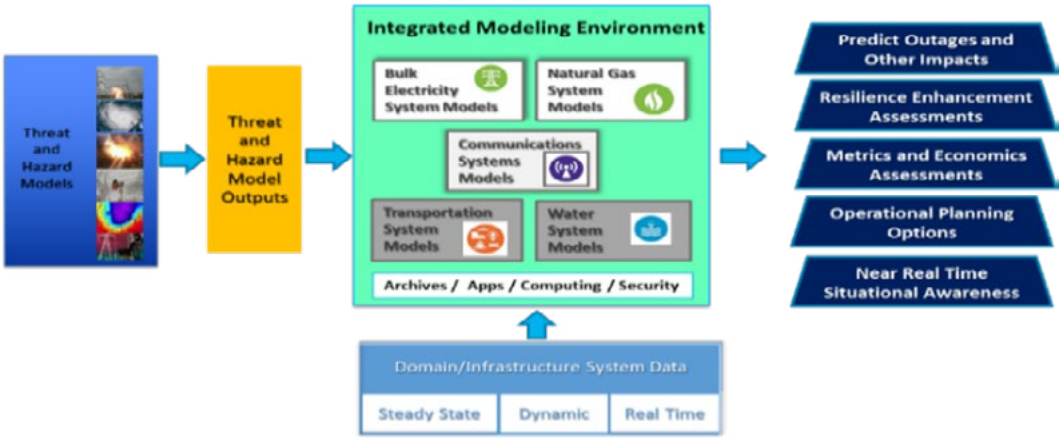

Figure 1

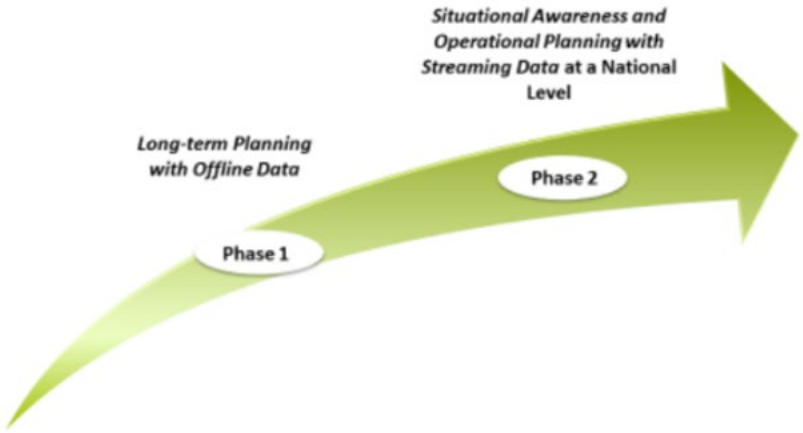

Figure 2

DOE Leadership and Coordination

While NAERM is managed by the Office of Electricity (OE), it is a Departmental level effort, drawing on the expertise and capabilities of multiple offices and National Laboratories (including Argonne, Idaho, Los Alamos, Lawrence Livermore, National Renewable Energy Lab, Oak Ridge, Pacific Northwest, and Sandia National Labs). This allows for the leveraging of DOE research investments under cross-cutting activities such as the Grid Modernization Initiative (GMI) and GMLC.

A critical foundation for NAERM is understanding bulk-power system entity capabilities and gaining access to system models, operational data, and domain expertise. This requires extensive engagement with industry experts. The benefit back to these entities is expected to be assessing the resilience implications of energy planning decisions on associated infrastructure, such as the optimal placement of energy storage.

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NAERM will cultivate a real-time situational awareness and analysis capability for emergency events for optimal operations and recovery, so that Federal agencies can quickly and effectively prepare and respond. This includes providing recommendations in coordination with State and local governments, the Federal Emergency Management Agency (FEMA), and the National Guard. These capabilities will also be leveraged by DOE's National Nuclear Security Administration (NNSA), the Department of Defense (DoD), and the Department of Homeland Security (DHS) in support of their national security missions.

Major Decisions/Events

- OE leadership has previously discussed the value of NAERM with other Federal agencies and industry stakeholders. While no formal partnerships are in place, regional planning entities and other stakeholders have expressed interest in adapting modeling advancements for their individual use, e.g. analyzing multi-domain interdependencies. Determination must be made on next steps to formalize stakeholder agreements, particularly, how to effectively transfer core modeling advancements to industry.
- In September 2020, OE briefed the National Treasury Employees Union (NTEU) on OE's proposed reorganization including a description of how NAERM efforts would be embedded in its new program office. By October 23, 2020, OE will have met the NTEU obligation and will move to finalize the reorganization.

Recovery/Puerto Rico

DOE's enhanced recovery function in Puerto Rico is improving infrastructure resilience through proactive coordination and preparedness to bring prosperity back to the islands and secure critical systems against future disaster damage.

Summary

DOE's Office of Cybersecurity, Energy Security, and Emergency Response's (CESER) Division of Infrastructure Security and Emergency Response (ISER) identified an opportunity for an enhanced recovery support capability, particularly related to remote territories and islands, in the *2017 Hurricane Season FEMA After-Action Review*. The *After-Action Review* specifically identifies the value of proactive coordination in the recovery phase as well as pre-recovery activities for improving national infrastructure resilience, and as a result, the Department's effectiveness in disaster response.

Enhanced DOE pre- and post-disaster recovery support capabilities are being brought to fruition through designating an Energy Systems Recovery Coordinator and dedicating technical assistance (TA) and research and development (R&D) programmatic resources. The Energy Systems Recovery Coordinator, located in the Office of Electricity (OE), serves as the responsible party and has a leadership role for coordinating all Departmental recovery activities and for representing DOE in interagency coordination frameworks. The Coordinator works collaboratively with program directors across the Department to identify and leverage existing work for recovery support, while establishing accountable means to reflect lessons learned back to those program managers. The Coordinator also ensures all senior leadership remain apprised of recovery-related work. Additionally, the Coordinator oversees recovery-related DOE and National Lab Mission Assignments from the Federal Emergency Management Agency (FEMA), while also developing Department-wide financial recovery-related resource requests for disaster-specific supplemental appropriations.

Recognizing the state of urgency to address these critical challenges, a few key opportunities and anticipated outcomes stand out as DOE, under OE's leadership, enhances its recovery support capabilities:

Comprehensive Pre- and Post-Disaster Preparedness Support – Resilience in Recovery Phase

Coordinating pre- and post-disaster preparedness activities offers a unique opportunity to reduce current and future risk and contribute to a more resilient and secure Nation. Proactive and coordinated preparedness activities, such as assessing vulnerabilities in electrical infrastructure, identify and mitigate risks that might endanger or pose additional recovery challenges prior to the urgency and confusion that typically follows a disaster response. Coordinating pre-disaster preparedness work ensures that risk mitigation actions are taken during the recovery process, improving the resilience of infrastructure to future disasters and lowering the Federal restoration and recovery cost burden.

Existing DOE Programs Serve as Springboard for Enhanced Recovery Support Capabilities

Expanded, coordinated, and enhanced recovery support capabilities build on ready-made tools, techniques, and relationships developed across the DOE applied program offices [OE, CESER, Fossil Energy (FE), Nuclear Energy (NE), and Energy Efficiency and Renewable Energy (EERE)], including the State, Local, Tribal, and Territorial (SLTT) portfolio of preparedness support supported by ISER. These capabilities also draw on technical reports, training materials, playbooks, and relationships developed as a part of the Energy Transitions Initiative (ETI) and Grid Modernization Initiative (GMI) and serves as a springboard for DOE's disaster recovery support for localities and Federal partners. Additionally, an enhanced recovery support capability, supplemented by the deployment of advanced tools, analytic frameworks, and technologies in affected areas, provides a platform for collaborative engagement with partners across DOE's research and development offices to incorporate lessons learned into program planning, including ETI and GMI projects.

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An Enhanced Recovery Support Capability – Clarifying DOE's Roles and Responsibilities for Interagency Coordination

The Energy Sector Recovery Support Function (RSF) role is the primary means for DOE to coordinate with interagency partners on matters of recovery support. Clarifying roles, distinguishing duties, and dedicating personnel to fulfill the responsibilities of the RSF provides consistency in inter- and intra-agency communications, allows for the accumulation of field experience; the development of long-term relationships with local and Federal partners; and an enhanced information conduit to the programmatic offices.

Status

The Department is currently engaged with recovery efforts in the Commonwealth of Puerto Rico and the United States Virgin Islands (USVI) with recovery support to the Commonwealth of the Northern Mariana Islands (CNMI) scheduled to commence in early FY2021.

In April 2020, DOE finalized an Interagency Reimbursable Work Agreement (IRWA) with FEMA to support DOE's role in the resilient recovery efforts from Hurricane Maria in Puerto Rico. The support provided will augment planning and operational activities as well as capacity building for public entities in Puerto Rico—e.g. Puerto Rico Electric Power Authority (PREPA), Energy Office, Vivienda, and Puerto Rico Energy Bureau (PREB)—to support the significant federal investments being made by FEMA and the Department of Housing and Urban Development (HUD) as part of the recovery of the Commonwealth. Additionally, DOE will provide subject matter expertise and assistance directly to FEMA and HUD as they implement public assistance and Community Development Block Grant–Disaster Recovery (CDBG-DR) funding.

To further improve coordination of energy sector recovery efforts in Puerto Rico, DOE co-leads an Energy Technical Coordination Team (TCT). The goal of the TCT is to collectively pursue the best recovery solutions and match to those solutions the resources of the Federal government, nongovernmental organizations, and private sector in a unified and collaborative manner.

Supported via the IRWA with FEMA, recovery efforts in the U.S. Virgin Islands are also ongoing since 2018. DOE and its national labs have been providing staff time, subject matter expertise, and technical assistance to interagency partners, the Territory, and the utility, the USVI Water and Power Authority. DOE is also working with FEMA to establish a USVI Energy TCT using a similar approach as to the one developed in Puerto Rico.

An IRWA has been signed for the CNMI, and work for this recovery effort will commence in 2021.

DOE Leadership and Coordination

While DOE—under its delegated authorities and responsibilities under Presidential Policy Directive 8: National Preparedness—has a long history of supporting communities both before and in the wake of disasters, the 2017 hurricane season and the devastation experienced in Puerto Rico and the U.S. Virgin Islands revealed the need for a more purposeful and coordinated approach to pre- and post-disaster recovery support across the Department. OE has therefore become a leader in coordinating DOE's intra- and interagency efforts.

The National Response Framework designates DOE as the Emergency Support Function-12 (ESF-12), the primary coordinator of Federal energy system restoration. The role ISER plays in supporting Federal disaster response through ESF-12 is regularly lauded by industry, Federal partners, and local constituents in affected areas. Staff from DOE's Power Marketing Administrations (PMA) make up a significant portion of the all-volunteer ESF-12 cadre. The PMAs have a long history of responding to some of the most severe hurricanes to make landfall in the continental United States and the U.S. Territories, including the devastating 2017 Atlantic season that brought Hurricanes Irma and Maria to the shores of Puerto Rico, the U.S. Virgin Islands, and several states in the southeast U.S.

The Energy Sector RSF role is the primary means for DOE to coordinate with interagency partners on matters of recovery support. OE, through the Energy Systems Recovery Coordinator, provides leadership for the RSF Leadership Group (RSFLG) Energy Sub-Group for PR and USVI recovery and ensures coordination across all responsible parties. Clarifying roles, distinguishing duties, and dedicating personnel to fulfill the responsibilities of the RSF provides consistency in inter- and intra-agency communications; allows for the accumulation of field experience; continues the

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development of long-term relationships with local and Federal partners; and enhances information conduits to the other DOE program offices.

OE is leveraging the interagency's coordinating frameworks that deploy resources cost-effectively and equitably in support of disaster recovery. FEMA Mission Assignments are funded requests to partner agencies for specific support to FEMA or to the communities it serves. Memorandums of Understanding and IRWAs are other common coordination mechanisms, most recently used to facilitate DOE's recovery support in the U.S. Virgin Islands. An enhanced recovery support capability will provide a structured approach for tapping into and leveraging these coordination frameworks to execute DOE's mission.

Outside of the formal Energy RSF format, DOE-OE is actively engaged with the Department of Interior's Office of Insular Affairs in coordinating support for the territories and insular areas on both pre- and post-recovery efforts. This longstanding Federal relationship, coupled with the existing relationships with stakeholders in these vulnerable communities has increased the ability to "hit the ground running" when assembling the resources needed to support recovery efforts.

Regional Resource Adequacy and Grid Reliability

Resource adequacy and grid reliability remain central topics of relevancy for the Bonneville Power Administration (BPA), especially given recent supply/demand issues precipitated by a series of hot weather events in the Western United States over the summer of 2020. These topics are all the more relevant given projected closures of certain generating facilities and reliance on renewable energy sources.

Background

During the summer of 2020, several severe hot weather events caused Western United States electricity demand to nearly exceed available generating capacity in certain hours. The Bonneville Power Administration (BPA) joins other regional utilities through the Northwest Power Pool[1] on an initiative to develop a program to ensure that the region maintains energy supply and demand parity in a very high percentage of likely conditions.

This is an issue of emerging concern in the region and to the entire Western Interconnection.[2] With coal plants retiring faster than previously anticipated, the Northwest faces a potential shortfall of several gigawatts of capacity to serve load. At the same time, the region is building new renewable, carbon-free generating resources. Such renewables can produce significant energy under the proper conditions, but they do not share the same long-term capacity attributes of the resources they are replacing (e.g., coal plants) to ensure resource adequacy.

The Northwest Power Pool initiative proposes a regional program structure to define how much dispatchable capacity is needed and to allocate accountability for carrying that capacity. The program will also look at deliverability and for ways to take advantage of regional diversity to help participants meet obligations and be as efficient as possible with existing resources.

Issue(s)

Key issues for BPA **and its customers** include:

- Regulatory, legal, and jurisdictional concerns related to the unique status of BPA and public power.
- Valuation of and compensation for BPA's hydropower generation.
- Inclusion of transmission deliverability in the resource adequacy evaluation and fair compensation for the use of BPA's transmission system.
- Interaction with short-term energy markets, such as the Western Energy Imbalance Market.

Status

BPA has been participating in the current Northwest Power Pool initiative since the work began in the fall of 2019. The multi-phase initiative involves information gathering, design, and implementation. It is currently in the second phase, and participants are developing detailed design criteria.

1 Resource adequacy and grid reliability remain central topics of relevancy for the Bonneville Power Administration (BPA), especially given recent supply/demand issues precipitated by a series of hot weather events in the Western United States over the summer of 2020. These topics are all the more relevant given projected closures of certain generating facilities and reliance on renewable energy sources.

2 For more on the Western Interconnection, see https://www.wecc.org/epubs/StateOfTheInterconnection/Pages/The-Western-Interconnection.aspx.

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Bonneville Power Administration and Western Area Power Administration Responses to Summer 2020 Western Wildfires

Wildfires occur in portions of the Pacific Northwest and the mid-Western states each year. Most of the territory in these states are grasslands, forests, mountains, deserts, and wetlands which are at high risk for wildfires and impact two of the four Power Marketing Administrations: Bonneville Power Administration (BPA) and the Western Area Power Administration (WAPA). Because both BPA and WAPA have vast diverse territories, each region has taken its own approach based on local circumstances to determine the best way to prevent wildfire ignition and damage to their power lines.

Summary

Recently, Western states—particularly California, Oregon, Washington, Colorado, and Arizona—experienced major wildfires due to drought conditions, extreme heat, and extreme wind. Utilities in these states experienced major damage to their transmission lines which prevented the delivery of power to millions of people. These wildfires occurred in both Bonneville Power Administration (BPA) and Western Area Power Administration (WAPA) service areas.

Transmission equipment in seven of BPA's 13 transmission maintenance districts were impacted by the fires. As fires raged, field crews from 10 BPA districts assessed, monitored, and worked with dispatch to de-energize and re-energize lines in response to the needs of customers and fire fighters. BPA also took one step that is not typical: it preemptively de-energized one line near Eugene, Oregon, in close coordination with a utility customer. Most utility preemptive shutoffs are aimed at lower-voltage distribution lines that may be near vegetation and trees. BPA's lines generally carry higher voltages and have greater clearance from brush and trees as a result, of aggressive vegetation management practices.

In total, BPA had 38 transmission lines out of service due to the fires. Some outages were due to the fire damage. Others were removed from service so fire fighters could work on or near BPA's rights-of-way, or so BPA crews could safely work on the transmission lines. BPA continues to work with two customers near Eugene that are still affected, both of which also have work to do on their systems.

The magnitude of several fires in Oregon and Washington states, and the speed with which they spread, led BPA to establish an incident management team to coordinate the agency's response to protect and maintain the region's power grid. BPA line crews were rapidly deployed to areas where BPA transmission and fiber facilities experienced service interruptions. BPA uses fiber optics attached to some of its transmission lines for operational communications, and, also leases unused fiber strands to third parties for their use. Damage to fiber near Wenatchee, Washington, impacted BPA operational data and BPA fiber customers.

Prior to this wildfire season, BPA released a comprehensive Wildfire Mitigation Plan that lays out how it will keep its transmission lines and other equipment from starting fires as well as how it will safely operate and communicate with first responders and others as wildfires both near its equipment or rights-of-way.

BPA officials remain in regular contact with customers, state emergency management officials, and other local entities. In addition, BPA is focused on its mission to meet the power needs of people in the Pacific Northwest, even as it prepares for more

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potential fire outbreaks. That preparation incudes continuing to act on its Wildfire Mitigation Plan, proactively managing the vegetation on its rights-of-way, and monitoring and maintaining equipment.

WAPA Actions

Each region has its own approach to mitigating wildfire risk based on the local environment and needs. WAPA and many other utilities have common practices within their vegetation management programs. They are:

- WAPA's crews observe and report any obvious issues during inspections on the lines of others to its dispatch centers who, in turn, notify their counterparts at other utilities.
- Utilize hand-held transmission line inspection tools with the ability to capture line and hardware condition, and danger tree and fire risk data.
- Establish fire management layers within its geographic information system (GIS), populated by wildfire management agencies databases, such as California Department of Forestry and Fire Protection (CALFIRE). These layers allow WAPA to be aware of current fire risk and active fires overlaid on our transmission system.
- Regular contact with the land management/ fire management agencies to coordinate and maintain relationships for effective interaction during emergency management scenarios.
- Integrate NIMS into broad training and exercise.
- Complete multiple line inspections every year, including aerial and ground.

WAPA Integrated Vegetation Management (IVM)

Our IVM program is highly effective and economical. IVM uses a two-stage approach.

- First, WAPA reclaims easement areas by clearing out tall-growing vegetation. This leaves only the low, natural vegetation in place.
- The following year herbicides are applied to keep vegetation growth low.
- The result is reduced ecological impact and savings compared to a one-time complete removal process. The goal of removing fast or tall-growing vegetation is to allow the fire to pass right under the transmission line without impacting it. This is important because maintaining a reliable flow of electricity is critical for customers serving towns and cities in Arizona and Southern California, especially when there is a fire.

IVM focuses on:

- Annual aerial and ground patrols with high-resolution imagery.
- Ground patrols occur five times a year in northern California and twice a year in other regions.
- Contracting with independent third-party inspectors to identify, validate and review IVM work.
- Removing incompatible vegetation and leaving well-established low-lying plants instead of clear-cutting. The remnants from cutting would be scattered to within 12 inches of the ground.
  - This limits fuel load while being environmentally conscious of the damage behind clear-cutting.
  - Wildfires are natural occurrences and are important for healthy ecosystems when under control. Precluding wildfire is not our goal. Keeping flames low and cool protects the lines and encourages healthy, smaller fires.
- Using herbicides on bare ground around the radius of the wood structures in our system.
- All of these options are more economical than high-tech solutions while being as effective, if not more effective, at mitigating the impact of wildfires on transmission lines.

WAPA Partnering with Forest Service in Rocky Mountain

WAPA's Rocky Mountain Region—which covers Colorado, Wyoming, and parts of Nebraska and Kansas—and its environment team partnered with the U.S. Forest Service to gain access and conduct machine clearing in rights of way on two national forests that had only been hand-cut for over a decade, leaving potentially dangerous fuel build up under the lines. Lack of mechanized clearing meant WAPA was unable to properly maintain its lines on these two forests.

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Through this partnership, WAPA was given permission to clear vegetation that had grown under and around its transmission lines. This growth increased the risk of fire and threatened the reliability of WAPA's system.

This effort garnered a Gears of Government award this year (2020) from the Executive Office of the President, recognizing the team's exceptional work to deliver key outcomes for the American people, specifically around mission results, customer service and accountable stewardship.

WAPA also provided emergency assistance to California local utilities during the wildfires. WAPA and the Bureau of Reclamation provided approximately 5,400 megawatt-hours of reserve hydropower between August 14 and 19, 2020. WAPA's Sierra Nevada region provided more than 3,300 MWh from 18 dams in the Central Valley Project in northern California, while the Colorado River Storage Project provided nearly 1,900 MWh from Glen Canyon Dam in Page, Arizona, and Morrow Point Dam in western Colorado. Desert Southwest provided more than 200 MWh from Hoover Dam on the border of Arizona and Nevada; Davis Dam in Arizona; and Parker Dam in California.

Hydroelectric dams are crucial sources of reserved energy in case of system emergencies. The large reservoirs, such as Lake Mead and Lake Powell, function as enormous batteries and can quickly dispatch a large amount of electricity on the grid with limited preparation. WAPA has plans in place with several utilities to provide emergency power from these and other dams in its 57 hydroelectric powerplant fleet.

In some cases, WAPA was able to offset this generation and continue to meet its customers' demand by increasing hydropower output from other dams to provide power to local areas. Also, WAPA did not de-energize any of its lines during the California energy emergency, keeping its transmission customers powered when many other communities were experiencing blackouts.

WAPA Key Lessons Learned

- Develop relationships with other organizations before you need them.
- Be up-to-speed on NIMS.
- Have excess inventory and MOUs on hand and be flexible with restoration.
- Have agreements ready to go for fire retardant services.
- Develop contacts to allow your crews to access restricted areas to perform critical work.
- Recognize fire department's leadership role in restoration; it requires significant coordination with them.
- Offer power line rights-of-way as fire breaks.
- Proactive vegetation management today will save lives and possibly lives in the future.

SN Wildfire Mitigation Plan

Following the devastating 2018 wildfire season, California passed Senate Bill 901, which required utilities to proactively work to mitigate the risk of wildfires started by power lines. Although WAPA is not subject to state regulation, in certain cases WAPA has chosen to voluntarily comply with state requirements.

WAPA developed a Wildfire Mitigation Plan in September 2019. It:

- Identifies specific steps we can take to minimize the probability that our facilities may be the origin of, or a contributing source to, the ignition of a wildfire.
- Defines a plan to establish and maintain consensus and communications among bulk transmission grid operators regarding whether WAPA's affected line(s) would be de-energized in response to a wildfire threat, and the communications and operations protocols that would be implemented to maintain grid resiliency.
- Outlines our expanded on-the-ground detailed inspections; vegetation/fuels inspections; potential risk and equipment failure detection technologies; and aerial inspection methods.

WAPA is also:

- Participating on an ad-hoc committee with the Transmission Agency of Northern California to review wildfire mitigation efforts.
- Compliant with California general orders and resource codes on vegetation management.

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- Regularly coordinating with CALFIRE on fuel reduction projects, incident response teams, fire suppression efforts and educational events.
- Committing to disabling automatic reclosing on lines close to a wildfire and also de-energizing lines when necessary and notified by incident command for the safety of firefighting activities.

Conclusion

In conclusion, by identifying and proactively addressing wildfire risks, both BPA and WAPA will be able to better protect assets that may be affected by a catastrophic wildfire associated with their systems. Preventing wildfires is a team effort. BPA and WAPA constantly evaluate their vegetation management, asset management, and wildfire prevention plans with their customers, neighboring utilities, and other federal and state agencies to continuously improve their practices and procedures.

BPA and WAPA are committed to doing what is right and safe, including and especially when operating and maintaining the organization's transmission system.

Columbia River Treaty

The Columbia River Treaty (CRT) is a United States-Canada international energy and flood risk management (FRM) treaty. The United States Entity initiated the CRT Review in 2008 ahead of the first opportunity to trigger termination, with subsequent negotiations for the post-2024 future of the CRT between the Nations still underway.

Background

The Columbia River Treaty[1] is an international energy and flood risk management treaty. In exchange for Canada agreeing to construct three large storage dams in British Columbia, to operate those dams for FRM, and to optimize power generation, the United States agreed to pay Canada for 60 years of flood risk management protection and to provide Canada with half of the downstream hydropower benefits produced in the United States from the operation of the Canadian Treaty dams known as the "Canadian Entitlement."

The CRT was signed in 1961, and ratified by the United States Senate and initiated in 1964. In the United States, the CRT is implemented by the Administrator of the Bonneville Power Administration (BPA), as the chair of the United States Entity; [2] and the U.S. Army Corps of Engineers (USACE) Northwest Division Engineer, as the member of the United States Entity.[3] In Canada, the CRT is implemented by the British Columbia Hydro & Power Authority.[4] Today, the CRT provides for coordinated power and FRM benefits, as well as other benefits, to both countries within the Columbia River Basin.[5]

The CRT has an unending term, with each country having a unilateral termination right that can be exercised on at least 10 years notice beginning September 2014. The United States Entity initiated the CRT Review in 2008 ahead of the first opportunity to trigger termination. Discussions with regional sovereigns and stakeholders were initiated in 2010 and concluded in December 2013 with a Regional Recommendation submitted to the U.S. State Department.

Summary

The United States Government reached consensus on a high-level position for negotiations of the post-2024 future of the Columbia River Treaty in June 2015, and received authorization to negotiate with Canada on the Columbia River Treaty in October 2016. Government Affairs Canada notified the U.S. Department of State in December 2017 of Canada's mandate to negotiate the Columbia River Treaty with the United States. Negotiations began in spring 2018 and continue to date. Both the U.S. Department of State and Canadian negotiators have discussed shared objectives and exchanged information on flood risk management, hydropower, and ecosystem considerations. The negotiation team of the United States consists of the U.S. Department of State; the United States Entity; the U.S. Department of the Interior (DOI) Office of Water and Science (and DOI's Bureau of Reclamation); and the National Marine Fisheries Service.

Currently, the Office of Electricity and BPA are engaged with USACE and DOI to calculate the overall value of the CRT to the United States Government per the direction of the Council of Economic Advisors and National Economic Council. The intent is to use this internal valuation effort to establish a single Federal position and advance the interests of the United States in the negotiations going forward.

1 Treaty Between Canada and the United States of America Relating to Cooperative Development of the Water Resources of the Columbia River Basin, Can.-U.S., Jan. 17, 1961, 542 U.N.T.S. 244 (1964), https://engage.gov.bc.ca/app/uploads/sites/6/2012/04/Columbia-River-Treaty-Protocol-and-Documents.pdf.

2 "Entity" means an entity designated by either Canada or the United States of American under Article XIV of the Treaty and includes its lawful successor. Article I, 1(g) of the Columbia River Treaty.

3 *See* https://www.state.gov/columbia-river-treaty/.

4 *See id.*

5 The Columbia River drainage basin is the drainage basin of the Columbia River in the Pacific Northwest region of North America. The basin covers 258,000 square miles and includes parts of seven States and one Canadian province. *See* https://www.americanrivers.org/river/columbia-river/.

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COVID-19 Response – Power Marketing Administrations

The pandemic of Coronavirus disease 2019 (COVID-19), caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), has played a defining role in 2020. With COVID-19 came new challenges to the energy sector, including the Department of Energy's (DOE) four Power Marketing Administrations (PMAs): Bonneville Power Administration (BPA), Southeastern Power Administration (SEPA), Southwestern Power Administration (SWPA), and Western Area Power Administration (WAPA). The PMAs have coordinated with both DOE's Office of Electricity (OE) and industry partners to ensure the successful and safe continuation of operation of their respective electric systems while operating within the COVID-19 environment.

Summary

BPA, SEPA, SWPA, and WAPA quickly responded to the national emergency[1] associated with the global COVID-19 pandemic of 2020, having coordinated with both DOE and electric utility industry partners, and in accordance with guidelines provided by the Centers for Disease Control and Prevention (CDC); the Office of Management and Budget (OMB); and the Office of Personnel Management (OPM).

The PMAs continue to actively participate in electric utility industry and Government working groups and task forces to adopt the best applicable processes and practices in dealing with COVID-19. Thus far, these processes and practices have allowed for continued reliable operation of the Nation's electric power system.

Major Actions Taken

Ensured business continuity by implementing COVID-19 safety precautions, such as CDC-approved cleaning procedures, social distancing, and the use of face coverings.

- Implemented home-to-work transportation for field workers, greatly reducing the risk of COVID-19 exposure from coworkers.
- Planned resiliency and continuity options around the sequestration of certain essential personnel (e.g., control center employees) at control centers or other facilities in order to decrease the risk of infection.

Established a maximum telework posture.

- Increased information systems functionality and security to maximize telework capabilities using remote access and collaboration tools for all telework-capable employees.
- Established new safety procedures for personnel who operate and maintain the transmission system—such as electric power transmission system dispatchers, maintenance employees, and hydro and transmission schedulers—and whose operation and maintenance of the transmission system required reporting to their normal worksites.
- Developed and instituted field crew safety procedures.
- Redesigned control centers to allow social distancing.

Activated the Incident Command System (ICS),[2] which was enhanced by developing and implementing dashboards that automate the retrieval and presentation of COVID-19-related data.

Closely coordinated with OE to develop return to workplace (RTW) plans.

Regularly reported to employees current regional and service area COVID-19 statistics as indicators for decision on workforce status.

1 Declared by the President on March 13, 2020. *See* https://www.whitehouse.gov/presidential-actions/proclamation-declaring-national-emergency-concerning-novel-coronavirus-disease-COVID-19-outbreak/#:~:text=1601%20et%20seq.),%2C%20beginning%20March%201%2C%202020.

2 For more on the ICS, *see* https://www.ready.gov/business/implementation/incident.

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Implemented administrative leave approved by DOE for caregiving responsibilities, thus providing additional support for those employees who needed it.

Surveyed employee wellness periodically, following-up with virtual town hall meetings to address concerns and obtain additional feedback.

Broadly shared pandemic plans and RTW plans across industry.

Funding the Response

PMA funding that needs to be carried forward for any future pandemic response is listed below. This type of funding was categorized as non-reimbursable in the ratemaking process by the DOE Chief Financial Officer in consultation with OMB and Congressional staff. BPA did not request any funding from DOE for the listed assistance.

To enable telework capability for COVID-19 response, the PMAs received Coronavirus Aid Relief Economic Security (CARES) Act funding, which was provided to DOE departmental administrations and administered by the Chief Information Officer's office as follows:

- SEPA—$50,000
- SWPA—$550,000
- WAPA—$2 million

To procure needed supplies, such as personal protective equipment (PPE), the PMAs combined supplies provided by DOE and the National Stockpile with additional PMA-purchased supplies from external vendors.

The PMAs fell under an OE-led ICS within the DOE hierarchy and received non-reimbursable PPE through:

- The Office of Cybersecurity, Energy Security, and Emergency Response (CESER);
- The Federal Emergency Management Agency (FEMA); and
- Surplus from other DOE organizations (e.g., other offices).

To set up recreational vehicles or other living arrangements for sheltering or sequestering mission essential employees at work if needed, the PMAs received funding from CESER.

OMB provided guidance for the use of CESER funds following two WAPA sequestration pilots in the Sierra Nevada region for its power system dispatchers April 27-May 1, 2020, and May 1-May 5, 2020.

Continuing and Upcoming Needs and Concerns

As the PMAs continue to assess work force posture and respective RTW plans, the following needs and concerns remain:

- The Secretary's authorization of home-to-work transportation usage expires March 26, 2021, and may require extension to maintain a safe work posture for those critical positions listed in the Secretary's existing authorization.
- Individual PMAs still need the ability during national emergencies to provide meals to sequestered employees, as the sequestration of mission-essential employees may still be necessary in the future.
- The PMAs could be impacted if wholesale power customers are unable to pay their bills due to "no shut-off" polices.
- Telework status will eventually change upon entry into new phases of crisis response and may require a change in management process.
- Management of social distancing by locality.

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Purchase Power and Wheeling Scoring

The Power Marketing Administrations (PMAs) have long-term power marketing plans and power sale contracts with their customers. When the Federal hydropower generated is insufficient to fulfill contractual power commitments, the PMAs purchase power to fulfill their obligations. Without the Purchase Power and Wheeling (PPW) Program, the PMAs could not fulfill their contractual delivery requirements, placing the recovery of annual costs and repayment of the Federal investment at risk. Receipts for PPW are linked to expenditures for PPW in the budget and there is language and scoring to reflect that principle.

Summary

The Southeastern Power Administration (SEPA), Southwestern Power Administration (SWPA), and Western Area Power Administration (WAPA) have long-term contractual obligations with customers to market and deliver Federal power. The PPW program is critical to meeting the PMAs' mission to deliver power. If sufficient power is not generated from Federally-owned sources to fulfill the contractual obligations, generally due to drought conditions, the PMAs are required to purchase power to fulfill their obligations.

PPW Receipt authority was enacted in Fiscal Year (FY) 2001 to provide greater ability to meet the highly variable hydropower generation outputs and the purchase of replacement power when needed.[1] Receipt authority for offsetting collections in excess of amounts matched with cash remains unused and expires at the end of the fiscal year. Alternative financing of PPW supplements the receipt authority. No appropriations are requested or enacted for PPW, resulting in a zero net budget authority request.

As PMA and generating agency requirements rely on power receipts, the PMAs have adopted a strategy to accumulate unobligated reserve balances for PPW programs as a way to strengthen their ability to deliver on contractual power commitments to customers during unanticipated adverse conditions. The accumulation of unobligated balances from receipts credited as offsetting collections to fund PPW provides the PMAs sufficient cash on hand to respond to current and future adverse conditions such as drought. This includes replenishment of unobligated balances to the levels defined in each PMA's respective risk mitigation strategy.

The PPW program is highly variable—it is affected by energy market conditions; generation and transmission system constraints; reservoir storage levels; drought conditions; and downstream flow restrictions. Flow restrictions result from many different events including icing; flooding; environmental activities; health and safety; recreation; irrigation; and navigation requirements. Adequate PPW authority is essential to meeting the variability in the program, including maintenance of reserves. Without PPW, the PMAs would be required to expend emergency funds payable in the same year with significant rate impacts to customers. PPW allows for a smoothing of rate impacts.

Due to disagreement on scoring of PPW in recent years, Congress has been limiting the PMAs' PPW funding levels. During the FY 2018 appropriations process, the PMAs were asked to provide more information concerning the accumulation of unobligated balances for PPW in the PMAs' accounts. Section 308 of the Consolidated Appropriations Act, 2018, required DOE to prepare and submit a report, in consultation with the Office of Management & Budget, on how SEPA, SWPA, and WAPA execute current receipt authority for PPW expenditures to the Committees on Appropriations of the House and Senate. The report explains the execution of the program and the importance of the reserve balance strategies for the PMAs. The final report[2] detailing PPW authority and expense recovery through the rate setting process was sent to Congress in September 2019.

1 https://www.govinfo.gov/content/pkg/BUDGET-2001-BUD/pdf/BUDGET-2001-BUD.pdf

2 https://www.wapa.gov/About/the-source/Documents/pma-ppw-expenditures-congress-report.pdf

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Key Facts/Points

SEPA

- Actual PPW expenditures each year vary significantly and depend heavily upon water conditions. Hydropower unit outages are highest during severe drought conditions. SEPA's risk mitigation strategy is to carry unobligated balances sufficient to cover 90 days of expenses. This provides funding early in the new fiscal year and allows time for the collection of receipts necessary to match use-of receipt authority or potential Continuing Fund activation. SEPA recovers PPW expenses by passing actual costs incurred through to customers on a monthly basis.
- SEPA's FY 2020 receipt authority request was $65.7 million and $56 million was enacted.
- The FY 2021 receipt authority request is $71.2 million. The House Mark is $52 million, reflecting a reduction of $19.2 million, or 27 percent. SEPA did not appeal the Mark following updated analysis of FY 2021 hydrological conditions, generation, contractual commitments, pricing, and program risk.

SWPA

- Actual PPW expenditures each year vary significantly, dependent upon water conditions and hydropower unit outages, and are highest during severe drought conditions. Drought conditions are largely unpredictable and can develop quickly (in a matter of months) in SWPA's region.
- To provide for efficient response to drought conditions, the unobligated balance strategy proactively builds up a balance of PPW funds within range of the estimated single-year severe drought PPW need of $93 to $95 million.
- Maintaining receipt authority for PPW in each fiscal year's appropriation language that is within range of the estimated single-year severe drought PPW needs allows SWPA to manage its unobligated PPW balances, permits SWPA to replenish the PPW funds balance (if expended), and enhances the ability to respond to a multi-year drought.
- SWPA's FY 2020 receipt authority request was $83 million and $43 million was enacted.
- SWPA's unobligated balance at the end of FY 2020 was $88 million; still short of SWPA's unobligated balance strategy of $93 to $95 million.
- In FY 2021, SWPA requested $70 million in receipt authority. SWPA has appealed the House Mark of $15 million.

WAPA

- Actual PPW expenditures each year vary significantly, dependent upon water conditions. Hydropower unit outages are highest during severe drought conditions. WAPA plans for a level of adversity as experienced in FY 2014, and will develop risk mitigation for severe conditions, as in the FY 2001-2008 drought in the Pick-Sloan Missouri Basin. The budget request and rate process provide for a level of surety. Reserve strategies have been developed to mitigate the impacts of a severe long-term drought.
- WAPA's FY 2020 receipt authority request was $258.9 million and $227 million was enacted.
- At the end of FY 2020, WAPA reached the reserve strategy objective of $393 million for the Construction, Operation and Maintenance account. This strategy was aligned upon with the preference power customers.
- The FY 2021 receipt authority request is $227 million. WAPA has submitted an appeal of the $172 million House Mark. The WAPA appeal is for $192 million, based on current information on hydro conditions, generation, contractual commitments, pricing, and program risk.

Implications

- Alternative financing authorities are voluntary on the part of the customers. Over-reliance on alternative financing increases risk that PPW requirements may not be funded and that the PMAs may not be able to fulfill their contractual power delivery obligations.
- Continued limitations on PPW receipt authority leave the PMAs at risk of breaching contracts, service interruptions during time of drought, and customer vulnerability to higher priced purchase power and rate spikes.

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Science and Security Policies

Department Leadership has developed a series of policy initiatives to reduce the risk posed by specific threats, including threats by certain foreign governments, to the U.S. research enterprise, including the DOE National Laboratories. These policies were set out through a series of three leadership memos, the first of which was issued in April 2018, the second in December 2018, and the third in January 2019. The policies are implemented through a series of DOE Orders.

The key goal of these policies is to address risks to research security and integrity while maintaining an open, collaborative, world-leading science enterprise. Throughout the development and implementation of these policies, DOE has been actively engaging with the interagency Joint Committee on the Research Environment (JCORE) led by the Office of Science and Technology Policy (OSTP).

To take action on these issues, DOE created the Federal Oversight Advisory Body (FOAB), which is comprised of representatives identified by the Office of the Under Secretary of Energy, Under Secretary for Science, and the Under Secretary for Nuclear Security. The FOAB assists in implementing these polices, and formulates new policies as needed. The FOAB is co-chaired by these three representatives and has representatives from program offices that include, but are not limited to, the Office of Intelligence and Counterintelligence; Office of International Affairs; and the Office of General Counsel.

Science and Security Policies

DOE has taken several concrete actions to mitigate the security risk at the national laboratories and throughout the DOE complex. These actions apply to international collaborations with countries of risk,[1] but allow continued and enhanced collaboration with countries that share U.S. core science values and principles.

Science and Technology Risk Matrix

The International Science & Technology Policy memo of December 2018 called for the establishment of a Science and Technology Risk Matrix. The purpose of the Matrix is to identify and put in place enhanced protections for critical and emerging research areas and technologies that are critical to U.S. economic and national security; global leadership; and competitiveness, and to mitigate against the detrimental exploitation of these research areas and technologies in ways that could harm the United States, and specifically the U.S. scientific enterprise.

The Matrix is comprised of emerging and critical research areas identified by the DOE science community that need protection from certain state-sponsored threat actors but are not otherwise protected by classified information and export controls. The Matrix places technologies into three color-coded risk categories – red, yellow, and green. Red is the most restrictive, and is limited in scope and narrowly defined. Collaboration with countries of risk in red technology areas requires specific approval by Departmental heads, granted through an exemption process. Yellow and green technology areas do not need to follow this exemption process prior to engagement.

The Chief Research Officers of the National Laboratory complex developed the Matrix by consensus at the request of DOE HQ. The Matrix is comprised of six initial emerging and critical research areas: Quantum Information Science, Artificial Intelligence/Machine Learning, High Performance Computing, Accelerator Science, Battery Technologies, and Biotechnology.

1 Foreign Country of Risk. Any foreign country determined to be of risk, following consideration of, but not limited to, the Office of the Director of National Intelligence Worldwide Threat Assessment and The National Counterintelligence Strategy of the United States of America, by the Under Secretary for Science in consultation with the Under Secretary of Energy; the Under Secretary for Nuclear Security; and the Office of Intelligence and Counterintelligence. At this time, the countries of risk list is limited to China, Russia, Iran, and North Korea. Each of the policies detailed only applies to countries of risk.

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The Science and Technology Risk Matrix was disseminated to the national laboratory complex and DOE program offices in December 2019 and will be updated, as needed, in coordination with the laboratories. It was implemented through a series of DOE Orders covering DOE sponsored foreign travel, agreements with national laboratories, and foreign national access to the national laboratories.[2]

DOE Order 486.1

Department of Energy Foreign Government Talent Recruitment Programs

In January 2019, DOE announced a policy prohibiting all DOE employees and contractors, including laboratory personnel, as well as DOE financial assistance recipients, from participating in foreign government talent recruitment programs sponsored by countries of risk. This policy for DOE employees and contractors, laboratory employees, and on-site research and development subcontractors was implemented in June 2019, but has not yet been implemented for financial assistance recipients as of October 2020.

The Order implementing this policy prohibits DOE employees and contractors from working in the DOE complex and participating in foreign government talent recruitment programs of countries of risk. Its goal is to mitigate against the unauthorized transfer of science and technical information to foreign government entities through their participation in foreign government talent recruitment programs of countries of risk.

DOE has been in close coordination with other science agencies under the leadership of OSTP on developing any new requirements for financial assistance to ensure there are no conflicting requirements for institutions created once implemented. Specifically, DOE is working to ensure that the Department's initiatives in these areas align with the recently issued National Strategy for Protecting Critical and Emerging Technologies (C&ET) and other proposed executive directives.

DOE Order 486.1A

Foreign Government Sponsored or Affiliated Activities

DOE expanded the scope of restricted activities[3] for DOE employees and contractors (including laboratory employees and on-site research & development contractors) in September 2020. Restrictions on these activities do not strictly prohibit them, but employees and contractors must obtain an exemption in order to participate in these activities. This Order was implemented in October 2020.

Major Decisions/Events

Implementation of the foreign government talent recruitment program for FY 21 Financial Assistance Awards is pending and is expected to be completed calendar year 2020. Implementation of additional protection measures for financial assistance awards is pending.

2 DOE Order 550.1 Chg 1, *Official Travel;* DOE Policy 485.1A, *Foreign Engagements with DOE National Laboratories;* DOE Order 481.1E Chg 1, *Strategic Partnership Projects;* DOE Order 483.1B Chg 2, *DOE Cooperative Research and Development Agreements;* and DOE Order 142.3A, *Unclassified Foreign Visitors and Assignments Program.*

3 https://www.whitehouse.gov/wp-content/uploads/2020/10/National-Strategy-for-CET.pdf

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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. The July 2015 Executive Order 13702 established the National Strategic Computing Initiative (NSCI) and identified DOE as one of the lead agencies. The NSCI called upon the DOE Office of Science (SC) and DOE National Nuclear Security Administration (NNSA) to "execute a joint program focused on advanced simulation through a capable exascale computing program emphasizing sustained performance on relevant applications and analytic computing to support their missions."

- 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 at least one exascale (10^{18} operations per second) computing capability in calendar year 2021 with two other DOE exascale systems delivered in the 2022-2023 timeframe. This activity, referred to as the ECI, is a partnership between the SC and the NNSA that addresses DOE's science and national security mission requirements.

Issue(s)

Early summer 2020, Japan overtook the U.S. on the Top500 list that identifies the world's most powerful high performance computers with the deployment of their 415 petaflop Fugaku system. "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 petaflops (10^{18}). Recognizing the importance of HPC to economic competitiveness, nations in Europe and Asia, particularly China, continue to invest in HPC. The Chinese strategy is increasingly to base their HPC systems on domestic technology, and China continues to lead the U.S. in the number of systems on the Top500 list. On the recent June 2020 TOP500 list, China has 226 systems vs. U.S.' 114 systems. 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). In addition, China has 3 exascale machines in the pipeline: a Sunway system in Jinangnan targeted for 2020, a NUDT system in Tianjin targeted for 2021, and a Sugon system in Shenzhen targeted for 2022. The Chinese have an advantage in that they are not held back by an installed base that needs backward compatibility and therefore, there is no need to "play it safe," leading to an open

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ended design space ranging from the conventional to the exotic. However, in the past two years, there has been no announcements of new Chinese systems in the Top500.

Currently, within DOE SC and DOE NNSA, the total leadership computing capability (combined capability of existing DOE high-performance computers) is over 400 petaflops. In FY 2017, the SC R&D portion of the ECI was segregated into the Office of Science Exascale Computing Project (SC-ECP) in SC's Advanced Scientific Computing Research (ASCR) program. ECP provides the R&D necessary to effectively use exascale-capable systems while ECI is focused on the actual delivery of the exascale hardware. ASCR provides funds in ECI to support site preparations, non-recurring engineering investments and acceptance activities at the Argonne Leadership Computing Facility (ALCF) and the Oak Ridge Leadership Computing Facilities (OLCF). 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. Naive 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.

For NNSA, the execution of ECI resides with the Advanced Simulation and Computing (ASC) program mostly in the Advanced Technology Development and Mitigation (ATDM) subprogram. Starting in FY2021, the NNSA ECI activities will be transitioned to the other ASC subprograms (Integrated Codes, Physics and Engineering Models, and Verification & Validation subprograms) to transfer the next-generation exascale application technologies to production service. The Computational Systems and Software Environment (CSSE) subprogram is responsible for procuring the El Capitan system and investing in production-ready exascale computing technologies. A General Plant Project (GPP) funding in the Facility Operation and User Support (FOUS) subprogram will "extend" the power from the walls of Lawrence Livermore National Laboratory (LLNL) Building 453 to the El Capitan system.

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 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 six 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

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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.

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 to 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 its 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 (FY 2016-2020) has focused on R&D directed at achieving system performance targets for parallelism, resilience, energy consumption, memory, and storage. The second phase, approximately the last four years of the ECP, will support production readiness of application and system software, and start of ECP operations. The other DOE ECI activities includes procurement of exascale computer systems, domain-specific software development in the Biological and Environmental Research and Basic Energy Sciences programs.

Milestone(s)

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 were finalized established when the project was baselined at Critical Decision 2 in February 2020.

In 2018, two DOE SC National Laboratories, Oak Ridge National Laboratory and Lawrence Berkley National Laboratory, were awarded the prestigious Gordon Bell Prize for work done on the Oak Ridge Leadership Computing Facility's (OLCF's) Summit supercomputer.[3]

In March 2019, DOE announced a contract with between Argonne National Laboratory and Intel to build an exascale system, called Aurora, in partnership with Cray (now HPE) and is expected to be deliver in the 2021-2022 timeframe. Aurora will be based on a future generation of Intel Xeon Scalable processor, Intel's Xe compute architecture, a future generation of Intel Optane Datacenter Persistent Memory, and Intel's One API software, all connected by Cray's Slingshot interconnect and the Shasta software stack.

In May 2019, DOE announced a contract between Oak Ridge National Laboratory and Cray (now HPE) to build an exascale system, called Frontier, in partnership with AMD and expected to be delivered in calendar year 2021. Frontier is based on Cray's Shasta architecture and Slingshot Interconnect and AMD EPYC CPU (central processing unit) and AMD Radeon Instinct GPU (graphic processing unit) technology.

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/

3 https://www.olcf.ornl.gov/2018/11/20/2018-acm-gordon-bell-prize/

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In August 2019, DOE announced the award for the NNSA exascale system, named El Capitan, which will be delivered to LLNL starting early 2023. HPE will be the system integrator in partnership with AMD. Similar to Frontier, El Capitan will be powered by next-generation AMD EPYC Genoa CPUs and AMD Radeon Instinct GPUs, interconnected by Cray's Slingshot fabric, and using the AMD Radeon Open Compute platform (ROCm) and Cray Shasta software stacks.

In 2019, a team from ETH Zürich was awarded the prestigious Gordon Bell Prize for their work simulating quantum transport—or the transport of electric charge carriers through nanoscale materials—using the Oak Ridge Leadership Computing Facility's (OLCF's).[4]

When the Deputy Secretary approved Alternatives Analysis (Critical Decision 1) and the issuance of research and development contracts with competitively selected vendors (Critical Decision 3a) in January 2017, approval for Establishing the Project Baseline (Critical Decision 2) was delegated to the Under Secretary for Science. An independent review of ECP, in December 2019, recommended that the project was ready for approval of their project baseline. An Energy Systems Acquisition Advisory Board (ESAAB), convened in February 2020, approved ECP's project baseline.

Major Decisions/Events

Application and exascale software testing and scaling will be initiated on exascale testbeds during the first three months of 2021.

The first exascale system is to be delivered during calendar year 2021.

Background

Over the past decade, 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 must be addressed to realize productive, efficient, and economical exascale systems: [5, 6, 7]

Parallelism

Parallelism (also termed "concurrency") is a computer architecture in which multiple processors simultaneously execute multiple, smaller calculations broken down from an overall larger, complex problem. 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. The Fugaku computer (415 Petaflops) has over 7 million cores. Exascale computers will have parallelism a thousand-fold greater than petascale systems. 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. System management software and science

4 https://www.olcf.ornl.gov/2019/11/21/tiny-transistor-leads-to-big-win-for-eth-zurich-2019-acm-gordon-bell-prize-winner/
5 http://science.energy.gov/~/media/ascr/ascac/pdf/reports/Exascale_subcommittee_report.pdf
6 http://science.energy.gov/~/media/ascr/ascac/pdf/meetings/20140210/Top10reportFEB14.pdf
7 http://www.energy.gov/seab/downloads/report-task-force-next-generation-high-performance-computing

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applications software for petascale systems, already difficult to develop, are not designed to work at such extreme parallelism. 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 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 adapt dynamically to a constant stream of transient and permanent failures of components. Applications must be designed to be resilient, in spite of system and device failures, to produce accurate results.

Energy Consumption

Current 10-20 petaflop computers consume approximately 10 megawatts (MW) of electrical power. Simple extrapolation to the exascale level 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 and partnerships with computer vendors have resulted in engineering improvements that have reduced the required power significantly.

Definitions

Artificial intelligence

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

Capable exascale computing

A supercomputer that can solve science problems 50 times faster (or more complex) than a 20-petaflop systems (e.g., Titan, Sequoia; 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.

Nanometer

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.

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Petaflops

A measure of a computer's processing speed 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 classes of problems much more quickly than classical computers.

Scientific application

Simulating real-world phenomena using mathematics. The most well-known scientific applications are weather prediction models.

Uncertainty Quantification

The science of quantifying, characterizing, tracing, and managing uncertainties in experimental, computational and real-world systems.

DOE National Virtual Biotechnology Laboratory

DOE's Office of Science (SC) set up the National Virtual Biotechnology Laboratory (NVBL) in response to the COVID-19 pandemic. NVBL capitalizes on the world leading expertise, capabilities, and facilities at DOE national laboratory complex for tackling COVID-19 and creates an effective mechanism for the broader research community to work with the laboratories on combating the pandemic. For decades, DOE has wrestled with the biggest challenges in science, from high energy physics to genomics. In this time of need, NVBL has enabled major advances for combating the threats posed by COVID-19. The NVBL is a model for the future, helping to increase coordination across the national laboratories and leverage unique proficiencies and tools for common national needs.

Summary

The U.S. Department of Energy National Virtual Biotechnology Laboratory (NVBL) is a consortium of DOE National laboratories, each with core capabilities relevant to the threats posed by COVID-19. Funded by the Coronavirus Aid, Relief, and Economic Security (CARES) Act in March 2020, the NVBL is taking advantage of DOE user facilities, including light and neutron sources; nanoscale science centers; sequencing and bio-characterization facilities; and high performance computer facilities, to address key challenges in responding to the COVID-19 threat. Examples include developing innovations in testing capabilities, identifying new targets for medical therapeutics, providing epidemiological and logistical support, and addressing supply chain bottlenecks by harnessing extensive additive manufacturing capabilities. The NVBL collaborates extensively with researchers, both in academia and the private sector. In addition, the DOE user facilities are available to users in all sectors of the research community.

Issue(s)

The SARS-COV-2 Public Health Emergency called for unprecedented rapid research response. Facing a global pandemic, the DOE national laboratories are mobilizing on a national scale in ways similar to their origins in the Manhattan Project. That sprawling R&D apparatus developed during WWII, which would become the starting point for today's DOE national laboratory complex, was created to bring together our scientific and technical capabilities during a national crisis. With an extraordinary amount of bioscience and biotechnology expertise distributed across the 17 DOE laboratories, but with a need to focus research efforts against COVID-19 as one team, DOE and the laboratories launched the NVBL.

The NVBL framework provides DOE with a standing mechanism to i.) quickly assess R&D needs associated with a rapidly evolving situation; ii.) identify critical capabilities existing within the national laboratory system, DOE user facilities, and DOE's broader research enterprise; iii.) develop a multi-program and multi-institutional plan to deploy DOE's unique capabilities; and iv.) coordinate efforts with other Federal agencies, state and local representatives, and partners in industry.

Institutionalizing the NVBL framework within Office of Science (SC) programs will enable DOE to respond to future shifts in federal priorities or emerging opportunities, including future national crisis situations, in the broader S&T landscape

Status

Funded by CARES Act funding in March 2020, NVBL supports the following five research projects.

Epidemiological Modeling

To aid U.S. policymakers in responding to the COVID-19 pandemic, a team of researchers developed an integrated COVID-19 pandemic monitoring, modeling, and analysis capability. This project takes advantage of National Laboratory supercomputers—including the world's most powerful—along with significant National Laboratory capabilities in scalable

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data and computing; spatial demography and human dynamics research; and economic and risk modeling. Ultimately, this project's analysis framework, multiscale modeling system, and scalable COVID-19 data collection process will provide improved understanding of COVID-19 impacts and heightened situational awareness to government leaders.

Manufacturing

The rapid spread of COVID-19 has resulted in significant supply chain issues regarding critical medical supplies and equipment, especially personal protective equipment. Shortages in supplies such as N95 surgical masks and respirators, face shields, swabs, and ventilators put medical professionals at risk and delay an effective response to the ongoing crisis. This project will leverage advanced manufacturing capabilities at the National Laboratories, including additive manufacturing processes for metals, composites, and polymers, to facilitate accelerated production of these items. Manufacturing techniques will be integrated with materials modeling and characterization at DOE user facilities, including x-ray light and neutron sources; nanoscience centers; and computational facilities.

Molecular Design for Medical Therapeutics

The COVID-19 disease caused by the SARS-CoV-2 virus is a pressing global emergency for which there are no approved medical therapeutic interventions beyond palliative care. This project is applying a combined computational and experimental approach to accelerate scientific discovery for therapeutics targeting SARS-CoV-2. The efforts take advantage of the National Laboratory capabilities, including supercomputing and artificial intelligence; materials characterization at x-ray light and neutron sources; and nanoscience research.

COVID-19 Testing R&D

Until there is an effective vaccine for SARS-CoV-2, the virus that causes COVID-19, laboratory-based diagnostic tests are critical for protecting vulnerable populations, managing risk to all populations, supporting work strategies, and tracking the evolution of the virus and disease. Even with an effective vaccine, a new generation of tests will be required to monitor susceptibility, infection, and immunity. To address these challenges, the COVID-19 Testing R&D project is leveraging deep expertise at the National Laboratories in chemical analysis and biology to develop new approaches for improved diagnostic testing, including antigen and antibody testing.

Viral Fate and Transport

Significant capabilities across the National Laboratories related to contaminant fate and transport support the emergency response to COVID-19. Experimentation combined with physics-based and data-driven modeling and simulation are being used to address the challenge of SARS-CoV-2 transport, transmission, and fate. This research will provide critical data and modeling results to influence the response to the current crisis and understand factors involved in emergence, circulation, and resurgence of pathogenic microbes.

Milestone(s)

The NVBL working group was established on March 9, 2020.

An Expert Panel meeting was held to solicit community input on March 19, 2020.

The CARES Act was signed on March 27, 2020, providing DOE $99.5M for COVID-19 response.

NVBL projects initiated from April 2020 to June 2020, each with 3 – 6 months duration.

The NVBL 2020 Virtual Symposium was held on Wednesday, October 28, 2020, to highlight its accomplishments.

Background

DOE's rapid research response to COVID builds on the Department's participation in the National Biodefense Strategy (released September 2018). The Secretary of Energy is a member of the interagency Biodefense Steering Committee, which is responsible for the federal government's awareness of, preparation for, response to, and recovery from bioincidents. The Office of Science maintains a part-time representative at HHS to take part in the Biodefense Coordination Team, which carries out the policy requirements of the Strategy.

When the COVID-19 public health emergency was announced, the Secretary named the Director,

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Office of Science (SC-1), to be responsible for DOE research response and the creation of the Coronavirus R&D Task Team (CRDTT), a cross-DOE team that met weekly until summer 2020. One of SC-1's first activities was to release a Dear Colleague Letter to the scientific community asking for avenues of research that should be prioritized, and that fall under DOE's broad purview and do not include human health research.

In addition to NVBL, DOE COVID rapid research response activities include the HPC Consortium co-led by SC, the epidemiology/forecasting Tiger Team activities led by SC, the COVID Insights project led by AITO, and transportation modelling work led by EERE.

DOE Quantum Information Science and the National Quantum Initiative

The emerging fields of Quantum Information Science (QIS) – the ability to exploit intricate quantum mechanical phenomena to create fundamentally new ways of obtaining and processing information – are opening new vistas of science discovery and technology innovation. QIS is currently at the threshold of a revolution, creating opportunities and challenges for the Nation, as growing international interest and investments are starting a global quantum race, with implications for economic competitiveness and national security. How this revolution will develop, how great the opportunities for the U.S. science and technology sectors, and how rapidly the field will proceed, will hinge on a strategic and targeted U.S. initiative embodied in the National Quantum Initiative Act, in which DOE has a leadership role.

Summary

It is critical to United States' national security and economic competitiveness to establish and maintain global leadership in the emerging field of Quantum Information Science (QIS). This is the objective of the initiative mandated by the National Quantum Initiative (NQI) Act, Public Law 115-368, enacted on December 21, 2018. The U.S. faces fierce international competition in QIS; main players in this field include China, the EU, U.K., Canada, Australia, and the Netherlands.

DOE has a unique position to cover a wide range of QIS activities from early-stage research to securing communications – catalyzing research, development, and adoption of advanced QIS technologies and practices. Participating offices within DOE include the Office of Science (SC) and the National Nuclear Security Administration (NNSA). DOE's distinctive potential for vital contributions to the NQI is reflected in the unique capabilities and expertise that are resident in the DOE National Laboratory complex.

SC's QIS investments are focused on three key areas: early-stage core research within the SC programs, support for National QIS Research Centers, and plans to develop a quantum Internet that will connect the National QIS Research Centers and DOE laboratories. As the NQI Act recognized the interdisciplinary nature of the field, SC has emphasized collaboration and coordination of QIS activities across all the SC program offices, as well as with NNSA, DOE technology offices, other federal agencies, universities, and the commercial sector.

Issue(s)

The NQI Act established a National Quantum Coordination Office as well as a coordinated multiagency program to support research and training in QIS, encompassing activities at DOE, the National Institute of Standards and Technology (NIST), and the National Science Foundation (NSF). As the Nation's leading supporter of basic research in physical sciences, the support of the NQI is a high priority for SC/DOE.

Specifically, the NQI called for DOE to carry out a basic research program in QIS and to establish and operate up to five National QIS Research Centers to accelerate scientific breakthroughs in quantum information science and technology. These centers will promote basic research and early stage development to accelerate advancement of QIS, and advance mission needs in communication, materials and chemistry, devices and sensors, and quantum computers.

The NQI Act also called for the President to establish a National Quantum Initiative Advisory Committee (NQIAC). Under the NQI Act, NQIAC is to comprise members who are representative of industry, universities, and Federal laboratories and are qualified to provide advice and information on quantum information science and technology research, development, demonstrations, standards, education, technology transfer, commercial application, or national security and economic

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concerns. The President signed Executive Order (EO) 13885 establishing that the NQIAC be administered by DOE. Members of the NQIAC are appointed by the DOE Secretary, in consultation with the Director of the White House Office of Science and Technology Policy. NQIAC shall advise the Secretary and the Subcommittee on QIS (SCQIS) of the National Science and Technology Council (NSTC) and make recommendations to the Secretary to consider when reviewing and revising the NQI Program. DOE provides funding and administrative and technical support, as required. The SCQIS serves as the central interagency coordination across Executive Branch Agencies. DOE has close ties in QIS with other Agencies, including NSF, NIST, elements of the Department of Defense, and the Intelligence Community

Status

QIS within SC is a long-term effort and since the initiation of SC's investments in FY 2017, the approach taken is to include whole of SC and to invest in a wide scope in QIS. All six core science programs – Advanced Science for Computing Research (ASCR), Basic Energy Sciences (BES), Biological and Environmental Research (BER), Fusion Energy Sciences (FES), High Energy Physics (HEP), and Nuclear Physics (NP) – and the isotope program in SC are supporting research in QIS relevant to their missions but the investments of these standalone programs collectively make a significant impact on cross-cutting science areas: Fundamental Science, Quantum Computing, Quantum Communication, and Quantum Sensing.

DOE's support for science at the National labs has been, and continues to be, instrumental to progress in QIS. For example, high energy physics groups at Fermilab, SLAC, Lawrence Berkeley, and Argonne have been developing QIS technology for sensing and data analysis. User facilities like the Basic Energy Sciences-managed Nanoscale Science Research Centers are providing expertise in the development of new materials, instrumentation for QIS R&D, as well as offering opportunities for synergies across the labs and with researchers supported by other agencies. The Oak Ridge Leadership Computing facility is providing DOE QIS researchers access to current commercial quantum cloud computers through their Quantum Computing User Program.

As DOE continues to establish its leadership in QIS, the DOE National Laboratories remain strongly invested in future QIS advances via awarded and planned efforts. The Laboratories bring their extensive resources and expertise to the field and, in some cases, supplement DOE's investments with their internal initiatives.

Five of the DOE National Labs (Argonne, Brookhaven, Fermi, Lawrence Berkeley, and Oak Ridge) lead the National QIS Research Centers. These Centers constitute DOE's largest investment to date in QIS and cross the technical breadth of SC. They span a wide scope within QIS that includes communication, computing/emulation, devices/sensors, materials/chemistry and foundries, and address all levels of the QIS science and technology innovation chain from fundamental science to devices, systems, prototypes, and applications. The Centers combine the talents of universities, national labs, other federal agencies, and the private sector in concerted efforts to support rapid progress and economic advancement.

Developing a quantum internet is an Administration and a DOE priority with a goal to help accelerate scientific discovery in all SC domains. Over the past decade, there have been intense international efforts to advance the science of quantum communication and realizing the vision of a future quantum internet. One driving force is the global recognition that quantum communication has inherent security, grounded in fundamental principles of quantum physics and unattainable by today's classical internet. Another driver is the accelerating development of peer quantum technologies, such as quantum computers that will simulate complex scientific processes inaccessible to current computational platforms, and quantum sensing that promises measurements of precision unobtainable today. Quantum networks are needed to connect quantum computers to classical computers, connect distributed quantum computers, integrate quantum sensing technology, and discover new science. Quantum communication research is in its infancy, and scientific advances are needed to develop and deploy this next-generation networking capability. In FY 2019, SC initiated a small research program to advance the field of quantum networking primarily focused on the development of quantum repeaters needed to support a terrestrial quantum internet. The Quantum Internet Blueprint recently

released by DOE portrays a plan for the Quantum Internet Project (QuIP) to develop a secure, reliable backbone initially connecting the National QIS Research Centers and ultimately the DOE National Laboratories.

DOE is active in NSTC Subcommittees focused on QIS. Dr. Steve Binkley (SC Principal Deputy Director) is co-chair of both the Subcommittee on QIS and Subcommittee on Economic and Security Implications and Quantum Science. Representatives from ASCR and HEP participate in NSTC QIS Sub-Committee's QNIWG (Quantum Network Interagency Working Group). Government activities and updates related to NQI are described in the National Quantum Coordination Office's web-site: https://www.quantum.gov/. An overview of all SC QIS activities is consolidated in one public web-site: https://science.osti.gov/Initiatives/QIS which also provides access to all SC sponsored workshop reports

Milestone(s)

In May 2019, SC released a request for information to solicit community input on the National QIS Research Centers. The feedback received on topical areas, collaboration, partnerships, and management was incorporated in the funding opportunity announcement issued on January 10, 2020. The selection of the five National QIS Research Centers was announced by Secretary Brouillette in a virtual event on August 26, 2020. The overall DOE program funding is up to $625 million over 5 years.

In October 2019, Google announced quantum supremacy which resulted from the collaboration of researchers from ORNL, Google, NASA and a number of academic institutions. ORNL's Summit, the Nation's fastest supercomputer, was used in this demonstration to compete with Google's quantum computer Sycamore.

In February 2020, scientists from Argonne National Laboratory and the University of Chicago entangled photons across a 52-mile network in the Chicago suburbs, an important step in developing a national quantum internet. Located at Argonne, the loop is among the longest land-based quantum networks in the nation and is seen as a foundational building block in the development of a quantum internet. Experts in quantum hardware, quantum communications, and traditional and novel networking and infrastructure, along with experienced photon science and detection teams and materials scientists, came together in early February 2020 to develop a Blueprint for a Quantum Internet. The plan released in July 2020 is based on the experience and expertise of testbed networks established by ANL-FNAL-University of Chicago collaboration, and by BNL-Stony Brook University collaboration. Key steps for the future include forming Laboratory, academia and private sector collaborations for basic science, engineering, and technology development.

On August 28, 2020, the members of the NQIAC were announced. The NQIAC is co-chaired by Dr. Charles Tahan, OSTP Assistant Director for Quantum Information Science and Director of the National Quantum Coordination Office, and Dr. Kathryn Ann Moler, Dean of Research at Stanford University. The NQIAC held its inaugural meeting on October 27, 2020.

Major Decisions/Events

Pursuant to DOE O 413.3B, pending Critical Decision 0 approval, the next phase of DOE's Quantum Internet Project will require the Deputy Secretary as the Acquisition Executive to approve the Alternatives Analysis (Critical Decision 1) by the end of FY2022 and the issuance of research and development contracts with competitively selected vendors (Critical Decision 3a).

Background

In October 2014, an Interagency Working Group on QIS was created under the Subcommittee on Physical Sciences of the NSTC's Committee on Science to assess Federal programs in QIS, monitor the state of the field, provide a forum for interagency coordination and collaboration and engage in strategic planning of Federal QIS activities and investments. The Interagency Working Group was elevated to a standing Subcommittee of the NSTC in FY 2018, with the Principal Deputy Director of the Office of Science serving as a co-chair. Since 2014, the NSTC groups have produced a number of policy documents that address the Federal investment strategy:

- *Advancing Quantum Information Science: National Challenges and Opportunities (2016)*
- *National Strategic Overview for Quantum Information Science (September 2018)*

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- *A Strategic Vision for America's Quantum Networks (February 2020)*
- *Artificial intelligence & Quantum Information Science R&D Summary: Fiscal Years 2020-2021 (August 2020)*
- *Quantum Frontiers: Report on Community Input to the Nation's Strategy for Quantum Information Science (October 2020)*

Starting in early 2014, SC's ASCR, HEP, BES, and NP program offices conducted a series of workshops and roundtable discussions to engage their communities in the development of a SC QIS strategy. FES conducted a similar roundtable in 2018. These community engagements led to investments beginning in FY 2017 by ASCR's launch of two QIS programs, one focused on quantum applications and algorithms and the second on quantum testbeds. Since FY2017, QIS has become a major initiative within DOE with programs of varying sizes being initiated by HEP, BES, BER, FES, and NP that support a wide scope of research in QIS.

Definitions

Quantum Information Science (QIS)

The study of the ways in which uniquely quantum phenomena such as superposition, entanglement, and squeezing can be harnessed to obtain, process, and transmit process in ways that cannot be achieved based on classical behavior.

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.

ITER Project

ITER is a large-scale international fusion energy research facility to demonstrate the scientific and technical feasibility of fusion energy. The U.S. is one of seven member countries contributing hardware and funds to the ITER facility in France under a binding international agreement. Owing to the significant cost and concerns over project management, continued U.S. participation in the ITER project has been a matter of discussion for several years. Based on significant improvements in project management, the Secretary of Energy recommended to Congress in May 2016 that the U.S. should remain in ITER.

Summary

ITER is an international research and development (R&D) facility under construction in France by the U.S. and six other international member states. The seven signatories to the 2007 ITER Agreement are the United States, European Union (EU), China, India, Russia, Japan, and Korea.

ITER remains the best candidate today to demonstrate sustained burning plasma, a necessary step to demonstrating fusion energy power. ITER's design objectives are to produce at least 500 MW of fusion power for pulses lasting at least 400 seconds.

Congress authorized U.S. participation through the Energy Policy Act of 2005, and the internationally binding ITER Agreement was signed by the members 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(s)

Since 2008, the U.S. contribution has risen from a range of $1.45B to $2.2B, to a current range of $4.7B to $6.5B, which includes ~$1B in cost contingency. 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 tokamak building and the vacuum vessel's fabrication. Poor project management at the ITER Organization (IO) and poor IO/Member coordination also contributed to the delays of the Project. Recent management changes implemented at the IO since 2015, including a new Director-General, significantly improved project performance and led to stabilization of the cost and schedule estimates. In a report to Congress in May 2016, the Secretary of Energy recommended that the U.S. remain a Member of ITER. A subsequent report in 2019 by the National Academies of Sciences, Engineering, and Medicine recommended continued support of U.S. involvement in ITER.

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 ITER's technical and organizational complexity, the project construction costs have increased, and the schedule has slipped substantially. In 2016, the ITER project schedule to achieve First Plasma was changed from November 2019 to a date no sooner than December 2025. A reassessment of the schedule due to COVID-19 is expected to result in a further delay to the baseline schedule. The U.S. estimated costs for the overall Project have increased from an initial estimate of $1.45B to $2.2B in 2008, to a current range of $4.7B to $6.5B. The original plan for ITER was to achieve thermonuclear burn by 2016. Presently, the estimated date for achieving thermonuclear burn is the mid to late 2030s.

In March 2015, a new Director-General of the ITER Organization, Dr. Bernard Bigot, was appointed. Since that time, substantial improvements in project management and performance have occurred. As of September 2020, the subproject to achieve the First Plasma milestone in late 2025 is over 70% complete. An analysis of COVID-19 impacts on the schedule are expected to be presented at the ITER Council (the seven member-country governance council overseeing the ITER Organization) meeting in mid-November 2020.

Status

Under Director General Bigot's direction, project management and execution has dramatically improved. The evidence of ITER management improvements includes a better organizational structure and the hiring of qualified people in

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key positions; good performance of the ITER project measured against the updated schedule and the defined milestones; and positive results from independent reviews of the ITER schedule and the overall management (e.g., the biannual Management Assessment review, the most recent of which was completed in 2020).

The U.S. ITER Project comprises in-kind hardware contributions (~80%), plus monetary contributions to support the ITER Organization functions and responsibilities. The U.S. ITER project has continued to meet its deliveries and key schedule milestones for hardware. As of August 2020, the U.S. contributions--including design, manufacturing, and hardware delivery to be installed for First Plasma--is 65% complete, with 38% of First Plasma scope delivered to the ITER site.

The U.S. ITER Project (i.e., the U.S. contribution) achieved Critical Decision-1 (Approve Alternative Selection and Cost Range) in January 2008. The U.S. ITER project achieved a Performance Baseline for First Plasma (Critical Decision-2) and approval for start/continuation of hardware fabrication (Critical Decision-3) in January 2017.

Milestone(s)

- In May 2016, the DOE Secretary submitted a report to Congress with 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, DOE delivered a Status Report to Congress in February 2016 and an update in August 2016.
- DOE tasked The National Academies of Sciences, Engineering, and Medicine to re-evaluate the U. S. continued participation in ITER. The report from the Committee on a Strategic Plan for U.S. Burning Plasma Research, released in January 2019, recommended that the U.S. remain a Member of ITER.
- ITER partners celebrated the start of machine assembly on July 28, 2020. The first major assembly activities for the ITER tokamak involve joining vacuum vessel components with their corresponding toroidal field magnet coils produced by China, Europe, Japan, Korea, Russia, and the United States.

Major Decisions/Events

DOE will continually assess U.S. participation in ITER and provide periodic recommendations to Congress.

Major upcoming decisions and events include the following:

- In November 2020, an ITER Council Meeting will occur. The U.S. Head of Delegation is a DOE senior leader (typically SC-1).
- Future meetings of the ITER Council are scheduled for June and November 2021.
- The December 2025 milestone date for First Plasma is currently being assessed for potential COVID-19 delays.
- The post-First Plasma U.S. contributions to the ITER project have not yet been baselined.

Background

At the November 1985 Geneva Summit, a Reagan-Gorbachev initiative led to the ITER Conceptual Design Activities (CDA). These began in April 1988 and were completed in December 1990. They 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 six-year ITER Engineering Design Activities (EDA) Agreement. The U.S. completed its responsibilities under the EDA in 1998 but did not extend its participation, effectively withdrawing from ITER.

On January 30, 2003, President George W. 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 several critical issues, including the siting of the ITER project in France; the 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 before signing it under the authority provided by the Energy Policy Act (EPAct) of 2005. DOE is the lead U.S. Government agency

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responsible for the delivery of U.S. commitments to ITER construction. These commitments include roughly 80% in-kind hardware components (with associated R&D and other costs), as well as 20% monetary contributions to the ITER Organization to cover shared expenses such as personnel, assembly, commissioning, and agreed-on site infrastructure costs. After research operations commence, the DOE will contribute 13% of the monetary costs of running the ITER research facility, in addition to the 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 Associate Director of the Office of Science for the Fusion Energy Sciences program office has responsibility for managing the U.S. project and provides input to strategic decision-making at higher Department levels.

The U.S. ITER Project Office (USIPO) at Oak Ridge National Laboratory is responsible for the delivery of U.S. components. The pace of deliveries is expected to ramp up significantly over the next three years to move toward the completion of U.S. First Plasma commitments.

Congress, particularly the Senate, had expressed serious concern over the management of the ITER Organization in the past, but is now apparently satisfied with the progress made under the leadership of Director-General Bigot. In FY 2020, Congress appropriated $242 million for ITER (the President's Request was $107M), including $85M to make current and some past cash payments to the ITER Organization. Congress is aware that the elimination of U.S. cash payments in FY 2016 and 2017 and the provision of partial payments in FY 2018 and 2019 has impeded the ITER Organization's ability to execute on design, assembly, and installation of the ITER machine and facility.

DOE/NNSA Role in Nuclear Arms Control Negotiations and Implementation

The Department of Energy's (DOE) National Nuclear Security Administration (NNSA) supports the negotiation and implementation of nuclear arms control agreements.

Summary

The Department of Energy's National Nuclear Security Administration (DOE/NNSA) provides essential policy and technical support to the negotiation and implementation of nuclear arms control agreements. DOE/NNSA participates in the U.S. Government policy development process and in international negotiations for these agreements, ensuring DOE/NNSA interests and equities are represented and communicated. In addition, DOE/NNSA develops and evaluates policy options and technical capabilities to enable current and future monitoring and verification initiatives, and works with other NNSA elements, U.S. Government agencies, and international partners toward this end. This work is led through the Deputy Administrator for Defense Nuclear Nonproliferation and the Office of Nonproliferation and Arms Control (NPAC), working closely with the Office of Defense Programs and the Office of Defense Nuclear Nonproliferation Research and Development.

Issue(s)

The New START Treaty expires on February 5, 2021, but may be extended up to an additional five years if both the United States and Russia agree. The United States has not made a decision regarding extension. Following three rounds of talks with the Russian Federation in Vienna, Austria, during the summer of 2020, the United States proposed a framework for a potential path forward on a follow on agreement to New START, which if agreed to, could facilitate an interim extension of the current agreement. The United States indicated that any extension is conditional upon: (1) serious engagement on a new agreement covering and accounting for all nuclear warheads; (2) China joining the United States and Russia in a future trilateral agreement; and (3) improvements to New START verification requirements regarding the number of inspections, the timing of inspection notifications, and the exchange of telemetric information. While the United States assesses that Russia is complying with the New START Treaty, it possesses large numbers of non-strategic nuclear weapons (NSNW) and is developing new kinds of strategic offensive nuclear weapons systems. Russian NSNW and some of their new kinds of strategic offensive arms are not subject to New START's limits and, therefore, pose an unconstrained threat to U.S. national security.

Status

Russia has publicly stated its interest in extending the New START Treaty but has rejected the most recent U.S. conditions. China has also called on the United States and Russia to extend New START while rejecting any calls to join talks for a trilateral nuclear arms control agreement. President Donald J. Trump has made clear that Russia and China must be brought into any future arms control agreement, and the Special Presidential Envoy for Arms Control, Marshall Billingslea, has been regularly conveying this message during the past six months.

Milestone(s)

The United States has not made a decision regarding New START extension, but has tied a decision to extend the Treaty to progress toward a new arms control agreement that includes accounting for, and potentially limiting, total numbers of all nuclear warheads. If the President decides to extend the current New START agreement, the U.S. process for extension can move quickly as Congressional approval is not required. Russia has indicated that its domestic process will take more time, as the State Duma must agree, though it is generally believed that this would happen quickly if President Vladimir Putin so decided. New START does not include a date by which the sides must reach agreement on extension, so agreement can be reached any time prior to the Treaty's expiration on February 5, 2021.

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Background

DOE/NNSA has a long history of providing critical support to the negotiation and implementation of nuclear arms control agreements and developing and evaluating technical capabilities for arms control verification. DOE/NNSA remains active in the ongoing U.S. interagency arms control policy development process, and has been heavily involved during the past six months in supporting high-level talks between the United States and Russia on a new agreement covering all nuclear warheads.

DOE/NNSA arms control activities and responsibilities include the following:

New START Treaty

DOE/NNSA engages in policy development, negotiation, and implementation support, and compliance analysis for the New START Treaty. This includes representing DOE/NNSA in the U.S. interagency Backstopping Committee process and Verification and Compliance Analysis Working Group (VCAWG) and participating in the Treaty's two annual Bilateral Consultative Commission (BCC) meetings.

Trilateral Arms Control/New START Treaty Follow-on

DOE/NNSA engages in policy development, negotiation support, and development and analysis of monitoring and verification measures, particularly with regard to technical measures that may be deployed at nuclear weapon production facilities to account for total nuclear warhead stockpiles. DOE/NNSA has participated in nearly all meetings with Russia on a new agreement since negotiations led by U.S. Ambassador Marshall Billingslea began in June 2020.

Nuclear Explosive Testing Limitations

DOE/NNSA engages in policy development and technical implementation for the Comprehensive Nuclear-Test-Ban Treaty (CTBT), the Threshold Nuclear Test Ban Treaty (TTBT), and other nuclear explosion testing limitations. This includes representing DOE/NNSA in the U.S. Interagency Verification and Monitoring Task Force (VMTF) and providing technical support to maintain and enhance the effectiveness of the CTBT International Monitoring System (IMS) and CTBT International Data Centre (IDC). It also includes oversight of technical projects that contribute to U.S. and international nuclear explosion monitoring capability.

Open Skies Treaty

DOE/NNSA engages in policy development, implementation, and compliance analysis, and works to ensure DOE/NNSA equities are represented within the U.S. interagency. [Note: On May 22, 2020, the United States submitted notice of its decision to withdraw from the Treaty due to ongoing Russian violations, and effective November 22, 2020, the United States will no longer be a party. In a press statement on May 21, 2020, Secretary of State Pompeo said the United States may reconsider its withdrawal should Russia return to full compliance.]

Future Monitoring and Verification Initiatives

DOE/NNSA engages in development, evaluation, and exercising of technical capabilities to enable current and potential future nuclear warhead monitoring and verification initiatives that balance operational and security considerations across the NNSA Enterprise. This includes oversight of technical projects across the National Laboratories, Plants, and Sites and work with other NNSA and U.S. Government elements as well as international partners.

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Columbia-Class Submarine

Naval Reactors Development of Life-of-Ship Reactor Core.

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 its capabilities to ensure continuous and credible sea-based strategic deterrence.

Issue(s)

Naval Reactors is developing a reactor plant with a life-of-ship core, which will serve in excess of 40 years, and electric drive propulsion for the COLUMBIA-Class. Work to support the COLUMBIA-Class submarine is tightly synchronized between Navy and DOE-funded propulsion plant work.

Status

The FY 2021 DOE budget request will continue supporting oversight of the lead ship propulsion plant components and safety analysis work required to support lead ship reactor testing. Navy began procuring long-lead material for the propulsion plant and manufacturing the life-of-ship reactor core in FY 2019.

Milestone(s)

To meet increased operational availability, stealth, and energy requirements for the COLUMBIA-Class submarine, ship construction starts in 2020.

Milestone	Date
Delivery of lead ship to the Navy	FY 2028
Strategic patrol of lead ship	FY 2031

Major Decisions/Events:

The President's FY 2021 DOE and Navy Budget requests fully support the project's requirements. Maintaining support is critical to meeting the schedule and supporting USSTRATCOM requirements.

Background

The current OHIO-Class fleet has already been extended from a service life of 30 years to its current life of 42 years. The OHIO-Class's service life cannot be extended further and will begin to retire in 2028 at a rate of one per year.

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Emergency Operations and Continuity of Operations

The Department of Energy's (DOE) National Nuclear Security Administration (NNSA) maintains a wide range of capabilities in the core areas of crisis operations, continuity programs, and emergency management.

Summary

The Office of Emergency Operations (NA-40) 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. The Office is currently focusing on one key mission area that will require transitional leadership attention and awareness.

Issue(s)

DOE has one (1) critically important ongoing emergency management mission focus:

Coronavirus (COVID-19)

NNSA's Office of Emergency Operations coordinated tracking and updates across the DOE/NNSA complex. NNSA's mission work has continued through the pandemic with minimal disruption. From nuclear weapons activities; to arms control and nonproliferation; to maintaining its support for naval nuclear propulsion, NNSA met critical timelines for program and major project deliverables while adhering to COVID health and safety requirements. NNSA is now conducting a detailed study of lessons learned during the pandemic for maximizing infrastructure and operational efficiency and effectiveness during future disruptive events.

Status

The Office of Emergency Operations continues to safeguard the health and safety of workers and the public; protect the environment; and enhance the security and resilience of the Department and the Nation by applying a whole-of-community approach to mitigate, prevent, prepare for, respond to, and recover from all-hazards emergencies.

Threat Assessment

Using a variety of open source and restricted distribution sources of information, emergency management specialists within NA-40 serve as subject matter experts at Biological Event Monitoring Team (BEMT) and Threat Working Group meetings. NA-40 provides critical analysis and data information into briefing up to 200 leaders and their staff for use in decision making related to the current COVID-19 emergency and the Department's and NNSA's response to the pandemic. In cooperation with public health and occupational medicine epidemiology experts, a weekly pandemic threat assessment is provided to the Threat Working Group and addresses risk from the virus to the DOE/NNSA complex. The focal point for threat assessment is the analysis and recommendation to senior leadership of emerging items of concern that may impact DOE/NNSA safe return to work in accordance with current policies, guidelines, and procedures. The NA-40 representative developed the National Capital Region (NCR) COVID-19 Phase Line Recovery Report to provide senior leadership with situational awareness regarding the attainment of return-to-work gating criteria. In total, NA-40 threat assessment products provide pandemic threat briefings for the 250+ members of the DOE Threat Working Group and DOE Threat Working Group Senior Executive Steering Committee. Additional topics include a weekly update on the effectiveness of vaccine development and of medical countermeasures, followed by a question and answer session to further address topics of specific interest or concern.

Safe Return to Work Analysis

NA-40 has continued developing and delivering the Weekly Reopening Reporting Criteria Stoplight Chart to DOE Leadership every Monday. The Stoplight Chart is based on the gating criteria outlined in the President's Opening Up America Again Guidelines, which provides a status assessment on COVID-19

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symptoms, cases, hospitalizations, state directives, mass transit, and dependent care for DOE and NNSA Headquarters and select Labs, Plants, and Sites. The purpose of the Stoplight Chart is to help inform and support DOE and NNSA leadership in determining each site's phase transition decisions. To do so, the Stoplight Chart is presented to DOE and NNSA leadership every Tuesday at the Emergency and Incident Management Council (EIMC) meeting.

Lessons Learned

NA-40 leads the NNSA Recovery Team Working Group, which includes membership from NNSA HQ Offices and Field Element representation. The Working Group was formed to develop and implement the NNSA Phased Recovery and Re-Entry Plan and serve as a forum to raise awareness on common issues of concern related to the process at HQ and in the field at DOE/NNSA labs, plants, and sites. The Plan was developed by the Working Group and received final approval and signature by the NNSA Administrator on June 2, 2020. Once the Plan was signed and implemented throughout the Enterprise, the Working Group focused its efforts on sharing COVID-19 lessons learned from NNSA HQ and Field Offices and addressing medical, human resources, management and administration, and legal issues in light of the COVID-19 operational environment. The Working Group continues to meet every Friday to share COVID-19 Lessons Learned with NNSA HQ offices and field elements.

NA-40 is also working in close partnership with NA-50 to support the NA-2 directed COVID-19 Lessons Learned for Enduring Organizational Improvement initiative. Currently, NA-40 is developing a draft project plan for this initiative, which is scheduled to begin in October 2020. The purpose of this initiative is to systematically evaluate our pandemic lessons learned as an Enterprise—to include those identified by the Office of Enterprise Assessments and the Energy Facility Contractor's Group—and determine which lessons NNSA should apply during normal working conditions beyond the COVID-19 environment to enhance the efficiency, resiliency, and continuous improvement of the NNSA for the long term. As part of this initiative, four teams will be formed to evaluate the cross-cutting impacts to the NNSA mission, people, infrastructure, and governance and management framework. The top three lessons learned will be determined by each of the four teams for their respective areas and submitted for approval for incorporation into NNSA's Annual Report to Congress in Spring 2021.

Senior Leadership Briefing (SLB)

NA-40 has taken the lead in generating and maintaining a very forward-leaning briefing document submitted to a large group of stakeholders to provide a high-level overview of DOE/NNSA actions, activities, and requirements in response to a situation or event requiring the engagement of the Emergency Response Organizations. Broken down into seven (7) Lines of Effort (LOE) that represent priority critical government and business functions (Safety and Security; Health and Medical; Energy; Communications; Transportation; HAZMAT; and Food/Water/Shelter) that are based upon the National Response Framework, the LOEs provide Senior Leadership with bottom line up front information needed to inform critical decisions in a format recognized across the interagency. Scalable and flexible, the SLB is tailored to each event to provide the Senior Leader information reflective of the requirements of the response and is currently being distributed each weekday in response to the current COVID-19 situation.

Milestone(s)

To ensure DOE/NNSA are best prepared to continue essential functions during the present COVID-19 pandemic, NNSA's Office of Emergency Operations will continue to complete the following critical tasks.

Milestone	Due Date
Develop and deliver the Weekly Reopening Reporting Criteria Stoplight Chart to DOE Office of Science	Every Monday
Conduct of Weekly NNSA Recovery Team Working Group meetings	Every Friday
DOE Headquarters COVID-19 status change from Phase 2 to Phase 3	TBD

Major Decisions and Events

Provide Introductory Leadership Briefings

As part of the transition process, briefings for the new DOE and NNSA leadership teams will be

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required to outline the Secretary's responsibilities in the event of a nuclear incident or major disaster impacting the nation's energy infrastructure.

Continue to Strengthen Emergency Management Processes and Procedures

NA-40 is addressing recent findings from the COVID-19 Lessons Learned, which recommend refinement of emergency management processes and procedures. DOE Order 151.1D, *Comprehensive Emergency Management System,* was revised on 11 August 2016 to standardize and enforce DOE's management and administration of the Emergency Management System complex wide. DOE Order 150.1X, *Continuity Programs,* is currently in the revision process. NA-40 is developing Emergency Relocation Group (ERG) and Devolution Emergency Response Group (DERG) training, scheduled for December 9, 2020. This training provides further opportunity to strengthen continuity preparedness through training of COVID-19 lessons learned and status of phased recovery for the Department's Continuity personnel.

Modernize the Consolidated Emergency Operations Center (CEOC). In line with the NNSA Strategic Vision (Mission Priority #5; Modernize the national security infrastructure), NNSA's NA-40 team aims to modify and update the 24/7/365 existing watch office space to create an improved operational capability that can assist in meeting our national security missions today and into the future. A sequenced infrastructure improvement process has been identified that will start in 2021 that will allow for upgrades to physical space and technological solutions in classified and watch operations spaces without loss of function in the process.

National Nuclear Security Administration NEPA

The Department of Energy's (DOE) National Nuclear Security Administration (NNSA) National Environmental Policy Act (NEPA) compliance is critical for NNSA activities, including Plutonium Pit Production.

Summary

NNSA must complete appropriate National Environmental Policy Act (NEPA) reviews and comply with NEPA requirements for all operational activities. Major activities such as procurements and construction cannot begin until NEPA reviews are complete. The NNSA Office of the General Counsel (NNSA GC) is responsible for ensuring that all programmatic and site-specific NEPA reviews are conducted in full compliance with the law. In addition, NNSA GC assists the Department of Justice when a party challenges NNSA's NEPA compliance in federal court. Consistent with the new regulations promulgated by the Council on Environmental Quality (CEQ), all new NEPA activities initiated after September of 2020 comply with the new CEQ regulations. NEPA actions which were initiated prior to the new regulations' effective date are being completed consistent with regulations in place at the time the action began.

Issue(s)

The timing and procedural accuracy of NNSA's NEPA actions is critical for continued timely NNSA operational activities. In particular, NEPA compliance will be vital in ensuring NNSA meets the statutory requirement to produce at least 80 pits a year by 2030 with at least 30 of these pits produced at the Los Alamos National Laboratory (LANL). NNSA plans to produce the remainder of the pits using the facility originally intended for the Mixed Oxide Fuel (MOX) Fabrication Facility Project at the Savanah River Site. Local and regional groups and politicians are particularly interested in the Pit Production NEPA process and environmental groups have promised litigation, which could delay implementation of the Plutonium Pit Strategy at both LANL and the Savannah River Site in South Carolina (SRS).

Status

NNSA's NEPA analyses at most sites is proceeding normally. NNSA's NEPA strategy for plutonium pit production is being executed on schedule, but environmental groups have promised litigation.

Milestone(s)

Completed

December 2019: Final Supplement Analysis (SA) of the Complex Transformation Supplemental Programmatic Environmental Impact Statement (CT SPEIS).

August 2020: Final SA for the Site-Wide Environmental Impact Statement (EIS) for Continued Operation of LANL.

September 2020: Amended Record of Decision (AROD) for the CT SPEIS for LANL pit production activities.

September 2020: AROD for the Site-Wide EIS for the Continued Operation of LANL.

September 25, 2020: Final EIS for Plutonium Pit Production at the SRS.

Anticipated

Expected no earlier than October 25, 2020: AROD for the CT SPEIS for SRS pit production activities as the second selected site.

Expected no earlier than October 25, 2020: ROD for the Plutonium Pit Production at SRS EIS.

Background

Plutonium pits are critical components of every nuclear weapon, with nearly all current stockpile pits having been produced from 1978–1989. Today, the United States' capability to produce plutonium pits is limited. To produce pits with enhanced

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safety features to meet NNSA and Department of Defense (DoD) requirements, mitigate against the risk of plutonium aging, and respond to changes in deterrent requirements driven by growing threats from peer competitors, the DoD requires NNSA to produce no fewer than 80 plutonium pits per year by 2030, and to sustain the capacity for future programs. This mission-need to produce 80 pits per year by 2030 is codified in statute. To achieve the nation's pit production requirement, NNSA proposed to repurpose a facility at SRS to produce plutonium pits while also maximizing pit production activities at LANL as the best way to manage the cost, schedule, and risk of such a vital undertaking.

In June 2019, NNSA publicly announced its approach to NEPA compliance for the expanded pit production mission. The plan was to first conduct a programmatic review to assist in decisions as to how to execute the pit mission and thereafter to conduct site-specific reviews. NNSA has completed almost all NEPA milestones for pit production, at this time only awaiting an AROD for Complex Transformation and a ROD associated with the Environmental Impact Statement for the Savannah River Site. Upon the completion of NEPA documentation process, environmental groups have promised to bring litigation against the Department, which would allege inadequate NEPA review. Neither project work nor litigation can be started until publication of the respective RODs and ARODs. Typically, construction work subject to the NEPA process is halted pending the outcome of any litigation and a judge may issue an injunction prohibiting execution of the work subject to the NEPA. However, in certain circumstances NNSA may proceed with construction during the litigation, but may have to take corrective actions depending on the outcome. NNSA is prepared to assist the Department of Justice in defending NNSA's NEPA compliance.

NNSA's NEPA strategy is to build upon and update previous analysis of the environmental effects of pit production. NNSA has previously evaluated the environmental effects of pit production levels far higher than the ones contemplated by the current program. The fact that pit production has been considered on a larger scale in the past does not excuse NNSA of doing the necessary NEPA analysis of this level of pit production going forward. It does, however, allow NNSA to build upon previous analysis rather than starting from scratch and complete the necessary analysis in a timely and efficient manner.

Previously, NNSA prepared the Complex Transformation Supplemental Programmatic EIS to analyze the potential environmental impacts associated with pit production at different site alternatives: LANL in Los Alamos, New Mexico; SRS near Aiken, South Carolina; Pantex Plant near Amarillo, Texas; Y–12 National Security Complex in Oak Ridge, Tennessee; and the Nevada National Security Site north of Las Vegas, Nevada. At SRS, the Complex Transformation Supplemental Programmatic EIS also evaluated a pit production facility that would use the MOX facility and pit disassembly and conversion facility infrastructure. Additionally, pit production at LANL has been analyzed in several NEPA documents over the past two decades. RODs have authorized pit production levels of no more than approximately 20 pits per year at LANL. However, higher levels of pit production have been analyzed in: The Complex Transformation Supplemental Programmatic EIS, which analyzed pit production levels as high as 125 pits per year for the 5 sites listed above; and in the 2008 LANL Sitewide EIS, which analyzed up to 80 pits per year at LANL in the Expanded Operations Alternative.

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DOE/NNSA Nuclear Emergency Support Team

The Department of Energy (DOE)/National Nuclear Security Administration (NNSA) is responsible for preparing for and responding to nuclear incidents and accidents domestically and overseas. These response missions include both national security and public health and safety disciplines.

Summary

The Nuclear Emergency Support Team (NEST) encompasses DOE/NNSA nuclear and radiological emergency response functions, including all NEST field-deployed and remote technical support elements. Managed by NNSA's Office of Nuclear Counterterrorism and Counterproliferation (CTCP, NA-80), NEST is responsible for executing the Department's Primary Mission Essential Function (PMEF) #2, Respond to Nuclear Incidents, which involves "providing operational support and decision-making in protecting against and responding to a nuclear incident, both domestically and internationally." NEST's critical incident response missions include countering weapons of mass destruction (WMD) threats; responding to accidents and incidents involving U.S. nuclear weapons; and conducting operations to protect public health and safety. NEST is comprised of experts from the CTCP offices and national laboratories, plants, and sites who execute or support the incident response missions for which the Department is responsible.

NEST's missions derive from a body of legal statutes, presidential policies, and international agreements, which prescribe the Department's specific roles in responding to various contingencies. In particular, in the event of an incident involving a nuclear threat device, including an improvised nuclear device or a nuclear weapon out of state control, presidential policy requires the Secretary of Energy to perform a critical coordination role with the Attorney General (for domestic incidents) or the Secretary of Defense (for overseas incidents) to inform the President and provide assessments of potential courses of action.

NEST Assets

Although NEST has existed in various incarnations for over four decades, individual NEST assets have been operational for more than 60 years. The following NEST elements execute the full range of the Department's countering WMD, nuclear weapon accident response, and public health and safety missions.

Joint Technical Operations Team (JTOT)

JTOT provides technical and scientific expertise along with operational support personnel in the field and at Home Team locations to support Federal Bureau of Investigation (FBI) and Department of Defense (DoD) operations to identify, characterize, and defeat WMD threat devices.

Stabilization Program (STAB)

The STAB program provides specialized training and equipment to regional FBI counter-WMD teams in over a dozen major U.S. cities, enabling rapid assessment of nuclear threat devices and identification of courses of action to defeat such devices through technical reachback during NEST operations.

Accident Response Group (ARG)

ARG scientists, technical specialists, and crisis managers rapidly deploy to the scene of an accident or incident involving a U.S. nuclear weapon or components and to assist in the resolution of the accident.

Radiological Assistance Program (RAP)

Divided into eight regions centered on DOE/NNSA laboratories and covering the entire United States, RAP personnel provide rapid response and technical advice during incidents involving radioactive materials that pose a threat to public health and safety or the environment.

Aerial Measuring System (AMS)

NNSA maintains a fleet of three fixed-wing aircraft and two rotary-wing aircraft based at Nellis Air Force

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Base in Nevada and Joint Base Andrews in Maryland. AMS aircraft are equipped with radiation detection systems to provide measurements of air and ground contamination following a nuclear incident. AMS also perform Preventative Radiological/Nuclear Detection in support of major public events such as the Super Bowl.

Radiation Emergency Assistance Center/Training Site (REAC/TS)

REAC/TS scientists provide medical advice, specialized training, and onsite assistance for the treatment of all types of radiation exposure accidents.

National Atmospheric Release Advisory Center (NARAC)

NARAC provides near-real-time modeling predictions of the atmospheric transport of material from a radioactive release, including the associated effects on human health and the environment.

Federal Radiological Monitoring and Assessment Center (FRMAC)

FRMAC a scalable, deployable federal interagency organization, initially managed by NEST, that provides verified radiation measurements, interprets radiation distributions, and characterizes overall radiological conditions during major radiological or nuclear consequence management events.

Nuclear Search Program (NSP)

NSP is the nation's rapidly deployable scientific and technical team for Targeted Search Operations. NSP personnel are trained and equipped to detect, locate, identify, and quantify radiological or nuclear material and assess the risk for decision makers for safe and effective recovery and follow on actions.

Disposition & Forensic Evidence Analysis Team (DFEAT)

DFEAT scientists and operational personnel support FBI operations to disassemble nuclear/radiological threat devices, conduct forensic analysis, perform device assessments, and disposition such devices.

DOE Forensics Operations (DFO)

DFO scientists and operational personnel support FBI and DoD operations to collect nuclear debris for forensic evaluation following a nuclear detonation.

Capability Requirements

The operational scenarios below describe how NEST is postured and resourced to fulfill national incident response requirements. These capabilities are sustained as part of broader national response capabilities with key mission partners, including DoD, FBI, the Department of Homeland Security (DHS), and state, local, and/or tribal officials.

During steady-state (non-crisis) operations, CTCP can make available NEST experts—both federal personnel and management and operating contractors—to federal, state, local, and/or tribal entities; foreign partners; and international organizations (e.g., International Atomic Energy Agency) in furtherance of national security and public health and safety objectives.

During the early stages of a nuclear threat or incident, NA-80 may deploy NEST assets in a tailored manner to key mission partners and DoD Combatant Commands. NEST personnel would support contingency planning and potential or actual response operations while leveraging the Department's cadre of overseas officers at U.S. embassies and liaison officers at DoD Combatant Commands. NEST may also activate remote technical assistance capabilities depending on the severity of the incident.

During an operation to counter a confirmed or suspected nuclear/radiological device, an accident involving a U.S. nuclear weapon, or the discovery of material out of regulatory control requiring emergency removal, NEST will stand up Home Team capabilities to provide remote technical assistance to partners on a timeline consistent with their operational capabilities and requirements (i.e., NEST will be ready to receive and assess data as soon as it is available). NEST will have the capacity to deploy personnel to support a single full-spectrum operation, to include disposition and forensic exploitation at fixed DOE facilities in support of event attribution, while maintaining coverages as directed in national policies.

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Following a release of radioactive materials (e.g., nuclear detonation, deliberate radiological dispersal, reactor accident, or other incident involving a radiological release), NEST will provide timely, credible technical support to public health and safety officials on a timeline consistent with the availability of data from federal, state, local, tribal, and/or international partners. NEST will provide technical assessments and guidance; gather and organize radiological data; collect samples for forensics analysis; and provide other scientific support as needed. In the case of a nuclear detonation, NEST will perform post-detonation functions to exploit collected data in support of attribution. Prior to the cessation of operations, NEST will transition incident management and/or stewardship of the impacted area to appropriate authorities.

Status

NA-80 continues to evaluate and adjust NEST's operational posture as the nationwide impacts of the COVID-19 pandemic continue. Although the health of the NEST workforce continues to be a high priority, we remain mindful of the responsibility to perform critical national security and public health and safety missions, including its continued ability to execute incident response capabilities as described in PMEF #2.

Major Decisions/Events

Provide Nuclear Incident Response Briefings to Senior Departmental Leaders

As part of the transition process, briefings for the new DOE and NNSA leadership teams will be required to outline the Secretary's responsibilities according to presidential policy in the event of a nuclear or radiological incident.

Provide Nuclear Threat Briefings to Senior Departmental, Interagency, and White House Leaders

As the office responsible for administering the SIGMA 20 caveat, CTCP provides nuclear threat briefings to the senior leaders of DOE and NNSA, select interagency partners (e.g. the Department of State, DHS, and DoD), the National Security Council, and the White House, including the President and Vice President.

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Production Modernization

The Department of Energy's (DOE) National Nuclear Security Administration (NNSA) has undertaken a major modernization of the Nuclear Security Enterprise's production infrastructure.

Issue(s)

The National Nuclear Security Administration (NNSA) cannot accomplish its mission to sustain the nuclear deterrent without reliable infrastructure that provides necessary capabilities for today and allows for the opportunity to expand future capacities. Modernization investments cannot be deferred as the NNSA is committed to fulfilling current requirements for stockpile stewardship. The Production Modernization program focuses on the NNSA's ability to produce critical components for nuclear weapons, including primaries, canned subassemblies (multiple components and materials), radiation cases, and non-nuclear components. Production Modernization is broken into four component subprogram areas: (1) Primary Capability Modernization; (2) Secondary Capability Modernization; (3) Tritium Modernization and Domestic Uranium Enrichment; and (4) Non-Nuclear Capability Modernization.

The program supports production modernization and qualification of explosive, pyrotechnic, and propellant materials; modernization of uranium operations, ensuring delivery of secondary components needed to maintain the stockpile; restarts and modernizes lapsed depleted uranium (DU) alloying and component manufacturing capabilities; maintains production of the Nation's enriched lithium supply; operates the national capability for producing tritium, and is building additional capacity to meet national security requirements; and provides funding to modernize production of non-nuclear components for multiple weapon systems.

Status

A key priority for production modernization activities is developing the capability to produce 80 pits per year (ppy) during 2030, consistent with federal law, national policy, and DoD requirements. Pits will be produced at two locations: Los Alamos National Laboratory (LANL) and the Savannah River Site (SRS). The FY 2021 Request supports pit production personnel and capabilities necessary to produce War Reserve pits starting in 2025 at LANL; production activities at Kansas City National Security Campus (KCNSC); certification activities at Lawrence Livermore National Laboratory (LLNL); and design, long lead material procurements, and planning for demolition and equipment removal at SRS. Production Modernization investments also support other key production capability modernization activities for strategic materials and non-nuclear components. These efforts are all critically linked to investments in repairing, replacing, and modernizing NNSA's facilities and stabilizing deferred maintenance to ensure the safety and reliability of the specialized infrastructure and equipment needed to provide capabilities that support the Nation's nuclear deterrent.

Milestone(s)

Over the next six years, Production Modernization plans to reach the following milestones:

- Build and certify plutonium pits to meet the First Production Unit (FPU) War Reserve pit and continue to sustain pit production to achieve 10 ppy then 30 ppy.
- Transition casting, salvage and accountability, and other operations to the newly constructed Uranium Processing Facility (UPF) at Y-12.
- Obtain CD-2/3 approval for the Energetics Material Characterization (EMC) capability.
- Coordinate with Holston Army Ammunition Plant on producing the first war reserve production lot of PBX-9502 for the W80-4 using newly synthesized TATB. This war reserve (WR) PBX-9502 culminates a multi-year effort with Holston Army Ammunition Plant to reconstitute the production of Insensitive High Explosives (IHE) for main charge production.

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- Initiate start up activities at High Explosive Synthesis, Formulation, and Production Facility (HESFP) for LX-17 production in support of the W87-1.
- Obtain WR production of W87-1 booster and main charge materials.
- Complete installation of DUF6 to DUF4 conversion line and begin production.
- Re-start conversion of DUF4 to metal capability at commercial vendor.
- Achieve CD-1 in FY 2024 for re-establishing a domestic uranium enrichment capability.

Major Decisions and Events

- Successfully produced five development (DEV) pits in FY 2019 and produced 3 process prove-in (PPI) pits in FY 2020.
- Install equipment to produce the first WR pit during 2023 in PF-4.
- Achieved CD-0 approval in FY 2020 for the Energetic Materials Capability Facility, with continued support for Analysis of Alternatives activities.
- Completed Lithium Processing Facility CD-1 package and transitioned to preliminary design activities.
- Established Non-Nuclear Capability Modernization as a new program for FY 2021.

Background

The Department of Energy (DOE)/NNSA is focused on manufacturing nuclear weapons components of strategic interest that need to be replaced. These key components—including primaries, secondaries, and radiation cases—are critical to weapon performance, and their manufacture is tightly controlled. Production of these components and the materials needed to construct them was reduced or stopped during the 1990s when they were no longer required. Conducting LEPs and a greater emphasis on a responsive manufacturing infrastructure now require restoring or increasing the capacity of these material and component capabilities, necessitating new methods and approaches to provide sufficient throughput and efficiency. These strategic components require the availability of materials and subcomponent streams that are managed by DOE/NNSA and need to be tightly coordinated with component production.

The Primary Capability Modernization program consolidates management of nuclear material processing capabilities in the National Nuclear Security Administration's (NNSA) Nuclear Security Enterprise (NSE). The program includes Plutonium Modernization as well as High Explosives and Energetics Modernization. Current priorities include producing the first war reserve plutonium pit during 2023, 30 pits per year (ppy) during 2026, and restoring national capability to produce 80 plutonium pits per year (ppy) during 2030. The High Explosives and Energetics Modernization program manages investments to modernize the HE and energetic manufacturing process that has atrophied over the history of nuclear weapons production.

The Secondary Capability Modernization program is responsible for ensuring the availability of strategic materials and other sub-component streams necessary for the secondary stage, as well as modernizing the facilities and operations required to process these materials, fabricate them into parts, and assemble the final components. The program includes (1) Uranium Modernization; (2) Depleted Uranium Modernization; and (3) Lithium Modernization. Parts of the uranium operations infrastructure no longer meet modern nuclear safety and security standards. The Secondary Capability Modernization program focus specifically on decreasing mission dependency on these legacy sites and transitioning these capabilities to modern, secure, and safe facilities. Transitioning to modern facilities shortens production schedules; reduces risk and cost; and improves manufacturing processes for nuclear weapons materials. The Secondary Capability Modernization program also restarts the depleted uranium (DU) capabilities that lapsed in the early 2000s due to low demand signals and de-prioritization. The program is investing in key new technologies to modernize production of DU and ensure that the capability can remain cost-effective and efficient when meeting future demands. Lithium Modernization program supports technology maturation and process improvements that make lithium processing more efficient, safer to workers, and less impactful to surrounding infrastructure. The current lithium operations facility and its processes are oversized for today's mission, do not meet current codes/standards, and is well beyond its designed operational life. The program ensures the current lithium processing capability is sustained until the Lithium Processing Facility (LPF) becomes operational in the 2030s, and is developing the plan to bridge operations from the current facility to LPF.

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The Tritium Modernization and Domestic Uranium Enrichment (DUE) program produces, recovers, and recycles tritium to support national security requirements, and is responsible for establishing a reliable supply of enriched uranium to support U.S. national security and nonproliferation needs. Tritium is recovered from gas transfer systems, purified, and returned to the pipeline for future use at the Savannah River Site. The DUE program preserves and advances uranium enrichment technology to meet U.S. national security needs by down-blending highly-enriched uranium declared excess to national security needs to provide low enriched uranium (LEU) for tritium production. LEU inventories identified by the DUE program will sustain tritium production through 2041, at which point the U.S. will require a new domestic uranium enrichment capability to meet tritium production and other national security needs.

The Non-Nuclear Capability Modernization program manages strategic investments to modernize capabilities for design, qualification, and production of non-nuclear components for multiple weapon systems of non-nuclear parts. Non-nuclear components and subsystems make up more than half the cost of each life extension program. The program focuses on improving and/or increasing the capability and capacity of the NSE to manufacture nuclear weapons components such as neutron generators, electronic assemblies, gas transfer systems, and power sources. The Non-Nuclear Capability Modernization program supports efforts to identify and rectify supply issues such as obsolescence, discontinuation, or scarceness that affect component availability over time.

Recapitalization of the Nuclear Security Enterprise Infrastructure

Without predictable, stable, and timely funding from Congress, the age and condition of NNSA's infrastructure will put NNSA's mission, the safety of its workers, the public, and the environment at risk.

Summary

An effective, responsive, and resilient nuclear security infrastructure is essential to the U.S. capacity to be flexible enough to adapt to shifting requirements. Such an infrastructure offers tangible evidence to both allies and potential adversaries of U.S. nuclear weapons and nonproliferation capabilities and can help to deter, assure, and hedge against adverse developments, and discourage adversary interest in arms competition.

NNSA's infrastructure is vast, extensive, complex, and, in many critical areas, several decades old. Sixty percent of NNSA's facilities are beyond their life expectancy of 40 years and nearly forty percent are in poor condition. Many of the nuclear security enterprise's (NSE) critical production, utility, safety, and support systems are failing.

NNSA manages its own industrial base within its NSE and does not rely solely upon the commercial industry's infrastructure. This includes national laboratories, plants, and sites with many unique single point of failure production and test facilities that perform the research, development, production, testing, and dismantlement necessary to maintain and certify a safe, secure, reliable, and effective nuclear stockpile. This same infrastructure supports our nonproliferation and counter-terrorism mission (e.g., the same facilities that provide enriched uranium are also used to down-blend uranium).

Issue(s)

Infrastructure risks are generally considered to be high consequence, low probability events, making infrastructure investments a natural offset for short-term requirements. As a result, competing interests over the past thirty years postponed infrastructure modernization investments, which directly contributed to erosion of the critical infrastructure needed to ensure the U.S. nuclear deterrent's viability into the future. The need to recapitalize elements of our infrastructure has reached a tipping point. Without consistent, stable, and predictable funding from Congress, the age and condition of NNSA's infrastructure puts NNSA's mission, the safety of its workers, the public, and the environment at greater risk.

Status

With support from the Administration and Congress, NNSA is undertaking a risk-informed infrastructure recapitalization effort. NNSA is making progress in repairing, replacing, and modernizing NNSA's facilities and stabilizing deferred maintenance, yet much more remains to be done.

NNSA is working to better understand and quantify the condition of our infrastructure by introducing new tools and processes to quantify and prioritize our infrastructure needs. Some notable achievements in FY 2020 include:

- Completed 4 projects with a total project cost of $174 million, under budget by $38 million and ahead of schedule by an average of 6 months.
- Began Construction on 2 projects with a combined Total Project Cost of $219 million.
- Began Conceptual Design on 2 projects worth $600 million and preliminary/final design on 3 projects worth $2.9 billion.
- Performed $400 million of design work and $1 billion worth of construction.

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Milestone(s)

Infrastructure modernization is one of the five major mission priorities for NNSA, as listed in our Strategic Integrated Roadmap. Major milestones include, but are not limited to:

- 2022 - Complete NNSA Albuquerque Complex
- 2022 - Modernize the Enterprise Secure Network and Cyber Infrastructure
- 2025 - Complete the Uranium Processing Facility
- 2025 - Complete high explosive facilities
- 2025 - Reduce deferred maintenance (DM) by 30 percent
- 2028 - Complete Chemistry & Metallurgy Research Replacement Project
- 2031 - Complete Lithium Processing Facility
- 2031 - Complete Tritium Finishing Facility
- 2035 - Complete execution of the Security Infrastructure Revitalization Program

Major Decisions/Events

The President's FY 2021 budget supports the NNSA's efforts to replace aging infrastructure with modern and efficient facilities. NNSA remains committed to achieving its major construction projects on schedule and on budget using best value acquisitions and ensuring safe quality construction.

Implementation of project management best practices, including the conduct of independent cost estimates, completing 90 percent design before establishing baselines, and properly aligning contractor incentives, will help ensure that the FY 2021 Request for these projects will be work executed on budget and schedule.

The Security Infrastructure Revitalization Program (SIRP) receives continued investment in FY 2021 to address physical security system upgrades at each NNSA lab, plant, and site.

Background

NNSA modernizes infrastructure by prioritizing investments to improve the condition and extend the life of structures, capabilities, and systems resulting in improvements in the safety, security, and quality of the workplace.

To accomplish this complex challenge, NNSA makes strategic, prioritized investments in 1) Maintenance and Repair of Facilities; 2) Recapitalization; and 3) Line-Item Construction. These investments help achieve operational efficiencies and reduce safety, security, environmental, and program risk. NNSA uses prioritized enterprise risk management criteria to maximize return on investment, achieve program results, and reduce enterprise risk.

NNSA is simultaneously re-capitalizing our production capability in plutonium, uranium, lithium, tritium, and high explosives, as well as our ability for uranium enrichment and plutonium disposal. These simultaneous efforts will be a focus for NNSA for the next two to three decades. Additionally, NNSA is working to modernize aging and deteriorating mission-enabling infrastructure, such as light laboratories, utilities, manufacturing shops, emergency operations centers, and office buildings. To this end, NNSA is currently managing 30 Line-Item Construction projects worth $22 billion.

Among our top security priorities, NNSA is focused on recapitalizing the NSE's security infrastructure. This includes replacing and refreshing aging physical and cyber security infrastructure. NNSA initiated a security revitalization program several years ago to refresh its security infrastructure with a consistent budgetary approach to avoid large budget spikes. Mission growth is also driving increased security requirements across the NSE. Examples of these security investments include (1) new security systems and additional security portals to support more mission work, and (2) new perimeter intrusion detection and assessment systems (PIDAS). The West End Protected Area Reduction Project reduces the Perimeter Intrusion Detection and Assessment System footprint by almost half while integrating with the new Uranium Processing Facility at the Y-12 National Security Complex.

Between FY 2015 and FY 2020, NNSA requested a higher percentage of funding for Recapitalization and Maintenance projects. These funding increases are essential to arresting the declining state of infrastructure, increasing productivity, improving safety, eliminating costly compensatory measures, decreasing DM, and shrinking the NNSA footprint through the disposition of unneeded facilities.

During this period, in FY 2018, Congress directed NNSA to establish the Infrastructure Modernization

Initiative to reduce DM by 30 percent by 2025. At the end of FY 2019, NNSA's total DM on fixed assets (real property) stood at $4.8 billion. Excessive DM is an indication of the risks posed by infrastructure, but it is a financial surrogate that does not adequately measure condition, functionality, importance, or replaceability of infrastructure.

Therefore, NNSA is working to address DM, but our primary focus is on reducing the risk aging infrastructure poses to our workers, the environment, and the mission. Accordingly, we are deploying a new, science-based infrastructure stewardship approach that focuses on data-driven, risk-informed decision-making using innovative infrastructure tools and metrics to better assess conditions and prioritize investments.

Annual Assessment of the Nuclear Weapons Stockpile

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

Issue(s)

The annual assessment process provides assurance to the President of the United States and Congress that the U.S. nuclear weapons stockpile is safe, secure, reliable, and militarily effective. Each year, the Department of Energy (DOE) and the Department of Defense (DOD) undertake a comprehensive evaluation to assess each warhead's existing certification basis in light of new information generated by the Stockpile Stewardship Program. This process provides the ability to maintain a credible nuclear deterrent and is used to determine whether a nuclear test is required to address any technical issues within the stockpile.

The directors of the national security laboratories (Lawrence Livermore National Laboratory, Los Alamos National Laboratory, and Sandia National Laboratories) and the Commander of the United States Strategic Command (USSTRATCOM) provide an independent, comprehensive written assessment on the state of the nuclear weapons stockpile. They then provide the Secretary of Energy with an in person discussion on their assessments. To complete the cycle, the Nuclear Weapons Council (NWC) prepares a joint memorandum, signed by the Secretaries of Energy and Defense, summarizing the overall assessment of the stockpile. This memorandum, combined with the Laboratory Director Letters and the USSTRATCOM Commander Letter, form the Report on Stockpile Assessments (ROSA). The ROSA is submitted to the President by February 1 of each year, and provides assurance that the nation's nuclear deterrent remains safe, secure, reliable, and militarily effective.

Annual assessment is required by public law, 50 United States Code Section 2525, which requires the Secretary of Energy and the Secretary of Defense to submit an annual assessment to the President by February 1 of each year. The President, in turn, is required to transmit the final package to Congress by March 15 of that same year.

Status

The Deputy Administrator for Defense Programs issued the 2020 (Cycle 25) Annual Assessment Execution Plan to the directors of the national security laboratories on January 14, 2020. This plan provides the necessary requirements and milestones to complete the Annual Assessment Review process and provide the ROSA package to the President by February 1, 2021 and to the Congress by March 15, 2021.

Milestone(s)

Action for Cycle 25 Assessment	Date
Annual Assessment Reports published and distributed	July 27, 2020
Laboratory directors sign Annual Assessment Letters	Sep 30, 2020
USSTRATCOM Commander provides Annual Assessment Letter	Dec 1, 2020
Laboratory directors participate in Annual Assessment Review - brief the following: • Deputy Administrator for Defense Programs • NNSA Administrator • Secretary of Energy	Dec 8, 2020 (tentative)
ROSA submitted to the to the President	Feb 1, 2021
President forwards the ROSA to Congress	Mar 15, 2021
Officials provide briefing to Congress, if ROSA is not forwarded	March 30, 2021

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Major Decisions/Events

The Secretary of Energy will be briefed on the results of Cycle 25 by the three national security laboratory directors and select Department of Defense members on December 8, 2020 (tentative).

Background

The annual assessment process requires subject matter experts from the three NNSA design laboratories to apply broad-spectrum, rigorous analysis techniques to inform their assessment of the current safety, security, and military effectiveness of the U.S. nuclear stockpile. These assessment tools and practices include focused experiments and integrated above ground experiments, computational simulations underpinned by past underground test data and modern experiments, and physical surveillance of randomly selected systems from the stockpile. The data collected by the laboratories are subject to peer review from other laboratories and red teams of nuclear weapons experts. The results of this rigorous process are captured in the laboratory system specific annual assessment reports and summarized in the Directors' annual assessment letters. Recent Director's letters reflect their assessment of the safety, reliability, and performance of the nuclear weapons stockpile, and affirmed that there is currently no technical requirement to perform a nuclear test.

Stockpile Management

The Department of Energy's (DOE) National Nuclear Security Administration (NNSA) directs and oversees all stockpile design, development, and production activities to ensure the United States nuclear weapon stockpile remains safe, secure, and reliable.

Summary

The Office of Defense Programs directs and oversees all stockpile design, development and production activities to ensure the United States nuclear weapon stockpile remains safe, secure, and reliable throughout the Nuclear Security Enterprise. This includes extensive surveillance of the warheads and bombs in the stockpile to identify aging concerns or defects. These surveillance activities allow the NNSA Laboratory Directors to certify that the nuclear stockpile remains safe, secure, and effective without resorting to underground nuclear explosive testing.

Stockpile Major Modernization

Stockpile Major Modernization is the stockpile management subprogram necessary to extend the expected life of stockpile systems for an additional 20 to 30 years. This subprogram develops warheads for new Department of Defense (DoD) delivery platforms, that are both based on current stockpile warheads and consistent with current military capabilities, for which current stockpile warheads cannot be made to work without significant impacts to required military requirements. NNSA, in conjunction with DoD, executes a modernization program following the joint NNSA-DoD Phase 6.X weapons acquisition process guidelines, which provides a framework to conduct and manage refurbishment activities for existing weapons.

Stockpile Sustainment

Stockpile Sustainment directly executes sustainment activities for the total (active and inactive) stockpile for the B61, W76, W78, W80, B83, W87, and W88 weapons. As required by 50 United States Code 2525, safety, security, and effectiveness assessments are carried out annually to determine whether the systems continue to meet their certified requirements without the need for an underground nuclear explosive test. Sustainment activities for each weapon system includes surveillance activities, Weapon Assessment activities, and system maintenance, including production of limited life components (LLCs).

Production Operations

Production Operations activities provide a manufacturing-based program that drives individual site production base capabilities for warhead modernization activities; weapon maintenance; surveillance; weapon assembly and disassembly; and weapon safety and reliability testing. This program enables individual site capability and capacity to sustain the nuclear security enterprise's production mission, and it encompasses the workforce, facilities, and equipment that provide manufacturing and capacity across multiple sites.

Weapons Dismantlement

Weapons Dismantlement and Disposition (WDD) focuses on the safe and secure dismantlement of excess nuclear weapons and components. The WDD program has four major activities:

1. **Disassembly:** WDD enables the dismantlement of weapons and canned subassemblies and is a significant supplier of material for future nuclear weapons production and Naval Reactors.
2. **Component Disposition:** WDD ensures waste streams are identified to allow for the permanent disposition of weapon components.
3. **Retired Systems Management:** WDD enables safety studies that ensure weapons in the stockpile awaiting dismantlement remain safe while in DOD custody.
4. **Component Characterization:** WDD ensures that all potential hazards contained in weapon components are characterized to allow the weapons complex to safely work with individual weapon components.

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Status

Stockpile Major Modernization

NNSA continues to focus on delivering four major modernization programs, having completed the W76-1 LEP in 2019. The W80-4 moved to Phase 6.3 in 2019, as approved by the NWC. The W88 Alt 370 and B61-12 LEP are working towards FPU in Q1 FY22 and Q4 FY21 respectively. Lastly, the W87-1 modification is entering Phase 6.2, Design Definition and Cost Study, in FY21.

Stockpile Sustainment

The Stockpile Sustainment program was renamed from Stockpile Systems. The B83-1 is executing sustainment activities, including surveillance and weapon assessments.

Production Operations

The Production Operations work scope provides the base capabilities to enable weapon operations (assembly, disassembly, and production) planned for the warhead modernization activities, Stockpile Systems, and WDD programs to meet delivery requirements. Model-based enterprise pilot efforts will be funded out of Production Operations through FY 2023.

Weapons Dismantlement

WDD continues to make significant progress on dismantling weapons and component disposition. WDD is on pace to complete a goal of dismantling weapons that were retired at the end of FY 2008. The Department of Energy (DOE)/NNSA has developed return schedules to remove retired weapons from DoD facilities while meeting DoD operational requirements. WDD continues to characterize components coming off the dismantlement line, and sites are eliminating excess component inventories on schedule.

Milestone(s)

Stockpile Major Modernization

The NNSA modified and delivered the W76 sea-launched ballistic missile warhead, providing the US Navy with a lower-yield capability called the W76-2. The 2018 NPR outlined the need for this capability to support credible and capable nuclear deterrence. On August 25, 2020, Pantex completed the First Production Capability Unit (FPCU) for the B61-12, a non-nuclear explosive prototype that allows the program to exercise processes to ensure readiness for rate production. In April 2020, Pantex completed the W88 Alteration (Alt) 370 FPCU.

Stockpile Sustainment

Complete required weapons sustainment activities including Limited-Life Components, Joint Test Assemblies and minor ALTs. (FY21 GTJDL)

Production Operations

Model-based enterprise pilot efforts will be funded out of Production Operations through FY 2023.

Weapons Dismantlement

The FY 2017 NDAA restricted funding for dismantlement activities through FY 2021 to $56 million, and restricted the dismantlement rate to the schedule in the classified FY 2016 Stockpile Stewardship and Management Plan (SSMP). The WDD Program dismantled on the order of 300 warheads in FY 2020 (actual number is classified).

Timeline

Stockpile Major Modernization

B61-12 LEP and W88 Alt 370 expected completion is 2025. W80-4 expected completion is 2031. The W87-1 has an expected First Production Unit of FY2030.

Stockpile Sustainment

The Stockpile Sustainment program was renamed from Stockpile Systems, which was a continuing program. Cycle 26 of the Annual Assessment Process will begin at the end of the year.

Production Operations

Ongoing program.

Weapons Dismantlement

Ongoing program.

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Major Decisions/Events

Stockpile Major Modernization

Phase 1 of the W93 will begin in FY 2021 if authorized and appropriated. The W88 Alt 370 will reach First Production Unit (FPU) in Q4 FY 2021, while the B61-12 LEP will reach FPU in Q1 FY 2022.

Stockpile Sustainment

Cycle 25 of the Annual Assessment process is concluding with delivery of the Laboratory Directors Letters on Annual Assessment. These letters, and an assessment from the Commander of Strategic Command, will form the basis of the Report on Stockpile Assessments, which will be send from the Secretaries of Defense and Energy to the President in the January timeframe.

Weapons Dismantlement

National Defense Authorization Act (NDAA) dismantlement rate limitation is lifted in FY 2021. Attain Known State Authorization for the W84 System to address technical risks.

Background

Stockpile Major Modernization

One of NNSA's core missions is to ensure the United States maintains a safe, secure, and effective nuclear weapons stockpile through the application of unparalleled science, technology, engineering, and manufacturing. NNSA extends the service life of weapons that have reached the end of their original design life through Life Extension Programs (LEPs). Other modernization efforts include Alterations (ALTs), which do not change the weapon's operational capabilities, and Modifications, which do change the weapon's operational capabilities. NNSA also conducts surveillance and assessment to ensure that weapons currently in the stockpile remain safe, secure, and effective. Labs, plants, and sites across the Nuclear Security Enterprise work together on this enduring national security mission.

Stockpile Sustainment

Stockpile sustainment activities are responsible for the day-to-day health of the stockpile. These activities include surveillance, annual assessments, and routine maintenance to ensure weapons remain safe, secure, and reliable over the projected lifecycle. Stockpile sustainment performs single-system and multi-system sustainment activities (i.e., assessment, surveillance, maintenance, and response to emerging issues) for all weapons systems in the stockpile. Stockpile Sustainment includes limited life component (LLC) exchanges, surveillance activities, significant finding investigations (SFI), weapons reliability reporting, and annual assessments that provide a comprehensive understanding of the health of the stockpile.

Production Operations

The scope of Production Operations encompasses sustainment of all weapon systems capabilities that enable individual weapon production and are not specific to one material stream. The program's goal is to maintain the base capability required to sustain a responsive and resilient stockpile through focused management and production process engineering, manufacturing, and production technologies.

Weapons Dismantlement

Weapons Dismantlement and Disposition (WDD) is a critical element of NNSA's integrated effort to transform the enterprise and the stockpile. Specific activities include weapons disassembly, recycling of material and hardware for LEPs, disposition of retired warhead system components, and ensuring components are available for safety testing. Other supporting activities specific to retired warheads include conducting hazard assessments; issuing safety analysis reports; conducting laboratory and production plant safety studies; and declassification and sanitization of component parts. WDD relies on several enabling programs to complete its mission, such as the Office of Stockpile Production Integration for shipping, receiving, and equipment maintenance; Infrastructure and Operations for infrastructure sustainment and containers; and the Office of Secure Transportation for the movement of weapons and weapon components.

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Stockpile Research, Technology, and Engineering

The National Nuclear Security Administration (NNSA) must maintain a safe, secure, and effective stockpile without nuclear explosive testing.

Issue(s)

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).

The Stockpile Research, Technology, and Engineering (SRT&E) program provides the foundation for science-based stockpile decisions, tools, and components; focuses on the most pressing investments the nuclear security enterprise requires to meet Department of Defense (DoD) warhead needs and schedules; enables assessment and certification capabilities used throughout the enterprise; and provides the knowledge and expertise needed to maintain confidence in the nuclear weapons stockpile without additional nuclear explosive testing.

The NNSA Office of Defense Programs leverages leading-edge expertise in research and development to maintain the effectiveness of the nuclear weapons stockpile. These research, technology, and engineering activities include modeling, simulations, and flight tests that affirm the effectiveness of the nuclear weapons stockpile. Subcritical and hydrodynamic experiments, along with high energy density physics and advanced computing techniques, provide a technical basis for the annual assessment of the safety and reliability of the nuclear weapons stockpile.

Status

NNSA has developed leading-edge expertise in materials and weapons effects science; high energy density physics; advanced simulation and computing; and hydrodynamic and subcritical experiments. NNSA is delivering the simulation capabilities and high performance computing (HPC) resources to support the annual stockpile assessment and certification process.

Current priorities include continued execution of Enhanced Capabilities for Subcritical Experiments (ECSE) program activities and the procurement of, and site preparation at Lawrence Livermore National Laboratory for NNSA's first Exascale system to be delivered in 2022, and ready for program use in 2023. Both capabilities are needed to meet W80-4 LEP and W87-1 Modification certification requirements.

The SRT&E program includes Assessment Science; Engineering and Integrated Assessments; Inertial Confinement Fusion; Advanced Simulation and Computing; Weapon Technology and Manufacturing Maturation; and Academic Programs.

Inertial Confinement Fusion (ICF) will continue to maintain essential experimental capabilities and expertise in high energy density (HED) science. These efforts continue to provide data to reduce uncertainty in calculations of nuclear weapons performance and improve the predictive capability of science and engineering models in high-pressure, high-energy, high-density regimes.

ICF supports the national HED facilities, specifically, the National Ignition Facility (NIF), the Z Pulsed Power facility (Z), and the Omega Laser Facility (Omega); the experimental platforms, models, and experimental diagnostics that enable vast exploration of HED science for stockpile stewardship; and other national security applications throughout the Nuclear Security Enterprise.

Assessment Science supports subcritical experiments used to assess the state of the current stockpile, and certify warhead modernization programs and advanced diagnostics for subcritical hydrodynamic integrated weapons experiments that produce data for stockpile certifications.

Enhanced Capabilities for Subcritical Experiments (ECSE) will introduce a unique capability for the Nation by providing radiography and other

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capabilities for monitoring the performance of special nuclear material; understanding the effects of plutonium aging; and certifying future weapon systems. ECSE addresses a key gap in NNSA's ability to assess the aggregate influences of plutonium aging, modern manufacturing techniques, modern materials, and evolving designs to enhance manufacturability and improve safety and security.

The Academic Programs of Stockpile Research, Technology, and Engineering are designed to support academic programs in science and engineering disciplines of critical importance to the NNSA Nuclear Security Enterprise, such as nuclear science, radiochemistry, materials at extreme conditions, high energy density science, advanced manufacturing, and high performance computing.

Engineering and Integrated Assessments sustains NNSA's capability for creating and maturing advanced toolsets and technologies to improve weapon surety and support annual stockpile assessments.

Weapons Technology and Manufacturing Modernization develops the materials, technology, and manufacturing solutions that will significantly reduce the time and cost of planned and future warhead modernization programs and manufacturing processes. This area has already provided great benefits to the current stockpile and is instrumental to a more responsive and resilient nuclear enterprise.

The Advanced Simulation and Computing Program supports stockpile stewardship by developing and delivering predictive simulation capabilities for nuclear weapons systems in addition to deploying increasingly more powerful supercomputers at Sandia, Los Alamos, and Lawrence Livermore National Laboratories. Improvements in high performance computing and artificial intelligence are essential for NNSA next-generation simulation capabilities to support weapons design and science-based stockpile stewardship.

The Exascale Computing Initiative (ECI) is a partnership between the DOE Office of Science and NNSA.

- Exascale computing will also enable NNSA to evaluate the nuclear deterrent against evolving threats and, if necessary, identify mitigation options for the current and future stockpile.
- In FY 2020, NNSA signed a $600 million contract for its first Exascale supercomputer, El Capitan, slated to be delivered in 2022 and operating in 2023 at Lawrence Livermore National Laboratory (LLNL) to support NNSA's nuclear weapons programs. As a world leader in supercomputing, NNSA's acquisition of El Capitan is a critical addition to its next generation supercomputing systems.

Major Decisions/Events

Pursue Critical Decision-4 in FY 2025 for the ECSE project, to meet the W80-4 design validation experiment as well as W87-1 program requirements for system certification with a subcritical experiment in 2026.

Deliver the Crossroads high-performance computing system for annual assessment, modernization programs, and surety (safety, security and use-control) assessments; and prioritize delivery of an exascale-class computing environment in FY 2022 in preparation for the El Capitan system delivery in FY 2023.

Deliver modern technologies necessary to enhance secure manufacturing capabilities and to provide timely support to critical needs of the stockpile such as increasing technology and manufacturing readiness levels (TRLs and MRLs) with reduced systems costs.

Develop the next generation of highly-trained technical workers able to support the NNSA core mission and to ensure there is a strong community of technical peers, external to the NNSA national laboratories, capable of providing peer review and scientific competition to strengthen the basic fields of research.

Background

SRT&E provides the scientific foundation for science-based stockpile decisions, as well as the capabilities, tools, and components needed to enable assessment and certification. It balances the most pressing investments the nuclear security enterprise needs to meet DOD warhead needs and schedules, and the critical long-term R&D needed for a robust and responsive future stockpile.

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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.

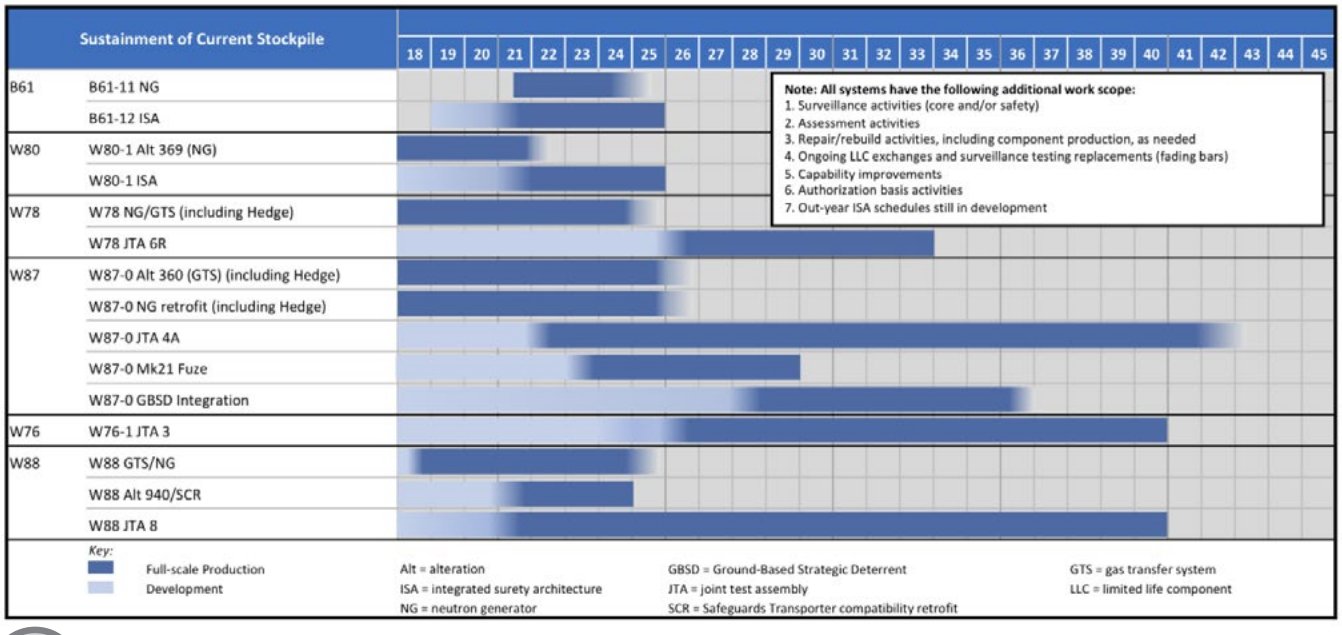
Issue(s)

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 employs a science-based Stockpile Stewardship Program (SSP) and is replacing or refurbishing the enterprise's aging infrastructure to hedge against technical and geopolitical surprise and provide a more capable work environment, all while continuing to reduce the overall size of the U.S. nuclear weapon stockpile. Within NNSA, Defense Programs fields 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 to ensure the effectiveness of nuclear weapons without underground explosive testing. NNSA uses these tools to make informed decisions on replacing and refurbishing weapons in the nuclear stockpile. NNSA leverages life extension programs (LEPs), alterations (Alts), and modifications (Mods), to address aging and performance issues; enhance safety features; and improve security in the nuclear weapons stockpile. 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

The scope, budgets, and schedules of the weapons modernization programs and the Department of Defense's nuclear delivery systems have been fully integrated through coordination within the Nuclear Weapons Council (NWC). Based on NWC guidance, NNSA will remain focused on delivering three LEPs (the W76-1, B61-12, and W80-4) and the W88 Alt 370 (including refreshment of the conventional high-explosive [CHE] main charge).

Milestone(s)/Timeline



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Major Decisions/Events

- NNSA completed the first production unit of the W76-2 in February 2019; completed assembly of the Full Operational Capability by the end of FY 2019; and completed the delivery of units to the U.S. Navy in July 2020. The W76-2 supports the low-yield capability requirement outlined in the 2018 Nuclear Posture Review.
- NNSA completed two successful flight tests of the B61-12 in March 2020, and the Pantex Plant released the first production capability unit for the LEP in August 2020. NNSA expects to deliver the FPU in the first quarter of FY 2022. 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. The B61-12 is scheduled to complete production in FY 2026.
- NNSA completed the System-Level Final Design Review for the W88 Alt 370 in FY 2018. Twenty system-level qualification tests—including the Commander's Evaluation Test 2 and Demonstration and Shakedown Operation 29 flight tests—were completed in FY 2019. In FY 2020, the program achieved First Production Unit (FPU) for the Nuclear Explosive Package and completed the First Production Capability Unit. The W88 Alt 370 is on track for FPU in Q4 FY 2021. Last Production Unit is expected in the fourth quarter of FY 2025.
- The W80-4 is on track to meet DoD's requirement for the first production unit (FPU) for the W80-4 in FY 2025. The recent USAF early down select to a single LRSO contractor is enabling a 1-year earlier powered flight test that reduces W80-4 program risk by informing the System Baseline Design Review.
- In September 2018, the Nuclear Weapons Council (NWC) authorized restart of Phase 6.2, Feasibility Study and Design Option, for the W78 replacement warhead and named it the W87-1. NNSA completed a study on the feasibility of deploying the W87-1 in a U.S. Navy flight body during FY 2019. The W87-1 Mod program will replace the W78 warhead and support the feasibility of the U.S. Air Force's Ground-Based Strategic Deterrent missile system.

Background

The SSP supports a multifaceted understanding of the stockpile and allows NNSA to predict, detect, and evaluate potential problems related to aging. Routine scheduled surveillance of nuclear weapons may lead to significant finding investigations, which in turn inform the need for corrective action, such as initiating an alteration (Alt) or modification (Mod). Some issues may be resolved without any changes to weapons in the stockpile. 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. As warheads and bombs age in the stockpile, they may require life extension programs (LEPs) to comprehensively address aging issues and meet modern safety and security requirements. LEPs involve modifications that refurbish warheads by replacing aged components to extend the service life of the weapon.

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NNSA Major System Project: Uranium Processing Facility (UPF)

Success on UPF is contingent upon stable funding by the Administration and Congress and sufficient material and labor supply chains.

Summary

The Department of Energy's (DOE) National Nuclear Security Administration (NNSA) is managing the Uranium Processing Facility (UPF) project at the Y-12 National Security Complex in Oak Ridge, Tennessee. UPF is essential to NNSA's Nuclear Security Enterprise improvement efforts. Success on this project has been built upon stable and predictable funding profiles and Congressional support of the President's Budget Requests. The project receives significant attention from Congress and DOE as the largest single NNSA project underway. Congress requires a yearly certification that the project is on cost and schedule.

Issue(s)

The project is on budget; however, delays in material delivery and craft labor hiring are challenging schedule performance.

Status

Construction of UPF continued unabated during the COVID-19 emergency. UPF has been on budget and schedule for seven years due to strong Congressional support of the budget request. Timely delivery of glove boxes, process skids, and equipment from vendors and the ability to attract and retain craft workers are key to maintaining the schedule. Sustained financial support for UPF is critical to ensure project execution as the project reaches peak nuclear construction in FY 2021. The Y-12/Pantex management and operating (M&O) contract is being recompeted with an expected transition date of Oct 1, 2021. This contract transition will have to be carefully managed to avoid a negative impact on cost and schedule performance for transition and start-up of the new facility.

Background

The $6.5 billion UPF project consists of two nuclear buildings, three industrial buildings, and supporting infrastructure. Budgeted at over $750 million, it is a major system acquisition approved by the Deputy Secretary. It relocates processing capabilities from the 75-year-old Building 9212 to ensure the long-term viability, safety, and security of the Enriched Uranium (EU) capability at the Y-12 National Security Complex. The UPF project modernizes EU processing capabilities at Y-12 to reduce program and safety risk. The project has successfully completed the first three of seven subprojects under budget and on schedule.

The goals and objectives of the UPF project are to support the following modernization strategy:

- Provide new floor space for the high-hazard, high-security operations to ensure the long-term capability and improve the reliability of EU operations.
- Relocate EU processing capabilities into UPF to reduce dependency on deteriorating, end-of-life buildings and move operations into a modern manufacturing facility.
- Significantly improve the health and safety posture for workers and the public by replacing administrative controls with engineered controls to manage the risks related to worker safety, criticality safety, fire protection, and environmental compliance.

Next Major Decision/Event/Milestone (in FY 2022)

Completion of the Mechanical Electrical Building Subproject: January 2022

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Y-12 / Pantex Management and Operating Contract Competition

NNSA will award a successor Management and Operating contract for the Y-12 and Pantex sites by October 1, 2021.

Summary

NNSA is soliciting a contractor to manage and operate the Y-12 National Security Complex (Y-12) in Tennessee and the Pantex Plant (Pantex) in Texas. The current Management and Operating (M&O) contractor—Consolidated Nuclear Security (CNS), LLC—is responsible for the NNSA Stockpile Stewardship and Management Program and Nuclear Nonproliferation Program activities conducted at Y-12 and Pantex. CNS is a limited liability company formed by Bechtel National, Inc.; Leidos; ATK Launch Systems; and SOC LLC. The current contract is comprised of two contract line items, management, and operations of the two sites for a period of up to 10 years and construction of the Uranium Processing Facility through project completion. A major requirement of the current contract was to combine the operation of the Y-12 and Pantex sites under one contract to streamline production operations and generate cost savings resulting from this combination. NNSA has validated cumulative cost savings of nearly $760 million for Fiscal Years (FY) 2014–2019 under this contract.

Issue(s)

The Y-12/Pantex contract had a base performance period of 5 years with options to extend up to a period of 10 years by meeting specific performance and cost savings targets. The Fee Determining Official determined that CNS met the standard of performance for the first Gateway Decision, and NNSA exercised Option Term 1 extending the contract for years six and seven, from October 1, 2019, through September 20, 2021. In June 2020, NNSA's Fee Determining Official concluded that CNS did not meet the performance standard for the second option, and the contract will expire on September 30, 2021. The June 2020 decision not to exercise Option Term 2 sets an aggressive timeline to award a new Y-12/Pantex contract to be in place by October 1, 2021.

The new contract will include modified cost savings provisions to incorporate lessons learned and build on the success of the current contract. NNSA issued a draft Request for Proposal (RFP) on August 24, 2020, and conducted site tours and one-on-one meetings with industry in September 2020. We anticipate issuing the final RFP in the first quarter of FY 2021, and awarding the contract in the third quarter of FY 2021 to support a transition to the new contractor by September 2021. There has been significant industry interest in this acquisition. The Major Systems Acquisition project for construction of the Uranium Processing Facility (UPF) at Y-12 will continue to be performed by CNS as a separate contract line item until project completion.

Background

Y-12 and Pantex represent key nuclear production capabilities in the Nuclear Security Enterprise. Pantex, near Amarillo, Texas, is responsible for maintaining the safety, security, and effectiveness of the nation's nuclear weapons stockpile. Work performed at Pantex includes support of the nuclear weapons life extension programs; nuclear weapons assembly and dismantlement; the development, testing, and fabrication of high explosive components; and interim storage and surveillance of plutonium pits. Y-12, in Oak Ridge, Tennessee, is the nation's only source of enriched uranium nuclear weapons components and provides enriched uranium for the U.S. Navy. It performs materials science and precision manufacturing; stores enriched uranium; and supports efforts to reduce nuclear proliferation risk.

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Low-Level Radioactive Waste Disposal

The Department of Energy utilizes an extensive infrastructure to dispose of low-level and mixed low-level radioactive waste to support cleanup progress. This includes both DOE and commercial radioactive waste disposal facilities.

Summary

- The Office of Environmental Management (EM) utilizes a variety of safe and efficient disposition paths for low-level and mixed low-level radioactive waste (LLW/MLLW) generated through cleanup activities.
- EM has safely and compliantly disposed more than 680 million cubic feet of LLW/MLLW at a variety of DOE and commercial disposal facilities.
- DOE's policy is to dispose of LLW and MLLW onsite, if practical. While the vast majority of waste is disposed of onsite, disposal at another DOE facility is used when onsite disposal is not available. LLW and MLLW waste can also be disposed of at a commercial facility if the facility is compliant with DOE and regulatory requirements and the disposal fees are cost-effective.
- Decisions on offsite/onsite disposal are made on a site-by-site basis based on the government's best interest.

Issue(s)

- As EM works to develop a new onsite disposal capability at the Oak Ridge site in Tennessee, Congress has directed EM to evaluate the cost of onsite disposal versus offsite disposal, including potential impacts to the local community. EM completed this evaluation in July 2020 and will brief the House and Senate Appropriations committees on the results at a future date. These briefings have not yet been scheduled.
- The Department is in a formal dispute with the Environmental Protection Agency (EPA) Region IV and the Tennessee Department of Environment and Conservation (TDEC) regarding how to manage radioactive surface water discharges from the current and proposed Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) disposal facilities.

Milestone(s)

- EM anticipates beginning operation of the onsite disposal facility at the Portsmouth site in Ohio in 2021.
- The schedule for a Record of Decision for a new Oak Ridge onsite disposal facility has been impacted by the formal dispute with the EPA Region IV and TDEC.

Background

- The operation of DOE disposal facilities requires coordination with states and federal regulatory agencies. Interactions with regulators and other stakeholders differ depending on the location of the DOE site.
- The Nuclear Regulatory Commission (NRC) categorizes LLW into four classes for commercial LLW disposal: A, B, C, based on the concentration of specific short-lived and long-lived radionuclides(10 CFR 61.55.), and Greater-than-Class C. Greater-than-Class-C LLW is LLW in which the concentrations of radionuclides exceed the limits for Class C LLW in 10 CFR 61.55. These definitions are only used by DOE for commercial disposal.
- Unlike NRC, DOE has no LLW class designations—disposal must meet disposal site waste acceptance criteria and performance objectives of the disposal facility, in accordance with DOE Order 435.1, *Radioactive Waste Management.*

DOE Disposal Sites

Hanford Site

The large majority of LLW and MLLW at the Hanford Site is disposed of in Hanford's Environmental Restoration Disposal Facility (ERDF). ERDF is a waste facility regulated under CERCLA. A new facility, the Integrated Disposal Facility, has been constructed

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and is awaiting commissioning for the disposal of low-activity vitrified waste from Hanford's Waste Treatment and Immobilization Plant Low Activity Waste Facility.

Idaho National Laboratory (INL)

INL has two operating disposal facilities: a facility for disposal of remote-handled LLW, and the Idaho CERCLA disposal facility, where LLW and MLLW from site cleanup activities is disposed.

Los Alamos National Laboratory (LANL)

Area G, operated by the National Nuclear Security Administration (NNSA), has very limited LLW disposal capacity remaining. There are no plans for additional LLW disposal capacity at LANL.

Nevada National Security Site (NNSS)

The Area 5 Radioactive Waste Management Disposal Facility provides disposal for LLW and MLLW from DOE sites. NNSS provides an excellent disposal environment due to its arid conditions and deep groundwater. The state of Nevada grants a permit for the MLLW disposal facility pursuant to the Resource Conservation and Recovery Act (RCRA).

Oak Ridge Reservation (ORR)

EM operates a CERCLA disposal facility, the Environmental Management Waste Management Facility (EMWMF), for waste resulting from the cleanup of the East Tennessee Technology Park, Oak Ridge National Laboratory and NNSA's Y-12 Site. A new CERCLA facility is planned.

Paducah

Paducah does not yet have a LLW disposal facility.

Portsmouth

The new Onsite Waste Disposal Facility will operate pursuant to CERCLA. The facility is designed to accept waste from decommissioning and demolition of the gaseous diffusion plant at Portsmouth, as well as remediated soil. Operations are expected to begin in calendar year 2021.

Savannah River Site (SRS)

EM operates several LLW disposal facilities for waste generated from its various onsite missions. SRS receives some offsite LLW from the Naval Reactors' east coast shipyards. SRS has trenches and engineered vaults (designed for higher-activity LLW) in its E-Area. In addition, SRS disposes saltstone onsite. Saltstone is the separated and treated low-activity portion of tank waste that is grouted and placed in large engineered disposal units.

Commercial LLW Disposal Sites

Currently, all operating commercial LLW disposal sites are in states where the NRC has delegated regulatory authority and oversight for those disposal sites to the states (called "Agreement States").

- Energy*Solutions*, located in Clive, Utah, accepts Class A LLW and MLLW.
- Waste Control Specialists LLC (WCS), located near Andrews, Texas, accepts DOE LLW and MLLW (Class A, B, or C as defined by NRC in 10 CFR 61.55) in its dedicated facility for DOE waste. WCS also operates a RCRA hazardous disposal at the same site that accepts LLW below 10 percent of the Class A limit. The WCS disposal facility is robust, e.g., grouted waste packages in concrete disposal containers within a double-lined concrete disposal facility.
- In addition, EM has utilized US Ecology for disposal of non-radioactive hazardous waste. US Ecology operates facilities in Idaho and Nevada.

Commercial MLLW Treatment

Most MLLW must be treated prior to disposal. Currently, DOE has limited onsite MLLW treatment capabilities and mostly relies on commercial MLLW treatment facilities. These include the Perma-Fix Northwest facility, located in Richland, Washington, near the Hanford site; and Energy*Solutions*' Erwin, Tennessee, facility.

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Soil and Groundwater Remediation

The Department of Energy's (DOE) Office of Environmental Management (EM) manages one of the largest groundwater and soil remediation efforts in the world. Soil and groundwater remediation activities include a variety of technologies to address different radioactive and hazardous contaminants. EM has successfully cleaned up 1.7 trillion gallons of contaminated groundwater and 40 million cubic meters of contaminated soil and debris.

Summary

EM is performing major soil and groundwater remediation activities at all of its sites, and complex groundwater plumes remain at the major EM sites. Highlights of EM progress to date include:

- EM has successfully treated 23 billion gallons of groundwater at the Hanford Site in Washington state using systems located along the Columbia River and at the Site's Central Plateau. The systems along the river treat approximately 1 billion gallons per year. In FY2020, Hanford has removed 30 tons of contaminated soil from areas near the Columbia River.
- EM has successfully treated more than 4 billion gallons of groundwater to remove trichloroethylene (TCE) contamination at the Paducah site in Kentucky. EM has also made progress in tackling the TCE contamination source term by installing systems and conducting projects that have removed almost 8,000 gallons of TCE from soil and groundwater at the site.
- EM has been successfully mitigating a chromium groundwater plume using pump-and-treat systems at the Los Alamos National Laboratory in New Mexico. This interim measure is successfully keeping the chromium from migrating off site.
- EM has made significant soil and groundwater cleanup progress utilizing an area completion approach at the Savannah River Site in South Carolina. To date, work has been completed at the Site's T, M, P, and R areas. In 2020, the Department recognized the successful cleanup of coal ash-contaminated land, which was completed $8 million under budget. This project received DOE's Project Management Excellence Award. EM has also removed more than 1.6 million pounds of non-radioactive material from groundwater at the site.

Energy Technology Engineering Center (ETEC)

One of EM's more visible soil-and-groundwater remediation efforts is the cleanup of the Energy Technology Engineering Center (ETEC) in California. EM is responsible for the cleanup of soil, groundwater, and building demolition in Area IV and the Northern Buffer Zone (NBZ) at the ETEC site, located at Santa Susana Field Laboratory (SSFL).

DOE signed an Administrative Order on Consent (AOC) in 2010 to clean up chemically and radiologically contaminated soils to background levels.

In 2020, DOE reached a Consent Order with the State of California to demolish 10 of the remaining 18 DOE-owned buildings at the site. EM expects to complete the demolition of the 10 buildings by the end of CY 2020 and continues to work with California on a path forward to address the remaining 8 buildings.

Los Alamos DP Road

- EM is responsible for legacy waste cleanup activities at the National Nuclear Security Administration's (NNSA) Los Alamos National Laboratory in New Mexico.
- Contaminated debris, likely from legacy DOE activities in the area, has been discovered on property being privately developed for housing. NNSA conveyed the property to Los Alamos County following the completion of cleanup activities in an adjacent former solid waste management unit. This property is known as the Middle DP Road Site (MDPR Site).

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The full extent of contamination is still unknown, pending sampling efforts that are currently underway.

Issue(s)

ETEC

The Department continues to work with the state of California on groundwater and soil remediation activities.

Los Alamos

- The extent of buried laboratory debris at the MDPR Site is unknown; therefore, work is underway to determine the potential presence of radiologically contaminated debris. The parcels upon which the MDPR Site is located are planned for business and residential development starting as early as FY2021.
- EM currently operates a network of 35 monitoring, extraction and injection wells at the Los Alamos National Laboratory to characterize a chromium plume and contain its movement, as part of an interim measure. The plume has responded positively to the interim measure, but the Department owes a final plan to the state of New Mexico as part of a Consent Order.

Status

ETEC

Planning for soil and groundwater remediation is underway.

Los Alamos

- The EM Los Alamos Field Office is preparing a preliminary screening plan to determine the extent of the MDPR Site contamination. Investigation is planned to begin in the second quarter of FY2021.
- The chromium plume interim measure was initially put on hold due to schedule delays as a result of COVID-19 but has been restarted as part of Phase 1 work scope.

Milestone(s)

Los Alamos

MDPR Preliminary Screening Plan is due to the New Mexico Environment Department by December 2020.

Major Decisions/Events

ETEC

In consultation with the State of California, EM will proceed with soil and groundwater remediation after the State issues its Environmental Impact Report.

Los Alamos

EM will determine the level of contamination and develop a remediation approach for the Middle DP Road Site.

Background

ETEC

In 2007, a court ordered that DOE complete an Environmental Impact Statement (EIS). The final EIS, completed in 2018, identified preferred alternatives for building demolition, groundwater and soils remediation. In 2019, DOE issued a Building Demolition Record of Decision (ROD) and is making steady progress on tearing down the 18 DOE-owned structures.

Los Alamos

The EM Los Alamos Field Office will perform additional investigation at the MDRP site.

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Tank Waste

The Office of Environmental Management (EM) has made significant progress in addressing waste generated from past spent nuclear fuel reprocessing activities and other plutonium production activities. This "tank waste" is EM's biggest technical and budgetary challenge.

Summary

EM is responsible for the safe and effective management, including treatment and disposal, of radioactive waste from past reprocessing and other plutonium production activities. This waste, stored in aging underground tanks at three EM sites, poses a significant financial liability to the government.

This tank waste is being conservatively managed as high-level waste (HLW). HLW, as defined in the Atomic Energy Act (AEA) and the Nuclear Waste Policy Act (NWPA), requires disposal in a deep geological repository. In 2019, the Department of Energy (DOE) issued an interpretation of the definition of HLW to increase options for disposing of waste that could be properly and radiologically classified as something other than HLW.

At the Savannah River Site (SRS) in South Carolina, EM has completed the major components of the tank waste treatment system. The last major component was the Salt Waste Processing Facility (SWPF), which began hot operations in October 2020. The SWPF will process the majority of the site's remaining tank waste inventory by separating the highly radioactive waste from the less radioactive salt solution.

The Idaho Cleanup Project, at the Idaho National Laboratory, is in the final stages of preparing the Integrated Waste Treatment Unit (IWTU) to treat the remaining sodium bearing tank waste. The IWTU is expected to begin operations in 2021.

The Idaho Cleanup Project is also responsible for 4,400 cubic meters of solid radioactive waste called "calcine" that was generated from the reprocessing of spent nuclear fuel. There is not yet a defined path forward for treatment of this material, which is being safely stored on-site.

At the Hanford Site in Washington state, EM is constructing the Waste Treatment and Immobilization Plant (WTP), which is intended to vitrify (convert into borosilicate glass) a large portion of the tank waste stored in underground tanks. The WTP is the largest, most complex, and most expensive construction project in the entire Department. The components of the WTP that will treat low-activity tank waste through the Direct Feed Low Activity Waste Approach are expected to begin operations by the end of 2023.

The West Valley Demonstration Project (WVDP) in New York State is the first and only DOE site to construct, operate, and demolish a vitrification facility used to treat high level radioactive tank waste. All 600,000 gallons of the tank waste have been vitrified, and the glass canisters are in storage at the site pending disposal.

Issue(s)

EM is still working to finalize the approaches and capabilities for treating tank waste at Hanford and Idaho, and is working to ensure sufficient funding to allow for full utilization of the tank waste treatment system at Savannah River. With the Department's interpretation of the term HLW, there are opportunities to make meaningful progress on dispositioning waste that has been historically managed as HLW but does not have a high radioactive content.

Status

HLW Interpretation

- In June 2019, DOE issued its interpretation of the AEA and NWPA definition for HLW, which allows waste to be classified and disposed according to its radiological characteristics (risk-based), rather than solely according to its origin (source-based).
- In August 2020, DOE issued the Environmental Assessment and Finding of No Significant Impact concluding that SRS Defense Waste Processing Facility (DWPF) recycle wastewater can be safely stabilized and disposed of as low-level radioactive waste (LLW).
- This first application of the HLW interpretation was completed September 22, 2020, with 8

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gallons of DWPF recycle wastewater shipped to the Waste Control Specialists, LLC (WCS) LLW disposal facility in Texas for treatment and disposal.

- In FY21, EM will evaluate potential next waste stream(s) under the HLW interpretation, and, if appropriate, will initiate the required environmental evaluations, and technical and safety analyses.

SWPF

SWPF received Critical Decision-4 (CD-4) and Authorization to Operate in August 2020, and began "hot" or radioactive operations in October 2020.

IWTU/Calcine

- The IWTU is in final commissioning in preparation for radiological operations. Construction of the facility was completed in 2011.
- Delays in commencing IWTU "hot" operations have caused the Department to miss a site treatment plan milestone corresponding to an Idaho Settlement Agreement milestone, resulting in fines of $6,000 per day (since 2012). However, the Department has performed supplemental environmental projects in lieu of paying the fine.
- DOE is in the process of analyzing potential alternatives for the treatment of the calcine material.

WTP

- Since 2013, EM has been pursuing the Direct Feed Low Activity Waste (DFLAW) approach to begin the treatment of low activity tank waste by the end of 2023. Construction of all facilities needed for DFLAW operation should occur in 2021.
- The Department is conducting a comprehensive Analysis of Alternatives to evaluate options for the treatment of Hanford's high level waste.
- DOE and the U.S. Department of Justice are engaged in holistic negotiations with the State of Washington and the U.S. Environmental Protection Agency (EPA) regarding the Hanford cleanup mission.

Milestone(s)

SWPF

The first transfer of 4,000 gallons of salt waste from one of Savannah River's underground waste tanks to SWPF is scheduled for Q1 FY21.

IWTU

Final IWTU facility modifications in preparation for the start of radiological operations are scheduled to be completed in early 2021. The start of radiological operations is currently targeted for 2021.

WTP

EM currently expects to meet a milestone to complete hot commissioning of the WTP Low Activity Waste (LAW) Facility, part of the DFLAW approach, by December 31, 2023.

Major Decisions/Events

- Aspects of the Hanford cleanup mission are the subject of negotiations with the State of Washington and EPA.
- Decisions will be needed as a result of the Analyses of Alternatives for both WTP and Idaho's calcine waste.

Background

SWPF

The waste in Savannah River's tanks is a mixture of solids and liquids. After the liquid is evaporated the result is sludge-like material and crystalline salts. The crystalline material is commonly referred to as salt waste. Removing salt waste, which fills over 90 percent of tank space in the SRS tank farms, is a major step toward emptying and closing the Savannah River Site's 43 remaining tanks. In 2002, Parsons Corporation was selected to design, build, commission, and operate for the SWPF one year, which will process salt waste at a rate eight times faster than recent waste treatment operations. Construction was completed in the spring of 2016, eight months ahead of the revised baseline schedule and $60 million under budget.

IWTU and Calcine

The IWTU will treat the remaining sodium bearing radioactive liquid tank waste at the Idaho National

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Laboratory using a steam reforming process. The tank waste is stored in three underground stainless steel tanks with a total volume to of approximately 850,000 gallons. This process will convert the liquid waste into a dry granular solid, which will be stored onsite in stainless steel canisters within concrete vaults until disposal.

Calcine material generated from the reprocessing of spent nuclear fuel is also stored at the Idaho National Laboratory. The calcine material is a dry granular solid stored in six Calcine Solids Storage Facilities onsite.

WTP

The WTP is intended to treat radioactive waste stored in 177 underground storage tanks, some of which have leaked. Originally, all of the components of the WTP would have been commissioned at the same time, with tank waste fed directly into the Pretreatment (PT) Facility, where it would be separated into high level radioactive and a low level radioactive waste streams, and subsequently fed to the HLW facility LAW facilities, respectively, for vitrification. Vitrified material from the LAW facility would be disposed of on-site in the Integrated Disposal Facility, while the vitrified HLW would be stored until disposal in an geologic repository.

The HLW stream constitutes roughly 10 percent of the expected volume, but represents roughly 90 percent of the radioactivity. Under current plans, the WTP is designed to treat all HLW in the Hanford wastes, but only one-third to one-half of the LAW. The Department has not yet identified the approach to treat the remaining LAW in the tanks, commonly referred to as the "supplemental LAW."

In the summer of 2012, the Department directed the contractor, Bechtel National, Inc., to suspend production engineering and construction on the PT and HLW facilities due to unresolved technical challenges. To keep the mission moving forward, 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.

WVDP

In 2018, EM and its cleanup contractor safely completed the demolition of the 50-foot-tall, 10,000-square-foot Vitrification Facility at the WVDP. The 278 canisters of vitrified waste produced at the facility are currently stored in casks on-site that have a design life of at least 50 years.

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Waste Isolation Pilot Plant/Transuranic Waste Disposition

The Waste Isolation Pilot Plant (WIPP) is integral to the Department's cleanup mission and is used to dispose of transuranic waste from atomic energy defense activities. WIPP not only supports legacy cleanup activities, but also ongoing national security and scientific research missions.

Summary

The Waste Isolation Pilot Plant (WIPP) in New Mexico is the nation's only deep geological disposal site for transuranic (TRU) radioactive waste resulting from atomic energy defense activities. TRU waste consists of tools, rags, protective clothing, sludges, soil, and other materials contaminated with radioactive elements, mostly plutonium. These man-made elements have atomic numbers greater than uranium on the periodic table of elements (thus "trans-uranic" or beyond uranium).

Since the commencement of operations in 1999, WIPP has disposed of approximately 70,000 cubic meters of transuranic waste from 22 different sites. EM has successfully completed TRU waste removal from 15 sites.

EM has had no serious injuries or fatalities during WIPP's operating history. This includes the transportation of TRU waste shipments to WIPP over 15 million miles without a serious accident.

EM's shipment rate to WIPP is limited to approximately 10 per week, though the number of actual shipments has been less due to COVID-19. This is expected to increase once a new ventilation system is in operation and when the excavation of a new disposal panel (Panel 8) is completed.

A number of infrastructure projects are needed at WIPP to maintain safety and ensure the facility is available to support DOE missions for the next 30 years. Two key projects underway are the new Safety Significant Confinement Ventilation System and the new Utility Shaft.

The National Nuclear Security Administration (NNSA) has announced plans to utilize WIPP to dispose of up to 7.1 metric tons (MT) of non-pit plutonium as TRU waste. This material is downblended with materials at the Savannah River Site (SRS) that allows the shipments to meet WIPP's waste acceptance criteria.

DOE is analyzing options for safely removing Los Alamos National Laboratory (LANL) TRU waste in temporary storage from the Waste Control Specialists, LLC (WCS) facility near Andrews, Texas. EM is working closely with key state and regulatory officials and WCS. At all times the safety of workers, the public and the environment remain DOE's overriding priority. In the interim, the waste continues to be stored in a safe configuration at WCS.

Issue(s)

EM and NNSA continue to demonstrate progress and evaluate opportunities to accelerate TRU waste disposal.

Status

WIPP-General

Waste emplacement operations were suspended in February 2014, following two unrelated events in the WIPP underground. On February 5, a salt haul truck caught fire, and on February 14, a waste drum in Panel 7, Room 7, breached, resulting in a radioactive release. The release did not pose a public health or environmental hazard, according to the U.S. Environmental Protection Agency. In January 2017, waste began to be emplaced from above ground, where it had been stored since shipments were halted. Waste shipments to WIPP resumed in April 2017.

Currently, due to COVID-19, WIPP receives up to approximately 5 shipments of TRU waste per week. Pre-COVID-19, WIPP was receiving up to 10 shipments per week.

FY 2021 shipments are expected to come from the Idaho National Laboratory, LANL, the Oak Ridge

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National Laboratory, SRS, the Sandia National Laboratories, the Lawrence Livermore National Laboratory (LLNL), and the WCS facility in Andrews, Texas.

A significant issue at WIPP continues to be underground air quality due to lower than normal air flow and diesel equipment exhaust. Mitigating measures underway include use of battery-electric vehicles, as well as booster fans.

WIPP's first six panels are already filled, with waste emplacement ongoing in Panel 7. Work is underway to mine Panel 8, which is anticipated to be completed in late 2021.

WIPP Infrastructure Upgrades

Many of the existing WIPP infrastructure systems are beyond their design-life and have been subject to harsh environmental conditions of salt, dust, and high heat.

The new Safety Significant Confinement Ventilation System and Utility Shaft will improve underground operations, allowing concurrent mining and waste disposal operations.

Due to air quality concerns, WIPP will be replacing its diesel equipment vehicle fleet with an all battery-electric fleet. The first electric vehicle arrived in the WIPP underground mine in FY 2019 but complete fleet replacement will take a number of years.

EM Support to NNSA Mission

Active coordination is occurring on near-term priorities, especially for LANL and LLNL. Shipments from LLNL to WIPP restarted in September 2020, for the first time in over a decade.

EM continues to downblend oxidized, surplus, non-pit plutonium using facilities in the K-Area Complex at SRS. This material was designated for WIPP disposal in a 2016 Record of Decision.

NNSA published an Amended Record of Decision (AROD) in August 2020, announcing its decision to dispose of up to 7.1 MT of non-pit plutonium as TRU waste at WIPP. This AROD changes the disposition pathway for a portion of the 34 MT of surplus plutonium that DOE/NNSA previously decided to fabricate into Mixed Oxide (MOX) fuel.

Legal

There is a current legal challenge to the methodology WIPP uses to account for the volume of waste (called the volume of record) disposed at WIPP. The case is currently in the New Mexico Court of Appeals.

Milestone(s)

None at WIPP, but various sites often have regulatory commitments associated with TRU waste shipment to and disposal at WIPP.

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Annual Budget Process

DOE's nominal budget process includes four main processes and overlaps with multiple years active at the same time.

The Department of Energy (DOE) develops and executes the budget using processes similar to other federal agencies, managed on behalf of the Secretary by the Office of the Chief Financial Officer (OCFO, CFO). Implementing policy direction for programs and projects requires requesting funding and allocating that funding to specific appropriation accounts and control points. Knowledge of this process and associated timelines are important for developing and implementing policy for execution of Departmental programs and projects.

A Nominal Budget Formulation Process

Each fiscal year budget is built on leadership priorities and from previous year budget cycles and appropriations, federal spending agreements, and improvements in budget tools, there is a general structure and flow to the process.

The Office of Management and Budget's (OMB) circular A-11, *parts 2 to 4,* sets the minimum requirements for a budget. DOE has established its own processes to meet OMB's requirements. Annually the DOE budget process has four broad concurrent steps: Planning, Programming, Budgeting, and Execution (PPBE) borrowed and modified based on the Department of Defense process.

The PPBE processes typically actively manage three to four years concurrently during a given year. The budget is rarely passed by the end of the Fiscal Year – only once in the last two decades – resulting in a Continuing Resolution that can last additional months. In November, 2020, four years will be under review or consideration by some part of DOE:

Fiscal Year (FY) 2020 (Prior Year)

Led by the CFO's Office of Finance and Accounting, final reviews are being completed of FY2020 spending and the annual financial audit of DOE's financial management is being completed.

FY2021 (Current Year)

Should there be a FY2021 enacted appropriation, DOE would be operating based on the enacted FY2021 appropriations act. CFO's Budget Office would be distributing funds guided by the Act and OMB apportionment. Instead, DOE (and the rest of the government) is operating under a CR, and the amounts the Budget Office is releasing are based on FY2020 levels. Once a full-year bill is passed, appropriation amounts will be updated based on the enacted bill.

A delay in getting a bill also means DOE is still actively negotiating with the Hill on the FY2021 request, specifically in support of technical questions for a conference and for appeals to both funding and language based on Senate and House marks.

FY2022 (Budget Year)

In coordination with OMB, DOE has already built a full FY2022 budget request. The input is being reviewed at OMB through late November. In a nominal year, in early December, DOE would get decisions in the form of a Passback (initial OMB proposal to the Department's input), followed by a Department wide appeal on specific items as determined by leadership, and then Settlement (final decision for the President's Budget Request (PBR)) in mid-December, after which all material would be finalized to send Congress in early February.

FY2023 (Initial Formulation)

Early data collection and bottoms-up identification of policy proposals and funding needs would begin in conjunction with Passback and Settlement. In a nominal year, this process ramps up considerably once the current budget being formulated goes to the Hill. This aspect will likely happen while Congress is still debating FY2021 funding.

Stages in the Annual Budget Process

Planning (Year round)

The purpose of the Planning phase of the PPBE process is to gather or update all the information, cost data, and options necessary to prepare to make resource decisions based on priorities during the programming phase. Planning considers the full range of work to be done against current plans and should be fiscally unconstrained so that all requirements and other mission needs are considered. All offices conduct this review either explicitly or implicitly throughout the year. Some offices conduct a discrete Planning phase with stated objectives, guidance, and outputs (e.g., the National Nuclear Security Administration (NNSA)).

Programming (Winter and Spring)

The purpose of the Programming phase of the PPBE process is to make decisions to align available program resources with priorities resulting in a balanced, integrated, executable budget to be proposed to OMB as the basis for that year's Congressional budget request. This process is fiscally conscious, allocating available resources against office and DOE priorities.]

Budgeting (February through November)

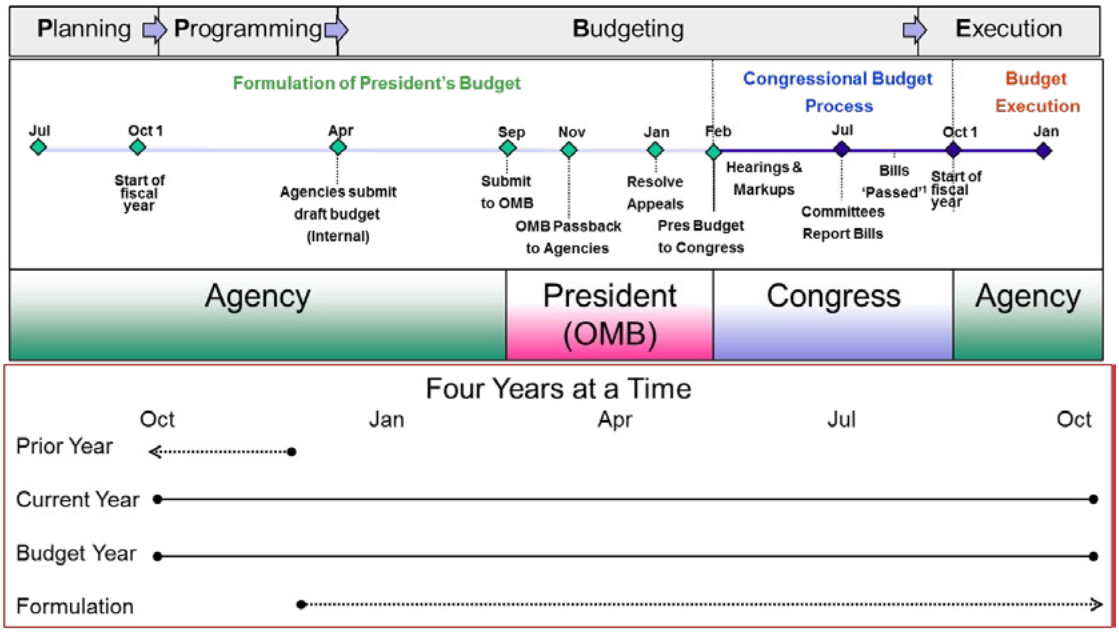
The Budgeting process includes development of the OMB and President's budget requests and then the process of getting the President's budget passed by Congress. This process starts in February or March and is supposed to end with Congressional passage of the budget by the following September. A wide range of inputs are considered from the output of the Planning and Programming efforts, to data on program performance and risks to achieving agency goals, to past financial performance.

Execution (October to September)

Execution is the process to spend enacted funds and to assess progress made toward achieving identified performance measures. These performance measures can either be low-level milestones for internal use, or high- level performance measures in accordance with the Government Performance and Results Modernization Act (GPRA-MA) of 2010. The results of the evaluation process feed back into the Planning process for the next PPBE cycle.

DOE's OCFO manages the front end of the execution process – understanding better congressional intent, requesting the apportionment from OMB, and preparing and issuing the allotment to program and functional offices. These offices then allocate funds and obligate them for the many missions of the Department. Those funds are later costed as work is completed. Failure to meet the legal requirements of execution can result in criminal penalties, so this process is carefully monitored through the DOE accounting system.

Overview of Nominal Funding Process



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Spend plans, execution dashboards, and ad hoc reporting give DOE effective insight into the rate of spending and how it compares to program financial plans.

To understand the manner in which appropriated resources are being used to meet mission goals, DOE also tracks performance against its strategic goals, Agency Priority Goals (APGs), and over 100 office-established annual goals.

Budgets in an Inauguration Year

Budgets in an Inauguration year are typically on a different schedule.

- In year one (1) of an administration, the multi-year PPBE process is compressed into a few months. Issues developed during the campaign and papers prepared by DOE for transition are used to structure policies. The incoming President sets budget toplines. The transition team, incoming agency leadership, OMB, and the OCFO work in less structured way than a Nominal year to build a budget from December/January to March/April. Congress then gets the budget with 4-5 months before the end of the Fiscal Year, not the usual seven (7).
- In year five (5) of an administration, much of the work has already been done during the Presidential campaign. During a change of Administration, the Inauguration and related activities often result in a delay to the release to Congress of the budget by a few weeks.

Corporate Business Systems Migration to the Cloud

Pursuant to OMB directive M-19-19, *Update to Data Center Optimization Initiative,* and the Federal Information Technology Acquisition Reform Act (FITARA), the Office of the Chief Financial Officer (CFO) and the Office of the Chief Information Officer (CIO) are moving aging data centers located in Germantown and Albuquerque to a Cloud service provider (Infrastructure-As-A-Service).

Summary

The Office of the Chief Financial Officer (CFO) manages over 35 DOE-wide mission support business systems including budget formulation and execution, procurement, accounting, payroll, human capital and financial data analytics. OMB Directive M-19-19, *Update to Data Center Optimization Initiative,* the Federal Information Technology Acquisition Reform Act (FITARA),[1] and the FITARA Enhancement Act of 2017, require agencies to consolidate and optimize data centers. In response to these requirements, the DOE Chief Information Officer (CIO) issued a Data Center Migration Plan, and CFO and CIO developed a plan to transition CFO-managed systems to Cloud infrastructure.

Issue(s)

The approved transition to the Cloud plan is a two phased implementation. Phase I consolidated all business systems into either Linux or Windows platform, and was completed in April 2019. Phase II will migrate all systems to the Cloud in six groups started in March 2020 and is in process.

Background

CFO and CIO jointly manage over 35 corporate-wide mission support business systems, ranging from financial management, procurement, human resources and data analytics, to invoice and contractor benefits management. CIO manages the system operating infrastructure and CFO manages system application, database layers and operations and maintenance (O&M). These systems operate on over 200 virtualized and physical servers using more than 220 TB of data storage in a Germantown data center coupled with a backup site in Albuquerque.

Pursuant to meeting the requirements of OMB Directive M-19-19, FITARA and the FITARA Enhancement Act, DOE decided in 2018 to expedite the migration of systems to a Cloud service provider (Infrastructure-As-A-Service) as the data centers in Germantown and Albuquerque had numerous power and cooling issues. The Albuquerque data center is scheduled to be decommissioned with the completion of the new NNSA Office Building in FY 2022.

Status

Select accomplishments to date include:

- Completed platform consolidation
- Finished trade-off studies for selection of Cloud service providers
- Selected Microsoft Azure as the Cloud service provider for all CF systems
- Established non-production environment in Azure
- Successfully migrated all sandbox environments to Azure
- Activities are scheduled for completion by the end of FY 2021.

1 Title VIII, Subtitle D of the National Defense Authorization Act (NDAA) for Fiscal Year 2015, Pub. L. No. 113-291, available at https://www.congress.gov/113/plaws/publ291/PLAW-113publ291.pdf

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Major System List*

*This list of Major business systems does not list all business support systems.

Financial, Auditing and Payroll

- Standard Accounting and Reporting System (STARS)
- A-123 Management of Entity Risks and Internal Controls Application (AMERICA)
- Departmental Audit Report Tracking System (DARTS)
- Conference Management Tool
- Funds Distribution System (FDS) 2.0
- Vendor Invoicing Portal and Electronic Reporting System (VIPERS)
- Financial Accounting Support Toll (FAST)
- DOE Payment and Collection System (DOEPAC)
- Laboratory Directed Research and Development/ Site Directed Research, Development and Demonstration (LDRD)
- Automated Time and Attendance Processing System (ATAAPS)

Human Resources

- Corporate Human Resource Information System (CHRIS)
- Employee Self Service (ESS)
- ePerformance
- DOE Employee Data Repository (DOE Info)

Procurement

Strategic Integrated Procurement Enterprise System (STRIPES)

Travel

- Enterprise Travel System (ETS2)
- Foreign Travel Management System (FTMS)

Evidence-Based Policy Making Act, DOE Data Governance, and Data Strategy

The Foundations for Evidence-Based Policymaking Act places new requirements on DOE to gather and analyze evidence about its programs, plan and conduct program evaluations, and build a data strategy that supports making its data open.

Summary

The Foundations for Evidence-Based Policymaking Act of 2018 (Evidence Act) requires agencies to gather and use evidence to support policymaking and evaluate the effectiveness of programs. Agencies are required to formally document evidence building activities and program evaluations in a plan called a "Learning Agenda," which is sent to the Office of Management and Budget (OMB) annually as part of the agency budget input. Agencies must also develop a data strategy and a formal plan to make agency data open by default. To lead these efforts, agencies are to name a Chief Data Officer, Chief Evaluation Officer, and Chief Statistical Official.

Issue(s)

Executing requirements of the Evidence Act requires DOE-wide education, coordination, and support. Making DOE data open by default will require a significant culture change and governance effort. Interest among departmental elements on Evidence Act requirements has been tepid thus far. Compliance efforts are currently an unfunded mandate.

Status

- Evidence Act activity is being coordinated by the Chief Data Officer and Chief Evaluation Officer within the Office of Chief Financial Officer.
- DOE's Data Governance Board has been established and is coordinating inter-departmental efforts on data strategy and Evidence Act deliverables.
- OMB's response to DOE's first Learning Agenda proposal is expected in November 2020.

Milestone(s)

- Chief Data Officer, Chief Evaluation Officer, and Chief Statistical Official named in 2019.
- DOE Data Governance Board (DGB) chartered in February 2020.
- Three DGB meetings held through October 2020; two additional meetings expected by end of calendar year 2020.
- DGB issued a data call to identify DOE's priority data sets, supporting IT systems, and data governance policies currently in use.
- Several departmental elements have conducted initial data maturity assessments.
- CF sent initial Learning Agenda proposals to OMB in September 2020.

Background

The Foundations for Evidence-Based Policy Making Act of 2018 builds on several existing laws that require agencies to measure the effectiveness of federal programs. The Act pushes beyond existing agency requirements to establish a strategic plan, program and agency priority goals, and performance monitoring by instituting new requirements to conduct in-depth evaluations. These evaluations require agencies to build and analyze a body of evidence to guide decision-making. The Act also creates expectations for agencies to manage data more strategically, most notably through new open data requirements.

OMB has published two guidance documents on implementing the Evidence Act:

- Phase 1: Implementation of the Foundations for Evidence-Based Policymaking Act of 2018: Leaning Agendas, Personnel, and Planning Guidance

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- Phase 4 Implementation of the Foundations for Evidence-Based Policymaking Act of 2018: Program Evaluation Standards and Practices
- A third OMB guidance document on Open Data requirements and expectations is currently being circulated in draft form for agency comments.

The Administration also published a Federal Data Strategy and Action Plan, which have several requirements that support Evidence Act deliverables, and are expected to be coordinated by DOE's Chief Data Officer.

Definitions

Open Data

Data with these attributes:

- Available to the public;
- Includes standard metadata;
- Built on schemas that are public and that use open standards; and,
- Machine searchable and readable.

Learning Agenda

A term used by OMB to describe a process by which agencies formally identify priority questions that once answered, will help focus and improve success of critical agency mission areas. The process requires gathering and analyzing data to build evidence and conducting evaluations to answer priority questions. This process is documented in a formal plan called a Learning Agenda.

Evaluation Plan

A formal plan from an agency to OMB that describes processes, procedures, and expectations for conducting program evaluations within an agency.

Capacity Assessments

A term used by OMB to describe a process by which an agency evaluates its resources, procedures, and ability to conduct certain activities. OMB is currently focused on agencies conducting capacity assessments of agency data maturity and ability to conduct program evaluations.

External Interactions

DOE's interactions with Congress, Intergovernmental Partners, and the Office of Management and Budget (OMB) are key to fulfilling the Department's mission and implementing the Administration's priorities.

Summary

Interactions with key external partners are outlined in three main sections:

- **Section I: Interactions with Congress**

  Information on committees of interest for DOE, members with special interests; required reports and updates to Congress; relevant pending legislation; leadership changes in a new Congress; and working with other legislative offices to clear materials for Congress.
- **Section II: Interactions with Intergovernmental Partners**
- **Section III: Interactions with OMB**

Section I: Interactions with Congress

Summary

The Secretary and members of DOE's legislative leadership team have regular interactions with Authorizing, Oversight, and Appropriations Committee Chairs and Ranking Members, and with individual Members of Congress, throughout the hearing, markup, and conference process. The Office of Congressional and Intergovernmental Affairs (CI), assisted by the Office of the Chief Financial Officer (CF) with respect to appropriations and the Office of the General Counsel (GC) with regard to authorization legislation, works with Congressional staff to address Member interests and constituent issues.

Within the Department, the Assistant Secretary for CI manages overall relations with Members of Congress and supports the Secretary as the chief strategic advisor on all congressional interactions not directly related to the House and Senate Appropriations Subcommittees. CI prepares Departmental officials for congressional hearings, including confirmation, programmatic, and oversight hearings before authorizing committees. In this capacity, CI manages testimony development, prepares DOE officials for engaging in hearings, and manages responses to questions for the record. GC provides technical drafting assistance to committees and members and prepares the Department's authorization legislation proposals. The Department's primary authorizing committees are: Senate Energy and Natural Resources; Senate Armed Services; House Energy and Commerce; House Armed Services; and House Science and Technology.

The Chief Financial Officer (CF) leads the Department's day-to-day interaction with the Senate and House Appropriations Committees, informs DOE leadership and staff of the interests and motivations of Appropriators, prepares the Secretary for interactions with Appropriators, and works with Subcommittee staff to achieve the Administration and Secretary's budget priorities.

Issue(s)

Committees of Interest for DOE

- **Appropriations Committees (CF)**

  The United States House of Representatives and United States Senate Appropriations Committees have jurisdiction over discretionary spending legislation for the Federal government. Each Appropriations Committee is divided into 12 subcommittees with jurisdiction over funding for designated Executive Branch departments and agencies. The Subcommittees on Energy and Water Development, and Related Agencies (referred to as "HEWD" for the House subcommittee and "SEWD" for the Senate subcommittee) have jurisdiction over DOE. References in this section to the Appropriations

Committee refer to both the full Appropriations Committee and HEWD and SEWD. Member and staff information for the 116th Congress, as of November 1, 2020, is provided below.

CF serves as the central point of contact between Congressional Appropriations Committees and the Department. CF staff interact with the House and Senate Appropriations Committees regularly, primarily through the HEWD and SEWD subcommittees. CF's congressional relations functions include presenting the President's annual budget request ("rollout"); preparing principals for hearings before the Appropriations Committees; responding to formal inquiries; and providing information to the Committees through reports; in-person and telephone briefings; and technical assistance. As needed, CF arranges, prepares attendees, and participates in Program and Functional Office interaction with the subcommittees.

Committee		Chairman	Majority Staff Contact	Ranking Member	Minority Staff Contact
HOUSE	Appropriations Committee	Rep. Nita Lowey (D-NY)	Shalanda Young, Staff Director	Rep. Kay Granger (R-TX)	Anne Marie Chotvacs, Staff Director
	Subcommittee on Energy and Water Development, and Related Agencies	Rep. Marcy Kaptur (D-OH)	Jaime Shimek, Clerk	Rep. Mike Simpson (R-ID)	Angie Giancarlo, Clerk
SENATE	Appropriations Committee	Richard Shelby (R-AL)	Shannon Hines, Staff Director	Patrick Leahy (D-VT)	Chuck Kieffer, Staff Director
	Subcommittee on Energy and Water Development, and Related Agencies	Sen. Lamar Alexander (R-TN)	Tyler Owens, Clerk	Sen. Dianne Feinstein (D-CA)	Doug Clapp, Clerk

- **Authorizing Committees (CI)**

  DOE activities fall within the jurisdiction of several congressional authorization committees. The Department's primary authorizing committees are: Senate Energy and Natural Resources; Senate Armed Services; House Science and Technology; House Armed Services; and the House Energy and Commerce Committee.

Committee	Chairman	Majority Staff Contact	Ranking Member	Minority Staff contact
House Energy and Commerce Committee	Rep. Frank Pallone (D-NJ)	Jeff Carroll, Staff Director	Rep. Greg Walden (R-OR)	Peter Kielty, Chief Counsel
House Committee on Science, Space, and Technology	Rep. Eddie Bernice Johnsen (D-TX)	John Piazza, Chief Counsel	Rep. Frank Lucas (R-OK)	Tom Connally, Counsel
House Armed Services Committee	Rep. Adam Smith (D-WA)	Paul Arcangeli, Staff Director	Rep. Mac Thornberry (R-TX)	Dave Sienicki, Professional Staff Member
Senate Energy and Natural Resources Committee	Sen. Lisa Murkowski (R-AK)	Brian Hughes, Staff Director	Sen. Joe Manchin (D-WV)	Sam Fowler, Chief Counsel
Senate Armed Services Committee	Sen. James Inhofe (R-OK)	John Bonsell, Staff Director	Sen. Jack Reed (D-R.I.)	Elizabeth King, Staff Director

- **Oversight Committees (CI)**

CI coordinates with GC in managing Congressional oversight and investigation requests, including the document production process for oversight committee requests on DOE matters. The primary legislative bodies that deal with oversight of DOE issues include:

Committee	Chairman	Majority Staff Contact	Ranking Member	Minority Staff contact
House Oversight and Government Reform Committee	Rep. Carolyn Maloney (D-NY)	Dave Rapallo, Staff Director	Rep. James Comer (R-KY)	Chris Hixon, Staff Director
Senate Committee on Homeland Security and Government Affairs	Sen. Ron Johnson (R-WI)	Gabrielle D'Adamo, Staff Director	Sen. Gary Peters (D-MI)	David Weinberg, Staff Director
House Energy and Commerce Subcommittee on Oversight and Investigations	Rep. Diana DeGette (D-CO)	Chris Knauer, Director of Oversight	Rep. Brett Guthrie (R-KY)	Alan Slobodin, Chief Investigative Counsel
House Committee on Science, Space, and Technology Subcommittee on Investigations and Oversight	Rep. Bill Foster (D-IL)	Dahlia Sokolov, Staff Director	Rep. Ralph Norman (R-S.C.)	Josh Mathis, Staff Director

Other Members with Special Interest

There are a number of Congressional Caucus Groups that focus on specific issues related to DOE. CI has primary responsibility for interacting with these caucus groups, and others. Some congressional caucuses of interest to DOE include:

- Advanced Energy Storage Caucus
- Arctic Working Group Caucus
- Artificial Intelligence Caucus
- Biofuels Caucus
- Brain Injury Task Force
- Climate Solutions Task Force
- Coal Caucus
- Cybersecurity Caucus
- Energy Caucus
- Energy Savings Performance Caucus
- Grid Innovation Caucus
- High Performance Building Caucus
- Long Rage Strike Caucus
- National Labs Caucus
- Natural Gas Caucus
- Northwest Energy Caucus
- Nuclear Cleanup Caucus
- Nuclear Security Working Group
- Oil and Gas Caucus
- Problem Solvers Caucus
- Propane Caucus
- Safe Climate Caucus
- Smart Cities Caucus
- Solar Caucus
- Sustainable Energy and Environment Caucus

Required Reports and Updates to Congress (CF)

There is a statutory requirement that the Secretary notify HEWD and SEWD at least three full business days in advance of making any grant awards or contracts of more than $1 million, issuing a letter of intent to make an allocation award, or announcing publicly the intention to make an award. CF works with program offices to notify appropriators of these awards.

Appropriations legislation instructs DOE to provide HEWD and SEWD reports on information of various

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topics. Reporting requirements appear in both legislative bill text and the report language that accompanies appropriations bill text. CF adopts requirements in report language for an enacted appropriations bill and the original House and Senate reports, even if the legislation accompanying the report was never passed. Appropriators are interested in the Department adhering to this practice.

CF manages reports required in appropriations bill and requested in report language by assigning reports to program offices and tracking progress to completion. Once CF receives a finished report, the report is cleared through the Office of the Secretary and provided to OMB for clearance. The final report and cover letters are transmitted under CF's signature. In general, reports required by appropriations language are shared only with the relevant Subcommittee and are not public.

Working with Other Legislative Offices to Clear Materials for Congress

- **Testimony and Questions for the Record**

  A committee initiates a request to hold a hearing by contacting CI or CF to identify a witness for a hearing under development. This witness may be the Secretary, Deputy Secretary, or other leaders in the Department from relevant Program or Functional Offices. This usually occurs through a formal letter of invitation from the Chairman, and at times CI or CF may receive advance notice from committee staff. CI manages appearances before authorizing committees on authorization-related topics; CF manages appearances before appropriations committees. CI and GC are responsible for Oversight testimony.

  Once testimony is drafted by the appropriate program office, CI and CF coordinate the draft testimony with relevant program and functional offices and officials for review and clearance, and then with the Office of Management and Budget (OMB) for approval. OMB may disseminate the testimony to other agencies or offices for review under this process. The Secretary and functional office witnesses often rely on CI or CF for Member biographies, briefing materials, and hearing preparation meetings, while Program Office witnesses use internal staff to work these tasks.

  Department witnesses are frequently asked to answer questions posed by Members of Congress after a hearing for the hearing record (Questions for the Record or "QFRs"). Responses to QFRs are prepared and cleared through the same process as testimony before being sent back to the Committee and incorporated in the official hearing record.

  For budget testimony the Secretary traditionally testifies at hearings on the President's Budget before the Department's major committees of jurisdiction: House Energy and Commerce; House Science, Space, & Technology Committee, Senate Energy and Natural Resources, Senate Appropriations Energy and Water Development Subcommittee; and House Appropriations Energy and Water Development Subcommittee. Under Secretaries and Assistant Secretaries may also be asked to testify on the budget.

  GC drafts DOE legislative proposals and obtains OMB clearance of these proposals. Further, GC acts as the DOE contact point with OMB on all non-budget legislative matters. This includes participating in the analysis and formulation of DOE positions and comments on pending and enrolled bills, as well as other agencies' proposed legislation and testimony.

- **Congressional Budget Office (CBO)**

  CBO is a legislative branch agency that produces independent analyses of budgetary and economic issues to support the Congressional budget process. CF staff provide technical assistance to CBO staff on an as-needed basis to explain President's Budget proposals or the impacts of pending legislation in Congress.

- **Government Accountability Office (GAO)**

  CF leads DOE interactions with the Government Accountability Office, a legislative branch audit agency with statutory authorities to review DOE programs and operations. CF designates lead offices for new audits, assists Program, Functional and Field offices in responding to data requests as needed, provides weekly reports on GAO activity, and tracks and reviews responses to GAO audit reports. As of October 13, 2020, GAO was performing 63 separate audits or assessments affecting DOE. The current number of audits is consistent with recent years.

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Milestone(s)

House Democrats are expected to hold caucus leadership elections November 18 and 19 and contested committee chair elections the week of November 30. House Republican elections will likely occur around the same timeframe.

The Senate has not indicated the timing on caucus leadership elections. Past practice has been that this happens at the beginning of a new Congress.

The 117th Congress is scheduled to begin January 3, 2021.

Relevant Pending Legislation

1. **Continuing Resolution through December 11**

   On October 1, the President signed a Continuing Resolution (CR) to fund the government through December 11, 2020. The CR continues spending at FY 2020 levels. Anomalies affecting DOE were included in the CR:

   - Section 113 - Intelligence authorization extension; and,
   - Section 127 - Stops the Western Area Power Administration payment to Treasury.

   Of note, Section 140 of the CR extends Section 3610 of the Coronavirus Aid, Relief, and Economic Security (CARES) Act for the duration of the CR. This provision authorizes Federal contractors and subcontractors to be paid weather and safety leave if unable to work due to COVID-19.

2. **FY 2021 appropriations bills**

   In July, the House marked up FY 2021 appropriations bills at both the subcommittee and committee level, and passed the bills off the Floor.

   The Senate has not released any FY 2021 appropriations bills to date. The expectation is that SEWD will release a bill after the election ahead of potential final year spending negotiations with the House. The Senate is not expected to mark-up this bill and will instead use the text of the bill to undertake FY 2021 conference negotiations with the House.

3. **FY 2021 Omnibus appropriations bill**

   During Summer 2020, the House Appropriations Committee considered the FY 2021 HEWD bill. This bill was considered on the Floor and passed. The expectation is that Congress will work to pass an Omnibus appropriations bill for the remainder of FY 2021. A decision on another CR will be made by leadership after the election.

4. **FY 2020 National Defense Authorization Act**

   The National Defense Authorization Act (NDAA) authorizes appropriations for defense programs of the Department of Energy, including the National Nuclear Security Administration (NNSA); the Office of Intelligence and Counterintelligence (IN); and portions of the Office of Science (SC) and the Office of Environmental Management (EM). The NDAA also establishes new defense policies and changes to previous policies.

   The NDAA process begins with the transmission of the President's budget request to Congress in January/February. The Administration/DOE often transmits legislative policy proposals to the committees of jurisdiction in conjunction with the budget request.

   The House Armed Services Committee (HASC) and the Senate Armed Services Committee (SASC) begin work on the NDAA following annual budget hearings, which typically lead to the drafting and markup of separate bills in the House and the Senate in May/June.

Leadership Changes in the 117th Congress

CF is currently aware of two potential changes to the Appropriations Committees for the 117th Congress: the retirement of House Appropriations Committee Chairwoman Nita Lowey and the retirement of Senate Energy and Water Development Appropriations Subcommittee Chair Lamar Alexander. At this time, the committee replacements are unknown. If the Senate majority changes, a period of reorganization of all committees will likely occur, including voting on Chairmen and Ranking Members and possible redistribution of committee staffs.

CF maintains collegial relationships with the majority and minority staff of the House and Senate Appropriations Committees, especially on the

Energy and Water Development Subcommittees. Appropriations staff interactions are focused on technical budget assistance and are normally less partisan than DOE's interactions with authorizing committees.

CI is currently tracking potential changes to DOE's authorizing committees for the 117th Congress:

- **Senate Energy and Natural Resources Committee**

  Senator Joe Manchin (D-WV) is the current Ranking Member of the committee and is expected to serve as Chair or Ranking Member for SENR in the 117th Congress (depending on Senate Majority). The current Chairman, Lisa Murkowski (R-AK), is term-limited under party rules governing committee chairmanship and will be unable to serve as Chair or Ranking Member for SENR in the 117th Congress. Sen. John Barrasso (R-WY) is widely expected to be the next Chairman or Ranking Member unless he decides to remain the Chairman of Senate EPW.

- **House Energy and Commerce Committee**

  Rep. Frank Pallone (D-NJ) is the current Chairman of the committee and is expected to continue in this role in the next Congress. Ranking Member Greg Walden (R-OR) is retiring from Congress and at this time a replacement is unknown. Reps. Michael Burgess (R-TX), Cathy McMorris Rodgers (R-WA), and Bob Latta (R-OH) have expressed interest in running to replace Ranking Member Walden.

- **House Armed Services Committee**

  Rep. Adam Smith (D-WA) is the current Chairman of the committee and is expected to continue in this role in the next Congress. Ranking Member Mac Thornberry (R-TX) is retiring from Congress and at this time a replacement is unknown. Reps. Joe Wilson (R-SC) and Michael Turner (R-OH) are next in seniority and therefore the likeliest to replace Ranking Member Thornberry.

Section II: Interactions with Intergovernmental Partners

CI maintains ongoing communications with governors, state legislators, tribal, and local officials across the country. CI proactively engages stakeholders to ensure that their views are considered as part of the Department's decision-making process. CI also communicates routinely with all relevant stakeholders on DOE announcements, initiatives, proposals, and grants; and assures appropriate follow-up.

The Department has a physical presence in 30 states. Of those, much of CI's focus is on 12 states where multiple, ongoing DOE missions are executed at DOE sites and National Laboratories (California, Colorado, Idaho, Illinois, Ohio, Kentucky, Nevada, New York, New Mexico, South Carolina, Tennessee, and Washington).

CI interacts on a regular basis with intergovernmental and tribal associations including but not limited to: the National Governors Association; regional governors associations; National Association of Attorneys General; National Congress of American Indians; National League of Cities; National Conference of State Legislatures; National Association of Counties; U.S. Conference of Mayors; Southern States Energy Board; and the National Association of State Energy Officials. The focus of CI's work with these organizations is to communicate the activities of DOE programs, policies, and initiatives; and solicit views, comments, and concerns from these groups. These efforts extend to a broad group of constituencies, to include business/industry, civic groups, colleges, universities, foundations, trade associations, and energy-oriented organizations.

Tribal Affairs

CI engages with the 566 federally-recognized tribes, and the tribes' more than 250 reservations. This includes: advising and informing DOE senior officials on potential impacts of Departmental programs on tribal interests and culture; developing and enhancing working relationships with Tribal leaders and organizations and entities working with tribal governments; representing DOE with sovereign Tribal governments and at tribal meetings and conferences; and recommending policies and procedures for ongoing collaboration between DOE and tribes. CI also works very closely with the

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DOE Office of Indian Energy (IE) to assist in the management of the Indian Country Energy Working Group, the National Tribal Energy Summit, and IE's work with congressional partners to advance the mission of implementing activities that assist American Indian Tribes and Alaska Native villages with energy development, capacity building, energy cost reduction, and electrification of Indian lands and homes.

Section III: Interactions with the Office of Management and Budget (OMB)

Summary

OMB is a critical partner in fulfilling the Department's mission and achieving Administration and Departmental priorities. CF serves as the Department's liaison to OMB to assess the effectiveness of agency programs, address competing funding demands among programs, and set funding priorities.

OMB Organization

The largest component of OMB is the five Resource Management Offices, the Budget or "B" side, organized along functional lines mirroring the U.S. federal government, each led by an OMB associate director. These are divided into divisions and branches. DOE works with three branches:

- Force Structure and Investment Branch (NNSA)
- Energy Branch (all programs excluding NNSA and the Power Marketing Administrations)
- Water and Power Branch (PMAs)

The Management or "M" side of OMB includes several offices that focus on policy and guidance for Departments to adhere to. For example:

- Performance Team: Manages implementation of the Government Performance and Results Act Modernization Act (GPRA-MA) that sets requirements for strategic planning and performance evaluation.
- Office of Federal Financial Management and Office of Federal Financial Policy: provide guidance and policy on financial management.

DOE staff also work with OMB-wide support offices which include the Office of General Counsel, the Office of Legislative Affairs, the Budget Review Division, and the Legislative Reference Division.

- The Budget Review Division performs government-wide budget coordination and is largely responsible for the technical aspects relating to the release of the President's budget each February.
- The Legislative Reference Division is the central clearing house across the federal government for proposed legislation or testimony. This Division is also responsible for preparing Statements of Administrative Policy (SAPs) for the President. These statements are used for OMB to communicate the President's and agencies policies to the government as a whole and set forth policymaker's agendas.

Transition Year Formulation

In a normal budget year, the contents of the President's Budget are negotiated between federal agencies and OMB from September to January, with a complete budget due to the first Monday in February. In recent transition years, the President has issued a top-level budget in either mid-February (Clinton), late February (Obama, Bush), or March (Trump). The full array of detailed budget publications has commonly been released in early April. The Trump Administration delayed a full budget release until May 2017. The Obama Administration delayed the budget requests in 2009 and 2013 due to the work needed to enact the Recovery Act and a full-year annual appropriation.

OMB typically has all budget-related policy appointees in place quickly. OMB will generally develop a top-level February budget in a manner that reflects the most important campaign promises, with fewer opportunities for cabinet agencies (which may not have confirmed appointees) to negotiate top-line numbers. OMB will usually initiate the process within a week or two of the Inauguration. OMB will usually provide:

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- A single number for each agency's appropriations; and,
- A few policy issues to be highlighted in the February budget document.

Clearance Process

OMB ensures that agency reports subject to review, rules, testimony, and proposed legislation are consistent with the President's budget and with administration policies.

Within the Executive Branch, there are several types of clearance processes required for DOE documents. Requirements for OMB clearance of legislative material and the type of reports subject to OMB review are outlined in OMB Circulars A-11 and A-19.

Strategic Plan and Agency Priority Goals

Agencies are required to develop an Agency Strategic Plan and Agency Priority Goals (APGs), reviewed and approved by the Office of Management and Budget (OMB).

Summary

Federal agencies are required by statute to produce an Agency Strategic Plan and Agency Priority Goals (APGs). These materials, which are planned for public release in February 2022, express the Department's goals and highest priorities.

Agency Strategic Plan

- Required by the Government Performance and Results Act of 1993 (P.L. 103-62) as amended by the GPRA Modernization Act of 2010 (P.L. 111-352)
- Covers 2022 – 2026
- Secretarial Decisions:
  - Content: Emphases and broad areas
  - Methodology for Plan development
  - Development timeline

Agency Priority Goals

- Required by the GPRA Modernization Act of 2010 (P.L. 111-352)
- Reflect top priorities of Administration and DOE Leadership
- Advance progress toward Strategic Goals and Objectives
- Near-term results should be achievable within approximately 24 months
- Require quarterly review by the Deputy Secretary
- Progress updates posted quarterly on Performance.gov

Status

The Office of Management and Budget (OMB) deadlines for providing draft materials begin in June 2021. DOE should begin development of the 2022-2026 Strategic Plan and 2022-2023 APGs at the start of calendar year 2021.

Milestone(s)

Agency Strategic Plan

- June 2021: Draft Mission Statement, Strategic Goals and Objectives due to OMB
- September 13, 2021: Full draft due to OMB
- November 2021: Agencies receive OMB feedback
- December 23, 2021: Agencies deliver final draft Strategic Plan to OMB
- February 7, 2022: Agencies publish Strategic Plan

Agency Priority Goals (APGs)

- June 4, 2021: Draft Impact Statements (Topic Areas) due to OMB
- September 13, 2021: Draft APG Statements (Impact and Achievement Statements) due to OMB
- November 2021: Agencies receive OMB feedback
- January 14, 2022: Agencies provide final APG Statements to OMB
- February 7, 2022: APG Statements published on Performance.gov
- February 2022: Quarterly APG reporting process begins for 2022-2023 APGs

Background

The Agency Strategic Plan is an opportunity for DOE Leadership to articulate priorities. The plan is required to be prepared only by Federal employees and include:

- Mission Statement.
- General goals and objectives.
- Description of how goals and objectives contribute to Cross-Agency Priority goals.
- Description of how goals and objectives will be achieved, including resources required and how DOE is working with other agencies on goal achievement.

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- Description of how goals and objectives incorporate views and suggestions obtained through congressional consultations.
- Description of how performance goals contribute to the general goals and objectives in the Strategic Plan.
- Key factors external to DOE that could significantly affect achievement of general goals and objectives.
- Description of the program evaluations used in establishing or revising general goals and objectives, with a schedule for future program evaluations.

The current set of Agency Priority Goals (APGs) cover FY 2020-2021:

- Commercial Adoption of Energy Technologies
- DOE Enterprise Cybersecurity
- Energy Sector Cybersecurity
- Environmental Management
- High Performance Computing (Exascale/Artificial Intelligence)
- Nuclear Stockpile Annual Assessment

Each APG has a Goal Leader and a Deputy Goal Leader within the Department. Quarterly Performance Reviews are held with Deputy Secretary and Goal Leaders to discuss progress. FY 2022-2023 APGs will be developed in conjunction with 2022-2026 Strategic Plan.

Department of Energy's Response to COVID-19

The health and safety of our DOE employees and contractors is paramount and guides all of the Department's return to the workplace decisions.

Summary

On May 18, DOE's COVID-19 Return to the Federal Workplace Framework was released, providing guidance for Federal officials to develop site/facility plans for DOE's transition from a maximum telework posture toward more normal operations. The status of operations varies across the DOE complex. Facilities located in different parts of the country have taken into account different state and local guidance, and some have maintained certain essential functions throughout the COVID-19 pandemic. Accordingly, DOE site/facility plans cascade from DOE's Framework, reflecting these varied circumstances and site-specific needs.

The approval level for transitioning to different phases also varies based on the site/facility. The Secretary makes the determination regarding DOE Headquarters. The Heads of Departmental Elements determine the status of field elements under their purview, in consultation with the applicable Under Secretary. For the Power Marketing Administrations, the final approval rests with the Administrators after informing the Head of Departmental Element and applicable Under Secretary. Where multiple Departmental Elements have employees working at the same site, a unified decision is made regarding the entire workforce at that site. Where DOE has sites/facilities in the same geographic region that are managed by different Departmental Elements, Federal officials align their return to the workplace to the greatest extent practicable.

DOE's Framework is a three-phased approach that aligns with *Opening Up America Again* and OMB, OPM, and CDC guidelines. It takes into account state and local government orders and conditions, as well as the current operating conditions and staffing of individual Federal facilities. For example, the DOE Headquarters COVID-19 Return to the Workplace Plan states that DOE HQ will monitor applicable state and local orders and consider the spirit and intent of those orders to the maximum extent possible while implementing its plan. DOE HQ will continue to assess any community changes to inform risk-based decision-making regarding progressing or regressing through the phases.

In Phases 1 and 2, mission-critical employees whose jobs are better performed onsite than through telework returned to the workplace. These employees include senior leadership; staff supporting Primary Mission Essential Functions (PMEF) and Mission Essential Functions (MEF); and other high priority senior-level program staff. Employees in Phases 1 and 2 were allowed to self-identify to remain on telework if they fell into one of the CDC-identified vulnerable populations, or if they lived with or cared for someone in a vulnerable population. Additionally, employees could self-identify if they were responsible for caregiving where services/facilities were closed or modified due to COVID-19. Employees not included in Phases 1 and 2 of the return to the workplace remain on telework or Weather and Safety Leave, as appropriate. Employees may not voluntarily return to the workplace without prior approval by the appropriate Head of Departmental Element.

COVID-19 Hotline Response Team

A COVID-19 Hotline Response Team was established on March 15, 2020, to serve as DOE's central point of contact for inquiries/reports from supervisors, employees, and on-site support service contractors regarding potential COVID-19 cases. It is staffed by a team of safety and health professionals from the Office of Management; the Office of Environment, Health, Safety and Security; and the Office of Enterprise Assessments. The COVID-19 Hotline Response Team uses a standardized questionnaire to gather pertinent facts; assess their relevance and significance; and develop recommendations for appropriate protocol for COVID-19 cases. At DOE HQ, the team conducts workplace contact tracing and tracks each case to its outcome. Additionally, to help improve communication with the workforce, the COVID-19 Hotline Response Team responds to requests for clarification on Frequently Asked Questions (FAQs), DOECASTs, and other COVID-19

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related guidance. The team tracks these questions to help guide the development of additional guidance and communications.

Flexibilities for Employees during COVID-19

Since the COVID-19 national emergency was declared, DOE has worked to provide as much flexibility as possible to employees while ensuring that DOE continues to meet its mission. Such flexibilities include:

- Instituting a teleworking policy that allows parents to telework with a child (or other persons requiring care) present at the home.
- Encouraging all supervisors to be as flexible as possible with employees (e.g., maximizing telework, adjusting work schedules) while ensuring mission requirements are met.
- Suspending core hours (9 AM – 3 PM) to permit schedule flexibility.
- Promoting the use of alternative work schedules to help employees balance work and personal responsibilities. Such schedules may allow employees to complete their biweekly work requirement in fewer than 10 workdays and to adjust start and end times to accommodate doctor appointments, dependent care issues, and other pressing matters.
- Authorizing 20 Hours of Excused Absence for Caregiving per pay period.
  - Since April, supervisors have had the authority to grant teleworking Federal employees up to 20 hours of excused absence per pay period to care for or provide educational instruction to children as a result of school/caregiving facility closures due to COVID-19.
  - This flexibility is also extended to employees to care for other family members, such as an elderly parent or an adult child with special needs, whose care facilities were closed due to COVID-19.
  - This authority has been extended multiple times based on local conditions affecting DOE employees. It is currently set to expire on December 19, 2020, which coincides with the typical end of the first half of the school year.

Additionally, where compliance has been impacted by the national emergency, DOE has offered temporary relief from adhering to certain DOE safety and security requirements. This relief has been critical to safeguarding the health and safety of DOE's workforce while allowing the Department to remain open to serve the American people and conduct mission critical functions.

Facility Changes at DOE Headquarters

At DOE HQ, many changes have been implemented to protect employees reporting to the workplace, such as:

- **Enhanced entrance screening criteria and protocols**

  DOE HQ uses CDC-informed enhanced entrance screening criteria to determine whether an individual (e.g., Federal employee, onsite support service contractor, visitor) may enter a facility. Returning personnel are advised that they may not enter the workplace if they have flu-like symptoms, including a temperature over 100.4 degrees Farenheit.

- **Social distancing protocols**

  Social distancing protocols have been implemented for Phases 1 and 2 and will be revisited prior to initiating Phase 3. For DOE HQ, this includes:

  - **Face Coverings** Personnel are encouraged, but not required, to wear face coverings while in HQ facilities, especially in high traffic areas where social distancing cannot be achieved (e.g., busy hallways, lobbies, elevators). Personnel who wish to use face coverings are asked to bring them to the facility. Depending on availability and demand, face coverings are provided at facility entrances at request.
  - **Common Areas** Areas such as cafeterias and gyms where employees are likely to congregate are closed until Phase 3.
  - **Meetings and other Gatherings** To the greatest extent practical, meetings are held using virtual tools. In-person meetings must adhere to social distancing recommendations (six feet) between participants and limit the number of attendees. Conference rooms and auditoriums have modified seating and capacity controls to ensure social distancing.
  - **Workspace Redesign** Open workspaces that cannot accommodate at least six feet

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of distance between employees may require employees to work onsite in shifts or use other mitigation strategies to allow for social distancing. Walk-up services (e.g., badging, food services) require the installation of sneeze shields and other appropriate safety barriers.

- **Hygiene items and services** DOE HQ installed hand sanitizer stations at DOE facility entrances and in high traffic areas and replaced soap dispensers, sink fixtures, and paper towel dispensers with touchless equipment.
- **Signage** DOE HQ posted signage throughout its facilities reminding employees to use proven hygiene practices and social distancing protocols, to stay home when ill, and to report any COVID-like symptoms.

Phase 3 with Increased Flexibilities

When DOE's COVID-19 Return to the Federal Workplace Framework was developed in May, it was assumed that Phase 3 would entail a return to normal, pre-COVID operations. However, based on then-current conditions, DOE issued updated guidance in July 2020 to allow for increased flexibilities when Phase 3 begins at DOE HQ. These flexibilities will help employees effectively manage schooling, dependent care, health vulnerabilities, and other issues.

When Phase 3 starts at DOE HQ, all full-time telework agreements provided at the start of the COVID-19 crisis will be rescinded and Federal employees will return to the workplace, unless they request increased flexibilities under a new *DOE HQ Phase 3 COVID-19* telework agreement. Employees who do not wish to telework in Phase 3 and intend to return to the workplace cannot be required to enter into a telework agreement in accordance with the 2010 Telework Enhancement Act.

Phase 3 with increased flexibilities includes:

- Supervisors working with Federal employees to return to set schedules in the workplace that allow for expanded telework flexibility (up to full-time, if warranted).
- Suspending core hours (9 AM – 3 PM) to permit schedule flexibility.
- Allowing employees to request schedule flexibility for commuting issues to accommodate for limitations in public transit services.
- Allowing employees to self-identify to remain on telework using the same criteria as permitted for Phases 1 and 2. At this time, employees are not required to identify what health condition qualifies them for identification in the vulnerable category.
- Authorizing employees in a telework status who are responsible for caregiving in instances where services are closed because of COVID-19 to use up to 20 hours of excused absence per pay period.

DOE HQ COVID-19 Phase 3 telework agreements will be reassessed every month to account for changes in essential services and conditions in the NCR due to COVID-19 and are revocable per Departmental guidance. Adjustments to these interim agreements can be made on an as-needed basis due to changes in individual circumstances. Employees are expected to notify their supervisors immediately if their situations or conditions change. Once Phase 3 starts, monthly emails from employees recertifying that conditions remain the same will be required.

Current Status of DOE

Approximately 18% of DOE's Federal employees are reporting into the workplace and 74% are teleworking. The majority of the Department's labs, plants, and sites remain in Phases 1 or 2. A few sites remain in Phase 0. At this time, only one site (EM-MOAB) has moved to Phase 3, as of September 21, 2020.

DOE HQ entered Phase 1 on June 8, 2020, and Phase 2 on June 29, 2020.

Next Steps and Leadership Communication

The Secretary currently sends out a weekly COVID-19 HQ-wide communications to employees that give updates on cases within the Department, answer frequently asked questions, and provide information about employee assistance resources.

Major Decisions/Events

DOE's senior leadership can continue to support the Department's Return to the Workplace Framework. Opportunities in this regard include:

- Continue supporting the exploration of a post-COVID-19 telework/remote-work posture that could save money and capitalize on efficiencies.
- Continue providing weekly communications to DOE employees regarding COVID-19.

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Enterprise Cybersecurity

The Department of Energy networks are targets of multiple nation states and other malicious actors. DOE Office of the Chief Information Officer (OCIO) coordinates and synchronizes cybersecurity functions across the full spectrum of DOE mission and operations. The Department also has a sector specific cybersecurity responsibility that is carried out by the Office of Cybersecurity, Energy Security, and Energy Resilience (CESER).

Summary

Protecting the information assets of the Department of Energy (DOE) is of vital importance to financial and national security posture. Due to the high concentration of advanced research, the responsibility for the transmission of 11% of the electricity for the United States, and the national security missions of the Department, DOE is constantly targeted by sophisticated nation-state adversaries. Additionally, DOE has statutory, sector-specific cybersecurity responsibility for the Energy Sector. This document is focused on the Chief Information Officer's (CIO) functions. CESER prepared a separate paper on DOE sector-specific cyber programs.

DOE is a complex agency both in the scope of its mission space and its unique organizational structure. DOE encompasses 17 National Laboratories and approximately 100 field installations across the country. The mission of the Department spans from open, collaborative research to maintaining the Nation's nuclear stockpile. Given this extreme divergence in mission focus areas, cybersecurity postures and approaches are carefully tailored to provide appropriate risk management for each installation. The organizational structure of the Department adds to this complexity. Cybersecurity funding and authority is divided between the CIO and the program offices. The CIO is responsible for developing policy, performing oversight, and providing an enterprise wide incident response and coordination capability. Program offices such as Science (SC), Environmental Management (EM), and the National Nuclear Security Administration (NNSA) directly fund the cybersecurity programs for their field elements at the National Laboratories, Power Marketing Authorities (PMAs), sites, and plants. In short, the CIO coordinates and oversees cybersecurity activities for the Department, and the program offices fund and execute DOE cybersecurity policies.

Creating policy and direction for such a large and diverse agency is extremely challenging. To ensure appropriate guidance on cybersecurity is promulgated, OCIO employs an open and collaborative development process for directives. This process is designed to capture and incorporate requirements from the multiple mission areas and provide appropriately tailored guidance for the complex.

The cybersecurity program of the Department has existed for over twenty years, but it has been primarily focused on protecting traditional information technology (IT). In FY 2020, the Department has increased its focus on cybersecurity risks associated with DOE's industrial control systems. These control systems are used to operate our advanced scientific tools, the electric grid in the PMAs, and in manufacturing and other plant facilities across the Department. The OCIO is coordinating the tailoring of policies to specifically address the cyber risk for control systems and is developing Department-wide capabilities to provide cyber monitoring, incident response, and education opportunities for protecting the DOE's critical infrastructure.

Issue(s)

Topic 1

Currently, enterprise visibility into the status of cybersecurity networks across DOE is an issue. Each site has insight into their environments, but the OCIO continues to deploy solutions that will roll this site-specific visibility up to an enterprise level.

Topic 2

The Department needs to update our cybersecurity strategy and policies. This includes updating the current IT cybersecurity policy, DOE Order 205.1C,

creating a strategy for protecting control systems, and developing a enterprise policy for the various national security systems at DOE.

Topic 3

DOE faces challenges in workforce recruitment and retention as we work to attract cyber professionals with the right training and experience. Workforce modeling in both the public and private sector predicts there will be a significant gap between the required number of cybersecurity professionals and the pool of available qualified candidates.

Topic 4

Supply Chain Risk Management (SCRM) is critical to ensuring IT products and services are secure for achieving mission outcomes by highlighting the risks of potentially malicious functionalities, counterfeits, and vulnerable products due to poor manufacturing and development practices. The DOE SCRM program supports compliance with the Federal Acquisition Supply Chain Security Act, North American Electric Reliability Corporation (NERC), and Critical Infrastructure Protection (CIP) requirements. Quantitative Risk Management (QRM) training and guidance helps cybersecurity SMEs express risk in terms of probability and cost to more effectively communicate with executives and budget planners. QRM is meant to supplement rather than replace existing qualitative approaches.

Status

Topic 1

In FY 2020, deployed Big Data Platform (BDP) as a central cloud-based repository for consolidating cybersecurity sensor data for cyber operations and analytics. In addition, the capability can be leveraged by other programs for their research if they have an approved plan.

Continuing to deploy cybersecurity sensors as part of the federal Continuous Diagnostics and Mitigation (CDM) program. Department of Homeland Security (DHS) funding for expanding the licensing and integration of cybersecurity sensors was diverted to support a major shift to remote work in FY 2020. DOE anticipates continuing the deployment when DHS restores funding in FY 2021.

Topic 2

- The Department is updating DOE Order 205.1C to address new threats. This process will take a year, and the process will include input from our Management and Operating (M&O) community, program offices, and other stakeholders.
- At the end of FY 2020, the Control Systems Working Group (CSWG) was established to coordinate across programs to develop a strategy that includes asset inventory; vulnerability management and assessment; instrumentation; configuration; and alignment with ongoing processes and systems. This effort is not currently funded.
- In FY 2021, DOE is developing a new policy to address national security systems at DOE. This effort is being led by the OCIO. The operators of these systems, NNSA and the Office of Intelligence (IN), will be critical partners in this process.

Topic 3

- The Department is leveraging both Cybersecurity and Science, Technology, Engineering, and Mathematics (STEM) direct hire authorities and internship programs.
- The Department is working in interagency forums to explore cybersecurity reskilling programs and expanding cybersecurity workforce initiatives to incorporate recruitment and retention incentive programs.
- National Labs face this same issue, but have more flexibility to address the problem. Because they are not limited to the same processes and compensation structure as the federal government, they can employ a number of site specific incentive programs to help attract the best available talent.

Topic 4

- Enterprise SCRM program achieved full operational capability in FY 2020 to evaluate potential exposure based on five risk lenses: Cybersecurity, Foreign Interest, Geo-Political, Compliance, and Financial. To date, the program has more than 90 active users, and has completed over 400 assessments. CESER and IN have additional programs in development related to testing individual IT components, which will further DOE's understanding of supply chain risk.

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- Factor Analysis of Information Risk (FAIR) methodology has been integrated into the DOE Enterprise Cybersecurity Risk Management methodology. We will continue to offer training and assistance in conducting risk analysis in scenarios such as investment tradeoffs and modernization efforts.

Milestone(s)

Update DOE Cybersecurity Strategy by 2nd QTR FY 2021.

Deploy the full-scale Vulnerability Disclosure Program by FY 2022.

Major Decision/Events

DOE CyberFire and International Hackathon scheduled for FY 2021. The biannual training and hackathon allows DOE to develop technical workforce skills and partner with key international, federal, and industry partners.

Department of Energy Actions to Improve Contract and Project Management to Facilitate Removal from the Government Accountability Office High Risk List

The Office of Environmental Management and the National Nuclear Security Administration are taking actions to improve their contract and project management to facilitate the Department's removal from the General Accountability Office's (GAO) High Risk List. Congressional oversight and increased statutory requirements will continue and may increase if progress is not made to resolve the issues identified by the GAO.

Summary

The Department of Energy (DOE) is the largest civilian contracting agency in the Federal government and spends approximately 90 percent of its annual budget on contracts and projects to operate its scientific laboratories; engineering and production facilities; and environmental restoration sites. DOE's contract and project management functions have been on the Government Accountability Office's (GAO) High-Risk List for Fraud, Waste, Abuse and Mismanagement since the list's inceptions in 1990. Over time, as DOE successfully implemented changes, GAO narrowed the focus of DOE's designation to the National Nuclear Security Administration's (NNSA) and the Office of Environmental Management's (EM) major contracts and projects exceeding $750 million.

The most recent GAO list report[1] includes DOE's contract and project management based on observations and recommendations applicable to EM and NNSA. Given the risks posed by EM's and NNSA's major contracts and projects, the Energy and Water Development Appropriations Bill, 2019, House Committee on Appropriations report (H. Rept. 115-697) required DOE to provide a plan for removal from the High-Risk List.

Issue(s)

DOE has implemented numerous improvements affecting contract and project management across the Department since its inclusion on the list. GAO recognized those improvements, and in January 2009, removed the Office of Science (SC) from the list because of improved contract and project management performance. This was the first instance of GAO narrowing the scope of the Department's high-risk designation since the establishment of the list.

NNSA and EM contract and project management remained on the list. In February 2013, GAO recognized NNSA's and EM's success in managing non-major contracts and projects (those less than $750 million), and narrowed DOE's high-risk designation further to include only major NNSA and EM contracts and projects. This designation remains as of the 2019 High Risk List, the last time it was issued by GAO.

GAO updates the High-Risk List and reports on the status of progress of departments and agencies in addressing high-risk areas at the start of each new Congress. Based on this schedule, the next list will be issued in 2021. GAO uses five criteria to assess progress. The criteria guide agency actions to make progress for removal from the list.

1 High-Risk Series: Substantial Efforts Needed to Achieve Greater Progress on High-Risk Areas. https://www.gao.gov/products/GAO-19-157sp

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GAO High-Risk Area 5-Criteria Progress Chart

The criteria and DOE's most recent progress assessment in 2019 are:

- **Leadership Commitment**

  Demonstrated strong commitment and top leadership support. – *Met*

- **Capacity**

  Agency has the capacity (i.e., people and resources) to resolve the risk(s). – *Not Met*

- **Action Plan**

  A corrective action plan exists that defines root causes and solutions, as well as provides for substantially completing corrective measures including steps necessary to implement solutions GAO recommended. – *Partially Met*

- **Monitoring**

  A program has been instituted to monitor and independently validate the effectiveness and sustainability of corrective measures. – *Partially Met*

- **Demonstrated Progress**

  Ability to demonstrate progress in implementing corrective measures and resolving the high-risk area. – *Partially Met*

GAO determined that the Department met the Leadership Commitment criterion and is continuing to make improvements to address the other criteria. The remaining observations and recommendations are applicable to only NNSA and EM.

DOE's continued presence on the list has resulted in increased Congressional attention to DOE's contract and project management challenges and, specifically in 2019, the Committee on Appropriations' report to the *Energy and Water Development Appropriations Bill, 2019,* directed DOE to provide a plan for getting off the list.[2] DOE submitted the plan with the status of actions to the Committees on Appropriations in July of 2020.

Status

Leadership Commitment

DOE leadership has consistently and continually engaged with program offices to improve contract and project management throughout the Department. In 2018, the Deputy Secretary launched a comprehensive initiative to improve acquisition management across the Department.[3] The initiative outlined strategies to consistently award contracts to responsible, high-performing entities; incentivize excellent performance; hold contractors accountable for results; and obtain the best value for the American taxpayer. The GAO highlighted this initiative in its 2019 report as evidence that DOE continues to meet the Leadership Commitment criteria.

Capacity

NNSA and EM need to recruit and retain people and resources for oversight of capital asset acquisitions to resolve issues identified by GAO in contract and project management to fully address the Capacity criterion. Prior to 2019, Congress placed a statutory limit on the number of NNSA personnel which has since been increased. NNSA started a hiring campaign to recruit additional staff which included

2 H. Rept. 115-697 - ENERGY AND WATER DEVELOPMENT APPROPRIATIONS BILL, 2019 https://www.congress.gov/congressional-report/115th-congress/house-report/697/1, page 79.

3 Deputy Secretary of Energy Memorandum "Improving Acquisition Management" – September 12, 2018

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a job fair that resulted in approximately fifty on-the-spot, contingent offers for new hires. Further efforts include targeted recruitments, especially at universities that graduate significant numbers of Science, Technical, Engineering, and Math (STEM) students. EM is addressing capacity issues by developing a new EM Cleanup Program Policy that provides guidance on resource requirements for contract and program management. Additionally, EM is continuing to partner with the US Army Corps of Engineers for project management support.

Action Plan

The Department implemented systematic action plans over several years to overhaul the methods and processes for managing contracts and delivering projects and services. DOE put in place dedicated project management oversight offices; standardized processes for training, qualifying and credentialing the corps of federal project directors; policies and procedures to methodologically track project execution; requirements for substantive, independent project reviews (including for safety) throughout the project execution cycle; earlier senior leadership involvement in project execution; improved cost estimation techniques; and higher expectations for contractor project delivery.

NNSA's implementation of these reforms has resulted in a record of delivering projects with estimated costs under $750 million, within cost and schedule baseline. Performance on these projects has also led outside agencies to seek counsel on managing construction projects. NNSA currently has only one project over $750 million under execution, the Uranium Processing Facility (UPF). UPF is a $6.5 billion nuclear project at the Y-12 National Security Complex with a projected delivery date in FY 2026. The project is parsed into seven sub-projects, two of which would each qualify as major projects. Four of the seven sub-projects have been delivered at or below baselines and, as certified to Congress, the overall project remains on cost and schedule.

EM has also made significant progress to address contract and project management issues. Prior to 2008, when DOE conducted a root cause analysis of contract and project management and developed an action plan, project baselines were only 44 percent successful (12 of 27 projects). The EM project portfolio which has been baselined after 2008 has a 94 percent success rate (60 of 64 projects).[4] EM expects to continue this positive trend by:

- Developing smaller well-defined projects and sub-projects;
- Increasing design maturity prior to construction;
- Using Project Peer Reviews;
- Strengthening project management requirements to approve each stage in the design and construction process; and
- Improving funding based on project phases.

Notwithstanding the above progress, GAO noted "EM's 2017 cleanup policy does not direct EM to develop a root cause analysis and corrective action plan at either a program or project level when there is evidence that a cost or schedule baseline will not be met or there are cost overruns."[5] To address these issues, EM is contracting for an independent assessment with the National Academy of Sciences (NAS) to:

- Assess program and project management practices benchmarked against DOE project management policies and other federal best practices for project planning and execution, technology insertion, contract management, project controls and reporting;
- Evaluate the efficacy of the EM approach for well-defined and measurable outcomes for cleanup activities and review EM's prioritization strategy and decision support for operational actions to achieve stated outcomes; and
- Evaluate the level and appropriateness of contractor and site operations oversight, as well as interaction with external entities to meet the stated outcomes.

EM is also revising the EM Cleanup Program policy to require a root cause analysis, including a documented plan with specific corrective actions for projects that exceed baselines or experience cost overruns.

4 DOE's definition of success is "completing 90% of projects across a three-year rolling average, not to exceed 10% of the original cost baseline for the original approved scope for all capital asset projects with a Total Project Cost greater than $50M." (DOE Order 413.3B Program and Project Management for the Acquisition of Capital Assets).

5 High-Risk Series: Substantial Efforts Needed to Achieve Greater Progress on High-Risk Areas. https://www.gao.gov/products/GAO-19-157sp

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Monitoring

GAO has acknowledged NNSA made progress in monitoring the management of NNSA contracts. NNSA revised contract clauses to strengthen oversight and reporting of management information; increased efforts to actively monitor and address subpar contract performance; and established field office peer reviews to evaluate contractor oversight activities. Beyond these efforts, GAO recommended that NNSA "should include quality cost information in its contractor performance evaluations to enable better performance assessments."[6] Consistent with this recommendation, NNSA is implementing guidance to review cost information in contractor performance evaluations.

For the EM program, GAO reported that EM faces challenges in monitoring and independently validating the effectiveness and sustainability of in-place and proposed corrective measures. GAO specifically noted that "EM's 2017 cleanup policy does not follow most selected best practices for program or project management."[7] EM analyzed the root causes leading to inadequate monitoring and found the need to improve the existing Integrated Planning, Accountability, and Budgeting (IPAB) System, and the Project Assessment and Reporting System (PARS); and to revise the EM Cleanup Program Policy to incorporate best practices. EM plans to enhance the monitoring of corrective measures by:

- Revising EM Cleanup Program Policy;
- Conducting Quarterly Program Reviews and annual site reviews to brief senior EM leadership on status;
- Generating EM Cleanup Program Portfolio monthly reports which provide status and metrics for projects and activities at all EM sites to EM senior leadership; and
- Conducting a study of options for updating or replacing the IPAB System and PARS, to provide current and complete data for decision-makers.

Demonstrated Progress

GAO reported the Department has partially demonstrated progress in implementing corrective measures and resolving problems with contract and project management. NNSA has been able to predominantly fulfill the requirements of this criterion. GAO identified the expansion of cost and schedule estimating capabilities by NNSA's Office of Cost Estimating and Program Evaluation (CEPE), and increased use of best practices in this area as progress achieved. GAO linked this progress with the Department reevaluating and subsequently terminating the Mixed Oxide Fuel Fabrication Facility in favor of a less costly approach. GAO recommended additional progress was needed by NNSA in adhering to leading practices for planning and implementing common financial reporting. NNSA is implementing this type of reporting through the current Congressional budget structure. This reporting will be supported with project estimates from the updated independent cost estimation capability. GAO also identified the need for better estimates by NNSA for uranium enrichment. Currently, NNSA's uranium enrichment project is too early in its lifecycle to support a substantive basis for its cost. NNSA will apply relevant project cost estimation methods following best practices as the project matures.

EM contracts and projects continue to face significant cost and schedule challenges due in part to insufficient periodic lifecycle cost estimate updates; changing parameters over the lifecycles of first-of-a-kind, complex projects; and the use of incentive contracts without appropriate performance guarantees and penalties. To address these challenges, EM plans to:

- Revise the EM Cleanup Program Policy to incorporate lessons learned, as well as recommended GAO best practices;
- Update metrics for all projects to determine success rates and factors; and
- Continue to separate very large complex projects into more discrete projects and sub- projects with separate Performance Baselines that can be completed over a shorter period with more scope certainty.

EM is also taking steps to improve management of contracts and projects by implementing environmental remediation via the End State Contract Model (ESCM). This reform strategy

6 Ibid.
7 Ibid.

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applies to complex acquisitions for cleanup-type requirements with end states that can be defined, and generally are valued over $100 million. The term "End State" is defined as the specified situation, including accomplishment of completion criteria, at the end of a task order period of performance. In EM's case the end state is directly linked to an environmental clean-up activity. The essence of the ESCM is to:

- Streamline source selection evaluations by using focused discriminators resulting in awards to highly qualified responsible contractors;
- Price work under orders as the work can be defined;
- Tailor risk and incentives in each order based on the work involved versus a "one size fits all" contract type; and
- Provide for a quick "off-ramp" for a poorly performing contractor via an IDIQ minimum ordering amount.

The ESCM goal is to improve contract and project management by decreasing solicitation timelines and costs; separating the work into tailored, manageable orders; obtaining better pricing from better defined work scope; and appropriately shifting risk and accountability to contractors by providing the ability to establish the appropriate contract type (cost-reimbursement or fixed-price) for the work under each task order.

Background

GAO designated "DOE's Contract and Project Management for the National Nuclear Security Administration and the Office of Environmental Management" as one of thirty-five areas of high-risk vulnerable to fraud, waste, abuse, and mismanagement, or that need transformation in the Federal Government. In 1990, GAO added the Department to the High-Risk List, based on an assessment that DOE's management and oversight of contractors was inadequate and left the Department vulnerable to fraud, waste, abuse, and mismanagement. GAO updates the High-Risk List and reports on the status of progress of departments and agencies in addressing high-risk areas every two years, generally at the start of each new Congress. The most recent High-Risk List was published in March 2019.

For more information, please visit the GAO High Risk List website at https://www.gao.gov/highrisk/overview.

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