ENERGY AND WATER DEVELOPMENT APPROPRIATIONS FOR 2017

HEARINGS

BEFORE A

SUBCOMMITTEE OF THE

COMMITTEE ON APPROPRIATIONS

HOUSE OF REPRESENTATIVES

ONE HUNDRED FOURTEENTH CONGRESS

SECOND SESSION

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT

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DEPARTMENT OF ENERGY

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ENERGY AND WATER DEVELOPMENT APPROPRIATIONS FOR 2017

WEDNESDAY, FEBRUARY 10, 2016.

DEPARTMENT OF ENERGY—NUCLEAR REGULATORY COMMISSION

WITNESSES

STEPHEN BURNS, CHAIRMAN, NUCLEAR REGULATORY COMMISSION

KRISTINE SVINICKI, COMMISSIONER, NUCLEAR REGULATORY COMMISSION

WILLIAM OSTENDORFF, COMMISSIONER, NUCLEAR REGULATORY COMMISSION

JEFF BARAN, COMMISSIONER, NUCLEAR REGULATORY COMMISSION

Mr. SIMPSON. The hearing will come to order. I would like to thank all the subcommittees again for their hard work on the fiscal year 2016 omnibus bill. I look forward to working with you during this busy year ahead. We just had an organizational meeting and things are moving relatively rapidly since the President's budget came out yesterday.

We are trying to get all our hearings in and try to move things up and go through regular order, and get individual bills done, which would be novel. We have not passed all of the individual appropriation bills and conference reports since 1994. It would be nice to actually get things done on time.

There are a lot of things in this world that I am uncertain about, but I am 85 percent sure of when October 1 comes. You would think we could get it done, but it is going to be a difficult year, and a more rapid year because we are obviously gone in August, and we have a couple of weeks where we are going to be out because of the party conventions in July.

I appreciate you all being willing to come first thing. I do not know if this is the first hearing in any of the subcommittees or not, but it is one of the first.

Although we just received the President's budget yesterday, we begin our oversight hearings today. The Appropriations Committee wants to move all 12 bills under regular order within the caps that are currently set in law, and finish our work on time.

We will need to maintain an aggressive schedule in order to conduct the thorough oversight that is needed to ensure that the fiscal year 2017 energy and water appropriations bill provides responsible funding to the programs within its jurisdictions.

Today's hearing is on the budget of the Nuclear Regulatory Commission. We have before us Stephen Burns, the chairman of the

Commission, and his fellow commissioners, Kristine Svinicki, Bill Ostendorff, and Jeff Baran.

Thank you all for being here today, and I would like to congratulate you on your leadership and the progress that has been made in recent months on the right-sizing of the NRC. I think you have done tremendous work.

I admit that initially I questioned the NRC's commitment to right-sizing. I was very troubled by the letter the NRC sent to us during last year's budget process.

While I am confident that had the NRC received a lower appropriation, you, the commissioners, would not have actually voted to adopt reductions that could risk safety and health before a more thorough review of lower priority activities was conducted, it was still disappointing to see a letter that suggested that you would.

That having been said, since then, the NRC has taken important first steps toward right-sizing. I congratulate you, and I look forward to further discussions on continuing these promising efforts.

The Commission plays an important role in ensuring that our nation can count on the clean and reliable energy that our nuclear power plants provide. The NRC must continue to assure the protection of public health and safety and provide a timely and predictable licensing process for the nuclear industry.

In addition, we must move forward on long term waste storage and the Commission must be prepared to advance new and innovative nuclear technologies.

I look forward to your thoughts on all of these issues. I would also ask the witnesses to please ensure for the hearing record that questions for the record and any supporting information requested by the subcommittee are delivered in final form to us no later than 4 weeks from the time you receive them. Members who have additional questions for the record will have until the close of business tomorrow to provide them to the subcommittee office.

With that, I would like to welcome our ranking member, Ms. Kaptur, to our first hearing of the new budget season, and yield her any time she may use for an opening statement.

[The information follows:]

Opening Statement
Chairman Simpson
Nuclear Regulatory Commission
10:30 am, February 10, 2016

The hearing will come to order.

I would like to thank all of the Subcommittee Members again for their hard work on the fiscal year 2016 bill and I look forward to working with you during the busy year ahead!

Although we just received the President's budget yesterday, we begin our oversight hearings today. The Appropriations Committee wants to move all 12 bills under regular order, within the caps that are set in law, and finish our work on time. We will need to maintain an aggressive schedule in order to conduct the thorough oversight that is needed to ensure that the fiscal year 2017 Energy and Water appropriations bill provides responsible funding to the programs within its jurisdiction.

Today's hearing is on the budget of the Nuclear Regulatory Commission.

We have before us Stephen Burns, the Chairman of the Commission and his fellow Commissioners, Kristine Svinicki, William Ostendorff, and Jeff Baran. Thank you all for being here today – and – I would like to congratulate you on your leadership and the progress that has been made in recent months to right-size the NRC.

I admit that, initially, I questioned NRC's commitment to right-sizing. I was very troubled by the letter the NRC sent to us during last year's budget process. While I am confident that had the

NRC received a lower appropriation – you – the Commissioners – would not have actually voted to adopt reductions that could risk health and safety before a more thorough review of lower priority activities was conducted – it was still disappointing to see a letter that suggested you would.

That having been said, since then, the NRC has taken important first steps towards right-sizing. I congratulate you - and I look forward to further discussion on continuing these promising efforts.

The Commission plays an important role in ensuring that our nation can count on the clean and reliable energy that our nuclear power plants provide. The NRC must continue to assure the protection of public health and safety and provide a timely and predictable licensing process for the nuclear industry. In addition, we must move forward on long term waste storage. And – the Commission must be prepared to advance new and innovative nuclear technologies.

I look forward to your thoughts on all of these issues.

I would also ask the witnesses to please ensure that the hearing record, questions for the record, and any supporting information requested by the Subcommittee are delivered in final form to us no later than four weeks from the time you receive them. Members who have additional questions for the record will have until the close of business tomorrow to provide them to the Subcommittee office.

With that, I would like to welcome our Ranking Member, Ms. Marcy Kaptur to our first hearing of the new budget season and yield her time for any opening remarks that she may have.

Ms. KAPTUR. Thank you, Mr. Chairman, very much, and good morning, Chairman Burns, and Commissioners Svinicki, Ostendorff, and Baran. Very happy to have you here today to talk about the Nuclear Regulatory Commission, and thank you for the work that you do.

Nuclear energy is a critical component of our nation's energy mix, and as a source of electricity which does not contribute to climate change, it will be particularly important as we strive to meet the targets of the clean power plan and to deliver on the commitments made to reduce our carbon emissions at COP21 in Paris.

As part of meeting these targets, we currently rely on an aging fleet of nuclear power generation facilities with an average age of 35 years. Many have already outlived their initial 40 year licenses while others are quickly approaching it.

At the forefront of my mind with regards to aging nuclear plants is First Energy's Davis-Besse plant in my own district, which in December of last year received a 20 year extension of its license. These plants provide good, stable and high paying jobs in addition to reliable and cost effective electricity, so in regards to this, I am happy to see Davis-Besse's license extended.

However, the bulk of our nuclear fleet is passing through this relicensing process, and I look forward to hearing about the steps you are taking at the NRC to ensure that communities in areas surrounding these plants are safe, especially as one in three Americans' lives lie within 50 miles of a nuclear power plant.

Last year at this hearing, there was a great deal of discussion on the right-sizing and re-baselining of the NRC's budget. I understand the report detailing that effort is scheduled to be completed in the next couple of months, and I hope you will be able to comment on the progress that you have made to that end as well, and the impact of your findings on the NRC's budget.

Finally, I would like to close by noting that yet another year has passed and we do not seem to be any closer to resolving how and even more controversially where to dispose of our nuclear waste.

The current approach of maintaining high level radioactive waste on-site at dozens of plants distributed throughout our country is far from ideal, and in the absence of a real forward motion at Yucca Mountain or another site, our Nation has no long term solution to this pressing problem. In fact, I was asked by someone in the press yesterday about this very issue.

In addition to $10 billion we have already spent on Yucca, the Department of Energy estimates that we have $27 billion of liabilities deriving from our failure to meet our legal obligation to dispose of this waste.

Interim storage may serve as a step in the right direction, but we truly require a permanent strategy. The government must live up to its responsibilities to our nation and provide for the eventual safe disposal of commercially spent fuel that is currently stored at these sites.

I look forward to your thoughts on how we can meet this obligation, and I thank you, Mr. Chairman, for yielding me this time.

Mr. SIMPSON. Thank you. Chairman Burns, you are going to give the opening statement, and others will have a few minutes if you wish to comment on the opening statement. Is that correct?

Mr. BURNS. Yes.

Mr. SIMPSON. Ok. The floor is yours.

Mr. BURNS. Thank you, and good morning, Mr. Chairman, Ranking Member Kaptur, and distinguished members of the subcommittee. We appreciate the opportunity to appear before you today to discuss the Nuclear Regulatory Commission's fiscal year 2017 budget request.

As you know, the NRC is an independent agency established to license and regulate the civilian use of radioactive materials in the United States. The resources we are requesting in fiscal 2017 will allow the NRC to continue to uphold our important safety and security mission.

Our proposed budget is $970.2 million, which includes 3,462 full time equivalent staff, and for the Office of Inspector General, an additional $12.1 million. Over our base budget, this represents a decrease of about $20 million and 90 FTE from the fiscal year 2016 enacted budget.

For further context, our request is $74 million and 280 FTE less than our fiscal 2014 enacted budget, and the fiscal 2017 budget request reflects our continued focus on our important mission while it also achieves resource savings and improves our efficiency. As we continue to work through the Project Aim initiative, we anticipate additional savings.

We are required to recover 90 percent of our budget through fees, so accordingly, $861.2 million of this fiscal 2017 budget request would be recovered from NRC licensees, resulting in a net appropriation of $121.1 million.

Let me highlight some of the work we plan to achieve. The NRC will continue licensing and oversight activities for 100 operating nuclear power reactors, and 31 research and test reactors.

The NRC expects to continue reviewing three new reactor combined license applications. Additionally, we will continue inspections of four new reactor units under construction, and continue our vendor inspection program.

We expect to review one small modular reactor design certification and to review three applications for medical isotope facilities.

The budget request provides funding for licensing reviews and oversight activities at reactors undergoing decommissioning, as well as continued oversight over nuclear waste and spent fuel storage facilities. We expect to review one application for a consolidated spent fuel storage facility.

We will continue to license and oversee the safe and secure use of radioactive materials, and in fiscal 2017, the NRC will complete approximately 2,000 materials actions, licensing actions, and about 900 routine health and safety inspections.

Of note, our 2017 request includes $5 million in non-fee billable activities to develop regulatory infrastructure and related activities to effectively review advanced nuclear reactor applications and technologies.

As we continue to work through Project Aim, we are confident the agency is on the right track. The savings have already been identified through a comprehensive evaluation that involved staff

and stakeholder input, and are reflected in part in our fiscal year 2017 request.

Still, we remain mindful of the importance of a highly skilled technical staff in carrying out our safety and security mission. While our size may change to reflect efficiency gains, the need for the service we provide the American people remains unchanged.

I want to highlight one other area we are focusing on improvement. We are cognizant of the committee's concerns regarding early commissioner involvement in rulemaking, and have approved a new approach to do so, and will provide requested information to the committee later, actually, beginning of next month, as provided in the committee report on the fiscal year 2016 appropriation.

On behalf of the Commission, I thank you for the opportunity to appear before you, and I know you share our dedication to our vital mission, and I would be pleased to answer your questions. Thanks very much.

Mr. SIMPSON. Thank you, Mr. Chairman.

[The information follows:]

WRITTEN STATEMENT
BY STEPHEN G. BURNS, CHAIRMAN
UNITED STATES NUCLEAR REGULATORY COMMISSION
TO THE
HOUSE APPROPRIATIONS COMMITTEE
SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
FEBRUARY 10, 2016

Good morning, Chairman Simpson, Ranking Member Kaptur and distinguished Members of the Subcommittee. My colleagues and I appreciate the opportunity to appear before you today to discuss the U. S. Nuclear Regulatory Commission's (NRC) Fiscal Year (FY) 2017 budget request.

As you know, the NRC is an independent agency established to license and regulate the civilian use of radioactive materials in the United States to ensure adequate protection of public health and safety, promote the common defense and security, and protect the environment. The resources we are requesting for FY 2017 will allow the NRC to continue to uphold our important safety and security mission.

We'd like to underscore that this budget request reflects a substantial reduction from the 2016 enacted budget. Project Aim is delivering on the promise to achieve efficiencies in both corporate and programmatic areas. The NRC has taken a hard look at the proposed budget, and is proposing reductions in both full-time equivalents (FTE) and contract support dollars that represent real savings. As we continue our work through the Project Aim initiative, we anticipate additional savings and efficiencies to come.

To put this in context, the FY 2017 budget request reflects a decrease of $73.7 million and 279.7 full-time equivalent employees from the FY 2014 enacted budget. We believe this FY 2017 budget request reflects our continuing focus on our important mission while achieving resource savings and improving the agency's efficiency and effectiveness.

In FY 2017, the NRC will continue licensing and oversight activities for 100 operating commercial nuclear power reactors, including the Watts Bar Unit 2 nuclear power station slated to begin commercial operation later in calendar year 2016, and 31 research and test reactors. The resources we have requested for FY 2017 also support ongoing work associated with implementing lessons learned from the Fukushima Dai-ichi Nuclear Power Plant accident in Japan. While we expect the bulk of the most safety significant enhancements to be completed in calendar year 2016 and to bring to closure our work on most of the longer-term "Tier 2 and 3" issues, resources requested for FY 2017 support the continued implementation of the "Tier 1" enhancements, including seismic and flooding hazard reevaluations, spent fuel pool instrumentation and mitigation of beyond design basis events.

During FY 2017, the NRC expects to continue reviewing three new reactor combined license applications. Additionally, the NRC will continue to conduct inspections of four new reactor units

under construction – Vogtle Electric Generating Plant, Units 3 and 4, and Virgil C. Summer Nuclear Station, Units 2 and 3 – and will continue to carry out its vendor inspection program for both new and operating reactors. The NRC also expects to receive and begin review of one small modular reactor design certification application from NuScale.

Further, the NRC plans to review three applications for medical isotope production facilities, including reviewing an operating license for one facility and conducting environmental and safety reviews of construction permits at two others.

The FY 2017 budget request includes $5 million in non-fee billable activities related to developing the regulatory infrastructure for advanced nuclear reactor technologies. This funding would prepare the NRC to undertake effective and efficient licensing reviews of advanced reactor technologies consistent with the maturity and development pace of the technologies. The intended activities to be initiated in FY 2017 would fall into three categories: licensing infrastructure, technical preparation, and outreach.

Additionally, the FY 2017 budget request provides funding for licensing reviews and oversight activities at power reactors undergoing decommissioning, including Kewaunee Power Station, San Onofre Nuclear Generating Station Units 2 and 3, Crystal River 3 Nuclear Power Plant and Vermont Yankee Nuclear Power Plant.

The FY 2017 budget request also ensures the NRC can continue to license and oversee the safe and secure use of radioactive materials used for medical, academic, industrial and research purposes. The NRC and Agreement states oversee approximately 21,000 specific materials licensees. In FY 2017, the NRC will complete approximately 2,000 materials licensing actions and approximately 900 routine health and safety inspections, as well as reactive and follow-up inspections.

In FY 2017, the NRC will continue its oversight over nuclear waste and spent fuel storage facilities, certify storage and transportation containers and respond to events involving our licensees. The NRC expects to review one application for an interim consolidated storage facility.

In FY 2017, the NRC's research program will continue to support the NRC's regulatory activities by evaluating and resolving safety issues for NRC-regulated nuclear power plants, other nuclear facilities and materials users that the agency regulates. The NRC will further enhance its regulatory programs through coordination and cooperation with other Federal agencies, States, Tribes, and international organizations and foreign governments. The NRC will continue to support international conventions on safety and treaty compliance, and support a wide range of activities to help foreign regulatory counterparts develop or enhance their programs and their controls over radioactive sources.

THE CHANGING REGULATORY ENVIRONMENT

Before I get into the specifics of the NRC's FY 2017 budget request, I would like to talk about our Project Aim effort to find efficiencies, use resources wisely, and streamline processes and regulatory decision making while continuing to meet our critically important safety and security mission.

Since 2001, the agency grew significantly to enhance its security and incident response regulatory structure, and to prepare for the projected growth in nuclear power in the United States. That forecast in growth has been adjusted downward in response to changes in the nuclear industry. As is appropriate, the NRC is being scrutinized by its stakeholders for its response to these changes and the resulting use of resources. The agency can and should maintain focus on our mission while we take a hard look at our workload and how to achieve efficiencies.

We are confident that the agency is on the right track. Over $9 million in savings has already been identified through a comprehensive evaluation that involved staff at all levels of the agency, as well as stakeholder input. The savings, particularly in the areas of rulemaking, travel and corporate support are significant. However, through Project Aim, we are seeking additional efficiencies. Corporate efficiencies include centralizing financial management and human capital staff, and reducing information technology security costs. The NRC's safety and security mission remains paramount as actions are taken to re-baseline the agency.

The Project Aim Steering Committee has delivered to the Commission a rebaselining paper that outlines additional proposed efficiencies. While still under Commission review, the now-public paper reflects more than 140 activities that could be eliminated or reduced over the next six months, of about $41.1 million in FY 2017. Total potential reductions identified over 18 months is $49.5 million. The staff will later submit to the Commission a paper outlining additional areas for longer-term efficiencies and projected workload changes through FY 2020.

However, we cannot emphasize strongly enough that the NRC's ability to ensure adequate protection of public health and safety and the common defense and security will always be our main concern. While our size may change to reflect workload reductions and efficiency gains, the need for the great majority of the services we provide the American people remains unchanged.

As we proceed, the agency remains mindful of the importance of its highly skilled technical staff and the need to maintain our expertise. We must keep a focus on knowledge management as some senior staff retire and new experts take their place. We must not forget that the success of the agency is due, in no small part, to the quality and dedication of the agency's people. Remaining one of the best places to work in the federal government is important to our ability to continue to recruit the most talented candidates, and retain our skilled and knowledgeable technical experts.

I want to highlight one other area where the Commission is focusing on improvement: the Commission's involvement in the rulemaking process. Over the last several years, the Commission has revised its rulemaking processes to improve its understanding of, and, where possible, reduce the cumulative effects of regulations. These new processes include increased opportunities for stakeholder interactions and feedback, publishing draft supporting guidance concurrent with proposed rules, requesting specific comment on the cumulative effects of regulations in proposed rules, and developing better-informed implementation timeframes.

We are cognizant of the Committee's concerns as expressed in the FY2016 Joint Explanatory Statement regarding the timing of Commission involvement. The Commission directed the NRC staff last September to propose a plan for increasing the Commission's involvement in the rulemaking process before significant resources are expended. The Commission has just issued its direction on the proposed plan, which presented eight recommendations to better define and enhance the Commission's role in the early stages of rulemaking. We believe our approved approach meets the intent expressed in the report language and we will provide the requested information to the Committee in March 2016.

FY 2017 BUDGET REQUEST

The NRC's proposed FY 2017 budget is $970.2 million and 3,462 FTE, excluding the Office of the Inspector General (OIG). The proposal represents a decrease of $19.8 million from the FY 2016 enacted budget, as well as a decrease of 90 FTE.

The OIG's component of the FY 2017 budget is $12.1 million, of which $11.2 million is for auditing and investigation activities for NRC programs and $1 million is for auditing and investigation activities of the Defense Nuclear Facilities Safety Board (DNFSB). These resources will allow the OIG to carry out its mission to independently and objectively conduct audits and investigations to ensure the efficiency and integrity of the NRC and DNFSB, to promote cost-effective management, and to prevent and detect fraud, waste, and abuse.

Under the provisions of the Omnibus Budget Reconciliation Act of 1990, as amended, the NRC FY 2017 budget request provides for 90 percent fee recovery, less the amounts appropriated for generic homeland security activities, waste incidental to reprocessing activities and DNFSB activities. Accordingly, $861.2 million of the FY 2017 budget will be recovered from fees assessed to NRC licensees, resulting in a net appropriation of $121.1 million. This appropriation is an increase of $2.1 million compared with the FY 2016 enacted budget due to the inclusion of $5 million in non-fee-billable resources for advanced nuclear reactor technology.

The NRC carries out its safety and security activities through two major programs: Nuclear Reactor Safety, which includes both Operating Reactors and New Reactors, and Nuclear Materials and Waste Safety, consisting of fuel facilities, nuclear materials users, decommissioning and low-level waste, and spent fuel storage and transportation. Compared to the FY 2016 enacted budget, the NRC's Nuclear Reactor Safety Program decreased by $3

million and 61.9 FTE; the Nuclear Materials and Waste Safety Program, including Decommissioning and Low-Level Waste, decreased by $1.8 million and 28.1 FTE.

I would now like to highlight portions of the FY 2017 budget request.

NUCLEAR REACTOR SAFETY

Operating Reactors

The FY 2017 budget request for the Operating Reactors Business Line is $587.5 million, a decrease of $1.7 million from the FY 2016 enacted budget. This reflects declining or completed workload associated with, among other activities, implementation of the Fukushima lessons learned, license renewals and National Fire Protection Association 805 license amendment requests.

New Reactors

The FY 2017 budget request for new reactors is $169.9 million, which represents a funding decrease of $1.4 million when compared with the FY 2016 enacted budget. The decrease is a result of delays in application submittals, and project slowdowns or suspensions. The New Reactors Business Line is responsible for the regulatory activities associated with siting, licensing, and overseeing construction of new nuclear power reactors.

NUCLEAR MATERIALS AND WASTE SAFETY

Fuel Facilities

The FY 2017 budget request for fuel facilities is $41.5 million, which represents an overall funding decrease of $2.9 million when compared with the FY 2016 enacted budget. The Fuel Facilities Business Line supports licensing, oversight, rulemaking, international activities, research, generic homeland security, and event response associated with the safe and secure operation of various operating and new fuel facilities such as conversion, enrichment, and fuel fabrication facilities, and nuclear fuel research and pilot facilities.

Nuclear Materials Users

The FY 2017 budget request for nuclear material users is $92.5 million, which represents a funding increase of $0.9 million when compared with the FY 2016 enacted budget.
The Nuclear Materials Users Business Line supports the safe and secure possession, processing, handling of nuclear materials in many diverse applications, along with associated activities related to licensing, oversight, rulemaking, international engagements, research, generic homeland security, event response, and State, Tribal, and Federal Program interfaces. This increase is due to the resumption of security rulemakings and to address an industry petition for rulemaking. These were delayed in FY 2016.

Spent Fuel Storage and Transportation

The FY 2017 budget request for spent fuel storage and transportation is $37.2 million, which represents an overall funding increase of $1.1 million when compared with the FY 2016 enacted budget. The Spent Fuel Storage and Transportation Business Line supports licensing, oversight, rulemaking, international activities, research, and generic homeland security associated with the safe and secure storage and transportation of spent nuclear fuel and other radioactive materials. This increase is due to safety and environmental reviews of an interim consolidated storage facility and related safety analysis.

Decommissioning and Low-Level Waste

The FY 2017 budget request for decommissioning and low-level waste is $41.6 million, which represents an overall funding decrease of $1 million when compared with the FY 2016 enacted budget. The Decommissioning and Low-Level Waste Business Line supports licensing, oversight, rulemaking, international activities, and research associated with the safe and secure operation of uranium recovery facilities, removal of nuclear facilities from service and reduction of residual radioactivity to a level that permits termination of the NRC license, and disposition of low-level radioactive waste from all civilian sources. The Commission has directed staff to proceed with a decommissioning rulemaking that would establish clear requirements for decommissioning reactors. Comments from stakeholders are being collected through March 18th of this year with the bulk of the work on the regulatory basis and proposed rule completed by the end of FY 2017.

CLOSING

As I said at the onset, this budget request represents a substantial reduction from the 2016 enacted budget. The President's Budget takes advantage of the Project Aim-identified efficiencies, and, as we continue our work, we anticipate additional savings and efficiencies to come.

Chairman Simpson, Ranking Member Kaptur, and distinguished Members of the Subcommittee, this concludes my formal testimony on the NRC's FY 2017 budget request. On behalf of the Commission, I thank you for the opportunity to appear before you. We look forward to working with you on the 2017 budget and going forward. I know you share our dedication to the vital mission of the NRC.

I would be pleased to respond to any questions that you may have. Thank you.

Mr. SIMPSON. Others? Ms. Svinicki.

Ms. SVINICKI. Thank you, Chairman Simpson, Ranking Member Kaptur, and distinguished members of the subcommittee for the opportunity to appear before you today at this hearing on the NRC's fiscal 2017 budget request and associated matters.

The Commission's chairman, Stephen Burns, has outlined an overview of our agency's budget request, as well as a description of some of the key challenges and opportunities before the agency in this year, fiscal 2016.

As described in the materials provided to your subcommittee concurrent with the budget request, the NRC has continued over the past year its comprehensive initiative to right-size the agency, streamline agency processes to use resources more wisely, improve timeliness in regulatory decision making, and promote a more unified agency purpose through agency-wide priority setting.

When I appeared before your subcommittee at this time last year, I testified that I looked forward to reflecting progress on these initiatives in our future budget submittals to you. I believe our fiscal year 2017 budget request coupled with the further efficiencies that we have identified and continue to identify under these Project Aim initiatives demonstrates this progress.

The NRC will continue to push forward on each of these fronts in the coming year while continuing to keep our critical mission of public health and safety and security always in the forefront.

I appreciate the opportunity to appear and look forward to your questions. Thank you.

Mr. SIMPSON. Thank you. Mr. Ostendorff.

Mr. OSTENDORFF. Good morning, Chairman Simpson, Ranking Member Kaptur, and distinguished members of the subcommittee. I appreciate the chance to be before you today with my colleagues.

I am in complete alignment with Chairman Burns' testimony this morning. Regarding Project Aim, I want to thank the subcommittee and the full committee for their support of the NRC's structuring our Aim reductions thoughtfully and in a disciplined manner.

I am personally pleased with the thoroughness of our staff's work in this area. I am confident when all is said and done, we will be in a better place.

Regarding NRC's work on advanced reactors, I want to highlight a couple of topics here. NRC submitted a report to Congress in 2012 talking about how we license advanced reactor technologies and our strategy. I believe we are preparing in a thoughtful way for advanced reactor technology license applications. Interest in the subject continues in the United States and overseas.

In September of this last year, the NRC co-hosted a workshop with our colleagues at the Department of Energy to discuss the development of these new reactors, and we had a chance to engage our stakeholders on the new technologies.

Our budget request includes $5 million in non-fee billable resources to continue this work, and to ensure the NRC is in the best possible position to license any such advanced reactor license application that may be submitted to us for our review.

I appreciate the opportunity to be here today, and I look forward to your questions.

Mr. SIMPSON. Thank you. Mr. Baran.

Mr. BARAN. Thanks, Mr. Chairman. Chairman Simpson, Ranking Member Kaptur, and members of the subcommittee, thanks for the opportunity to appear today. It is a pleasure to be here with my colleagues to discuss NRC's fiscal year 2017 budget request and the work of the Commission.

You have already heard a lot about Project Aim, and no doubt, you will hear quite a bit more before the end of the hearing. I want to briefly share just a few thoughts about this important initiative.

I have been very impressed by the willingness of the NRC staff to take a hard questioning look at what work the agency is doing and how we are doing that work. The staff has identified numerous ways to achieve the substantial savings that are reflected in the fiscal year 2017 budget request.

As my colleagues have noted, the Commission is currently reviewing a long list of additional potential efficiencies.

This effort is about more efficiently focusing on the right safety priorities, not about relaxing regulatory oversight of licensee performance and safety. That means identifying further savings while remaining focused on our core mission of protecting public health and safety.

As Chairman Burns noted, there has also been congressional interest in ensuring that non-routine NRC rulemakings are approved by the Commission early in the process before significant resources are expended. I agree with that objective.

The Commission looked at this issue and decided that the staff should send a brief streamlined rulemaking plan to the Commission to get approval for each non-delegated rulemaking. We just need to make sure that rulemaking plans stay lean and do not themselves require significant staff resources to prepare so we can achieve our shared goal of increased accountability and efficiency.

There are, of course, a number of other important efforts underway at NRC, from implementation of post-Fukushima safety enhancements, to a decommissioning reactor rulemaking, to preparations for the first small modular reactor design application expected later this year.

We are happy to discuss these and any other issues of interest. Thank you, and I look forward to your questions.

Mr. SIMPSON. Thank you. Again, thank you all for being here. I think it is important that all of you be here before the committee because I want the committee to get a chance to know you and you to know the committee. I appreciate all of you taking the time out of what I know is a busy schedule to come here.

Ms. Kaptur.

Ms. KAPTUR. Thank you, Mr. Chairman, very much for yielding to me in this round. Chairman Burns, I wanted to ask you if you could report to the American people on the year of 2015, and the safety of nuclear power production at the 100 commercial reactors, and the 31 test and research reactors across our country.

How would you compare what happened in 2015 to prior years if you were to give a weather report to the public in terms they can understand? How did 2015 compare to prior years?

Mr. BURNS. I think there was continued good performance overall within the industry. We had a couple of plants go into what we call Column 4, which required enhanced oversight on our part, the

Arkansas Nuclear One and the Pilgram plant both operated by Entergy. We are providing an additional oversight on that.

Again, apart from the operating fleet, I would note that we continue to inspect the construction of the four units in Georgia and South Carolina, and also reached a decision with respect to the operating license for Watts Barr Unit 2 in Tennessee. It has begun pre-operational testing and commercial operation is expected this spring.

The other part of it, which does not sometimes get as much attention, is our engagement with the Agreement States. As you may know, 37 of the states have an agreement under the Atomic Energy Act, where they carry out the regulation of radioactive materials under rules compatible with the national standards.

I think this is a good example of a very good Federal-state partnership, and we continue to engage them. We support them with training and communicate well with that.

As Commissioner Ostendorff elaborated on, we have two issues, one looking forward is the question about—as you will see in the budget proposal—additional areas for engagement on potential advanced reactor design. We expect a new small modular design.

The other issue in terms of again giving electricity markets cheap natural gas and all that, the question about continued operation of some nuclear units in those markets. We have indications of what I will call early shutdowns in the sense of before the end of the licensed life.

We are prepared to deal with that. We have initiated a rulemaking to make our processes for that a little more efficient and effective. That will take a few years. We are able to engage in that and have been.

That is sort of like a 50,000 foot level, if that answers your question.

Ms. KAPTUR. In 10 words or less, for 2015, what do you say to the American people about the safe performance of our nuclear plants?

Mr. BURNS. I think there was continued good performance of the nuclear plants in the county overall, and continued work on the enhancements that we identified in cooperation with industry after the Fukushima accident, so improving safety.

Ms. KAPTUR. I think it is really important to assure the American people of that safety in words that they can understand. I wanted to just ask a second question very briefly. We had testimony from some of our labs last year about the difficulty of recruiting people in very high-level skills. I would like to ask you in terms of qualified nuclear engineers, who are citizens of the United States as well as qualified technicians, nuclear technicians in the electrical field, for example, plumbing, pipe fitting, all the skills that are necessary. Do you have any specific focus on that recruitment issue and education issues? So we are able to recruit U.S. citizens for these positions? How does NRC position itself for that? That will be my final question on this round.

Mr. BURNS. The NRC has, as the Committee will know, has included within our appropriates for a number of years about $15 million grants program which we have been administering. I can provide the number of institution across the country for the record,

but that provides some funding in terms of training programs and similar things. Not only at the engineering level, but I think there are some trade schools. Basically, you know, community colleges and other places where you can get the trades involved.

I know in some of my visits, most recently, to the South Texas plant and the Palo Verde Plant in Arizona that it is interesting. You can see partnerships between the utility and local community colleges in terms of developing trades and a workforce that is, in effect, local that may contribute as employees of those plants in future years. So, again, our role in some respects is a small one, but I think we are trying to do the effect with what we have.

Ms. KAPTUR. I would urge you on in those efforts and thank you, Mr. Chairman.

Mr. SIMPSON. If the gentlelady would yield for just a second before I turn it over to Mr. Frelinghuysen. You did not ask for the $15 million in this budget request?

Mr. BURNS. That is correct. Again, this is the President's budget and in terms the approach the Administration has taken toward that. What I will say is it has been now, I think about 8 or 9 years, where it is routinely, and we have embraced that and carried it out, I think, in an effective manner.

Mr. SIMPSON. I appreciate that. The reason we gave it to the NRC is because we used to do it within the Department of Energy and the Department of Energy did not take it very seriously, and so we gave it to the NRC which I think you have done a good job with. Mr. Frelinghuysen.

Mr. FRELINGHUYSEN. Let me thank you all for taking on the commissioner assignments. I note that Miss Svinicki is a native of Michigan, but she spent some time in Idaho, so you probably know quite a lot about the Chairman which you probably should keep to yourself. But Mr. Ostendorff and Mr. Baran worked up here on the Hill. I think it is good, you know, to have you on the other side of the table, since, obviously, you have prepared members of Congress in your respective positions for such testimony. Yes, you want to get an Idaho comment in?

Mr. SIMPSON. No. I was just going to see if you would yield for just a second. I did want to say because it is kind of unusual that we have all of the commissioners here. When someone asks a question, if others would like to comment on it also, feel free to do so.

Mr. FRELINGHUYSEN. I just assume you would not comment on your career, but let me say I know you commanded a submarine as well, so you have another part of our nuclear obligation that comes before this committee.

A lot of anxiety, obviously, out there, and I am within shouting distance of Chuck Schumer, so I will not get into that. About the relative safety of our nuclear facilities, there was a report. I have read it or at least seen a summation about cyberattacks. Could you comment about that report? It seemed to be pretty disturbing. I think it is, in general, open sources here. That there is a degree of vulnerability. You have had double the amount of incidents that other Federal facilities have been subject to, and what are you doing about it?

Mr. BURNS. You are correct. Mr. Frelinghuysen, that there are actually two reports that came out, actually fairly close. One a

Chatham House report out of the UK, and then a Homeland Security within about a week. The Chatham House was a general perspective on cyber. Not particularly in the U.S. In fact, no one who prepared that report talked to anybody at the NRC about it. It is not clear who they talked to, an unnamed source.

The basic ideas or the issues you want to get at which is, you know, keeping the reactor controls systems, critical safety systems separate from the internet. Those are things that are required. Those are the things that are being done here. The principles they were enunciating I think were good. Homeland Security, about a week or two later, actually gave the nuclear industry a pretty good score in terms of where it was.

Part of that, I think, comes from the fact that we had established a set of regulations several years ago which the industry is implementing that addresses the cyber security type issues. They have gone through the first phase. We are doing inspections and follow up inspections this year. There is another phase it will do, but overall, I think this industry is in pretty good stead. It requires vigilance.

Mr. FRELINGHUYSEN. Are there a number of contracts? The IG laid out some evidence that, perhaps, maybe some of these contracts might be scrapped.

Mr. BURNS. Actually. I apologize, I may be referring to different points. Our inspector general issued a report with respect to our internal, NRC internal, issues, and there are some issues we need to address in terms of some of our contracts and the like. But overall, we have not experienced a significant attack. We need to be, you know, vigilant on this as every industry.

Mr. FRELINGHUYSEN. Let me just make a few comments and then I will stop.

Mr. BURNS. Ok.

Mr. FRELINGHUYSEN. The report does not fault your staff at the National Security Operations Center, the SOC. They are meeting the requirements of the $262 million contract, which I guess expires next May of 2017. This is a quote, "The problems are in the contract itself," said the report, "which found that the terms require staff to do a little more than manage a few anti-virus, anti-malware, and anti-spam systems." Is that true? We can upgrade to something a little more proactive?

Mr. BURNS. My understanding, and I would be pleased to provide more details for the record, is that we are addressing the IG's findings in the contracting process and taking the corrective actions there. So I think we agree with the findings that the IG had. We need to be better.

Mr. FRELINGHUYSEN. Ok. Thank you. Mr. Chairman.

Mr. SIMPSON. We are pleased to have with us today the ranking member of the full committee, Miss Lowey of New York. I know you have a very busy schedule, so we would be happy to recognize you next.

Ms. LOWEY. You are very gracious Mr. Chairman. I want to, first of all, thank you for bringing us together for this very important hearing. As you can imagine, I have been concerned about Indian Point. I do not think it is any surprise. It is in Buchanan, New York. It houses one decommissioned, two operational nuclear power

reactors owned by Entergy. Earlier this week Entergy notified the NRC and state authorities that radioactive tritium contaminated water leaked into the ground water at Indian Point.

Entergy found, "alarming levels of radioactivity at three monitoring wells." Just this morning Entergy has reported that tritium levels have gone up in the ground water beneath Indian Point. This is the third time since 2005, that we know of, that tritium has leaked into ground water at Indian Point. Though contamination has not spread to the Hudson River, and does not seem to pose an immediate threat to public health, it is clear that this incident requires a full and thorough investigation. Based on the many problems at Indian Point and what seems to be poor oversight on the part of the NRC it seems the NRC is not adequately prioritizing public health and safety.

There are three NRC resident inspectors who work fulltime at Indian Point. They are following Entergy's groundwater monitoring program and should have been on top of an inadequate pump system in place in recent years. While your agency is sending another inspector to the site this week, and has begun an investigation, I am deeply concerned that the NRC is turning a blind eye to glaring problems at a critical time when Entergy's relicensing process is underway.

So a few questions, and thank you, Mr. Chairman. When were these resident inspectors made aware of the groundwater leak at Indian Point? What actions has the NRC taken to address this tritium leak? Will the NRC be fully investigating the leak, as I urged you to do in a letter earlier this week? Could you elaborate for us what that investigation will entail and when findings should be expected?

Mr. BURNS. Certainly. I believe our resident inspectors and our regional office were informed of the leak or the spill Friday evening when Entergy identified it. It was at an amount that was actually below the threshold reporting limits, but Entergy reported it to us.

Ms. LOWEY. Could I just ask a quick follow up? Before you said when Entergy reported it, so there are three resident inspectors that are there.

Mr. BURNS. Right.

Ms. LOWEY. There is no way of them knowing or identifying the leak until Entergy reported it, is that correct? I just want to make sure I am understanding the sequence and the process.

Mr. BURNS. I would expect, and I can certainly confer with our regional staff, but I would not necessarily expect the resident to be present when the spill or the leak occurred or something like that. I mean, our inspectors do go through the plant. They observe certain evaluations, but they would not necessarily have seen that right away.

Ms. LOWEY. I mean, I am going to let you continue with the approval of our Chair, but there are three resident inspectors, so I just wonder what they are looking for as they are walking around there fulltime?

Mr. BURNS. They are looking for any number of things. They have a particular protocol, I believe, that we set that an inspector goes out and looks at. They may observe particular plant oper-

ations. They may observe this phase of equipment and things like that. They go through the plant at the various times to do that.

Ms. KAPTUR. Ok.

Mr. BURNS. Ok?

Ms. LOWEY. But it would not be incumbent upon them to identify a leak? They have to wait until someone tells them, is that correct?

Mr. BURNS. Unless they had observed it directly themselves. After all, the operator is responsible for the operations within the license requirements, and is ultimately responsible for the safety of the plant. If indicated, we will have inspectors, both we have the resident inspectors who make observations during their normal rounds in terms of what the plant is doing as well as send, as you indicated here, we have sent a specialist out there to help with the evaluation of what happened and the significance of it.

Ms. KAPTUR. Now, as I understand it, Entergy said to you, the NRC, that the radwaste sump pump has been out of service since October 2014. Will the NRC inspectors at Indian Point and other nuclear power plants begin doing annual or semi-annual reviews of all systems at these facilities? I am just puzzled about that.

Mr. BURNS. Well, I would expect, again, as part of our evaluation of this particular incident to understand how that contributed to the tritium spill or the tritium leak. I would expect that to happen. We will inspect during outages various pieces of equipment and in particular sometimes operation of equipment and those types of things during our inspection program.

Ms. KAPTUR. Mr. Chairman, lastly, it is since 2007 that Entergy has been seeking to extend its licenses for Indian Point's two reactors, Units 2 and 3, for another 20 years. Both of these reactors have eclipsed their original licensing periods. So despite the expiration of their licenses, Indian Point can continue to operate until a final decision is made by the Nuclear Regulatory Commission. Do you have any updates when the commission will make a final decision, and will the recent tritium leak impact the final decision?

Mr. BURNS. I believe that a supplemental environmental review is due later this year. I can provide you for the record what the timing is. I do not happen to know it off hand. I know there is a supplemental review. The question on the tritium leak. The tritium leak is part of the ongoing oversight process for the plant. I would expect actions related to the performance of Entergy to be taken account of through our normal oversight and evaluative process for that. They would not await the license renewal process.

Ms. LOWEY. Thank you, Mr. Chairman. I appreciate the time. Thank you.

Mr. BURNS. Thank you.

Mr. SIMPSON. Thank you. Mr. Calvert.

Mr. CALVERT. Thank you, Mr. Chairman. First and foremost, thank you for being here today. Thanks for your service to our country. After the fall of the Soviet Union some of the nuclear materials in some regions are still unaccounted for. There have been, as you know, multiple attempts recently by criminal networks with suspected Russian ties that have sought to sell radioactive material to extremists throughout portions of Eastern Europe. These repeated attempts to acquire nuclear materials signal, what appears

to be, a potential nuclear black market that has emerged in several former Soviet states.

Investigations have revealed that smugglers are explicitly targeting buyers who are enemies of the West, and those buyers' intentions are to target the West, in particular Americans. Considering the recent breakdown in relations between the West and Russia, cooperation and information sharing on matters have become more complicated.

Some individuals within Russian organized crime cling to a Soviet-era hatred of the West. Islamic extremists groups like ISIS, obviously, share that same hatred. Both organizations have made clear their intent and willingness to use nuclear weapons. This development represents the feared scenario in which organized crime and terrorist organizations, like ISIS, establish a mutual partnership. What procedures and equipment are in place to ensure that if an extremist is able to purchase nuclear materials, that they would be prevented from being smuggled into the United States? Considering that we have lost track of nuclear materials here in the U.S., what is being done to ensure bad actors could not acquire the domestic material?

Mr. BURNS. I think the response to your question actually crosses over a number of agencies. We may actually have less to do with it than some of the others. What we do is we keep in touch with the Department of Energy, the Customs Agency, and others that might have a role in that. I know, again, this is not something that the NRC operates or licenses.

Mr. CALVERT. If the gentleman would yield. That even bothers me more because if you have a number of agencies that are looking at this is there anything being lost in communication between those agencies?

Mr. BURNS. I do not think so. I think we have good cooperation and good communications among the agencies. On our end, what we can do, as the NRC, is we can do our best with respect to licensable radioactive material in the United States in terms of protecting sources, assuring that licenses are issued only to those who should have licenses. There are security aspects to that in terms of the category and quantity of radioactive or nuclear material. So that is where I think our responsibility lies.

In the interagency, and I know Commissioner Ostendorff is experiencing that, there is, I think, good communication, cooperation because we are concerned with that.

Mr. CALVERT. Commissioner.

Mr. OSTENDORFF. Thank you for the question, Congressman Calvert. I would just add two things here. The NRC, we have responsibilities under Federal law to rule on export license applications, and we work very closely with the State Department and the Department of Energy and the National Security Council staff on those matters. The Chairman mentioned the interagency, we ultimately meet, typically every 6 months, in the Top Secret, Sensitive Compartmented Information, TS/SCI, briefing in our SCIF, in NRC headquarters, to receive updates on threat assessments for nuclear materials, smuggling, al-Qaeda, ISIS, ISIL, other jihadist groups, and I think each of the commissioners spends quite a bit of time on a regular basis getting periodic updates in between these 6-

month briefings. With respect to the National Security Administration, I used to be an official there, 2007, 2009, they had the bulk of the programs. For instance, there is a container security initiative to use portal monitors to screen containers coming into the United States' various ports to detect nuclear materials, and I think NSA does a very good job at keeping us informed of anything they find of a concern in those areas.

Mr. CALVERT. Well, I just wanted to bring that up. I cannot think of anything more important than keeping nuclear material out of the hands of those who would harm us. One quick question on decommissioning, there is a nuclear facility in California near my congressional district, San Onofre. On the issue of decommissioning nuclear facilities, why does it take so long? I have been told by Edison it is going to take 10 years before they would be able to decommission that site. Any comments on that?

Mr. BURNS. There are different approaches to it. They are actually going at an approach called DECON, which goes toward a more immediate, although, as you indicated, maybe a decade-long process versus what we call SAFSTOR, which is basically set and do it some years later, even 10 years later. But part of it is that it allows the reduction of some residual radioactivity. It allows them to do it in a methodical way. I do not know that there is a magic date or timing they can do it, but it is a big deconstruction project. I know, having gone out to the one in Illinois, near Gurnee, Illinois, northwest of Chicago, the Zion plant, which they are undergoing, and one of the things they told me, they are actually at a point it is not radioactive material that is the concern, it is actually other heavy metals and other types of hazardous materials that you have got to be careful about as well. It is not just the radiation, for example, if they use lead paint when the plant was built in 1970 for signage and things like that. So from our standpoint, it is a safe approach that they can do; I recognize it may take some time.

Mr. CALVERT. Ten years seems like a lot of time, but thank you, Mr. Chairman.

Mr. SIMPSON. Ms. Roybal-Allard.

Ms. ROYBAL-ALLARD. Thank you, Mr. Chairman. Thank you so much for being here. The March 2011 accident at Japan's Fukushima Daiichi nuclear power station was caused by a tsunami that was triggered by a powerful offshore earthquake. After the disaster, NRC required U.S. nuclear power plants to re-evaluate their seismic risk. NRC is requiring the nuclear power plant seismic evaluations, as I understand it, to be submitted to the agency by the end of 2019. Based on the initial seismic screens completed in 2015, how many U.S. nuclear plants may be subject to greater earthquake forces than they were designed to withstand, and in the interim, is NRC requiring nuclear plants to make any major modifications to reduce seismic risk before the plant evaluations are completed in 2019?

Mr. BURNS. I would have to supply for the record that there are a number of them, I believe it is true, I do not know, it is a half-dozen or more, we will provide that for the record, that had a higher seismic evaluation conducted. What we have done, and for example, in California, the Diablo Canyon, I think its revised seismic

evaluation is due in 2017, and Columbia Station in Washington in 2019. What we do expect is that they are capable of meeting their current design basis, and if they have identified areas which there may be vulnerability, that they may be taking additional measures, but for the most part, the plants themselves, in terms of their design, are extraordinarily robust, so we are satisfied, given what we know at this time, that the plants can operate safely pending the final outcomes on the re-evaluations.

Ms. ROYBAL-ALLARD. Ok, and if the evaluations show that some modifications need to happen, what is the timeline or how long would you expect those things to take?

Mr. BURNS. On a plant-specific basis, and again, it would be in terms of assessing the significance of what it is, what the nature of the outcome is or what the equipment that might be affected, but we would establish a timeline, and again, if during that time, we would either have interim measures that would assure safety, and that could be a variety of things, I think.

Ms. ROYBAL-ALLARD. Ok. The decommissioning work that the NRC oversees, as has been stated, is critical to ensuring the safety of workers and those who live in neighboring communities, and in the county of Los Angeles, NRC lists two sites that are being decommissioned; first, Magnesium Alloy Products of Compton, which used thorium, and second, Isotope Specialties of Burbank, which fabricated radioactive sealed sources and packaged low-level radioactive waste for disposal. After these licenses expired, authorities found radioactive contamination at both sites. What is NRC's responsibility for ensuring that the safety of the public and the environment at these formerly licensed facilities, and also can you provide an update on the remediation efforts, and who is responsible for the cost of cleaning up the Compton and Burbank sites?

Mr. BURNS. I would be pleased to provide. I am not familiar with those two particular sites. There are a number of instances in which licenses that may have been terminated, for example, and I do not know if that is the case with these, under the Atomic Energy Commission, where we have gone back and said that there additional remediation needs to be done, but I would be pleased to provide you some information that is responsive on that.

Ms. ROYBAL-ALLARD. I would just appreciate it, and just in a more general question, what is NRC doing to ensure that licensed facilities that are closed in the future are held accountable for newly identified contamination post-closure?

Mr. BURNS. Primarily what we do in terms of close-out inspections, what I would expect us to do is have a thorough assessment of the site, understanding what the historic operations are, that sometimes the challenge with some of these sites is that they may have had historic operations, sometimes that went in before there was licensing either under the AEC or NRC, so making sure you have good site characterization, that you have good oversight of the activities done to decommission, and that, I think, going forward, those are the things for those areas that are under our jurisdiction that I think can help the most.

Ms. ROYBAL-ALLARD. Ok.

Mr. SIMPSON. Thank you. Mr. Fleischmann.

Mr. FLEISCHMANN. Thank you, Mr. Chairman. Chairman Burns, Commissioners, thank you all for being before us today. I represent the 3rd District of Tennessee, that is an east Tennessee district. Nuclear energy is important to my district, from the TVA Sequoia and Watts Bar facilities in the south to the famous X–10 nuclear reactor in Oak Ridge, which is the oldest reactor in the world. In my view, nuclear provides clean electricity, creates American jobs, and stimulates the Unites States economy. Chairman Burns, I am very interested in the development of small modular reactors, and this subcommittee has made funding for them a priority. As we anticipate an SMR application in the next year or so, what is the NRC's plan to address the funding, technical, and licensing issues of SMRs to support the commercialization?

Mr. BURNS. We expect to receive a design certification application from NuScale, which is located in Oregon, at the end of this year, and for, I think, about the last two years or so, I know it was going on before I came back to the NRC in late 2014, our staff has engaged with NuScale to make sure that I think on both sides we have a good understanding of expectations, in terms of we have an understanding in terms of what we are seeing, in terms of the technology, as well as they understand our needs in terms of what is needed for the design certification, and I think that dialogue has gone pretty well and puts us in good stead to receive and act on the design certification that we will get. The funding, we do not provide the funding for the design, develop and all that, that is primarily through the Department of Energy, and I think they have received some funding through the DOE. But one other thing I would add is, in addition to the NuScale application, I think we do expect to receive from Tennessee Valley Authority an application for an early site permit. Basically, it is at the Clinch River site, and basically what that is, it is looking at the site with an assumed technology. It gets you a review of some of the environmental issues and siting issues, geology, seismology, things like that. So I believe we are receiving that this spring, sometime this spring, I think in April.

Mr. FLEISCHMANN. In your consideration of SMR license applications, are there lessons to be learned from the recent licensing of Watts Bar 2 and Westinghouse AP1000 plant at Vogtle and V.C. Summer nuclear power station?

Mr. BURNS. Probably less so from Watts Bar 2, because Watts Bar 2 is completed under the 2-phase licensing process of a construction permit followed by an operating license. Now, it may well be that if some future applicants are interested in going that way, you can use the 2-step or you can use the so-called 1-step licensing that the Summer and Vogtle have gone through, so there may be some things to learn, and I believe our staff is doing the knowledge management on that. Commissioner Svinicki.

Ms. SVINICKI. Something that I would like to bring to the subcommittee's attention, in my time as a commissioner, I have occasionally been concerned that agencies like NRC are very tradition-bound. We are most comfortable making decisions on what we are familiar with, which is the large light water reactors like Watts Bar 2, and as we look over the horizon at small modular reactors, but maybe even more so to other advanced technologies that I

know your subcommittee has heard from DOE about multiple times, I wondered about our flexibility to adapt our regulations to something that looks quite a bit different from what we have licensed, which by the way, we are cautious about; even those can take quite a bit of time to do. So I have really challenged the NRC staff to say, what are the measures that could give us confidence when we tell Congress, if we get an SMR, we could do this in four years or something, half the time of what we have been doing? Something that is an odd analogy, I think, is that my confidence was raised that our staff has completed a review of a different, it is not a reactor, in Janesville, Wisconsin or near there, there is proposed to be a medical isotope production facility. That applicant came in in medical space, but it was a different kind of aqueous reactor, kind of a reactor, quasi-technology, to make medical isotopes, and I was impressed, and my confidence was increased at NRC's ability to be a little bit more agile and adaptable in adapting the regulatory framework to something else. Because for the NRC staff, this application and technology did not fit neatly at all into the regulations that we have, but what they did is, they looked at applicable parts of the regulations and said, take this from power reactors, this from other materials space, and we were able to find both a legal and technical path to do that. I think that was an accomplishment for us, because it was something we had not licensed before. It is not a perfect solution for SMRs and advanced reactors, but I do think it is a demonstration of something real in terms of our flexibility.

Mr. BURNS. I agree. Thanks.

Mr. FLEISCHMANN. Thank you all. Mr. Chairman, I will yield back and wait for round 2.

Mr. SIMPSON. Thank you. Mr. Fortenberry.

Mr. FORTENBERRY. Thank you, Mr. Chairman. Thank you all for joining us today. What is the future of nuclear power in America, or let me rephrase the question, in the world?

Mr. BURNS. The interesting part of the answer to that question is, I think if you look, you wind up in worldwide, you wind up having to look at different places. Start with the United States, right now, we have with cheap natural gas, what I will hear from utility executives, distortions in the electricity market in terms of how they see their nuclear units valued, so you have somewhat an uncertainty. You have units being built in the southeast and in regulated markets, and we have applications. We just issued yesterday the authorization for the combined licenses for South Texas Units 3 and 4, and they talk as if they are very serious about that. So that is in the U.S. If you look in Europe, my three years there, it was extraordinary in terms of how people talked about it. You have the Germans with the Energiewende, with turning away from nuclear, though buying some French nuclear and buying Polish coal generation. You have the United Kingdom going forward with its program. You have Eastern Europe going forward in its program. Then you move to Asia where you have India and China, China on a very aggressive building program, and India, less so, but also growing their nuclear generation. Then you have the question of so-called new entrants, with countries like Vietnam. You have a country like the UAE with 2 units under construction and another

two, so you have a mixed bag, and I am probably not the best fortune teller or forecaster on that, but that is what I have seen across the world on it.

Mr. FORTENBERRY. Well, the question becomes, maybe you can explain if there is any, your interaction with other countries' design standards, because to Mr. Calvert's question, the reality is, if we are going to have nuclear power, we are going to have problems with nuclear science, the waste, the technology getting in the wrong hands, the switches being flipped to potential military uses. So while I understand that is not the fullness of your charge, nonetheless, you are out on point creating regulatory atmosphere to ensure safety, but also, I would hope, to be helping us think strategically about how to prevent non-proliferation of harmful technology and new options for dealing appropriately with waste and other problems. This is the second part of the question. If you would return to the small modular reactor, what does that buy us in terms of those questions I just posed?

Mr. BURNS. Well, I think that is an interesting question, because some of things, for example, that we will need to look at, we have started to look at some of those in the siting, is what is the security profile for an SMR? What is, in fact, the number of operators that you need in a control room for an SMR; that is more of a safety question. But that is one of those things that we need to deal with. We have put out, I think, for public comment the question on what is the emergency planning profile for the small modular reactors. A lot of what you do here, and I think partly that is going to be to the extent that DOE helps with that, part of it is our engagement, that there is in some of the advanced designs, more inherent protection from a security safeguards perspective. I think those are important things to look at, and I think that is something that not just us in the United States, the extent, like there is a Generation 4 forum, those are the types of things that they will look at as well. Those are good questions; I am not sure we have all the answers yet, but what you hear is that there are some aspects of that just from the safeguard security standpoint that you may have better inherent activates.

Mr. FORTENBERRY. Yeah, assuming this is the way of the future and these become scalable and easily replicable, it does not lessen the deeper, harder questions and in fact it makes it worse, not just in terms of your job and making sure the immediate site is secure and that there is not going to be any significant accident but this larger issue of the problematic strategy that is facing humanity or the problems that are facing humanity in general about a strategy in which we control this technology and all of the potential harm that can come from it.

Mr. BURNS. Yes, and one of the things that we can do as NRC and we are doing, that NRC does to the extent that DOE and some of the broader non-proliferation issues you raise is that we are engaged with the International Atomic Agency in terms of looking, there is a new form on SMRs there, through my old organization, the Nuclear Energy Agency at the OECD. There is a multinational design evaluation program where there is cooperative and they are starting to look at the SMR.

Mr. FORTENBERRY. Mr. Chairman, does he have time?

Mr. SIMPSON. The gentleman's time has expired for this round.

Mr. FORTENBERRY. Thank you.

Mr. SIMPSON. Mr. Valadao.

Mr. VALADAO. Thank you, Chairman. Good morning, Chairman and Commissioners. I understand the NRC has been working hard to reduce the licensing backlog that has grown over the past four years and the NRC prioritizes license amendment requests based on the importance to safety, however, some license amendment requests do not necessarily impact safety but involve improvements in the economic performance for liability of the plants.

Many of these plant changes can only be performed during plant outages which occur every 18 to 24 months, which highlights the importance of a timely review by the NRC. Delays by the NRC in processing license amendment requests can have significant impact on the plant's bottom line, and hopefully the actual rate that our folks pay, by pushing off significant capital improvement projects.

Safety should come first, but because NRC is the country's sole commercial nuclear licensing and regulatory authority, it is imperative that the NRC provides timely servicing of the licenses it issues. Do you agree that license holders should be able to establish and rely on schedules that assume NRC will live up to its commitment to process all licensee actions within two years and do you believe that the NRC staff should adhere to the internal procedures to ensure timely and disciplined review of the license amendment requests? And what is the NRC's long term strategy for ensuring the capability to provide predictable and reliable and timely processing of license amendment requests?

Mr. BURNS. I do agree that it is important for us to set objectives like the 2 year objective. Again, they may not be hard and fast in all circumstances but it gives us something to work to. It enhances, I think, communication with licensees and the like. What we have been doing over the last couple of years, we have been working down the licensing backlog and I believe that through 2016, or by 2017, we will have worked it off so we have been giving that some good attention and are trying to meet those goals and objectives.

Mr. VALADAO. All right, I think I might have time for one more, if I am not mistaken, Chairman? One of the goals of Project Aim is to ensure adequate sizing of the agency is achieved by 2020 with the target of 3,400 full-time equivalents. When Project Aim's efforts began, NRC budget was well over one billion dollars with 3,778 staff positions. With FY16, the NRC was appropriated approximately one billion and NRC set a target staff ceiling of 3,600 positions by the end of fiscal year.

Based on the current projections, NRC seems to have met that ceiling target at the beginning of this calendar year. Your request for fiscal year 2017 again requests a decrease in funding as well as a decrease in staff. Because the previously anticipated level of reactor licensing did not occur, areas that had grown in anticipation of the projected workload demand, such as staffing and acquisition of a third building at a headquarters complex should be reexamined. Because housing is now a major fixed cost that the NRC carries annually in its budget, the committee would benefit from better understanding what actions the NRC is considering to re-

duce its housing footprint at the headquarters complex once its right-sizing efforts are completed.

Do you agree that the NRC should be reevaluating the need to occupy three buildings, especially in light of the staffing reduction targets? If so, what are the NRC's plans to right-size their physical footprint?

Mr. BURNS. Well, a point of fact, we are the minority tenant in the third building at this point. The most important thing, probably we have in there is our operations center which was upgraded a few years ago and we have some staff offices but we are the minority tenant. As we look at the overall staffing size of the agency, I would agree, we need to look at what our footprint is. What do we need in terms of space? And to the extent that we do not need, be responsible about the space we have and, where possible, reduce our footprint, if it maintains our—I think Commissioner Svinicki wanted to add something.

Ms. SVINICKI. Congressman, I was listening very closely to the figures in your question and if I heard correctly, I agree with all of the figures that you quoted. I did want to offer one clarification. I think you quoted 3,400 FTE as the ultimate goal for Project Aim in the year 2020. I want to clarify; it is accurate that we published that figure. It was a preliminary staff estimate at the very beginning of our Project Aim work. It is not informed by any of the work that we had done over the last 18 months and the Commission had not endorsed this figure. The Commission did endorse a figure of 3,600 for the current fiscal year as an interim step but I think it is fair to say that the Commission does not feel it has adequate information to know if 3,400 is the right number so we never endorsed that and we certainly have encouraged our staff not to be bound.

Frankly, I think that, as a personal view, that figure may not be ambitious enough thank you.

Mr. VALADAO. All right, well thank you. I yield back, Chairman.

Mr. SIMPSON. Mr. Visclosky.

Mr. VISCLOSKY. Thank you, Mr. Chairman. Chairman, in your testimony, you indicated that the NRC expects to review an application for interim consolidated storage in 2017. It is my understanding that waste control specialists in Texas announced that they may submit a licensed application during the coming year. It is also my understanding that there is an Energy Alliance in New Mexico that may also, at some point, submit an application. I do not thing the time is as clear. Do you have enough money in your budget to adequately address one, and possibly two applications during the coming year? And if not, what are you lacking to make sure that they receive consideration?

Mr. BURNS. I think my understanding is that we do have the money available in the current budget to address the Waste Control Specialists, which, as you indicated, is the first expected application. It may require some reprogramming of funds and then if it triggers the marks, we would come to the committee on it. Because we did not know and did not expect at the time the 2016 budget was promulgated, we did not particularly plan for it but we think we have the room in there for that, and the one in New Mexico I

think is not expected until '17. It is not in the budget so I think we would have to look.

I think again, my understanding is we may be able to shift some funds to be able to cover that but we could make sure we are clearer on that for the record.

Mr. VISCLOSKY. If you could, for the record, that you are clear for, if nothing else, the Texas application, assuming that it would come online for '16, I would appreciate it very much.

Mr. BURNS. Yeah.

Mr. VISCLOSKY. Just as far as spent nuclear appeal storage, what is in the pipeline and how do you expect to prioritize different application requirements?

Mr. BURNS. Primarily, the new things are these potentially consolidated storage sites. Other sites, I would have to get for the record. A number of plants already have the storage capacity. They have done the above ground dry storage or they have done the dry storage pads and some are working to it. I would be pleased to provide what new ones we may be getting from individual sites; I just do not have that number on the top of my head.

Mr. VISCLOSKY. But it would not be your anticipation? That would be for the coming fiscal year?

Mr. BURNS. Pardon?

Mr. VISCLOSKY. You would not anticipate those to be coming for the fiscal year we are funding. I just want to make sure you have enough resources if there are other things that are coming over the horizon.

Mr. BURNS. I think we are okay on that but I will check back on that.

Mr. VISCLOSKY. If you could for the record, please. Thank you. Thank you very much, Chairman.

Mr. SIMPSON. Thank you. Let me ask a couple of questions about the budget. First, I would like to thank the Commission for the work that you have done thus far to develop the issues and issue a supplemental environmental impact statement for Yucca Mountain because the Department of Energy seems to refuse to do so.

Can you lay out for us the schedule to complete the EIS supplemental and do you have sufficient funds to complete the supplemental?

Mr. BURNS. We do have sufficient funds to complete the supplemental statement. I anticipate it being issued this spring. My recollection was that it is sometime this spring, in March.

Mr. SIMPSON. Can you tell me what the next steps would be after the EIS supplemental and do you have sufficient funds for this next step, and if not, what additional funds would be required in 2017?

Mr. BURNS. What we have is the remaining carryover that was appropriated earlier from the high level nuclear waste fund. We have, on the order, about $2 million which essentially we have—I believe we have informed the Committee before, targeted towards transferring the bulk of the documentation into our archival—the so called ADAMS document system, and then that expends what we have. The steps, once the staff issues an environmental statement. The remaining steps with respect to what the agency would have to do relate to the hearing process that is required under the

act and we have pending, when the hearing was suspended, about 288 contentions that would go in front of our licensing board and then ultimately the decision would be subject to review by the commission.

We have estimated in the past that to complete a review, would take on the order of about $330 million.

Mr. SIMPSON. Would that be necessary in the next year budget or how long would that take?

Mr. BURNS. No, that would——

Mr. SIMPSON. Over what period of time?

Mr. BURNS. It would be multiple years and I am not quite sure the breakdown of that.

Mr. SIMPSON. Ok. As I mentioned in my opening statement, the NRC has taken important first steps towards right-sizing. The budget requested for fiscal year 2017 is $19. 8 million below the fiscal year 2016 and projects a reduction of 90 FTEs, as we mentioned. Before we discuss the right-sizing process in greater detail, I have a couple of questions about the budget request.

Do you all agree that the budget request will not impact safety?

Ms. SVINICKI. I agree.

Mr. BURNS. I agree.

Mr. OSTENDORFF. I agree.

Mr. BARAN. I agree as well.

Mr. SIMPSON. Do any of you have any additional comments on the actions that you have taken as part of the budget process to ensure that safety remains a top priority?

Mr. BURNS. As we develop the budget, I think that is always our top priority. We look those things where it is important for us to maintain oversight, where it may be important to us to have interface. For example, I mentioned our agreement state partners, where it is important to be able to move through an effective licensing process that assures safety and security so I am comfortable with where we are in this budget on that.

Mr. SIMPSON. Ok, in your testimony, it mentions $41.1 million in savings for fiscal year 2017 has been identified as the result of the rebase lining. Does that budget request reflect any of these savings?

Mr. BURNS. It reflects about $10 million of those savings and again partly because the process of our development, as you know, the budget development process, these were things we identified when we went through the Executive Branch process. We were fairly comfortable with the $10 million and what we have done and what the staff has identified in the rebase lining paper, which I think we have provided to your staff, is identified about $30–31 million additional areas, which are before the Commission for review right now. We got the paper about a week ago but that do reflect some additional, having taken a hard look, they reflect some additional potential savings.

Mr. SIMPSON. I understand that we are in the middle of a lot of changes that are going on and so forth. Will you be done with that and be able to identify whether that additional $31 million in savings is a reality in savings that can be achieved by the time we do a budget or an appropriation bill? Do you think in the next three or four months?

Mr. BURNS. Yeah, I would expect that.

Mr. SIMPSON. Donna is looking at me like: "Two to four months. We are talking two months maybe."

Mr. BURNS. I think that is our intention. I have read, myself and my colleagues can speak for themselves, I have read the paper, I flagged—I think the staff did a good job but sometimes they are just talking in shorthand, even to some of us who work within the building and I want to make sure I understand what those things are and I have a handful of those so that is part of our due diligence and I expect my colleagues are probably in the same boat.

Ms. SVINICKI. Yes, Chairman Simpson, I believe to a person, it is our intention to act promptly and the NRC staff has made very clear to us their desire for a timely Commission decision so that we can inform this budget cycle and your work.

Mr. SIMPSON. Thank you.

Mr. BARAN. I would just add, so the staff identified 151 specific items that would generate potential savings and a number of those, I think it is 29, were incorporated to the FY2017 budget request. The rest of them were not and so before the Commission right now is the 151 for our review, and to your prior question about are there anything in this budget that we feel would adversely impact safety? I think that is a key part of our review of these 151 items. I want to take a close look at those and make sure we are not doing anything that is going to relax regulatory oversight of licensee performance and safety.

That, for me, is going to be a top priority in looking at those 151. I think a lot of them are going to make a lot of sense. There are a few of them that could involve reduced inspection hours, for example. I would give those a hard look.

Mr. SIMPSON. Ok.

Mr. OSTENDORFF. I would say that I have looked at the 151 and I have discussed with my staff just this week. Although the Commissioners were paying proper attention to this, when I look at the reactor oversight program in last year, for instance and the enhanced oversight for Arkansas Nuclear One and the Pilgrim Plant in Massachusetts and our baseline inspection program activities that Commissioner Baran is referring to. It is not apparent to me that any of these proposed reductions would negatively impact our oversight but we need to dot a couple of "I"s and cross some "T"s here.

Mr. SIMPSON. Thank you. Ms. Kaptur.

Ms. KAPTUR. I would like to yield to Congresswoman Lowey for a final question and then I will——

Mr. SIMPSON. Ok.

Ms. LOWEY. Thank you for your gracious hospitality and thank you Mr. Chairman as well. Chairman Burns, I just wanted to bring to your attention, some questions regarding the Aim pipeline Spectra, which as an energy company, as you know, is constructing the Algonquin Incremental Market Expansion, the Aim project, which would expand the natural gas pipeline, which runs just 100 feet from vital Indian Point Structures. This is a great concern to me and many of my constituents and I strongly believe that the NRC has not adequately investigated the risk, nor responded substantively to the concerns that have been raised.

I remain particularly disappointed in your conclusion that a further independent risk analysis, beyond NRC's internal analysis is unnecessary. So my question is, does the presence of a potentially dangerous pipeline impact the security procedures NRC mandates at a nuclear power plant and what steps does the NRC plan to take to ensure the Indian Point Evacuation Plan is updated to reflect the additional risk of a pipeline in the vicinity?

Mr. BURNS. Congresswoman Lowey, we have looked at the pipeline issue. In fact, our staff met with one of the persons, Mr. Cooper, last week on it. Our evaluation is that there is not an adverse impact on the Indian Point Plan. Having said that, I believe we would look at what the impact might be and I would have to consult with our staff in terms of what they have done or what additional action might be required because of the analysis that they have done on what is called the security—if there is an impact or a potential impact on the security barriers. I do not know the answer to your question immediately but I can ask our staff to inform us and inform you of that but that, again, would be our primary. Looking at it, we would be concerned of—our concern is assuring that there is not an adverse impact on the safe operation of the plant or equipment or barriers involved or security barriers at the plant.

Ms. LOWEY. So, I am just trying to understand this. Does the presence of a potentially dangerous pipeline impact the security procedures the NRC mandates at a nuclear power plant?

Mr. BURNS. The impact of a pipeline on a facility that could have—that has, for example, an explosive—here the question is basically a rapid explosion and release from that pipeline, those types of things are taken into account and are looked at when new projects come in where an existing site is or are taken into account in the licensing of a new facility and what our staff does is make evaluation, whether or not it has an adverse impact from the ability—in terms of the ability to shut down the plant or protect the plant or something like that.

Ms. LOWEY. So then the question is are there steps that the NRC plans to take to ensure the Indian Point evacuation plan is updated to reflect the additional risk of a pipe line in the vicinity.

Mr. BURNS. I would have to ask and consult with the staff and would be pleased to get you an answer for that.

Ms. LOWEY. I would appreciate that and then one other question that I wondered with regard to Indian Point we talked before about the multiple safety issues at Indian Point. The recent tritium leak, transformers, elevated moated temperatures, temperature issues on the seals of the reactors and in the last two years energy has blamed vendor failures for major malfunction that resulted in shutdowns at Indian Point. I just wondered to other nuclear power plants experience so many vendor failures at this rate and has the NRCC thoroughly evaluated these vendor failures at Indian Point.

Mr. BURNS. We look at as part of our review what the attributed cause of a failure or a violation or some sort of transient at the plant and I could not speak right now as to whether or not Entergy is blaming vendors more than another licensee may. Ultimately the licensee is responsible for the safe operation of the plant. It may have issues in terms with respect to its vendors but ultimately they

need to have processes in place that ensure the quality of the material that they are installing in the plant as well as maintaining the plant.

Ms. LOWEY. And lastly and I think this is an issue that has come up over and over again. If a fifty mile area around Indian Point were to be evacuated every resident of West Chester County, New York City, even parts of Long Island would be forced to evacuate. Quite simply there is no way to move all those people safely. So for many of us Indian Point's evacuation plan leaves much to be desired relying on buses to get residents away from the potential in the event of an emergency. The plant was built but not allowed to go into operation because there was no feasible evacuation plan. Does the NRC actually believe the evacuation plan for Indian Point is feasible and could you share what the NRC is doing to work with nuclear power plants in densely populated regions to improve evacuation plans?

Mr. BURNS. Well we certainly work with a Federal and state partners with respect to emergency planning and emergency preparedness around nuclear power plant sites. Ultimately those entities, other Federal entities such as FEMA and the state are responsible emergency preparedness backgrounds. We have found that the emergency plans for the Indian Point plant meet Federal requirements but we continue to work with as I say with Federal and state partners in terms of improving and exercising those plans.

Ms. LOWEY. And lastly really lastly do you have any update on when the commission will make a final decision of relicensing and I wonder whether the recent tritium leak will impact that decision?

Mr. BURNS. Our evaluation of the tritium leak will go into our normal oversight process and the consequences or the significance of the leak would be taken into account as part of our day to day evaluation and oversight of operations. My understanding about the Indian Point renewal proceeding is that there is a supplemental environmental statement that is due out this spring, later this spring. There are potentially some additional hearings with respect to that and there could be a decision later this year but I think rather than—let me make sure we supplement that for the record because I think there is more time. There happens to be an unusual situation. I am actually recused from the decision on the renewal because of my prior role as senior staff counsel at the agency some time ago. But I would be pleased to get you the information that you want.

Ms. LOWEY. Thank you very much Mr. Chairman for your indulgence. I thought you were recused because you moved to West Chester County. Thank you very much.

Mr. FLEISCHMANN. Thank you Mr. Chairman. Commissioner Ostendorff I wanted to hear about your upcoming visit to my district to speak at the advanced reactor summit at the Oak Ridge National Laboratory and then I am going to have a follow up question sir but before I do that I wanted to convey to you my sincere thanks and appreciate not for the work only that you do at the NRC for the past 6 years but for all you have accomplished for the people of Tennessee in our country and your service at the House Arm Services Committee, at the NNSA and of course in our great United States Navy, sir.

Mr. OSTENDORFF. Thank you sir. I am flying out this afternoon to Knoxville. I will be speaking at 8 o'clock tomorrow morning delivering a keynote speech on advanced reactor technology at Oak Ridge National Laboratory. The key messages I will be delivering will be discussing the NRC's readiness to receive license applications for small modular reactors and other non-light water reactor advanced technologies. I will be talking about the experience we had with our current fleet that is under construction in Georgia and South Carolina as well as Watts Bar and the NuScale experience that was discussed by colleagues here and also will be talking about our experience in non-light water reactors technologies over the last 30 years. I am looking forward to engaging with the folks at Oak Ridge.

Mr. FLEISCHMANN. Thank you sir. A follow-up question, there is concern over the future of licensing nuclear technologies which are venture-funded start-ups. The NRC's current process for licensing is not compatible with this new funding model. How does the NRC plan to meet this challenge?

Mr. OSTENDORFF. Thank you for the question Congressman. Let me just talk a little bit about the experience we have had so far to date in pre-application meetings with NuScale. Again as the Chairman mentioned we are expecting a license from NuScale in December of this year. Our staff has been working very closely in pre-application meetings with their executives, scientists and engineers. Our staff has approved what we call design specific review standards that would guide our staff's review of an actual license application. I think a lot of the technology issues (whether or not electrical power is required to meet certain safety requirements, the use of passive safety features, new design aspects) have been addressed and will continue to be addressed by our staff. Mike Johnson who is our Deputy Executive Director for operations for reactors and Jennifer Uhle who heads our new reactor office have also been discussing the use of a step wise approach to provide incremental decisions back to potential investors through our work in pre-application meetings with an applicant or potential applicant to give them partial answers based on submittals that would deal with one aspect of a design. So I think we are making good progress in that area and I am looking forward to seeing applications coming in.

Mr. FLEISCHMANN. Thank you sir. My next question is for all of you all if you would like to participate I encourage that. The Oak Ridge National Laboratory is the home to CASL, the Consortium for Advanced Simulation of Light-Water reactors. CASL uses modeling and simulation to improve the performance and safety of commercial nuclear reactors. I am interested in knowing what kind of relationship you have with CASL and encourage you to take advantage of the valuable work being done at ORNL?

Ms. SVINICKI. Congressman thank you for the question. I have had the opportunity to visit Oak Ridge during my service as a Commissioner. I did want to note that you mentioned the X-10, the historic facility. I will say that as a bit of a nerd about science and someone who has studied nuclear science it was amazing to stand in that location and think about the atomic pioneers of the United States. So I am glad we have that type of preservation of facilities

like that and I commend the folks at Oak Ridge for realizing that is a part of our history. My only regret is we could not get every middle school science student to come through there. I did meet with the researchers in CASL and they are an impressive bunch but I think very significantly not only in terms of what is happening in Oak Ridge CASL is a consortium and it involves research institutions across the country, academic and DOE national labs and I think that kind of synergistic leveraging is how we can afford to do the cutting edge science that we need to do. It is leveraging virtual collaboration across the country through high speed communications tools and getting time on super computers at various DOE labs. But I was energized about it, I did listen to the presentations with an eye of saying how could NRC leverage some of its research needs, I am not sure at my level I walked away with any dazzling ideas of my own about how that could be done but I think that the CASL consortium is moving our cutting edge knowledge on nuclear science in the right direction.

Mr. FLEISCHMANN. Thank you does anyone else wish to comment?

Ms. ROYBAL-ALLARD. The NRC is organized into four distinct regions which oversee all licensees and facilities and while some of these regions have experienced nuclear reactor decommissionings others have seen an influx of nuclear power plant constructions. As part of the overall project game plan to enhance operational efficiencies have you looked at ways to incorporate these regional differences into future plans for the NRC and does it continue to make a sense to think about the NRC in terms of this regional distribution?

Mr. BURNS. I think the current regional distribution does make sense. Sometimes you get some questions about whether it might make more sense to say move the oversight of a particular reactor into a different region because you have other reactors operated by the same company in that other region. We once had five regions in the NRC. About twenty years ago we eliminated Region 5 which was primarily the West Coast and it is now overseen by our Region 4 that operates out of Dallas. What we have done with some of the regional offices is we have actually consolidated some activities into those regions. I am satisfied about where that is now. For example our Region 2 office out of Atlanta is doing new reactor construction over sight at the Vogtle and Summer plants and at the Watts Bar plant. They also do the fuel facilities across the country. Our Region 1 and Region 3 offices because that is where the bulk of the materials licensees that are still under direct NRC jurisdiction they have responsibility for that. So I think in the past we have taken some advantage of that leveraging in efficiency by consolidating some of those activities when the activity is not as prevalent in one of the regions. For decommissioning that is an interesting question but I think right now because you have activity in the various regions it probably makes sense to continue with that model. Because—in most of the regions that there is ongoing working in that area.

Ms. ROYBAL-ALLARD. To improve the transparency and to simplify how the NRC calculates and accounts for fees and the timeliness of communicating fees which is a key process strategy of

Project Aim. What specific measures has the NRC taken to improve transparency and engage with the regulated community and what actions have been taken to simplify how the NRC calculates these and what still needs to be done?

Mr. BURNS. We have been holding public meetings with mostly fee payers are probably most of the folks that come to that meeting as you would expect so our chief financial officer has been doing that. She is responsible for the development of the fee rule. We have been doing some things to align the fee rule more closely to our budget process and budget request so I think that helps transparency because you are not trying to interpret two different ways of looking at it. So those are some of the steps. We will be publishing soon the Fiscal Year 2016 rule probably about the beginning of March. Again I think having some public outreach on that it takes some work but I think we are getting better at it.

Ms. ROYBAL-ALLARD. Thank you.

Mr. FORTENBERRY. Thank you. I am going to return to the earlier question particularly as you brought up the interaction you had with the International Atomic Energy Agency and standards setting worldwide. I see the IAEA as growing not only in relevance but prominence and necessarily so given the trajectory of nuclear and nuclear threats. The mission of the agency seems to be shifting from one of ensuring safety to one of ensuring nonproliferation and that is a very important shift. So explain your interaction with—this is a mysterious question to me how we do provide funding for them through a variety of means. Does any of that come from your agency?

Mr. BURNS. I will take the last question you asked. I think only indirectly in the sense that we provide experts who may attend meetings. Some are our technical experts. I attend the general conference that is held once a year as part of the US delegation. So my understanding, that's the primary way that they direct. The rest of it is through primarily the State Department budget. The Department of Energy probably has this in a similar way in terms of support. But I think primarily the funding comes through the State Department's support for international organizations. The first part of your question, our engagement again primarily is on civil nuclear safety, civil nuclear security and where that has interfaced with nonproliferation. IAEA has always had in a sense that dual role. In many ways when it was founded coming out of President Eisenhower's atoms for peace speech in the early 1950s part of the idea was to move down from nuclear weapons but make the availability of atomic energy for civilian purposes available and necessary. That is the primary place that we play a role in terms of participating in some of what I will call standards making activities. We also do that through the NEA and a good example of where standards and this is more on the—I will give you an example both on what I call a purely safety side as well as a security side. We adopt the IAEA transport regulations. They are guides and then we and DOT will adopt them and that helps in terms of protection of material both from a safety and security standpoint. The other thing for example and source security one of things going on before 9/11 because I think as Mr. Calvert noted it came out of the problems identified with basically abandoned material in the

former Soviet Union. But then after 9/11 the new concern about terrorists getting material so there was an IAEA code of conduct which the US has subscribed to and in many ways our PAR 37 which is for source security reflects those types of ways of trying to protect and provide security over sources. So that is a quick illustration about we contribute, where we try to use the standards that are developed.

Mr. FORTENBERRY. All of the questions I have asked are pointed at the need for all of to think strategically about I think to your earlier point we all do this we tend to get captured by what is in front of us rather than what ought to be or could be. Because of your clear leadership in terms of setting policy or enforcing policy that to me dictates a certain necessity of relying on you as well for strategic advice in this regard.

Mr. OSTENDORFF. If I could say NRC staff frequently presents NRC–US industry best practices at IAEA conferences, workshops. We have staff that participates in leading missions to other countries to help try to show best practices to other countries trying to develop standards. I had a chance last June to give a major speech in Vienna talking about our cyber security practices—what we do in the United States—to the international community. Other Commissioners do similar outreach in their speaking engagements so I think we are very much aligned with your notion that we take a strategic leadership role.

Mr. FORTENBERRY. Thank you.

Mr. SIMPSON. Ms. Kaptur.

Ms. KAPTUR. Mr. Chairman, I began my questioning today, Chairman Burns, with asking you to grade the nuclear power industries safety and security for 2015 and you gave it a pretty good grade. In view of Congressman Lowey's questioning about the tritium leaks at Indian Point as we begin 2016 how do you think the industry is doing compared to 2015?

Mr. BURNS. It may be too early to tell but I think for the most part we have seen continued performance. The Indian Point issue is one we are following up on, but I would note again that we were informed of it by the licensee at a reporting below what was the mandatory reporting threshold. They are obviously in a highly charged environment up there and they are closely watched. But we will see issues in performance. I think we are on top of it and overall so far about six weeks into the year generally good performance.

Ms. KAPTUR. I want to ask a question following that on Project Aim and the relationship of that to corporate support and how we are ensuring the safety and security of our nuclear power production in this country. Can you expand on your comments so far about how you intend to ensure that project maintains or improves current safety and security requirements?

Mr. BURNS. Yes. Under Project Aim one of the other things that we have done besides the rebaselining report is we as a Commission approve what is called a strategic workforce planning and why that is so important I think is because it is having our human resources office in coordination with all of our staff technical offices focus on what are the technical skills we need to maintain as an agency so we can do those things we are expected to do. Inspect.

Review license applications. Learn from operating experience and the like. That is one of the keys and that came out of Project Aim. When we talk about corporate support one of the things we were looking at through Project Aim is how to be more effective in providing the support to the staff, corporate support and overhead type activities. It is your computer, it is your office space you are in, it is the training. It may be the training that you undertake. We need to make sure our people are supported with those things, but what we have identified and that is what we are going to look at in this rebase lining report. I think primarily you are looking at a lot of areas where you may get administrative type efficiencies. We need to be careful as Commissioner Baran said that some of those that have the interface with the safety mission to make sure that making a decision—no we do not need to do that, that we are making a good, well informed decision.

Ms. KAPTUR. That is a concern because Commissioner Baran inferred that there might be fewer inspections. He kind of hinted at that. And in view of Ms. Lowey's situation and my personal experience—horrendous experience over 3 decades of service now with two massive problems at a nuclear power plant that I represent I have to tell you I am very concerned about the industry at a point where natural gas prices and oil prices are impacting what is happening across the energy industry. And some of these plants from a operating standpoint are facing additional pressures and economic pressures in the market place and so I am very worried about investment in equipment, personnel and so forth. And how does a tritium leak happen at a plant? How is it possible that the core cover—the reactor head at a plant in Ohio was eaten through completely by the boric acid reaction with the steel? How is that even possible to a point where it was quite dangerous?

And so I am very worried about how you are protecting the safety of the public in view of what is happening in the marketplace. Do you want to comment on that?

Mr. BURNS. Where I think we maintain our presence and our oversight—particularly through our resident program sites—when we have incidents such as Congresswoman Lowey described at Indian Point where we send out specialty inspectors and have that type of reactive inspection that is where we are providing substantial value in the inspect area and those are the types of things we are not pulling back under Project Aim.

Maintaining that core staff, undertaking that responsibility remains at the centerpiece and the central point of our activities.

Ms. KAPTUR. Well Mister Chairman you also in your budget you talked about training and staff and so forth and I in my first round asked about trained personnel. Your budget does not include an appropriation for the integrated university program for high level nuclear engineers and I asked you about other trained personnel who are actually on the ground in these plants moving between plants and how they are trained. I am going to—and there is nothing specific in the budget on that, but I am going to ask you for your regions to provide for the record the types of relationships the NRC has for its training programs with various apprenticeship programs, community college programs, through its integrated university program with universities.

I want to know what you are doing because I think the pipeline is very haphazard. And I can tell you for the plant that I represent if it were not for the workers—and these were not nuclear engineers that went into that plant in the 1980s and the 1990s we would have had a nuclear mishap there.

So that training is so important and because of their work we were able to remediate two very serious situations in both decades requiring an enormous investment by the private sector to upgrade those plants.

I have fought for so many years unsuccessfully in this Congress to have more robust nuclear training programs. And I will tell you it was the plumbers and pipe fitters, it was the electricians that risked their own lives not knowing what was happening that saved us. And I want to give them more primacy in your budget and more direct relationships for training. Just know that. I continue to work for that. I would love to have your cooperation, but I will ask for that information for the record.

I am going to turn a little bit here to another question. Can you tell me do you maintain records of the waste heat that is generated by your various nuclear power plants around the country or could you obtain it for me, the ones that you regulate. If something is coming out of a big stack what is it and how much is it?

Mr. BURNS. I would have to give you something for the record on that.

Ms. KAPTUR. All right, very good. And finally a simple question and I do not want to go over on my time, Mister Chairman, on Ukraine, does the NRC have any relationship or collaboration ongoing with instrumentalities inside the nation of Ukraine?

Mr. BURNS. Yes and I ask Commissioner Ostendorff to supplement my answers since he visited Ukraine last year, but we do have some bilateral arrangements with them and we provide a cooperation and advice to them and I know I will pass it to Commissioner Ostendorff because he was there last year.

Mr. OSTENDORFF. Thank you. The answer to your question is yes we do.

Ms. KAPTUR. Ok.

Mr. OSTENDORFF. And at several levels. We have had Commissioner visits, various Commissioners. I was the most recent one there in June of last year working with a regulator and talking about the importance of an independent regulator with technical competence. We have had our security folks go over there to provide offers of assistance for security training. There is a video teleconference that occurred just this past fall between our senior staff and Ukrainian regulator staff to look at questions they have about trying to resume construction of the Khmelnitsky Plant about 4 hours west of Kiev. And how did we look at similar resumption of construction activities at our Watts Bar plant in Tennessee.

And I think we have a very healthy dialogue going on right now. We as a commission will have meetings with their head regulator Mr. Bozhko here in about three weeks when we have our annual regulatory information conference. He is coming to that in Rockville so I think that relationship is very alive and robust.

Ms. KAPTUR. I would ask for more specificity on that either privately or for the record.

Mr. OSTENDORFF. Sure, we can provide more details.

Ms. KAPTUR. I do have another question Mister Chairman but I want you to have the ability to rotate to other members.

Mr. SIMPSON. Mr. Visclosky, if you would like to go ahead and ask the other question and I can wrap it up.

Ms. KAPTUR. Ok, this is really my last question and that concerns the continued storage of spent nuclear fuel. The commission extended the length of time assumed to be safe for storage of spent fuel at reactor sites from 30 to 60 years and I am very interested in your opinion as to how that will impact the safety and security of the public. It assumes that we cannot find a storage site for this material.

Mr. BURNS. Yes, madam. That decision that you refer to relates to an environmental review that we are required to do with respect to licensing. It is not a decision in favor of extended storage. What it says is that from an environmental standpoint, from a safety standpoint it can be safely done, it can be safely done. That decision is actually in litigation here.

Ms. KAPTUR. I was going to ask you about that.

Mr. BURNS. Yeah, it is in litigation here and I think in the D.C. Circuit Court of Appeals.

Ms. KAPTUR. If the challenger succeeds in their argument do you believe the court should side with the challengers and what would be the impact to the rule and by extension operating plants.

Mr. BURNS. Well, I think the court should side with the agency on that. They are challenging our decision. I think the four of us are comfortable with the decision we made. It is hard for me to speculate what the court—if the court agreed even in part with the petitioners it is hard for me to speculate what that would mean—that they may remand it to the agency for further evaluation, they may issue some sort of an order. I would not want to speculate too far because there is multiple things that the court could possible do.

But we are confident that we reached an appropriate decision on the matter that was put before us and again I want to emphasize it is not a decision that was intended to reach in effect a license for an interminable period of time or to encourage that type of approach to ultimate treatment in handling of nuclear waste.

Ms. KAPTUR. Thank you very much and thank you Mister Chairman. Thank you all for your testimony today.

Mr. SIMPSON. A couple of questions, one, what are your estimated carry over balances at the end of this year?

Mr. BURNS. I believe at the end of this year—there is none from fiscal 2016 if I am articulating this right. We plan to fully obligate for '16. We have some carry over from prior years. I believe the total is maybe up to about $25 million—about $13 million fee based. That is what I understand.

Mr. SIMPSON. So this budget request does not assume use of any of those funds in the budget request that you currently have as carry over funds?

Mr. BURNS. Yes, that is correct. It does not.

Mr. SIMPSON. Secondly, on the rule making, and frankly I would like to commend the Commissioner for choosing to modify the NRC stats for the proposal on rulemaking so that it fully reflects the di-

rection we provided in the Omnibus. Rulemaking is significant authority under the law and the Commission should assume the responsibility of that authority early in the process as you all have mentioned you are starting to do in your testimony. Do you expect that we will receive the rule making plan no later than the March 15th deadline and that it will reflect the requirements outline of the Omnibus.

Mr. BURNS. Yes, I do expect you will get it by that date and it will conform to the language. It will be consistent with the language provided in the report.

Mr. SIMPSON. The committee received a report in January that indicated that the Commission now has 43 proposed rules pending instead of 93. Can you please discuss what happened to change the number of the rules and do you expect the number to reduce further once the new rulemaking plan is implemented?

Mr. BURNS. Actually I have been talking to my colleagues about supplementing that report. The report that we gave you focused on what was expected to be worked on in fiscal 2017. I think the number is higher. We are going to provide you a supplemental report. What we did not include in that report is some things like petitions for rulemaking and other things.

We need to get you some more up to date and better information about that. The other aspect just to highlight one other, there are some things that if you look at what is technically a rule making activity in front of the agency includes some things that are sort of long suspended, there are no activities on it, but I think in the interest of full disclosure and transparency we are going to give a supplement to that report.

Mr. SIMPSON. Is there any challenge in not having a fifth member of the Commission or decisions being postponed because there are splits of two to two or anything like that because we do not have a fifth commissioner that has been approved?

Mr. BURNS. I have not experienced—I think we worked well together. I do not know of anything we have put off because we do not have a fifth commissioner.

Ms. SVINICKI. As the longest serving current member of the Commission I would note I have served on a Commission of four, Commission of three, a Commission of five, back to four again. Five works well and Congress set us up at five for the kind of natural advantages you are talking about. It does help clarify outcomes, but I think actually the pace of doing the business before our agency I have to say candidly I am extremely impressed with how effectively I think this group of four even with the disadvantage of maybe a 2–2 and that has occurred. I do not mean to indicate that has not occurred since we went back down to four, but there are ways we have of determining that outcome. Often it goes back to staff delegated authority so I would say that maybe not speaking to whether or not we get a fifth, but I think this four is gosh-darn impressive.

Mr. SIMPSON. Thank you, Ms. Kaptur do you have one other thing?

Ms. KAPTUR. Yes, I just want to reiterate if I might to the Chairman and the members that based on what is happening in the marketplace with energy prices I would urge you to consider devel-

oping an economic model that can anticipate the impact on given firms economic performance based on what is happening in the energy markets and the likelihood that they would not be—they would be less likely to invest because of what is happening and to have a rating that you look at and you can identify out of the dozens of plants that are operating because I have a concern that there is going to be cost cutting and a lot of things are going to have to be done that might impact safety, so I would just urge you to consider that suggestion. Thank you.

Mr. SIMPSON. Let me just say in conclusion thank you all for being here and I am not one who is frankly easily impressed but I got to tell you in all honesty I have been impressed by you all. I appreciate the fact that you have tried to follow the Congressional direction or intent that we put in the language and tried to work with us on that. I know of a lot of agencies in the Federal government that could learn a lesson from the way that you have implemented this last budget and have been working with Congress. I appreciate that very much. I do not expect that you all agree on everything. If that were the case three of you would not be necessary, but it seems to me that you hash things out and try to come to a solution and that when you come to a solution you all say okay, that is what we are going to do and I appreciate that because it restores the credibility that had been deteriorated in previous years in the NRC and the one thing that is very important with the NRC is your credibility. Not only what you do but your credibility around not only this country, but around the world.

I appreciate the work that you do. I look forward to working with you as we implement this budget, as we continue on to progress with Project Aim and trying to right size the agency. I say that as one who supported increases in the NRC budget over the years when we saw the nuclear renaissance coming and we wanted to make sure that we had the personnel and everything so we were ready to license these things. Circumstances have changed so I appreciate the fact that you are willing to recognize that and work with us to maintain the right size of the agency and look forward to working with you and implementing this budget as we move forward. Thank you all for being here today.

QUESTIONS FOR THE RECORD

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT

HOUSE COMMITTEE ON APPROPRIATIONS

Hearing on the 2017 Budget Request for the
Nuclear Regulatory Commission
Wednesday, February 10, 2016

THE HONORABLE LUCILLE ROYBAL-ALLARD

Ms. Roybal-Allard. Concerns have been raised about the effectiveness of the Nation's current technology for radionuclide decorporation treatments -which can remove radioactive contamination from the human body after a radiological emergency.

NRC's Office of Nuclear Security and incident Response (NSIR) is responsible for developing NRC's emergency preparedness and response policies for accidental or deliberate release of radioactive material from licensed facilities. NSIR 's Division of Preparedness and Response is tasked with coordinating with DHS, FDA, EPA, and other Federal and state agencies, as well as providing technical support for emergency exercises and actual incidents.

Do NRC's emergency planning and response requirements include the potential use of radionuclide decorporation treatments?

How is the NRC coordinating with other Federal agencies to ensure the availability of the most effective decorporation treatments?

Will an effective decorporation treatment be available to the public in case of a nuclear power plant accident or terrorist attack?

Mr. Burns. Potassium iodide is a drug that, when used at the appropriate time and in the appropriate dose, blocks the uptake of radioactive iodine by the thyroid gland. The NRC's emergency planning and response regulations require that consideration be given for the use of potassium iodide in planning as a supplement to evacuation and sheltering. The NRC's regulations do not include consideration of the use of any other decorporation treatments as part of emergency planning. It is the State's prerogative to make its own decisions on whether to distribute potassium iodide, or any other decorporation agents to its citizens.

The NRC staff has previously worked closely with other federal agencies, including the U.S. Department of Health and Human Services and the Federal

Emergency Management Agency, on issues related to nuclear power plant emergency preparedness, including the use of thyroid blocking and other decorporation drugs. At present, there is no specific ongoing coordination between other Federal agencies and the NRC for decorporation drugs.

The Centers for Disease Control (CDC) administers and maintains decorporation treatments for radiological emergencies in what is called the Strategic National Stockpile. The Strategic National Stockpile contains large quantities of medicine and medical supplies that the CDC can deploy to protect the American public if there is a public health emergency severe enough to cause local supplies to run out. Once Federal and local authorities agree that the Strategic National Stockpile should be deployed, medicines will be delivered to any State in the United States in time for them to be effective. Each State has plans in place to receive and distribute the Strategic National Stockpile drugs and medical supplies to local communities as quickly as possible.

THE HONORABLE MIKE HONDA

Mr. Honda. We currently have over 70,000 tons of nuclear waste accumulating in storage pools and dry casks at nuclear power facilities, and the amount of waste continues to grow at sites that were not designed for long-term storage.

What is being done to find a solution to this problem, with so many sites nearing their safe capacity and without an available long-term repository site?

If the Mixed Oxide Fuel Fabrication Facility project in South Carolina is abandoned, where will the waste generated from diluting weapons grade plutonium be stored?

Mr. Burns. As Congress outlined in the Nuclear Waste Policy Act of 1982 (NWPA), as amended, the role of the U.S. Nuclear Regulatory Commission (NRC) is to serve as the independent regulator for the Department of Energy's (DOE) design, construction, operation, and eventual decommissioning of a geologic repository for permanent disposal of high-level waste at Yucca Mountain, Nevada.

Congress had reduced funding for the NRC's review of the DOE license application, with no funds appropriated for fiscal year 2012 (or in subsequent years). Recognizing the budgetary limitations, the Commission directed the Atomic Safety and Licensing Board to complete case management activities by the end of September 2011, and the Board suspended the adjudicatory proceeding on the application. At the same time, the NRC staff also completed orderly closure of its Yucca Mountain safety review activities. As part of this work, the NRC staff prepared and published three safety evaluation reports on DOE's application.

The NRC resumed work on its safety and environmental reviews of the DOE Yucca Mountain application using available carryover funds in response to an August 2013 ruling by the U.S. Court of Appeals for the District of Columbia Circuit. The staff completed and published the final volumes of the safety evaluation report in January 2015. In February 2015, the Commission directed staff to develop and issue an Environmental Impact Statement supplement. The

NRC expects to issue a final supplement later this year. The adjudicatory hearing, which must be completed before a licensing decision can be made, remains suspended. Until a repository is operational, NRC requirements provide assurance that spent fuel can be safely and securely stored today and into the future.

The NRC regulates mixed-oxide fuel fabrication facilities (MFFF) in accordance with the Strom Thurmond National Defense Authorization Act for Fiscal Year 1999. Section 3134 of the Act directs the NRC to license and regulate any facility under a contract with and for the account of the DOE that is used for the express purpose of fabricating mixed plutonium-uranium oxide nuclear reactor fuel for use in a commercial nuclear reactor licensed under such Act. An MFFF is currently under construction in South Carolina, pursuant to a construction authorization issued by the NRC in 2005. The NRC has not issued an operating license for the MFFF. Therefore, it has not yet generated any radioactive waste.

The DOE has not yet provided any information to the NRC on plutonium disposition paths other than the licensing of the MFFF.

WEDNESDAY, MARCH 2, 2016.

DEPARTMENT OF ENERGY, APPLIED ENERGY

WITNESSES

FRANKLIN ORR, UNDER SECRETARY FOR SCIENCE AND ENERGY, DEPARTMENT OF ENERGY
JOHN KOTEK, ACTING ASSISTANT SECRETARY FOR NUCLEAR ENERGY, DEPARTMENT OF ENERGY
CHRISTOPHER SMITH, ASSISTANT SECRETARY FOR FOSSIL ENERGY, DEPARTMENT OF ENERGY
PATRICIA HOFFMAN, ASSISTANT SECRETARY FOR ELECTRICITY DELIVERY AND ENERGY RELIABILITY, DEPARTMENT OF ENERGY

Mr. SIMPSON. The hearing will come to order. I would like to welcome our witnesses, Dr. Franklin Orr, Under Secretary for Science and Energy, John Kotek, Acting Assistant Secretary for Nuclear Energy, Pat Hoffman, Assistant Secretary for Electricity Delivery and Energy Reliability, and Christopher Smith, Assistant Secretary for Fossil Energy. This past summer the President announced "Mission Innovation", a pledge to double the investment into clean energy research and development over the next five years. Together, your programs' budgets represent the majority of where these increases would take place in order to meet the President's goal. An "all of the above" strategy would propose that all of the programs within the "Mission Innovation" category would receive a 20 percent raise each year in order to attain the goal of doubling clean energy research and development in the pledged five year period.

However, that is unfortunately not the case. In fact, the EERE budget receives a 50 percent increase when comparing funds in the "Mission Innovation" category to last year's level. This generous and unbalanced increase is proposed while the budget request reduces Nuclear's clean energy activities, and drastically reduces total funding for Fossil. In looking at the overall request it is clear that "Mission Innovation" is another attempt by the Administration to provide massive increases to the EERE budget at the expense of other Applied Energy technologies. A more balanced approach would fund emerging energy sources and support the reliable energy sources that we count on today.

Each of you has an important role in managing and developing the future of these diverse energy sources. I look forward to hearing how your vision supports a balanced approach and continues to make investments in our energy future. Please ensure that the hearing record, questions for the record, and any supporting information requests by the subcommittee are delivered in final form to us no later than four weeks from the time you received them. Members who have additional questions for the record will have until close of business on Friday to provide them to the subcommittee of-

fice. With that, I'll turn to my ranking member, Ms. Kaptur, for her opening statement.

[The information follows:]

Opening Statement
Chairman Simpson
Budget Hearing on the Department of Energy's
Applied Energy accounts
March 2, 2016

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I'd like to welcome our witnesses, Dr. Franklin Orr, Under Secretary for Science and Energy, John Kotek, Acting Assistant Secretary for Nuclear Energy, Pat Hoffman, Assistant Secretary for Electricity Delivery and Energy Reliability, and Christopher Smith, Assistant Secretary for Fossil Energy.

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With that, I'll turn to Ranking Member Kaptur for her opening statement.

Ms. KAPTUR. Thank you, Mr. Chairman and good morning. Dr. Orr, great to have you back here. Secretary Smith, again, and Secretary Hoffman, thank you for being here today, and Mr. Kotek. We are so glad that you are all here today and thank you for being here to present your 2017 program request. I am very sorry that Dr. Danielson could not be here today. I know all of our prayers go out to him and his family during this very, very trying time.

The research and development of energy technologies your programs have generated is revolutionizing everything around us, so we are living it in real time. The Vehicle Technology's office works to find ways to lightweight our cars, allows us to stretch each gallon of gas. Your new building codes are making our homes and places of work more efficient and more comfortable. The unbelievable growth of the fracking industry which originated from your research and has brought America back to the forefront of the world's energy producers, and has significantly reduced our dependence on foreign oil truly is transformative. And the boom in renewable energy is breathtaking, and I am so proud to have a leading silver company in our district that is reaping the benefits, First Solar. I was there at its birth and I have seen its growth, and I know its future is going to be exponential.

As Secretary Moniz noted yesterday, there are now 208,000 direct jobs in the solar industry. Two hundred and eight thousand. If you had asked somebody 30 years ago would that even be possible they would think that you were some science fiction movie.

These accomplishments in your work are truly bringing America into its new future. I am just glad I am given the opportunity to live during years to witness it. Too few Americans recognize just how important the role of the Department of Energy is in protecting our national security, in addition to being one of our most important tools to deal with the changes in climate that affect our environment. Our coastal dwellers certainly know that, and people in other parts of the country do too, such as those of us on the Great Lakes that have seen the very difficult challenge of algal blooms threaten our fresh water systems.

With that in mind, I am happy to see that in your final budget request of this administration your goals are just as ambitious as ever. Our Nation has made significant strides towards a new energy reality. Yet, they are but the first steps in the marathon of reaching energy independence for our country, and thus strengthening our national security and achieving carbon neutrality. The energy innovation championed by your offices holds the key to unlock the full potential of America's modern clean energy economy, and we look forward to hearing your goals for advancing our Nation's sustainable, diversified, and self-reliant energy future.

As I said to the Secretary when he was up here this week, one can look no further than my district where in our region we see a company like Nature Fresh from Canada come and make a $175 million investment in a new, I think about 200 acre, undercover production for vegetables using the CO_2 off of North Star Steel. I am telling you, this thing is delivering tomatoes and peppers to Kroger Company this month for the first time. It is astounding to witness the changes, the way our private sector is transforming based on a new energy future. So I am just so excited about what

you do and we look forward to your testimony today. Mr. Chairman, thank you for the time.

Mr. SIMPSON. Thank you. Dr. Orr.

Mr. ORR. Chairman Simpson, Ranking Member Kaptur, members of the subcommittee, thanks for the opportunity to testify on the Department of Energy's 2017 budget request for the applied energy programs. Before I get started with the details I would just like to say thanks for all the support that you provided in the Consolidated Appropriations Act of 2016 which, of course, we are in the middle of working hard on now.

Joining me today, of course, are my colleagues. As Ranking Member Kaptur noted, Dave Danielson was called away for a family emergency, but the Deputy Assistant Secretaries are here with us, and if there are detail questions they will be able to help us get past those.

As we meet here today, our Nation stands at an important point in the transition to a clean energy economy. Cost reductions and technological improvements are leading to increased deployment of clean energy technologies. If you just look at the last 7 years, the cost of utility scale portable tag solar power has declined by 59 percent. The cost of power purchase agreements for wind power fell 66 percent, and deployment of energy efficient LED lights went from 400,000 lights to over 35 million with a corresponding reduction in price of 90 percent. So that tells you something about what some combination of research and technology developments and deployment at scale can really do.

Yet, work obviously remains to enhance the energy security in U.S. clean energy competitiveness while we work on global climate goals at the same time. It is in this spirit that the President is joining in an unprecedented global initiative across 20 nations to commit to doubling public clean energy research and development known as Mission Innovation. This is, of course, complemented by a private breakthrough energy coalition, and no doubt, lots of other investors as well. A private sector-led effort to mobilize patient capital to support clean energy technology is emerging from the R&D pipeline. It is an opportunity to bolster the innovation ecosystem that has been so productive for this country over the years.

The Department of Energy Science and Energy programs invest in all stages of innovation across a diverse portfolio of clean energy technologies. This work is aimed at fundamentally enhancing American economic competitiveness and securing America's long term energy security in an environmentally prudent manner. The National Laboratories are key contributors to this work, and they provide the Nation with strategic, scientific, and technological capabilities that are very important to our future. The applied energy programs make use of the expertise that exists in the labs and, of course, strengthen it going forward. At the same time, they work with partners across government and industry to research, develop, demonstrate, and deploy innovative clean energy technologies.

The Department's 2017 request takes the first step in our effort to double the clean energy R&D effort over 5 years. It includes key new initiatives such as the regional energy innovation partnerships, a desalination hub, national-lab focus initiatives including small business partnerships. I will also mention the request is built

on technological foundations that came from our 2015 quadrennial technology review. I am forced to advertise for that because it was a lot of work. It actually, of course, has been hugely important as we thought about all the different ways we could invest the research portfolio. So it is based on kind of an analytical systems based analysis that really did play an important role in our budget debates.

The overall science and energy request is $12.9 billion which is $2.8 billion above the fiscal year 2016 enacted level. The applied energy portion of this request is $5.1 billion to advance the state of technological capability and enable the clean energy future. And as the Chairman noted, this is a big part of what is counted in the Mission Innovation area. In fossil energy this means continuing to develop our carbon capture and sequestration capabilities, and improving the performance of natural gas infrastructure. In nuclear energy we are moving forward on licensing small modular reactor designs, advanced reactors, and implementing the President's nuclear waste management plan with consent-based siding. I am sure we will talk more about that as we go forward.

In the renewal space this means continuing to drive down the costs of solar, expand the deployment of wind power, and take advantage of the Nation's hydropower and geothermal energy resources. As I know, the Secretary has noted for you a number of times, in the end it is about driving down costs, so energy is woven through every bit of the fabric of modern societies, and societies that do a good job on making the cost be low and be competitive will be ones that thrive going forward.

New in this year is 21st century transportation initiative to scale up clean transportation R&D that involves some things that we have worked on already, but continues the effort on batteries, biofuels, and automation. In energy efficiency, it means increasing the efficiency of home appliances, but also making industrial process and manufacturing more efficient as well. Again, those reduce costs in ways that benefit the whole economy.

Critical to bringing all these clean energy technologies to homes and businesses across the country is the Nation's power grid. And we are continuing to invest in this through our grid modernization initiative and through advances in energy storage and cyber security. To leverage the expertise the department holds across these programs we are also working to continue to build productive links across the agency. One of the ways we have done this is through cross cutting initiatives. The current initiatives include efforts on the energy water nexus, exascale computing, supercritical CO_2, subsurface science, clean energy manufacturing, and grid modernization.

We introduced this model in fiscal year 2015 and a number of those efforts have grown and matured since. A good example is the grid modernization cross cut which has led to a proposal of a grid modernization institution, and also our recent announcement of $220 million in grid modernization projects to be spent over the next few years. Building on the crosscuts' successes so far this year, we are also introducing a new cross cut on advanced materials. I would be happy to talk about that more later if you wish.

Today the Department's portfolio investment will drive innovation and technology advancement that is essential for economic growth enabled by affordable, clean, and reliable energy. And with the increased momentum on the international stage I believe we will look back on this period as one of significant acceleration in the transition to a clean energy economy. The fiscal year 2017 budget supports this transition, and my colleagues and I would be pleased to answer questions that you may have about the request, so thank you for this.

[The information follows:]

Testimony of Under Secretary for Science and Energy Franklin Orr
U.S. Department of Energy
Before the
Appropriations Subcommittee on Energy and Water Development
U.S. House of Representatives
March 2nd, 2016

Chairman Simpson, Ranking Member Kaptur, and Members of the Subcommittee, thank you for the opportunity to testify on the President's Fiscal Year 2017 Budget Request for the U.S. Department of Energy's (DOE's) science and energy programs. Before I begin I would like to thank you for your support in the FY 2016 Omnibus appropriations bill, which we are now implementing.

Our Nation stands at a critical point in the transition to a low-carbon economy. I believe we'll look back on this period as one of significant acceleration in innovation that will have made a clean energy future possible. In just the last seven years, the deployment of clean energy technologies has increased dramatically, in part due to cutting-edge investments made through partnerships between the government and private sector. In combination with increased global momentum to accelerate clean energy technology development, the Department's FY17 Budget Request aims to further accelerate this transition.

DOE's science and energy programs invest in all stages of innovation across a diverse portfolio of clean energy technologies. This work is fundamentally aimed at enhancing American economic competitiveness and securing America's long-term energy security in an environmentally prudent manner. The National Laboratories are key contributors to this work, providing the Nation with strategic scientific and technological capabilities. The applied energy programs harness these capabilities and this expertise while working with partners across government and industry to research, develop, demonstrate, and deploy innovative clean energy technologies.

The $12.9 billion Science and Energy Budget Request in FY 2017, $2.8 billion above the FY 2016 Enacted level, supports DOE's missions of enabling the transition to a clean energy future with low-cost, all-of-the-above energy technologies; supporting a secure, modern, and resilient energy infrastructure; and providing the backbone for discovery and innovation for America's future prosperity.

The Request takes the first step in fulfilling the U.S. Government's pledge to Mission Innovation, an unprecedented global initiative across 20 nations to double public clean energy research and development (R&D), in conjunction with commitments for private investments led by a coalition of 28 private investors from ten countries. The Request also continues to implement the President's Climate Action Plan through the development and deployment of clean energy technologies that reduce carbon pollution. Following COP-21, these investments will be a critical next step in enabling the transition to a low carbon energy future through innovation and cost reduction.

The FY 2017 Budget Request builds on the 2015 Quadrennial Technology Review, which provided a systems-based analytical foundation that informed the program proposals in the Request, and it continues to implement the President's Climate Action Plan through the development and deployment of clean energy technologies that reduce carbon pollution.

The FY 2017 Budget Request across the Department of Energy's discretionary applied energy portfolio is $5.1 billion. This funding will support important advances in fossil energy, renewable energy, energy efficiency, sustainable transportation, grid modernization, nuclear energy, Indian energy and technology transitions while increasing funding for new initiatives and priorities. In addition, $1.3 billion ($11.3 billion over ten years) will support game-changing investments in clean transportation infrastructure and technology as part of the Administration's 21st Century Clean Transportation Plan.

Highlights of the Energy FY 2017 Budget Request

ENERGY EFFICIENCY AND RENEWABLE ENERGY

The Office of Energy Efficiency and Renewable Energy (EERE) works with many of America's best innovators and businesses to research, develop, demonstrate, and support the deployment (RDD&D) of cutting-edge technologies and break down market barriers in sustainable transportation, renewable power, and energy efficiency, including advanced manufacturing. EERE implements a range of strategies aimed at reducing U.S. reliance on oil, increasing energy affordability, ensuring environmental responsibility, enhancing energy security, offering Americans a broader range of energy choices, and creating jobs.

The FY 2017 EERE Budget Request takes a significant first step toward fulfilling the U.S. pledge to seek to double federal clean energy research and development as part of Mission Innovation. The EERE Request of $2.898 billion includes $2.108 billion for the support of Mission Innovation, an increase of $702 million from the Mission Innovation Enacted FY 2016 level of $1.406 billion. These investments will drive innovation essential for economic growth, provide clean, affordable and reliable energy, and advance energy security. In addition, as part of the Administration's 21st Century Clean Transportation Plan, the FY 2017 Budget Request of $1.335 billion of mandatory funds, including $500 million for clean energy R&D, will support scale-up of clean transportation R&D through initiatives to accelerate cutting the cost of battery technology; advance the next generation of low carbon biofuels, particularly for intermodal freight and fleets; and establish a mobility systems integration facility to investigate systems level energy implications of vehicle connectivity and automation.

Sustainable Transportation

Vehicle Technologies

FY 2017 funding supports a number of aggressive vehicle technology goals: battery energy storage, electric drive research and development, and advanced power electronics initiatives in support of the EV Everywhere Grand Challenge that aims to reduce the combined battery and electric drive system costs of plug-in electric vehicles by up to 50 percent by 2022. Efforts

include improvements in lightweight materials and manufacturing processes through the Advanced Materials Crosscut. Work will continue on the Co-Optimization of Fuels and Engines effort, in coordination with the Bioenergy Technologies, to link R&D across fuels and engines early in the R&D cycle; and on SuperTruck II to achieve improved freight hauling efficiency goals. New in FY 2017, the Transportation as a System initiative will explore opportunities for energy efficiency at a system level, above the program's traditional vehicle-level focus. Major funding changes are the result of enhanced support for these activities, in particular, and for increased investment in next-generation lithium-ion technology and beyond lithium-ion R&D, which show great promise in meeting battery cost and performance goals.

Bioenergy Technologies
FY 2017 funding emphasizes development of innovative processes to convert cellulosic and algal- and other microbial-based feedstocks to bio-based gasoline, jet, and diesel fuels at a cost of $3.00 per gallon gasoline equivalent (gge), focusing on processes to develop "drop-in" hydrocarbon biofuels, from non-food sources. Efforts include a collaboration with the Vehicles Technologies, co-optimization of fuels and engines through the Co-Optimization of Fuels and Engines effort and the leveraging of recently developed synthetic biology tools to improve efficiencies in the conversion of biomass to fuels and related products. Major funding changes are the result of increased investment in algae and other microbes and in R&D to overcome technical barriers to the integrated production of fuels. Funding also fully supports competitively selected pilot or demonstration projects for advanced biofuels technologies through cost-shared partnerships.

Hydrogen and Fuel Cell Technologies
FY 2017 funding supports the goal to reduce the cost and increase the durability of transportation fuel cell systems, with a targeted cost of $40/kW and durability of 5,000 hours, equivalent to 150,000 miles, by 2020. In addition, the program is working to reduce the cost of hydrogen from renewable resources to less than $4.00/gge – dispensed and untaxed – by 2020. In FY 2017, Fuel Cell R&D will emphasize areas such as stack component R&D, systems, and balance of plant components. Hydrogen Fuel R&D will focus on technologies and materials that will reduce the cost to produce, compress, transport, and store hydrogen from renewable sources. Funding also provides resources to advance the development of quality control tools for the manufacturing of fuel cell components and systems.

Renewable Power

Solar Energy
FY 2017 funding supports the SunShot Initiative goal to make solar power cost-competitive without subsidies by 2020, equivalent to a cost of solar power of 6 cents/kWh. A major emphasis will support DOE's Grid Modernization crosscut through advanced power electronics solutions for distributed solar, coordinated demonstration projects targeting multiple grid attributes, improved accuracy and availability of solar forecasting technologies, and partnerships with utilities on future business and operational models to reduce "soft costs" of solar installation. SunShot will also support the Clean Energy Manufacturing Initiative by developing and demonstrating innovative manufacturing technologies to increase U.S. competitiveness. Efforts include developing the next generation of photovoltaic modules, integrating advanced

concentrating solar power components, and researching solar thermal-based desalination technologies in support of DOE's Energy-Water Nexus crosscut.

Wind Energy
FY 2017 funding supports offshore wind advanced demonstration projects, as well as complementary research and development through an offshore wind consortium targeting technology and deployment challenges to achieve a 16.7 cents/kWh cost target for offshore wind by 2020. Funding also supports innovative concepts for taller wind towers, turbines, and systems capable of accessing and using the stronger and more consistent winds at elevation. Additionally, leveraging DOE high-performance computing assets at the National Laboratories, funding will advance the Atmosphere to Electrons Initiative to optimize wind farms and will support world-class testing infrastructure capabilities critical for supporting U.S. wind energy innovation and cost of energy reductions. Funding supports DOE's Grid Modernization Initiative, and ongoing efforts to address the impacts of wind development on wildlife.

Water Power
FY 2017 funding continues the HydroNEXT initiative focusing on innovative, low-cost water diversion technologies to enable new stream reach hydropower, to progress to a cost target of 10.9 cents/kWh by 2020 from small, low-head new stream developments. FY 2017 funding also supports RD&D of marine and hydrokinetic technologies, including the procurement and construction phase of a grid-connected open-water test facility and development of concepts for revolutionary wave-energy converters.

Geothermal Technologies
FY 2017 funding supports full implementation of the Frontier Observatory for Research in Geothermal Energy (FORGE), including on-site research and development in enhanced geothermal technologies; and DOE's Subsurface Science, Technology and Engineering RD&D (Subsurface) crosscut to reduce the cost and risk of geothermal development. FY 2017 funding will expand temperature-gradient well drilling under the program's "Play Fairway Analysis," which assesses exploration risk and the probability of finding new geothermal resources on a regional scale, resulting in maps and studies that will reduce the industry's drilling and development risks, and will identify new prospective areas for geothermal exploration and development.

Energy Efficiency

Advanced Manufacturing
FY 2017 funding enables the RD&D of industrial efficiency and crosscutting clean energy manufacturing technologies; and supports the deployment of one additional Clean Energy Manufacturing Innovation Institute, with continued support of five existing institutes, as part of the larger interagency National Network of Manufacturing Innovation. Funding initiates an Energy Innovation Hub to develop integrated technological system solutions and enable technologies for de-energizing, de-carbonizing, and reducing the cost of desalination, and supports the second and final phase of the Critical Materials Hub. Funding also supports Industrial Assessment Centers and the Presidential Better Building's initiative to help American

commercial and industrial buildings become at least 20 percent more energy efficient over the next 10 years.

Federal Energy Management Program
FY 2017 funding supports major Administration initiatives to assist all Federal agencies in meeting aggressive energy, water, greenhouse gas and other sustainability goals to achieve deep energy savings. Additionally, FY 2017 funding initiates one new voluntary leadership challenge to reduce energy use in energy-intensive federal facilities, and increases focus on energy management at large Federal campuses.

Building Technologies
FY 2017 funding supports an increased emphasis on emerging technologies R&D in areas such as lighting, heating and cooling and building envelope, that are needed to support the long-term reduction of the Nation's building energy use by 50 percent; supports the equipment and appliance standards programs to establish minimum energy efficiency requirements pursuant to Federal statutes; and supports building-to-grid integration activities focused on improving the efficiency and resiliency of the electric grid, including connected buildings and building systems. FY 2017 funding establishes an integrated Low- Global Warming Potential (Low-GWP) Advanced Cooling (HVAC) R&D program to address near-term and long-term needs to reduce climate impacts of HVAC and refrigeration technologies; and initiates a Metropolitan Systems effort to develop tools for cities to become low carbon, affordable, livable, economically viable, and more resilient to extreme events.

Weatherization and Intergovernmental Program
FY 2017 funding supports the Weatherization Assistance Program, which provides access to home weatherization services for low-income households across the country, including approximately 35,700 homes in FY 2017. The State Energy Program will continue to disseminate best practices to help government facilities and operations reduce annual energy use by 2 percent by 2020. In FY 2017 DOE will also support a Cities, Counties and Communities Energy Program that will provide technical assistance and competitively-awarded funds to help catalyze more extensive clean energy solutions in community development and revitalization efforts.

Crosscutting Innovation Initiatives

In order to enable the required acceleration of clean energy innovation and commercialization in the U.S., EERE is establishing a new Crosscutting Innovation Initiatives program in FY 2017. This program will strengthen regional clean energy innovation ecosystems, accelerate next-generation clean energy technology pathways, and encourage clean energy innovation and commercialization collaborations between our National Laboratories and American entrepreneurs. First, the program will support Regional Energy Innovation Partnerships, a new competition to establish regionally-focused clean energy innovation partnerships around the country. These regionally focused and directed partnerships will support regionally relevant technology neutral clean energy RD&D needs and opportunities to support accelerated clean energy technology commercialization, economic development, and manufacturing. Second, through a Next-Generation Innovation funding opportunity, the program will accelerate next-

generation clean energy technology pathways. This funding opportunity will be open to off-roadmap RD&D projects with the greatest potential to change the trajectory of EERE core program technology pathways. Third, a new Small Business Partnerships program will competitively provide technology RD&D resources to small businesses through the DOE's National Labs to support their efforts to commercialize promising new clean energy technologies. Fourth, Energy Technology Innovation Accelerators will leverage the technical assets and facilities of the National Laboratories to enable American entrepreneurs to conduct RD&D that leads to the creation of new clean energy businesses.

ELECTRICITY DELIVERY AND ENERGY RELIABILITY

The Office of Electricity Delivery and Energy Reliability (OE) leads the Department's efforts to strengthen, transform, and improve electricity delivery infrastructure so that consumers have access to reliable, secure, and clean sources of energy. To accomplish this critical mission, OE works with private industry and Federal, state, local, and tribal governments on a variety of initiatives to modernize the electric grid. Grid modernization is critical to achieving public policy objectives, sustaining economic growth, supporting environmental stewardship, and mitigating risks to secure the Nation. The goal for the future grid is to enable U.S. economic prosperity and energy innovation in a global clean energy economy, delivering reliable, affordable, and clean electricity to consumers where, when, and how they want it.

OE programs work in partnership with industry and other stakeholders as well as other DOE offices, to enhance key characteristics of the U.S. electric transmission and distribution systems:

- Reliability—consistent and dependable delivery of high quality power.
- Flexibility—the ability to accommodate changing supply and demand patterns and new technologies.
- Efficiency—low losses in electricity delivery and more optimal use of system assets.
- Resiliency—the ability to withstand and quickly recover from disruptions and maintain critical function.
- Affordability—more optimal deployment of assets to meet system needs and minimize costs.
- Security—the ability to protect system assets and critical functions from all hazards.

Within the appropriation, OE funds:

- Research, Development, and Deployment—pursuing technologies to improve grid reliability, efficiency, flexibility, functionality, and security; and making investments and sponsoring demonstrations aimed at bringing new and innovative technologies to maturity and helping them transition to market.
- Modeling and Analytics—developing core analytic, assessment, and engineering capabilities that can evolve as the technology and policy needs mature to support decision making within the Department and for stakeholders.
- Institutional Support and Technical Assistance—building capacity in the industry and convening stakeholders to coordinate efforts to transform the electric grid; providing technical assistance to states and regions in their efforts to improve policies, utility incentives, state laws, and programs that facilitate the modernization of the electric infrastructure.

- Coordination of Federal Transmission Permits—coordinating permits, special use authorizations, and other approvals required under Federal law to site electric transmission facilities.
- Emergency Preparedness and Response—support preparedness efforts through our partnerships and support for innovation, and working with public and private partners to facilitate an efficient recovery from disruptions to energy infrastructure.

The OE mission is reflected in the Strategic Objective 2, support a more economically competitive, environmentally responsible, secure and resilient U.S. energy infrastructure, in the DOE Strategic Plan. OE also plays a critical role in implementation of the President's Climate Action Plan to mitigate the risks and enhance resilience against climate change.

The Request supports the Administration's energy strategy and emphasizes priorities that increase electric grid resilience, including managing risks, increasing system flexibility and robustness, increasing visualization and situational awareness, and deploying advanced control capabilities. The Request also continues crosscutting programs that coordinate across the Department. OE is part of the Grid Modernization and Cybersecurity crosscuts.

The FY 2017 Budget Request takes a significant first step toward fulfilling the U.S. pledge to seek to double Federal clean energy research and development investments government-wide over the next 5 years as part of Mission Innovation, an initiative launched by the U.S. and 19 other countries to accelerate widespread clean energy technology innovation and cost reduction. The OE FY 2017 Budget Request of $262 million includes $177 million that contributes to the Mission Innovation pledge, an increase of $24 million from the FY 2016
Enacted level of $153 million. These investments will drive innovation essential for economic growth, provide clean, affordable and reliable energy, and advance energy security.

Program Highlights

The FY 2017 Budget Request reflects the Administration's priority on modernizing the electric grid and boosting the resilience of infrastructure. The Request accelerates ongoing efforts to support the Administration's energy strategy and emphasizes programs that increase electric grid resilience, including managing risks, increasing system flexibility and robustness, increasing visualization and situational awareness, and deploying advanced control capabilities.

Energy Storage
The Energy Storage program supports energy storage technology cost reductions, performance improvements, and reliability and safety validations, and works toward an equitable regulatory environment and industry acceptance. The FY 2017 Request initiates 3–4 new highly leveraged, cost-shared demonstrations with states encompassing 8MW+ of energy storage assets.

Transformer Resilience and Advanced Components (TRAC)
TRAC increases investments in the development of technologies and assessments to mitigate system vulnerabilities to high risk, low frequency events such as geomagnetic disturbances and electromagnetic pulses. Activities will also focus on developing next-generation large power transformers to fill a critical gap identified through the 2015 Quadrennial Technology Review.

Research efforts will address the unique challenges associated with high power levels (voltage and current), high reliability requirements (25–40 years of field operations), and high costs of critical components.

Grid Institute
The FY 2017 Budget Request supports initial funding for a new competitively selected Grid Clean Energy Manufacturing Innovation Institute that will be a part of the multi-agency National Network for Manufacturing Innovation. This Institute will focus on technologies related to critical metals for grid application, and advances will be broadly applicable in multiple industries and markets.

State Distribution-Level Reform Program
Distribution-Level Reform is new in FY 2017 and will award 5–10 cooperative agreements competitively to states, for a performance period of two years to utilize a grid architecture approach to address their system challenges. Achieving an effective design in any given geographic area will require governmental leadership (Federal and state), technological and analytic expertise, and collaboration among many stakeholders. The states will play important leadership roles and could benefit from the assistance that the proposed program could provide.

Infrastructure Security and Energy Restoration
The FY 2017 Budget Request supports further development of a national energy infrastructure situational awareness visualization program with state, local, tribal and territorial entities; and analysis of threats including those resulting from the supply chains and electromagnetic pulses.

State Energy Assurance
The FY 2017 Budget Request supports regional and state activities to continuously improve energy assurance plans and improve capabilities to characterize energy sector supply disruptions; communicate with local, state, regional, Federal, and industry partners; and identify gaps for in the purpose of updating energy planning and emergency response training programs. This activity will assist OE's state, local, tribal and territorial stakeholders in planning, training, and exercising efforts to become better prepared to respond to energy emergencies.

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

The Fossil Energy Research and Development (FER&D) program advances technologies related to the reliable, efficient, affordable, and environmentally sound use of fossil fuels that are important to our Nation's security and economic prosperity. FER&D leads Federal research, development, and demonstration efforts on advanced Carbon Capture and Storage (CCS) technologies to facilitate achievement of the President's climate goals. FER&D also develops technological solutions for the prudent and sustainable development of our domestic unconventional oil and gas resources. DOE is proposing a restructuring of the FER&D budget to streamline the structure, align subprograms that support related efforts under the same program, and provide a more comprehensive view of the costs associated with NETL. Importantly, one of the key motivations for the structural change is to eliminate the categorization by fuel type which is no longer appropriate for this R&D portfolio. The new budget structure reflects the fact that

the CCS and Advanced Power Systems program supports CCS technologies, storage best practices, and innovative power systems integrated with CCS that are applicable to both coal and natural gas generation. Additional information on the restructuring can be found in Volume 3 in the FER&D chapter of the DOE FY 2017 Congressional Budget Request.

The FY 2017 Budget Request takes a significant first step toward fulfilling the U.S. pledge to seek to double Federal clean energy research and development investments government-wide over the next 5 years as part of Mission Innovation. The Fossil Energy R&D FY 2017 Budget Request of $600 million includes $564 million for the support of Mission Innovation, an increase of $31 million from the Enacted FY 2016 of $533 million. These investments will drive innovation essential for economic growth, provide clean, affordable and reliable energy, and advance energy security.

CCS and Advanced Power Systems (formerly Coal/CCS and Power Systems)

The CCS and Advanced Power Systems program conducts research to reduce carbon emissions by advancing the environmental performance and efficiency of fossil energy systems integrated with CCS technologies. In addition, FER&D continues to manage previously funded major CCS demonstration projects.
It is important to demonstrate that electric generation technology with CCS can be deployed at commercial scale while maintaining reliable, predictable and safe operations. Therefore, the FER&D portfolio includes several major integrated CCS demonstration projects encompassing different technological approaches and applications of CCS. A number of those projects have not yet reached financial close after six years. DOE intends to deobligate $240 million from CCPI projects that have not yet reached financial close and repurpose these funds to support the FY 2017 R&D portfolio.

Carbon Capture
Carbon Capture is focused on the development of post-combustion and pre-combustion CO2 capture and compression technologies for new and existing fossil fuel-fired power plants and industrial sources. The Request will enable selection of one additional large-scale post-combustion capture pilot and will fund a total of three large-scale post-combustion pilots. FY 2017 funding will also enable continued transformational research and development (R&D) technology development for pre- and post-combustion capture. The program will also support a Front End Engineering Design (FEED) study and initial construction of a large pilot facility to capture CO2 from a natural gas power system. The increase in FY 2017 funding will support two additional (four total) FEED studies for advanced combustion systems. The Advanced Combustion activity is moving under the Carbon Capture program in the proposed 2017 restructuring.

Carbon Storage
The overall goal of Carbon Storage is to develop and validate technologies to ensure safe and permanent geologic storage of captured CO2 from both coal and natural gas power systems. The FY 2017 Request supports: 1) storage field management projects, including the Regional Carbon Sequestration Partnerships, and other field characterization and injection projects; 2) risk and integration tool development; and 3) advanced storage R&D efforts, as part of the Department's

cross-functional SubTER technical team, to develop laboratory and bench-scale technologies for identifying and obtaining new subsurface signals, ensuring wellbore integrity, and increasing understanding of the stress state and induced seismicity.

Advanced Energy Systems (AES)
The AES mission is to increase the availability and efficiency of fossil energy systems integrated with CO2 capture, while maintaining the highest environmental standards at the lowest cost. The program elements focus on gasification, advanced turbines, supercritical CO2 (sCO2), and solid oxide fuel cells. The decrease in the FY 2017 Budget Request will refocus the program in order to support the Supercritical Transformational Electric Power (STEP) Generation initiative, which is proposed as an activity under AES as part of the FY 2017 restructuring.
STEP supports the Department's sCO2 crosscut which is focused on technology development for supercritical carbon dioxide-based power conversion cycles. These cycles can be applied to most heat sources, including fossil, nuclear, solar and geothermal applications, while offering significant improvements in efficiency, cost, footprint, and water use. Recognizing that the near-term deployment and potential market applications for commercial sCO2 power cycles are primarily in the fossil energy area, the STEP pilot project is being managed by the Office of Fossil Energy R&D. FY 2017 funding will support initiation of the design and construction of the STEP facility.

Crosscutting Research and Analysis (formerly Crosscutting Research)
Crosscutting Research and Analysis fosters the development of innovative systems for improving availability, efficiency, and environmental performance of advanced energy systems with CCS. Crosscutting Research and Analysis leads efforts that support university-based fossil energy research including science and engineering education at minority colleges and universities. Under the proposed restructuring, this subprogram will also support the Mickey Leland Energy Fellowship (MLEF) Program, which aims to increase in the number of women and under-represented minorities entering the scientific and engineering career fields within the U.S. workforce.

The increase in the FY 2017 Budget Request will focus on the development of new materials, catalysts, water efficient systems and technologies for power plants, and desalinization technologies for water produced through CCS. FY 2017 funding will also support immersive, interactive visualization technology and data communication optimization methods to improve the design and operation of advanced power systems with CCS.

Fuel Supply Impact Mitigation (formerly Natural Gas Technologies)
The Fuel Supply Impact Mitigation program is the new proposed name for the Natural Gas Technologies program. The program is comprised of three subprograms. The Environmentally Prudent Development subprogram will continue to conduct research in water quality, water availability, air quality, induced seismicity, and mitigating the impact of development of domestic unconventional oil and gas in collaboration with the Environmental Protection Agency and the Department of the Interior. The Emissions Mitigation and Quantification subprogram, which combines the former Emissions Mitigation from Midstream Infrastructure and the Emissions Quantification from Natural Gas Infrastructure subprograms, will conduct research on reducing methane emissions from natural gas infrastructure in the areas of advanced composite

materials, non-reactive coatings with embedded sensors, and internal and external pipeline inspection and repair without the need to evacuate natural gas from the pipeline. Additionally, the subprogram will support emissions quantification research focused on updating and improving component-level emission factors across the natural gas value chain for EPA's Greenhouse Gas Reporting Program and the Greenhouse Gas Inventory. The Gas Hydrates subprogram will conduct investigations to confirm the nature and regional context of gas hydrate deposits in the Gulf of Mexico in coordination with the U.S. Geological Survey.

NETL Research and Operations
The NETL Research and Operations program is new for FY 2017. This restructuring of NETL operational lines is proposed to better describe NETL's funding requirements, increase consistency with other national laboratories, and increase transparency in how funds are utilized, promoting enhanced visibility into cost drivers and more efficient resource allocation decisions. This program includes certain funds that were part of the former NETL Coal Research and Development program as well as certain funds that were formerly in the NETL portion of Program Direction.

The new NETL Research and Operations program supports NETL research activities. The program is comprised of the following subprograms: (1) Research and Development, (2) Site Operations, (3) Program Oversight and (4) Feasibility of Recovering Rare Earth Elements. The Research and Development funding supports salaries/benefits and travel for NETL staff directly associated with conducting both intramural and extramural research activities for FER&D programs, including scientists, engineers, and technical project managers. The Site Operations subprogram includes funding for Federal employees and contractors who perform site operations at the laboratories including operational costs such as grounds maintenance and utilities. The Program Oversight subprogram includes funding for Federal employees and contractors performing legal, finance, procurement, information technology, and human resources functions that are necessary for the performance of NETL research-enabling activities.

NETL Infrastructure
The NETL Infrastructure program is new for FY 2017. This budget line includes the former Supercomputer and Plant and Capital Equipment programs as well as portions of the Environmental Restoration, NETL Coal Research and Development, and Program Direction budget lines.

The new NETL Infrastructure program supports the upkeep of a lab footprint valued at $600 million in three geographic locations -- Morgantown, WV; Pittsburgh, PA; and Albany, OR. The funding will provide infrastructure repairs and improvements for both laboratory/research facilities and site-wide/general purpose facilities. This budget line also includes fixed occupancy costs for operating and maintaining research facilities and other site-wide facilities, such as support services and other related costs for building maintenance and information technology infrastructure.

The NETL high performance computer, Joule was commissioned in FY 2012. Given the rapid advances in computing technology, high-performance computers typically have an expected life cycle of approximately three years after which standard warranties run out, replacement parts are

not readily available, and maintenance costs rapidly escalate. Increased funding is requested to cover the cost of replacing all of the out-of-warranty high-speed processors. Thanks to advances in technology, the computational power of the next generation equipment will be much greater. It is anticipated that the refresh will upgrade the processing speed from 0.5 pFLOPS to 5 pFLOPS, a 10-fold increase. While the increase in funding is significant, it allows NETL to obtain and maintain a world-class supercomputer capable of using the most advanced software to enable key energy research.

Program Direction
Program Direction provides the funding for all headquarters personnel and operational expenses for FER&D. Also included is the Import/Export Authorization program, which will continue regulatory reviews and oversight of the transmission of natural gas across the U.S. borders. Program Direction funding no longer includes support for Federal employees performing research enabling functions. Program Direction at NETL continues to include functions such as legal, finance, procurement, information technology and human resources that are necessary for the performance of NETL activities.

FOSSIL ENERGY PETROLEUM ACCOUNTS

Fossil Energy Petroleum Accounts consist of two energy security programs authorized under the Energy Policy and Conservation Act: (1) the Strategic Petroleum Reserve including 695 million barrels of crude oil stockpiled at government-owned Gulf Coast storage sites and 1 million barrels of gasoline stored in commercial facilities in the Northeast (the Northeast Gasoline Supply Reserve) as well as the (2) Northeast Home Heating Oil Reserve 1 million barrels of ultra low sulfur diesel oil – also stored in Northeast commercial terminals. DOE is also responsible for legacy environmental cleanup/ remediation at the previously-sold Naval Petroleum Reserve No. 1 (NPR-1 at Elk Hills, California), and will continue post-sale activities in support of Naval Petroleum Reserve No. 3 (NPR-3 at Casper, Wyoming) landfill remediation and closure.

Program Highlights

Strategic Petroleum Reserve
The Strategic Petroleum Reserve (SPR) provides strategic and economic security against foreign and domestic disruptions in oil supplies via an emergency stockpile of crude oil. The program fulfills U.S. obligations under the International Energy Program, which avails the U.S. of International Energy Agency assistance through its coordinated energy emergency response plans, and provides a deterrent against energy supply disruptions. In 2015, the SPR acquired 4,194,296 barrels of crude oil using proceeds from the operational Test Sale performed in 2014. The acquisition operations were conducted without any safety or environmental incidents. The Northeast Gasoline Supply Reserve 1 million barrel inventory of gasoline continues to be maintained at leased commercial storage terminals along the East Coast to help mitigate the impacts of sudden and unexpected supply disruptions.

The FY 2017 Budget Request will provide the program with SPR operational readiness and drawdown capability of 4.25MB/d. The program will continue the degasification of crude oil inventory to ensure its availability and conduct wellbore testing and cavern remediation. Major

changes from FY 2016 include: full funding for Protective Force positions at all sites; additional preventive/corrective maintenance related to corrosion; and, the addition of a custody transfer flow metering skid.

The Bipartisan Budget Act of 2015 requires the Department to submit to Congress a Strategic Review of the SPR by May, 2016.
The Act also authorized DOE, subject to appropriation, to sell up to $2 billion in SPR oil to fund SPR infrastructure modernization. The results of the SPR Strategic Review will inform SPR infrastructure modernization and shall result in an FY 2017 budget amendment related to SPR modernization

Naval Petroleum and Oil Shale Reserves
Following the 1998 sale of the government's interests in NPR-1 (Elk Hills, CA), environmental cleanup/remediation activities under the Corrective Action Consent Agreement with the State of California Department of Toxic Substances Control (DTSC) began. Of 131 areas of concern (AOCs) for which DOE is responsible for the environmental cleanup, 22 Areas of Concern (AOCs) have received a DTSC certification of "No Further Action"; 66 AOCs are under DTSC review; 20 AOCs require additional testing; and, 23 AOCs are awaiting field investigation or remediation activities. In FY 2017, NPR-1 will continue these assessments and remediation activities.

The account also funds activities at the Naval Petroleum Reserve 3 (NPR-3) in Wyoming (the Teapot Dome field located 35 miles north of Casper, Wyoming), a stripper well oil field. On January 30, 2015, the Department finalized the sale of the Teapot Dome Oilfield for the price of $45.2 million. In FY 2016, NPR-3/RMOTC will complete Phase III of the disposition plan with activities including closure of contracts, preparation of field IT and equipment for disposal, records management processing, and disposal of personal property. FY 2017 activities include the closure and monitoring activities for the landfill. In nearly 40 years of operation under the Department's management, this stripper oilfield produced over 22 million barrels of oil resulting in over $569 million deposited into the U.S. Treasury.

Northeast Home Heating Oil Reserve
The Northeast Home Heating Oil Reserve (NEHHOR) FY 2017 Budget continues to maintain a 1 million barrel inventory of ultra-low sulfur distillate (ULSD), in Northeast commercial storage terminals, as a short-term supplement to the Northeast systems' commercial supply of heating oil for deployment in the event of an emergency supply disruption. New commercial storage contracts have been awarded and are expected to go in effect on April 1, 2016. The Program will continue to focus its oversight and management on quality analysis of the Reserve as well as information technology support for the sales system.

NUCLEAR ENERGY

Nuclear Energy (NE) supports the diverse civilian nuclear energy programs of the U.S.

Government, leading Federal efforts to research and develop nuclear energy technologies, including generation, safety, waste storage and management, and security technologies, to help meet energy security, proliferation resistance, and climate goals.

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STEP R&D
FY 2017 activities to support the Office of Fossil Energy lead STEP pilot scale project and other NE sCO2 R&D activities are consolidated within Reactor Concepts Research, Development and Demonstration.

Small Modular Reactor Licensing Technical Support
The Request is consistent with the requirements outlined in the cooperative agreement with NuScale Power, and includes funding for site permitting and related licensing activities to support the final year of development for small modular reactor technologies previously selected under this program.

Reactor Concepts Research, Development and Demonstration
FY 2017 activities will include cost-shared efforts to extend the life of the existing commercial nuclear reactor fleet through research in the areas of materials aging and degradation, safety margin characterization, and safety technologies; and research into advanced reactor technologies, such as fast reactor technologies and high temperature reactor technologies for the production of electricity and high temperature process heat to improve the economic competitiveness and safety of nuclear energy as a resource capable of meeting the Nation's energy, environmental and energy security goals. In FY 2017 NE's sCO2 R&D activities, including support for the Office of Fossil Energy lead STEP pilot scale project, are consolidated within RCRD&D.

Fuel Cycle Research and Development
The FY 2017 Budget Request will expand efforts that support the Administration's waste management strategy including continued implementation of the activities to lay the groundwork for consent based interim storage and transportation of nuclear waste, and activities associated with exploring potential alternative disposal options for some DOE-managed spent nuclear fuel and high-level radioactive waste. In addition, FCR&D efforts include research and development (R&D) on deep borehole disposal and extended storage of high burnup used nuclear fuel. The Request also supports continued progress toward the development of one or more light water reactor fuels with enhanced accident tolerance.

Nuclear Energy Enabling Technologies

The FY 2017 Budget Request supports R&D and strategic infrastructure investments to develop innovative and crosscutting nuclear energy technologies. This program includes a strong investment in modeling and simulation tools, provides access to unique nuclear energy research capabilities through its Nuclear Science User Facilities (NSUF), and addresses workforce needs in critical, focused nuclear energy related fields. Collectively, Nuclear Energy Enabling Technologies supports the goals, objectives and activities of the Gateway for Accelerated Innovation in Nuclear (GAIN) initiative to make NE research capabilities accessible to industry engineers and scientists in a public-private partnership.

Radiological Facilities Management
FY 2017 activities will include the procurement of 40 and delivery of between 33 and 36 plate fuel elements required annually by university research reactors as determined by need and fuel availability.

Idaho Facilities Management and Idaho Sitewide Safeguards and Security
Idaho Facilities Management program will continue investments to improve the reliability and availability of the Advanced Test Reactor (ATR), complete the refurbishment of the Transient Reactor Test Facility (TREAT), initiate the resurfacing, reconstruction, and sealing of major primary roads at INL as part of a Departmental effort through the National Laboratory Operations Board (LOB) to focus critical funds on revitalizing general purpose infrastructure at DOE national laboratories and plants, and initiate the disposition of excess contaminated facilities at INL identified through Departmental efforts associated with the Excess Contaminated Facilities Working Group. The Idaho Sitewide Safeguards and Security program will continue to sustain program functionality at the level necessary to assure high confidence in the protection of INL assets and a high degree of customer service by maintaining effective staffing levels, proactive preventative and corrective maintenance programs, and a robust cyber security program. The FY 2017 Request will focus on implementing infrastructure investments, capital improvements, emerging technology investments and enhanced cyber security program capabilities to adequately secure site assets.

International Nuclear Energy Cooperation
FY 2017 activities include developing new bilateral collaboration with a variety of countries through R&D Agreements, implementing arrangements and Action Plan updates, as well as maintaining existing multilateral cooperation commitments in the International Framework for Nuclear Energy Cooperation and the International Atomic Energy Agency. In FY 2017, INEC will initiate efforts to develop a program for international nuclear energy education outreach, modeled after the Department of State's International Military Education and Training program, with the goal of supporting diplomatic, nonproliferation, climate, and international economic objectives for the safe and secure use of peaceful uses of nuclear technology in emerging countries developing nuclear energy programs.

INDIAN ENERGY POLICY AND PROGRAMS

The Indian Energy Policy and Programs (IE) FY 2017 Budget Request supports ongoing technical assistance, education, capacity building and financial assistance to Indian Tribes,

Alaska Native Tribes and corporations, and Tribal energy resource development organizations. The increased funding over the FY 2016 Enacted level supports expanded technical assistance and competitive grant programs through intertribal networks to support clean energy development and deployment for Tribes.

While Indian Lands comprise just 2 percent of all U.S. lands, Indian Lands contain 5 percent of the total renewable energy generation potential of the entire Nation. The National Renewable Energy Laboratory (NREL)[1] has estimated that the annual renewable energy generation potential on Indian Lands (27,661 million MWh) is nearly seven times the annual U.S. electricity generation from all sources, which was 4,117 million MWh in 2011.

The Energy Policy Act of 2005 established the Office of Indian Energy Policy and Programs (IE) to promote Indian tribal energy development, efficiency and use; reduce or stabilize energy costs; enhance and strengthen Indian tribal energy and economic infrastructure relating to natural resourced development and electrification; and to bring electrical power and service to Indian land and homes, where 14.2 percent of tribal households lack access to basic electricity.

To meet the statutory mandate, IE coordinates programmatic activities across DOE related to the development of energy resources on Indian lands and works with other state and federal Government agencies, Indian Tribes, Alaska Native Village and Regional Corporations and organizations to promote Indian innovative energy policies and initiatives.

Program Highlights

In FY 2017, IE will double its FY2016 budget for Technical Assistance ($6 million) to Indian Tribes, Alaska Native Village and Regional corporations, and Tribal Energy Resource Development Organizations to meet the increased demand that has resulted from its outreach activities. The Office will continue to provide financial assistance ($12 million) in the form of grants for deployment of innovative energy systems and technologies and for efficient delivery of technical assistance through the intertribal technical assistance networks. The funding request provides an additional 6 FTEs within Program Direction that are necessary to carry out the programs, especially in the remote communities in Alaska and the Arctic.

In FY 2017, the Department requests a separate appropriation account for Indian Energy to better align the Budget with the program's mission scope and Departmental organization structure as a direct report to the Under Secretary for Science and Energy.

OFFICE OF TECHNOLOGY TRANSITIONS

The mission of the Office of Technology Transitions (OTT) is to expand the commercial impact of the Department of Energy's (DOE) portfolio of Research, Development, Demonstration and Deployment (RDD&D) activities over the short, medium and long term. The OTT's work includes implementing the key responsibilities and duties assigned to the statutorily-created Technology Transfer Coordinator, program management of the Technology Commercialization Fund (TCF), development of the statutory Technology Transfer Execution Plan and Annual

[1] Doris, E., *Geospatial Analysis of Renewable Energy Technical Potential on Tribal Lands*. DOE/IE-0013 (Feb, 2013).

Technology Transfer Report, and the implementation of the Clean Energy Investment Center (CEIC). The OTT provides institutional support of technology transition activities throughout the Department including administrative, budgetary, planning and execution responsibilities.

OTT is led by the Department's Technology Transfer Coordinator, the principal advisor to the Secretary of Energy on all matters related to technology transfer, commercialization, and lab-to-market initiatives. The Coordinator serves a corporate role to develop and implement a strategic plan to ensure the Department's transition of technologies to the market. This includes coordinating early-stage technology transition activities within Departmental programs, later-stage applied technology research and development, and eventual deployment and commercialization of energy technologies by the private sector. These activities span the work of the National Laboratories and external stakeholders conducting research funded by the Department.

Technology transfer is a national priority as evidenced by enacted legislation and policy initiatives. OTT activities accomplish priorities set out in policy documents such as: (1) Climate Action Plan: Deploying Clean Energy, Unlocking Long-Term Investment in Clean Energy Innovation; (2) Cross-Agency Priority Goal on Lab-to-Market: Accelerating and improving the transfer of new technologies from the laboratory to the commercial marketplace; and (3) Presidential Memorandum 2011: Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses. The OTT activities align with the Department's Strategic Goal #1, Objective #3: "Deliver the scientific discoveries and major scientific tools that transform our understanding of nature and strengthen the connection between advances in fundamental science and technology innovation."

Program Highlights

The Department requests $8,400,000 for the OTT Program Direction in FY 2017. For FY 2015 and FY 2016, the technology transition activities are funded through funds executed within DOE's applied energy and science programs. For FY 2017, the Department is seeking funding consistent with the OTT's operational requirements, to fully establish the OTT as an integral and critical function within DOE. The resources requested for FY 2017 are required to maintain adequate staffing to fulfill Congressional and Administration direction to increase Departmental engagement for the transition of new and evolving energy technology to the U.S. markets, a principal component of Mission Innovation.

Beginning in FY 2017, 0.9% of funding for the applied energy programs' research and development activities will be transferred into a TCF, managed by the OTT. The estimated FY 2017 transfer is approximately $20 million based on the Department's FY 2017 request; however this funding level will be calculated from the FY 2017 enacted budget.

The TCF will be used to provide catalytic seed-stage funding for high-potential national laboratory-based energy technology not yet transferred to the private sector. The TCF funding will focus on early commercialization activities such as market analysis, customer development, prototype development, testing and validation. To further facilitate transition to the private

sector, laboratories will conduct all these activities in cost-shared collaboration with a private sector partner or partners.

The OTT also manages the Clean Energy Investment Center (CEIC). The CEIC's primary mission is to catalyze private, mission-oriented investment in energy technologies to address the significant gap in U.S. clean energy technology investment. The CEIC will be a single point of access to identify DOE and laboratory experts, projects and informational reports and whitepapers covering DOE's portfolio of energy research, initiatives and projects. The CEIC will lead efforts to develop a Lab "Partnering" Service to enable connections between the private sector and the National Laboratories.

Crosscutting Activities

One of the ways the Department is increasing the productive links between the science and energy programs is through the budget crosscuts the Department introduced in the FY2015 budget cycle.

Building on the success of these initiatives, my office is continuing to bring together subject matter experts across our programs to overcome overarching challenges. The crosscuts embody the improved agency-wide coordination the Secretary envisioned when he created the Office of the Under Secretary for Science and Energy as part of the Department's FY 2013 reorganization.

Taking an enterprise-wide approach to research efforts will continue to improve outcomes and avoid redundancy between program offices. The FY 2017 Request includes just over $1.4 billion in crosscutting research and development across seven initiatives: energy-water nexus, exascale computing; grid modernization; subsurface technology and engineering; supercritical carbon dioxide technology; advanced materials for energy innovation, and cybersecurity.

Energy-Water Nexus: Supports the Nation's transition to more resilient energy-water systems

Water and energy systems are interdependent. Water is used in all phases of electricity generation and energy production, accounting for over 40% of total water withdrawals and over 5% of total water consumption. Conversely, energy is required to extract, convey, and deliver water of appropriate quality for diverse human uses, and then again to treat wastewaters before return to the environment; this accounts for 3% of total electricity consumption. Current trends are increasing the urgency to address the energy-water nexus in an integrated way. Precipitation and temperature patterns, U.S. population growth and regional migration trends, and the introduction of new technologies could shift water and energy demands.

The Energy-Water Nexus crosscutting initiative, which draws on ideas presented in DOE's report, *The Water-Energy Nexus: Challenges and Opportunities* (June 2014), is an integrated set of cross-program initiatives that 1) builds and deploys a DOE mission-critical data, modeling and analysis platform to improve understanding and inform decision-making for a broad range of users; 2) strategically targets crosscutting technology RDD&D opportunities within the system

of water and energy flows; and 3) is informed and supported by focused policy analysis and outreach and stakeholder engagement. Taken as an integrated whole, these investments position DOE to contribute strongly to the Nation's transition to more resilient energy-water systems. The FY 2017 Request continues to strategically expand activities in the four focus areas listed below. Features of the Request include an investment in a low-carbon, low-energy, low-cost desalination innovation hub; regional-scale data, modeling, and analysis test beds; and research into the beneficial use of non-traditional water.

Exascale Computing: Enables U.S. leadership in the next generation of high performance computing

Since the beginning of the digital era, the U.S. Federal government has made pivotal investments in the computer industry at critical times when market progress was stagnating. We are once again at a critical turning point in high performance computing (HPC) technology, with industry innovations in hardware and software architectures driving advances in computing performance, but where the performance of application codes is suffering because the technology advances are not optimized for memory intensive, floating point HPC use. Yet the importance of HPC simulations is increasing as the U.S. faces serious and urgent economic, environmental, and national security challenges based on dynamic changes in the energy and climate systems, as well as growing security threats. Providing tools for solving these and future problems requires exascale capabilities.

Committed U.S. leadership toward exascale computing is a critical contributor to our competitiveness in science, national defense, and energy innovation as well as the commercial computing market. Equally important, a robust domestic industry contributes to our nation's security by helping avoid unacceptable cybersecurity and computer supply chain risks.

Addressing this national challenge requires a significant investment by the Federal government. For this reason, in July 2015, the President set forth the National Strategic Computing Initiative, a whole-of-government effort designed to create a cohesive, multi-agency strategic vision and Federal investment strategy, executed in collaboration with industry and academia, to maximize the benefits of HPC for the United States. A key goal of this initiative is to accelerate the development of exascale computing capabilities with a thousand-fold improvement in performance over current high-performance computers. DOE's Exascale Computing crosscutting initiative focuses resources across the Department to work toward this goal. The initiative is organized around four pillars: application development, software technology, hardware technology, and exascale systems. In FY 2017, DOE proposes to expand its efforts in the first three technical focus areas, and begin efforts in the fourth focus area in FY 2018.

Grid Modernization: Provides tools to set the Nation on a cost-effective path to the grid of the future

The reliability and functioning of the Nation's electricity grid is often taken for granted. Whereas rolling blackouts are the norm in many developing countries, U.S. customers have historically benefitted from highly reliable and affordable power transported through long-lived transmission and distribution infrastructure. Our extensive and resilient power grid has fueled the Nation's growth engine and long been an exemplar for other countries. Access to electricity is such a

fundamental enabler for the economy that the National Academy of Engineering named Electrification the greatest engineering achievement of the 20th century.

The Grid Modernization crosscutting initiative supports strategic investments by DOE in foundational technology development, enhanced security and resilience capabilities, and greater institutional support and stakeholder engagement, which will provide tools necessary for the evolution to the grid of the future. Investment is critical now as industry is considering approaches to address aging infrastructure. The FY 2017 Budget Request includes a new emphasis on cooptimization demonstration projects in the areas of (1) clean, resilient distribution feeders; (2) balance in areas with lean reserve margin grid operations; and (3) improved planning tools.

Subsurface Science, Technology and Engineering RD&D (Subsurface): Advances a new era of capabilities across a range of energy applications
Over 80 percent of our total energy supply comes from the subsurface, and this importance is magnified by the ability to also use the subsurface to store and sequester fluids and waste products. The Subsurface crosscut will address identified challenges in the subsurface through highly focused and coordinated research in wellbore integrity, subsurface stress state and induced seismicity, permeability manipulation, and new subsurface signals to enhance renewable energy supply, ensure material impact on climate change via CO_2 storage, and significantly mitigate environmental impacts from energy-related subsurface activities and operations.

Subsurface resources constitute the Nation's primary source of energy, which provides safe storage capacity for CO_2 and presents an opportunity for environmentally responsible management and disposal of hazardous materials and other energy waste streams. In addition to these four core pillars, the FY 2017 Request funds R&D on an identified grand challenge on advanced imaging of geophysical and geochemical signals in the subsurface.

Supercritical CO_2 Technology: Synchronizes R&D activities around a collective technology demonstration opportunity
The supercritical carbon dioxide (sCO_2) based power generation initiative is a technology-focused crosscut that will facilitate industry's transition to realize power cycles based on sCO_2 as the working fluid. Demonstrating and developing this power cycle has the potential to revolutionize electric power generation for fossil, concentrating solar, geothermal, nuclear and waste heat recovery applications in a way that is cleaner and more efficient, and which reduces cost. The FY 2017 Request builds on industry outreach and focused R&D efforts in FY 2015, and the development of more detailed conceptual plans, technical approach, and cost and schedule estimates relevant to a 10 MWe pilot test facility in FY 2016. These inputs will inform the development of the Supercritical Transformational Electric Power Generation (STEP) solicitation, to be issued and awarded in FY 2016, for the design, construction and operation of a 10 MWe pilot test facility. Initiation of design and construction of the STEP facility would begin in early FY 2017. Recognizing that the near-term deployment and potential market applications for commercial sCO_2 power cycles are primarily in the fossil energy area, the STEP project is being managed by the Office of Fossil Energy.

Advanced Materials: Accelerating advanced materials development from discovery through deployment

Affordable, reliable, high-performance materials are key enablers to most transformational changes in technology, including critical clean energy applications. New materials discoveries have the potential to revolutionize whole industries, but only a small fraction of these materials make it to widespread market deployment. As a result, many new materials concepts that are hailed as scientific breakthroughs in the laboratory either never realize commercial application, or spend decades in the development cycle at significant cost. The reality is that no matter how well a material performs in the laboratory, the uncertainties and risks associated with scale-up and production, as well as the real or perceived liabilities associated with material failures in service, significantly slow the development and deployment cycles. To relieve this uncertainty and reduce risk, most sectors require a new material be "qualified" before commercialization, requiring arduous and resource-intensive testing loops that can take years or even decades to complete. Accelerating advanced materials development from discovery through deployment is critical for U.S. manufacturing competitiveness in the 21st century.

The Advanced Materials Crosscut serves as the principal forum for coordinating advanced materials related activities across the Department. This newly-formed crosscut focuses on a subset of materials R&D that will involve close coordination among the participating offices to form a cohesive network with the following capabilities: (1) predictive tools, (2) functional (applied) design validation, (3) process scale-up, (4) qualification, and (5) digital data and informatics. This crosscut is anchored by a shared vision of the optimal approach to designing, scaling, and qualifying materials that harnesses a suite of innovative capabilities, tools, and methodologies that represent a radical improvement over resource and time-intensive testing loops necessary under current conditions.

Cybersecurity: Protecting the DOE enterprise and improving cybersecurity in the energy sector

The Department of Energy (DOE) is engaged in two categories of cyber-related activities: protecting the DOE enterprise from a range of cyber threats that can adversely impact mission capabilities and improving cybersecurity in the electric power subsector and the oil and natural gas subsector. The cybersecurity crosscut supports central coordination of the strategic and operational aspects of cybersecurity and facilitates cooperative efforts such as the Joint Cybersecurity Coordination Center (JC3) for incident response and the implementation of Department-wide Identity, Credentials, and Access Management (ICAM).

Under the Presidential Policy Directive on Critical Infrastructure Security and Resilience (PPD-21), DOE is the Sector Specific Agency for the energy sector and has a number of responsibilities, including the following: 1) collaborating with infrastructure owners and operators to strengthen the security and resilience of critical infrastructure; 2) serving as the day-to-day Federal interface for the prioritization and coordination of sector-specific activities; 3) carrying out incident management responsibilities consistent with statutory authority and other appropriate policies; and 4) providing technical assistance to the energy sector to identify vulnerabilities and help mitigate incidents, as appropriate.

Conclusion

I appreciate the opportunity to discuss how the Budget Request advances the Department's mission in delivering fundamental scientific research and accelerating the development of clean energy technologies. The Department of Energy is focused on investing in a portfolio clean energy technologies to secure America's energy future and enhance American competitiveness. The Fiscal Year 2017 Budget Request aims to continue and advance this pursuit.

Mr. SIMPSON. Thank you. Do others of you have opening statements?

Mr. ORR. No.

Mr. SIMPSON. Ms. Kaptur.

Ms. KAPTUR. Thank you, Mr. Chairman, very much. I wanted to ask Dr. Orr, first on sustainable water utilities, your budget request includes $9 million for work in energy efficient resource recovery in water supply and waste water infrastructure. I also note you have a desalinization initiative. Desalinization does not affect the Great Lakes, but I will tell you, algae does. Particularly in Lake Erie, but recently in the Ohio River last year. And when I asked the Secretary the other day about this issue of the Great Lakes versus the coasts, salty water versus fresh water the answer he gave was, well, look at our proposal for regional centers.

But I am asking you, in terms of what our urban water systems are facing in places like Toledo, a place called Carol Township, Ohio which had to shut down its water system a couple of years ago because of algal blooms. What Sandusky faces, Loraine, and ultimately, Cleveland. This is a big issue for us. The algae is being produced because of excess of nutrients. But I am really interested in how the Department of Energy might look at this region to deal with the daunting challenge, certainly we will see it this year, of a watershed that is being heavily impacted by algae, and where our utility plants are spending enormous amounts of money. Not just on chemicals, but on electricity to do what they have to do to provide pure water, and frankly, treat the waste water. So my question is, for the $9 million for your work in energy efficient resource recovery in water supply and waste water infrastructure can you outline what you are hoping to achieve with this funding? And if I can get you a little bit to think about the Great Lakes I would sure appreciate it.

Mr. ORR. We could actually have a good time with this topic for a long time but I suspect our time will be limited but I will just say a couple of things. One, that this question of how we take water that, I mean one extreme is ocean water but there is a lot of stuff in the middle, there is produced water from the Utica shale in Ohio that is less saline than ocean water.

There is, you mentioned the waste water treatment area. In one sense, waste water contains a series of nutrients and chemicals. The nutrients that you mentioned that come from fertilizer use are one thing and so the possibility exists to recover some of those resources that can be useful at the same time that we are purifying water, the place where the desal idea comes in is that there are kind of multiple steps in getting to a pure water stream or a water stream that can be useful for agriculture or for cooling at a power plant and so on.

And we are really trying through this initiative to look at each of those pieces so particularly the water that is in preparation for—that might come from waste water or non-traditional water, dealing with the energy requirements that are in the waste water streams as well, those really fit in this whole question of how we use energy and water together so I think that they are very much in the purview of the energy and water nexus.

Ms. KAPTUR. This is not under your energy and water initiative, this is a separate——

Mr. ORR. But I am actually making the argument that they really are connected because the way—I mean right now, if you just take the ocean water as one thing, there is plenty of water but you spend energy to get the salt out of the water and that is really true of any other material that is in the water that we do not want to be there and algae fits within that, so thinking about the energy use of all of these processing steps, particularly the early ones where you would have impacts across the whole country and not just in drought places.

Ms. KAPTUR. We each represent a place and I would urge you as you think through how this initiative, along with the energy water nexus initiative is going to work, to seriously look at Lake Erie. It is the shallowest of the Great Lakes and because of climate change, without ice cover in the winter, there is more evaporation and because we have the largest watershed in the entire Great Lakes that dumps into Lake Erie with all those nutrients, we have a huge problem and the amount of those nutrients is increasing. This cannot continue, it simply cannot continue and we have now had alarming things happen with our freshwater systems; meanwhile the plant operators are spending more and more on electricity to do what needs to be done to provide a freshwater supply to people so it is really at a tripwire stage.

Mr. ORR. And this is actually a place where I actually do agree with the Secretary that one of the ideas behind the regional efforts to understand the combinations of energy and water use is really because there are these differences. The specific applications that you are talking about are ones that involve a combination of energy and water that is quite different from what might exist in Arizona for example so the regional focus in those modeling efforts is a chance to look at those kinds of problems.

Ms. KAPTUR. And a lot of what I have read about algae, usually what goes on is they have to produce new algae to create fuel where you are looking at biofuels but here you have this stewpot that is already out there. I do not know if we can collect these materials; that is another issue but I would like to stop them from flowing into, we actually need to arrest them from flowing into the lake.

Mr. ORR. We probably want to look at the upstream fertilizer use too as another way to get at some of the same problems.

Ms. KAPTUR. And the resource recovery issue which you kind of hinted at, I read an article recently about phosphorous over the next—already we are in a phosphorous deficit situation globally and what it is going to require would be phosphorous recovery in order to help our farmer that needs a bit of refinement maybe on the second round you can talk a little bit more about how you view the energy water nexus, what progress you have made since it was first discussed in the 2014 report and I will wait for the second round to do that. Thank you, Mr. Chairman, thank you.

Mr. FLEISCHMANN. Thank you Mr. Chairman and good morning everyone. It is good to see you all again and I appreciate all of the kind words in our earlier visit about Oak Ridge and I represent the third district of Tennessee and I am going to start with you, Ms.

Hoffman because Chattanooga is also a very large city—I was pleased to hear of your visit last week at the Oak Ridge National Lab for a roundtable discussion on the Department of Energy's grid modernization initiative with a number of electric power officials from my Congressional district.

I was particularly glad that you met with representatives from both Chattanooga and Oak Ridge and other localities in between. Could you please talk about the grid modernization initiative, both the challenges and opportunities for our country, what lessons have been learned between the partnership between Chattanooga, the electric power board with its smart grid, Oak Ridge National Lab and the Department of Energy, ma'am?

Ms. HOFFMAN. Thank you very much, Congressman. I really do appreciate it and I did enjoy the visit to Oak Ridge and having a roundtable discussion with a lot of stakeholders in the region.

The grid modernization initiative is a strategy that the Department has pulled together looking at the integration of renewable resources, energy storage, Microgrids, data integration and one of the things that we are trying to do is work very closely with the regions where they are at to how they can expand some of their capabilities in advancing the grid activities.

Some of those include partnerships with buildings and looking at that data and how the data can improve the efficiency and the operations of the electric grid but also looking at how it can improve better customer services so some of the activities in the regions, the importance of the grid is very apparent with the electric power board at Chattanooga and some of the projects that they are looking at from a Microgrid point of view as well as their data integration for reliability and resilience.

Mr. FLEISCHMANN. Thank you so much. Mr. Kotek, the small modular reactor program will help promote our leadership in the use of nuclear power worldwide and represent significant investment in first of a kind engineering for small modular reactors in the United States. Can you please update the subcommittee on the progress made towards preparing for the eventual commercialization of SMRs and what is your assessment of the current market for this emerging industry, sir?

Mr. KOTEK. Thank you very much for the question. Very pleased with where we stand with the current work we have going on and the SMR program, our request this year, for fiscal 2017 will complete our funding commitment to new scale for the development and certification activities for the new scale design.

We expect to see them submit a design certification application to the Nuclear Regulatory Commission by the end of this calendar year. In terms of potential users and a market for that technology, as you may know, we are currently engaged in some site specific work looking at particular locations that our utility partners may want to use for construction and SMR, one of course is TDH site in Tennessee. The other is a construction called UAMPS, Utah Associated Municipal Power Systems which is looking at a series of potential sites in the west, including a couple of sites at the National Laboratory Site.

I was very pleased that a couple of weeks ago, we were able to reach an agreement with UAMPS on a site use permit that would

allow the private entity to potentially use locations on National Laboratory site which could offer them advantages in terms of site characterization data, access to infrastructure and other benefits.

So we are seeing in the U.S., utility interest, as you may know there are several states that are now starting to consider SMRs as a potential vehicle for them to meet future electricity demands.

We are also hearing more interest internationally in the potential use of SMRs, which may offer very attractive low carbon, actually zero carbon life cycle alternatives for countries with maybe smaller electrical grids where it does not make sense to build two units of 1,000 megawatts each or something.

Of course, I expect that interest to firm up more as the new scale design goes through the design certification process and is a product which can actually be ordered which is still several years down the road but I am very pleased with the progress thus far so thanks for the question.

Mr. FLEISCHMANN. Yes, sir. I have another question for you, sir. I know you have had a few visits to the Oak Ridge National Lab this past year and I hope you have had a chance to see the nuclear facilities that support the Office of Nuclear Energy and the Office of Science.

It has been challenging that ORNL has not received adequate nuclear infrastructure funding in the administration's budget request for many years.

I understand this is a complex situation but now the office of science is having to fund more than its fair share. On a related issue, the lab's nuclear activities generate low volumes of liquid radioactive waste. This waste is processed by the office of environmental management as part of Legacy Waste Management on the Oak Ridge reservation.

I am told the systems used to process this waste will be decommissioned and this will require ORNL to develop and operate a new radioactive liquid waste treatment system.

If this system is not operational by 2020, ORNL's nuclear missions are at risk due to the lack of a waste disposal capability. Is there a path forward on this problem, sir?

Mr. KOTEK. Thank you, sir, for the question. Everything you just talked about, really, touches on the question of funding for those facilities.

Of course, that has been an issue that we have dealt with, both this committee and the counterparts on the Senate over the last couple of years. This year, we have gotten, I believe the number is 26 million dollars in the Office of Science budget, up from I think it was 12 in last year's request so there has been an attempt by the Department to address the funding challenges there.

With respect to the question of fair share, as an example, what we call the doors open costs for the facilities that we have in Idaho at the Idaho National Laboratory, we fully fund those out of the nuclear energy budget even though NNSA science and other programs might use those facilities, they will pay for the incremental costs of their programs but in terms of the base operating cost, say the door is open, waste management, et cetera, I think it is fair to say that we have taken a similar approach here with the facilities

at Oak Ridge and the Science budget. I think our science counterparts are here this afternoon, is that right?

Mr. ORR. Yes, we will be back this afternoon.

Mr. KOTEK. And so they may have more that they may want to add on that subject at that time, thank you.

Mr. FLEISCHMANN. Thank you, sir. One final question, Dr. Orr, I would like to talk about the success of the manufacturing demonstration facility at ORNL. They are doing a terrific job and have attracted a number of businesses that are coming to work and solve big manufacturing problems.

The Department of Energy budget goes into some length about mission innovation for clean energy.

The budget proposes this as a new initiative to establish regional innovation and partnerships called Regional Clean Energy Innovation Partnerships.

Can you please tell me how the advanced manufacturing office and the MBF might fit into this initiative with the lab and the University of Tennessee, the MBF and the advanced composites institutes?

We already have a lot of original capabilities, how would these play into the proposed initiative, sir?

Mr. ORR. Well we will certainly continue the very successful effort that is in the advanced manufacturing arena and the composite at Oak Ridge is a prime example of ways that you can take the scientific capabilities of a place like Oakridge and make them available and build an ecosystem around them.

The regional partnerships overlap in some ways and not in others but the idea there is that if you take assets like universities and entrepreneurial communities and national labs that are distributed around regions in the country, that they will look at the combination of energy challenges and opportunities that they have and those challenges and opportunities will be different depending on where you are. If you are in Maine, then maybe it is wind, offshore or not, and a whole variety of approaches that fit in the area there. If you are in Southern California, it is a different energy challenge and a different set of opportunities to deal with and a different set of assets to put to work. The idea would be to create some non-profits that would manage a local energy ecosystem research effort that would benefit that area and would undoubtedly have benefits beyond as well but to take advantage of both the heterogeneity around the country and the creative juices of all the people that can work on things that matter for their areas but we will still continue to invest in things like the advanced composites institutes because those have their own ways to contribute in a more specific way.

The regional partnerships would be technology neutral in the sense that they would go beyond the specific application.

Mr. FLEISCHMANN. Thank you, Dr. Orr. Mr. Chairman, I yield back.

Mr. SIMPSON. Ms. Royal-Allard.

Ms. ROYBAL-ALLARD. Thank you all for being here. The DOE's Weatherization Assistance Program is a critical program that helps low income families retrofit their homes to become more energy efficient, ultimately reducing the cost of their energy bill.

In fact, the DOE evaluation of the Weatherization Program found that a single family—a home saved, on average, $283 per year.

Meanwhile, DOE's Building Technologies Program works to advance technologies and practices to make buildings in the U.S. energy efficient.

To ensure that beneficiaries of the Weatherization assistance program are receiving the most up to date and effective building technologies, does collaboration exist between the weatherization assistance program and DOE's building technologies program?

Mr. ORR. Indeed, one informs the other and we are certainly wanting to do the best job we can in terms of both providing efficiently and at the same time taking advantage of what we have learned on how to do this across the building space.

Kathleen, do you want to add anything to that? This is Kathleen Hogan who is the Deputy Assistant Secretary here and has this in her purview.

Ms. ROYBAL-ALLARD. Ok well let me just add to that and maybe you can answer. Once the building technologies program identifies effective technologies, how quickly are they introduced into the market and how are they adopted by the Weatherization Assistance Program?

Also, if you could maybe comment on what sorts of new building technologies you are phasing in for the Weatherization Assistance Program in 2017?

Ms. HOGAN. Sure, so as Dr. Orr spoke, there is a lot of collaboration between these two efforts and when we work with the Weatherization Program, the thing to keep in mind is that when the community action agencies that field the cruise to go in and do the audit look at the opportunities in those homes, they do have to identify opportunities that have a positive savings to investment ratio so we are always talking about the technologies that are up and coming and what can deliver on that positive savings to investment ration in low income homes so there have been any number of technologies but also sort of improved practices because some of the things that are providing the greatest savings in weatherization are things like improved insulation, improved home ceiling, just really getting the things that are, you know, letting the conditioned air leak out of the home, the really low cost measures that can give sort of the deeper savings to the low income homes.

I think some of the technologies we are looking at, include things like windows, higher efficiency air conditioning, type measures. I think we are also looking at the opportunity for renewable energy in the regions of the country where that can make sense as well.

Ms. ROYBAL-ALLARD. Thank you. According to the DOE, addressing soft costs like financing, permitting installation, labor inspection, another non-hardware cost provides the greatest opportunity to spur strong U.S. growth in solar deployment in coming years.

In an effort to make solar deployment faster, easier and cheaper, the DOE's Solar Market Pathways, which began in 2014, is a program that supports solar related projects.

In fiscal year 2017, the DOE plans to build upon the success of the Solar Market Pathways program and supports six to ten new awards. How do they activities proposed in 2017 apply to the Nation as a whole and are you ensuring this research is not repli-

cating or subsidizing work that is more appropriate in the private sector.

Mr. ORR. Thank you for the question, it is an excellent one. I think that the cost evidence indicates that the hardware costs have come down more quickly than the related costs, and I know this to be true from my own experience installing solar cells at my house in California, and that there is an opportunity on both sides. We have not given up on the fundamentals of photovoltaics. We know that there is still more to be done there, and there is some really exciting work with perovskites, for example, that could lead to real cost reductions in the future.

But at the same time a parallel effort like the one you described which looks all the ways that the process slows down and, therefore, costs more, these are regulated at State and local levels and so, in one sense, creating some best practices and a competition amongst places to figure out how to streamline the process, offers some ways to get to a more efficient process and, therefore, to lower cost. So we think that the appropriate thing to do is to work on both sides of the equation because we know that this can be done more efficiently.

Ms. ROYBAL-ALLARD. Mr. Chairman, I am not sure if I have time for another question or not.

Mr. SIMPSON. Go for it.

Ms. ROYBAL-ALLARD. Go for it? Ok. Dr. Orr, the budget request contains a new request for funds to support the SMART Consortia Initiative within the Vehicle Technologies Office, yet does not expand on these efforts. The SMART Consortia Initiative is part of the Smart Cities efforts announced by the President last year to invest in technology collaborations to help local communities reduce traffic, foster economic growth, improve the delivery of city services, and manage the effects of climate change. Can you outline what exactly the vehicle technologies office proposed to fund in support of this effort?

Mr. ORR. Mm-hmm. So, I am going to have to ask for help on that, but I will start by saying that one of the things that we learned in doing the Quadrennial Technology Review was thinking about energy systems offered some ways to be much more efficient. And if you think about cities and the way we have complicated systems that supply electricity, some more that supply water, that deal with wastewater, and that move all of us around, and all of those are linked together in interesting ways, so figuring out how to look at those systems as systems, and look for the efficiencies that come from being able now to deploy sensors and use advanced computing to manage these systems, that there are real opportunities there that we are only kind of just beginning to figure out how to work on. So we are taking this area as one example of ones where we can make some progress and learn how to do it better at the same time.

So, let us see, Reuben, I guess you are the right one. This is Reuben Sarkar.

Mr. SARKAR. Reuben Sarkar. Thank you for the question. Just to build on what Dr. Orr had said, within DOE and within the transportation sector, we do not exactly have a program called Smart Cities, per se. Smart Cities is the vernacular that is used by a

number of agencies to describe data-driven cities, and the ways that we can use controls and information to make cities more efficient.

What we do have is a Smart Mobility program that is going to be part of our Transportation as a System program, and builds on our component level of research which looks at the efficiency of an individual vehicle and takes it up to the level of how do we make future mobility systems more efficient when we think about things like connected and automated vehicles, a multimodal transportation, and the convergence of IT systems into cars.

And so our Smart Mobility program is a multi-lab consortia, part of our Transportation as a System program, and it is very complementary to the work that is being done by other agencies, like DLT and their Smart Cities challenge, but it looks very specifically at how do we optimize the energy benefits that we get when we look at all of these future mobility systems, these new business models that are coming, both in the movement of goods, and, as well, in the movement of people.

Ms. ROYBAL-ALLARD. Ok. What did you do to ensure that you did not duplicate any efforts from the Department of Transportation? Was there some coordination?

Mr. SARKAR. Yes. So we do both joint program briefings in which DOT comes and briefs us on their efforts and then we brief them on ours. We also recently hired a lab M&O contractor from the National Renewable Energy Lab from DOE and we embedded them with DOT on their Smart Cities team. And we use that person as the liaison to make sure that we are coordinating our activities and that what we are investing in is a very high value to what DOT is investing in.

Ms. ROYBAL-ALLARD. Ok. Thank you.

Mr. SARKAR. Thanks.

Mr. SIMPSON. Mr. Honda.

Mr. HONDA. Thank you, Mr. Chairman, and welcome. Dr. Orr, I have a question about energy efficiency programs, and much of the focus on energy efficiency goes towards large power consumption devices, such as appliances and motors through the Energy Star programs. But the proliferation of consumer electronic devices means their energy consumption is adding up to a very significant level, especially if you go global. Furthermore, the vampire devices that continue to draw power even when they are not in use are adding to consumer utility bills and our overall energy usage as well as our resources. So, what is your office doing to address this ever-growing concern that I have?

And then with regard to energy efficiency in manufacturing, saving energy cannot only reduce cost, but also reduce climate and environmental impact. What is your office doing to help the Nation's small- and medium-sized manufacturers to become more efficient?

Mr. ORR. Well, you are absolutely right that energy efficiency is something that offers lots of benefits and often ones that pay off economically with shorter payback times than lots of the other investments, so it is a really important area. I am going to ask Kathleen Hogan to talk about the specifics of the appliance efficiency standards with respect to how they apply to the so-called parasite or vampire devices, I guess, is what they are called.

But I will note that, in general, that the efficiency standards that we have worked on have had a real impact in saving lots and lots of money for consumers and, at the same time, reducing greenhouse gas emissions. So it is an area that really does deserve considerable effort and we will continue to do that.

Kathleen.

Mr. HONDA. In your response would you also address where we are at in improving the energy process, the Energy Star program? Because I think that there are ways that we can double the efficiency, but I do not know where we are at and what needs to be done, whether it is going to be industry-driven or Energy Department-driven.

Mr. ORR. Well, the one thing I would say there is that in establishing the energy efficiency standards we actually do work quite closely with industry. It is a process that Kathleen can describe in more detail.

Mr. HONDA. Thank you.

Ms. HOGAN. Yes. Terrific. So, as you point out, this is a big problem, and one of the reasons it is a big problem is because there are so many types of devices that are out there. So you are always looking for the common elements where you can find energy efficiency opportunities, and that is really where the appliance standards have come into place. We have had appliance standards for external power supplies or things that have, you know, that power supply element. We can work with industry to find the appropriate standards there.

We also have an ongoing rulemaking for battery chargers, sort of another area to look for improved efficiencies. We also, in our fiscal year 2017 budget, are proposing a new research and development area for miscellaneous electric loads that would leverage the great work we are doing in our advanced manufacturing office around something called wide bandgap materials, or also called, potentially, sort of like semiconductors. It is the next generation of semiconductors, right. So the extent that we can make semiconductors much more efficient, we can really drive down the energy use of all of these miscellaneous energy loads, so an exciting opportunity there.

Mr. ORR. Say a word, Kathleen, too, about the business competitions for reducing energy use and the energy-efficient businesses.

Ms. HOGAN. Just working more broadly with industry to drive down their loads.

Mr. ORR. Yes. Yes. But we have also worked with a variety of businesses to challenge them to reduce their energy consumption as well, and then publicize what they do.

Ms. HOGAN. That is right.

Mr. HONDA. So, perhaps, to the chair, I request that we can get together and sit down and go through the myriad of efforts that is going on, and also maybe look at converting that into cost savings in terms of the kinds of fields that is necessary to generate just—that will be saved because of this efficiency. I have a question on waste energy. Dr. Orr.

Mr. ORR. Mm-hmm.

Ms. HOGAN. You know, I just checked the Zero Waste Energy Development Company operates the first large-scale commercial dry

fermentation anaerobic digestion facility in the United States. This facility can process 90,000 tons of organic waste per year. That is just about wet waste. It generates about 1.6 megawatts of clean energy. Now, this type of facility not only keeps tons of wet garbage and green waste out of landfills, but also diverts mixed construction waste and debris for recycling and reuse. Replicating this innovative approach to recycling and landfill diversion will move our country to a more sustainable future.

Can you explain to me how DOE intends to help both maintain our existing WTE infrastructure and capitalize on the potential of the WTE technology in meeting the Nation's renewable energy and GHG emissions goal.

Mr. ORR. Well, I cannot explain it to you, but I bet one of my colleagues can. I would just say that being able to do that kind of thing, this is kind of the putting together of technologies that offer combinations. So they are kind of hybrid things that really do—just as a credit to a bunch of smart people.

But, Reuben, can you help us on this?

Ms. HOGAN. Ok, Reuben is a smart guy, huh?

Mr. SARKAR. Yes. In our bioenergy program, we have included both municipal solid waste as well as wet waste streams as part of our feed stocks that we are having for our next-generation pilot and demonstration programs that will be coming soon. And so we have bio solids to bio power represented in the next pilot and demonstration programs.

Ms. HOGAN. Well, we have one already established. How do we go about replicating and scaling up this kind of a process where you are actually doing 90,000 tons a year? And that is only a portion of our city. And if we can incentivize or create more programs like this, we generate the process where we avoid landfills, filling and base, avoid the smell and odor, and things like that. Is there a place where we can go to to use this as an example for replication?

Mr. SARKAR. Yes. And maybe, just so I can clarify, our integrated bio refinery program, which is part of our demonstration and market transformation program, we will be conducting both pilot and demonstration-scale plants, so taking things from lower-scale, less integration, and moving them up into larger-scale facilities.

And the goal is that demonstrating at a higher scale will then lower the technical risk and will provide access to more bank financing or financing through the loans program. And our goal is that once you demonstrate the lower risk of a technology and the viability, then you are able to then replicate those plants at others.

Ms. HOGAN. But if we are able to do that already, what is the next step?

Mr. SARKAR. Within the bioenergy program, we fund only up through the demonstration-scale facilities and not all the way into the commercialization phase for plants. I can follow up and get you a more clear answer.

Mr. ORR. And I would just say that, you know, in the end, it is about cost, so continuing to work to reduce costs means the ability to deploy more widely, that when municipalities see that it is in their interest to do this, they will.

Ms. HOGAN. To the chair, if I may, can we invite you to come down to the district and look at this, so you can help me articulate better how we do this, so replicate this throughout the other communities in the near future?

Mr. ORR. Yes. We will look to figure out some way to do that.

Ms. HOGAN. Thank you. Thank you, Mr. Chairman.

Mr. SIMPSON. Mr. Calvert.

Mr. CALVERT. Thank you, Mr. Chairman. I apologize that I am late. We are having hearings around here everywhere, at the same time, but we cannot help that. But I have a couple of quick questions.

Obviously our grid, our electric grid, and I apologize if this question has already been asked, has become more complex over the years and certainly we have more challenges, extreme weather events, and now we have all these different sources of power, solar cells on everybody's roof, changing the dynamics on how the grid operates.

I hear from the various electric providers that this is causing them all kinds of engineering problems and so they need to make various fixes to it. So I guess the question would be, how is the grid today? Do you look at it as resilient and capable of doing this job in the future?

Mr. ORR. I would say that we are partway through the process of modernizing the grid to be as effective as it can be. Partly through the Recovery Act, for example, we install lots of sensors known to the technical experts as synchro phasors, but these tell us about voltage and frequency and kind of the state of the grid. That helped us be able to identify problems as they were developing and respond to them more quickly. But there is actually quite a lot more that we can do.

As the fraction of renewables grows, as more distributed generation appears, that offers both some challenges and some opportunities. As we use storage to provide batteries or flow batteries or some things like that as a way to provide some balancing on the grid, those are all opportunities that we have to figure out how they work, both physically, but also from a market standpoint, and so our Office of Electricity is working hard on these things. I'll ask Pat to join me in responding here just for a moment. It is the reason we have created our Grid Modernization Initiative and our Grid Modernization Lab Consortium. We have 14 of our national labs working on various components on this, and we have a 5-year, multiyear program plan that is aimed at really improving services, improving efficiency, and at the same time, making the grid more reliable and resilient and able to recover more quickly when bad things do happen. So it is a very important effort for us.

Pat, do you want to add to that?

Ms. HOFFMAN. Yes, I would, thank you. Thank you, Congressman, for the question, and I think the grid is undergoing a transition, and like any transition, we have to help with the process as we move forward. California has reached its first 10,000 megawatts per hour ramp rate in California. Also, we have had a request for 1.3 gigawatts of energy storage on their system. I think California represents a leading edge of what is to come. The reason the Department of Energy did the Grid Modernization Initiative was real-

ly to take a look at the integration of distributed energy resources, renewable technologies, but also find a way to effectively integrate that, but to deal with some of the challenges that are occurring on the system. So part of the budget request, which is looking at grid modernization, which is the 262 request from OE and the budget request that is coming from EERE, we are integrating those aspects of renewable energy resources, looking at energy efficiency, looking at how we can better manage demand on the system. So these are great opportunities to provide the flexibility that the grid requires, but it is a work in progress and it is efforts that we will continue to work on.

Mr. CALVERT. Ok. I appreciate that. One other quick question, I know we spend a lot of time talking about solar and wind. We have some automobile companies that are, especially in California, moving forward with hydrogen technology, especially Hyundai has some technology that they are excited about, but, obviously, the infrastructure, just as we had with electric cars, is woefully not there. There is no way to power up your Tesla as you are going up the 5 freeway in California. So are there any plans for hydrogen vehicle infrastructure and where do you see hydrogen vehicles going? Do you think that it is a workable technology? I know Mercedes is putting a lot of money into that.

Mr. ORR. Yes, I am going to pass to Reuben here in a moment, but I will say that this is one of those really interesting areas where there is a real competition. If you think about an electric vehicle, there, you are storing the energy on the vehicle in a battery, and then that drives an electric motor. A fuel cell vehicle is one where you store the energy in the hydrogen and then put that on the vehicle and then use a fuel cell to convert that into electricity to drive the vehicle. So they are competing technologies.

There is interesting progress on both sides, and we will see what that diversity in the marketplace provides. There are now charging stations are appearing around the country. I would say overall on the hydrogen side, they are probably more limited on the hydrogen side for now than the electric side, but it is definitely a competition. Reuben, do you want to add to that?

Mr. SARKAR. Yes, I will just build on it a little bit. As mentioned, hydrogen builds on an electrified platform, so there is benefits for electric vehicles as is for hydrogen. We do work in two areas. One, as you mentioned, there is already vehicles on the road, and so we are actually supporting the deployment of those stations in places like California. Through our H2USA public-private partnership, we have about 45 companies and agencies involved in developing the expeditious process for rolling out those stations in places like California, first on examples, working on safety codes and standards, trying to get standard reference designs for stations. We have developed equipment that can qualify stations very quickly and enable us to actually deploy those hundred planned stations much more rapidly. Then on the research side, we continue to drive down the cost of fuel cell systems on vehicles by lowering the amount of precious metal catalysts and things that we have onboard the vehicle, and at the same time, lowering the cost to store hydrogen off the vehicle at stations.

Then lastly, the biggest nut that we are working on cracking is renewable hydrogen from advanced sources. We already can make renewable hydrogen from solar and wind today, and if we can push down the cost further through advanced water-splitting technologies, you have an opportunity to really deeply decarbonize transportation, and so we work on it both on the deployment side with the cars today as well as on the long-term research side.

Mr. CALVERT. Good. Thank you. Thank you, Mr. Chairman.

Mr. SIMPSON. Thank you. First, let me ask, following up on the grid and modernization of the grid, we act as if we own the grid; we don't. The grid is privately owned by private utility companies. What is our role in helping modernize the grid? When you say "we are partway," what do you mean? The private sector is partway? What is our role in helping the private sector do this? I understand there are BPA and TVA but the line that comes to my house is owned by Idaho Power.

Mr. ORR. You are exactly right that it is complicated. The players range from utilities that generate the electricity in both investor-owned and the regulated utilities. There are the wires themselves and the transmission and then the distribution system, which often can be owned in separate ways, and then there are the regional balancing authorities that make sure that there is enough generation on the grid and that the whole thing is operating and stable. You are absolutely right that we are not the regulator, but, in some ways, that gives us a way to be a convener for the conversation amongst all these players. There are regional differences and some significant efforts going on to understand how it should work in particular markets. We can participate in all those conversations in a way that is harder for the Federal Energy Regulatory Commission to deal with or the state public utilities commissions. We can help conduct that conversation, and we can do research on the components that they need to do all this at the same time that we recognize that maybe the only thing that is more complicated in its regulatory approach is water, I think, because that goes right down to the community level. But, nevertheless, I think it is both an opportunity for some experimentation and some demonstration of what we need to learn, and the challenge as we figure out how to make it all work together.

Pat, correct whatever I said that was wrong.

Ms. HOFFMAN. Thank you, Mr. Chairman, for the question. With respect to the grid, yes, it is owned majoritively by the utilities and other entities out there and we do not own the grid. The issue that it comes down to is, how do we invest in new technology while minimizing risk for those entities? So there are a couple things that as utilities are looking at the integration of whether it is wind, it is how do they evolve their system to be able to keep pace with the demands of the new technologies that are coming on the system, so a couple things.

With respect to grid technologies, we want to help reduce the cost of the technology. We want to de-risk the technologies so that the grid operators can install these technologies more cost-effectively based on rate payers and consumers and——

Mr. SIMPSON. But, ultimately, it is up to them to install it.

Ms. HOFFMAN. It is up to them to install it, but we can help bring down the cost and we can bring down the risk. The other area is that the grid is a network system, that Idaho Power is connected to the Western Interconnect, and there are issues that would affect Idaho Power would affect the rest of the Western Interconnection. So how do we look at those systems issues from a wider area so that the utilities can advance their technologies but also be a part of the system so that they do not affect the rest of the system as they invest in these technologies? So those are a couple things that the analytics that we do support where technologies can be best placed on the system, the value of the technologies, and how we can improve the resilience of the grid writ large.

Mr. SIMPSON. Tell me about the Grid Modernization Institute. What exactly will it do? I think you have requested $14 million for that in the budget.

Ms. HOFFMAN. So thank you for the question. The Grid Modernization Institute is a core part of our mission innovation area with the Office, but what we would exactly like to do is focus on high-risk components that we need to have manufacturing in the United States to support. I know that, at least some of the numbers that I have seen, is the utilities will invest probably close to a trillion dollars over the next 20 years in upgrading components on the electric grid. What we would like to do with the Manufacturing Institute is take a look at some of those high-risk, hard, difficult-to-manufacture components and focus the Institute on investing and manufacturing for those type of devices or components. For example, one might be magnetic materials to help with cores and transformers. Transformers are a very difficult component to manufacture. We need more transformer manufacturing in the United States. Another area might be in the wires, the transmission and distribution wires of low resistivity materials so that we can actually get additional capacity and more efficiency in our transmission and distribution system. So those would be the efforts and the topics. We would run some workshops to fine-tune whether this is the best topic, but this is just an example of some of the things that we would look at.

Mr. SIMPSON. So you would do research into those arenas?

Ms. HOFFMAN. Yes, yes.

Mr. SIMPSON. Mr. Smith, not to leave you out of this conversation, since fossil fuel seems to be the major source of energy in this country, let me ask you a couple of questions.

Your office proposes to increase the STEP program, which seeks to realize more efficient electrical power generation from the use of a super critical fluid in the generation process. The increase would fund the initial design and construction of a pilot facility to demonstrate the use of this fluid.

Due to the more near term deployment of this technology in the fossil energy field, the STEP initiative has been managed out of your office. However, coordination efforts are still ongoing with the Office of Nuclear Energy and Solar Energy Office in EERE.

Can you update the committee on those coordination efforts and describe how they are incorporated in the long-term plan in this technology?

Mr. SMITH. Thank you very much, Mr. Chairman. So, in Dr. Orr's introduction, he talked a little bit about the cost cutting initiatives that cut across the offices within the Department of Energy.

So, this is actually an excellent example. We do have a cost cutting initiative which is for the Supercritical CO_2, the STEP initiative. That is co-chaired by the Office of Fossil Energy and the Office of Nuclear Energy, so we work very closely on that initiative.

Nuclear Energy released an RFP in the first quarter of 2016. That is going to then feed into the work that EERE is doing. We are going to have a FOIA that we put out some time in March leading ton an award that will be made some time in the fiscal year, probably in September. The hope is that we will move forward on construction some time in the following year. So, again, very close collaboration between the Office of Nuclear Energy and the Office of Fossil Energy.

We have noted that this technology is applicable to renewables, it is applicable to fossil energy, it is also applicable to nuclear energy. When you look at the different fuel sources used, the greatest efficiencies for a Supercritical CO_2 we expect to occur in the temperature ranges that would be fossil applications, so that is why the highlight has moved from nuclear energy to fossil energy.

Again, we work very closely with the Office of Nuclear Energy in executing this project, and in doing the research together.

Mr. SIMPSON. John, do you have anything to say on that?

Mr. KOTEK. No, other than just to echo what Chris said. It is working very well from our perspective, and of course in addition to that cooperation, we have a little bit of work looking at the specifics of how you would link up a nuclear system through an energy conversion system like this. So, a little bit of work there, but the most of what we are doing is in cooperation with his office.

Mr. SIMPSON. Mr. Smith, the Bipartisan Budget Act of 2015 directed DOE to complete a strategic review of the Strategic Petroleum Reserve and to develop and submit to Congress a plan for modernization of the reserve.

What is the current status of the review, and do you expect to meet the deadline of early May?

Mr. SMITH. Mr. Chairman, thank you for the question. Certainly, we do expect to meet or exceed that deadline for May. We are working on that right now, and expect to get it to the committee shortly.

Mr. SIMPSON. I know this is before the report comes out but do you anticipate there would be recommendations for fiscal year 2017 in the report, and if so, if it is the May deadline, it may be too late because we are moving with the budget as quickly as possible.

Mr. SMITH. Understood. So, we understand there is a May deadline that was input in the language. We also understand there is an opportunity to influence the ongoing process. So, we do expect to be able to move more quickly than May to get something back to the committee. In fact, that process has started within the Department of Energy and in our collaboration with OMB. So, that is ongoing in real time as we speak. We expect to be, as we noted in our congressional justification, submitting an amendment to our budget very shortly.

Mr. SIMPSON. The Bipartisan Budget Act of 2015 established an Energy Security and Infrastructure Fund. That authorization allows appropriations' acts to direct the sale of up to $2 billion worth of oil from the reserve and to use the proceeds for the construction, maintenance, repair, and replacement of strategic petroleum reserve facilities.

The budget request does not include use of this authorization, however. The budget request includes an increase of $45 million or 21 percent for the Strategic Petroleum Reserve. It is described as necessary to address the backlog of major maintenance activities.

Why did we not use the fund that was created to do this in the budget request?

Mr. SMITH. There are two areas that we are looking at funding, our base budget, including the additional $45 million, which is to handle deferred maintenance, which we see as being essential for the immediate operation of the Strategic Petroleum Reserve.

So, this is the ongoing maintenance and deferred maintenance to ensure that the Petroleum Reserve is able to operate as it is intended.

In addition, we are expecting to submit an amendment to the fiscal year 2017 budget, which will be for modernization of the Strategic Petroleum Reserve. That would include life extension, and that would also include modernization of——

Mr. SIMPSON. Somebody is calling "bull" on that.

That is wind energy.

Mr. SMITH. But I would also include the modernization of docks and to increase the distribution capacity of the Strategic Petroleum Reserve. That is the scope of the work that would be included within the budget amendment.

Mr. SIMPSON. Ok.

Mr. ORR. A simple way to think about this is we need to keep the dern thing operating in order to sell the oil that it takes to generate the income to do the big picks.

Mr. SIMPSON. Mr. Kotek, I have not called you that in a long time.

Mr. ORR. Has he called you worse?

Mr. SIMPSON. No, I have never called him worse. I just have known him for a long time. What is the general health of the Advanced Test Reactor in Idaho, and has it adequately been funded to provide maintenance and upgrades necessary for it to last, and what projects and upgrades to the ATR are still outstanding but are not proposed in this year's budget request?

Mr. KOTEK. Thank you, sir, for the question. Of course, the ATR is central to both my programs in the Office of Nuclear Energy and to the work of the Office of Naval Reactors.

One of the first things that I got into deeply when I came back to DOE about this time last year was to ensure that we had a plan in place to adequately invest in the long-term safe and efficient operations of that reactor. Both we and the Office of Naval Reactors see a need for that facility out until the 2050 time frame.

So, what we have done is we have worked cooperatively with the Office of Naval Reactors and with the laboratory to put in place a 5 year rolling strategy focused on improving the reliability and predictability of ATR operations.

Of course, the Congress in the fiscal 2016 budget provided additional funds beyond what we had already requested, which we will use to accelerate some of the work that we had identified in that plan.

We have in our request for this year fully funded the activities that we had identified to be conducted in fiscal 2017 as part of that plan. The increase we received in fiscal 2016 came after we had put the 2017 plan in place.

We will work with Naval Reactors and with the contractor to ensure that those funds are spent efficiently and at the highest priority for the long-term safe operation of the ATR because it is just essential to a wide range of DOE missions.

Mr. SIMPSON. In this year's request, the Integrated Waste Management Systems account is proposed to fund two distinct activities, storage and transportation R&D and consent-based siting activities.

In previous years, the focus of the Integrated Waste Management Systems account was on a generic research and development applicable to Yucca Mountain and other waste solutions.

Does this new proposal still maintain this focus, and how much of this research and development applies specifically to Yucca Mountain and how much applies to an interim storage facility?

Mr. KOTEK. Thank you, sir, for the question. The $76.3 million we have for the Integrated Waste Management System is roughly split 50/50 between activities focused on consent-based siting and then work on nuclear fuel storage and transportation, which would be applicable regardless of what site was chosen for the ultimate storage or disposal of fuel.

Of course, we do not have anything specifically tied to Yucca Mountain in our request, but we are looking at being ready to transport fuel, for example, when we are in a position to start moving fuel, for example, from shut down plant sites to consolidated storage, which of course, we have set as a priority.

On the consent-based siting side, about $25 million that we have requested would be intended to be used for grants to states, tribes, local governments, potentially others that are interested in learning more about what it would mean to host a facility, either for storage or disposal, and either for civilian waste or defense waste repository sites, to help them understand what those challenges might be so that they can decide for themselves whether they might be interested in over the long term becoming what we call a "willing and informed host."

Mr. SIMPSON. So, I guess your legal counsel has made a determination of how far down that road we can go before we get the roadblock of not allowing the department to look at interim storage?

Mr. KOTEK. Well, the language in our request in the fiscal 2016 request speaks to continuing to lay the groundwork for the consent-based siting process, and of course, what we are embarking on now is a series of public meetings and other activities designed to get input from states and others as to what should be considered in the design of a consent-based siting process.

For the fiscal 2017 request, we have in our language specifically said we now want to move forward with implementation of that process.

Of course, as you point out, there is a need for new legislation to do a number of the things that we have included in the administration's strategy, assure access to the Waste Treatment Fund, setting up a new organization, an independent organization, and other things.

Mr. SIMPSON. Well, I would just add I am not opposed to that. We are going to have this type of thing regardless of what happens with Yucca Mountain. We have to face that reality at some point in time, that we need a facility, more than one facility, as a matter of fact.

Ms. Kaptur.

Ms. KAPTUR. Thank you, Mr. Chairman. I wanted to go back, Dr. Orr, to the issue of municipal utility systems, and ask, do you or any of your colleagues have any example at DOE on where the department has worked with a local municipality to make their energy use more efficient by reducing their energy costs for water and wastewater treatment?

And in doing so, integrating the full range of Department of Energy technologies that might involve a new conduit, grid modernization, on-site installation of renewable energy technologies, including sensors, and implementing wastewater resource recovery so that we can recover essential elements, such as phosphorus, in the organics that result at the end of the treatment process?

Do you have any example literally where the department has put its full weight behind transforming a community's utility system?

Mr. ORR. Well, it is an excellent question and I need to ask for some help. Kathleen, are you on the hook for this one?

Ms. HOGAN. So, we have a number of engagements where we are assisting states and municipal governments through a variety of programs that we have, focusing on their water treatment and wastewater treatment to improve energy use.

So, one very applicable technology is combined heat and power, right, where you can get the biogas recovery from anaerobic processes, trap the energy, use it on-site, and get substantially reduced energy bills for that wastewater treatment facility. We also have been working through our renewable energy program and have some solar applications.

I think, as you are highlighting, that is not necessarily the full soup to nuts type of thing that can happen at a wastewater treatment facility, but we are trying to think through as part of the energy-water nexus what would be a fuller suite of opportunities for the Department of Energy to engage in, as well as with our partner agencies. So, certainly EPA would have an important role in these types of efforts. So, we have some of this thinking underway.

Ms. KAPTUR. First of all, thank you for the fine work you do, and I hope you keep thinking along those lines because as I said to the Secretary, one thing I have noticed, I have served on almost a majority of the subcommittees of the Appropriations committee in my career, and one of the startling facts for the Department of Energy as critical as your work is, I have found a remarkable lack of sensi-

tivity to place, and your authorizing legislation probably does not give you full weight in that regard.

I have found lots of separate programs, but no integration, and certainly at the community levels at which we work, and I think Congressman Honda was referencing some issues this morning, and I think the chairman was.

I think your department has in some ways been cordoned off from that kind of thinking to relate to regions and places. I think you have a lab perspective, which is critical for the work that you do, but it is a little bit hard to integrate your programs, and I do not think it serves America as well as it could.

If you need additional authorizing power, let us know. I think when you create something like an energy-water nexus that gives you the ability to integrate.

Along those lines, let me also ask about the weatherization program. Congresswoman Roybal-Allard asked about the program. Again, here, do you have any examples of communities that have benefitted from weatherization assistance in accessing it through the states, but have developed robust local partnerships that use all of DOE's energy programs to help revitalize and target those dollars to neighborhoods, not just individual homes, but integrating your technologies along with those weatherization programs through workforce training and development, in places where these investments are made, accessing historic preservation, which is not your job but it exists out there, grid modernization, where it is possible, recapture of waste energy where possible, installation of renewables where it is possible, sensors where it is possible.

So, again, will you target that weatherization in a way, even though it is a smaller program, where it really can have a major impact?

I will just say in one of the regions I represent, there is a historic neighborhood. Unfortunately, the weatherization program, it comes in and does its thing, but what it could do if it could link these other assets that you have and other partners—it could do so much more.

It seems to be unable to do that because the dollars flow through the state and the state is a long way from neighborhoods, at the local municipal level, let's say.

So, do you have any examples where that broader approach has been taken, to your knowledge?

Ms. HOGAN. So, I would again say this is an active conversation at the department. We understand the importance of addressing communities as holistically as possible.

I would point to one of the parts of our budget which is in the Office of Weatherization and Intergovernmental Programs. We are asking for a community oriented program where we could integrate this more holistic thinking in terms of solving the issues that are facing communities and really focusing on neighborhood revitalization opportunities where clean energy can really help be part of that goal.

Ms. KAPTUR. Literally, I represent neighborhoods where there is waste heat right near these homes, and there is no thinking about how to work with industry. The weatherization program comes in here, it does not connect at the local level.

So, I would urge you. We put extra money in the budget for 2016 for weatherization. I do not know if your authority allows you to try to create some pilots around the country where you try to integrate programs. Please let me know if something prevents you from doing that. I do not think you are having maximum impact.

Ms. HOGAN. We will certainly take those words. Again, we are thinking through how to field an effort with partners across the country so we can bring those partnerships together. The weatherization program does have very strict rules in terms of when money is put into the weatherization program.

It goes out in formula allocations to help the states, with the community action agencies, to deliver the weatherization services, and I think we look at the weatherization program as a very important network and set of activities that are happening in the community, but we agree with you about the importance of a broader set of partnerships that can leverage that or bring other things to the table to help these communities.

Again, we are actively thinking this through and would love to come back and talk with you once we have done a little more thinking.

Ms. KAPTUR. Thank you for your openness to that very, very much. I think we could do something to modernize what is happening out there in the country.

Finally, in terms of industrials, to change the subject to industrial assessment centers, Dr. Orr, I am glad to see the ongoing support for these. I would like to hear a little bit more about it, but I wanted to put this on the record this morning.

I probably represent one of the largest automotive platforms in the country. I represent the largest Chrysler Fiat plant on the continent, with the manufacturer of the Wrangler and the Cherokee. I also represent General Motors' sole transmission facility, where we have moved from V4 to V6 to V8, and we are going up to V10, and becoming more energy efficient, serving all of its product lines.

I represent GM's plant at Parma, Ohio, also. I think all of my automotive plants would benefit by your expertise in helping them save on their energy bill. Those components going to the Cruze, one of our most efficient GM vehicles. I represent Ford's breakthrough EcoBoost plant at Brook Park, very important in the energy efficiency of Ford, and also I represent their heavy truck plant at Avon Lake, Ohio, that was repatriated from Mexico.

So, it would be great to have some kind of a forum where we could look at the combined energy use. One of the GM plants has put a solar roof on their facility. To help these companies, which can go global at any point and outsource their production, to look at energy and figure out hey, what can we do here to secure this manufacturing, critical manufacturing, for our country.

So, if there is something you could do through this industrial assessment center to look at corridors like this. Just down the road is the General Dynamics tank plant. You know, we have big manufacturing in our region.

Ask the question of how can the industrial assessment centers be used to help small and medium facilities look for energy savings opportunities?

Mr. ORR. I actually would like to ask Kathleen to respond to that, if you do not mind.

Ms. HOGAN. We can take that on. Certainly, the industrial assessment centers have the opportunity to help small and medium facilities look for energy savings opportunities generally within the region, right? So they are a regional-type center. In addition to the industrial assessment centers we have efforts, as Dr. Orr was referring to earlier, where we will work directly in partnership with major companies to help them better understand and manage their energy use through things like our better buildings, better plants effort. And we have had tremendous success working in partnership and helping these organizations find savings on the order of 20 percent to 25 percent, you know, over a set of years as they, you know, strategize over the right investments to make. So we are happy to engage in this conversation.

Ms. KAPTUR. Every day when I am home I drive by the—and I am not criticizing—I am just reporting that the Chrysler facility, Chrysler Fiat facility at Toledo there is a big methane plume that just keeps burning off. And I see that and I go, is this really the best thing we can do? And I keep looking at what is going on across the region in these big plants, and so I will look forward to that, and I thank the Chairman for his forbearance on this. It is really important to our area.

Mr. SIMPSON. I have not heard a problem here that a small modular reactor could not fix. Mr. Fortenberry.

Mr. FORTENBERRY. Speak about the problem of small modular reactor, I do not want to go there on this one. I want to talk about renewable energy in a macro sense in terms of both capacity and the storage issue, and then implementation in a micro sense, the distributed generation, even down to the home owner level. I live in Nebraska. We get about 7 percent of our energy from wind. The surrounding states vary from 20 percent to 30 percent. We have got a little bit different model for energy generation in that we have a public power system and some transmission infrastructure challenges that I think have precluded the rapid development of wind.

But, nonetheless, the cost of wind has come down 66 percent, I understand. What do you foresee, in terms of your own research, in terms of potential further declines in wind to make it even more competitive? And then the storage issue, research on the storage issue? And then integration of wind as well as solar on a micro level along with the micro storage issues? What is research looking like, the trajectory of research in that regard?

Mr. ORR. I will ask my colleagues to join in here in a minute, but let me start by saying that one of the primary reasons for investing in the grid modernization initiative that is one of our key cross cuts, and I would say the best developed of our cross cutting efforts, is because that effort integrates a lot of the things that you just talked about. It aims at being able to accept deep penetration of intermittent renewables and other kinds of distributed generation. It aims at providing a variety of balancing options, so one of those, of course, is storage. Grid scaled, battery storage is one way to provide that, and sometimes scale of works.

Mr. FORTENBERRY. Incentives for demand or incentive pricing for catch of demand?

Mr. ORR. Yeah, so that is a place where we need a better market mechanism to recognize.

Mr. FORTENBERRY. So basically you run your dryer at night?

Mr. ORR. Well, yeah.

Mr. FORTENBERRY. And get a credit for that?

Mr. ORR. And in my case, at my house in California, I have time of day pricing.

Mr. FORTENBERRY. Oh, good.

Mr. ORR. And I do have some solar cells in the backyard, so I fixed it so that we do not run the dryer in the high cost period of that.

Mr. FORTENBERRY. Right.

Mr. ORR. I mean, it is an interesting system of systems, so particularly, we have micro grids that might generate power, mostly on their own, and be able to deal with a crisis, for example, or a disruption. But then be able to come back online in a reliable and straightforward way.

Mr. FORTENBERRY. So define microgrid?

Ms. HOGAN. Well, microgrid, it could be as small as a good sized building, but it is often and could operate on its own.

Mr. FORTENBERRY. I mean, I think that is where we are at in terms of we shifted to the concept of distributed generation and there has been some mild implementation of that. In California it is more possible with solar than where I live. But at the same time, you know, if it was cost affordable, feasible, why not think about, particularly in new home construction, becoming your own micro energy farm through a combination of not only wind and solar micro wind, but also geothermal? I understand there might be on the horizon solar panels that basically look like windows now that are translucent, and that takes care of this problem of aesthetics as well.

Anyway, just speak briefly, if you could, to the technologies that are on the horizon for storage that will further empower integration of renewables into the overall portfolio and then drop prices that make it more feasible for micro systems to develop? I mean, where are we at in this? That is the core of my question.

Mr. ORR. Yeah. We are in the middle of that process. In terms of batteries per grid scale, there are some things called flow batteries, for example, that you would not want to put these on a vehicle, but where they basically do an electrochemical reaction and store the products in tanks. You need space to do this, but you can do really big quantities. But people are looking at other kinds of battery storage and battery chemistries for that sort of thing as well.

That is different from the other end of the scale where, on a vehicle, what you care about is the weight and volume of that battery and it is much smaller, so.

Mr. FORTENBERRY. So what is the time horizon on the integration of these technologies in reality into the market system?

Mr. ORR. Well, Pat Hoffman's troops are busy. We have a significant boost in the energy storage for some demos in 2017 to go test some of these ideas. So Pat could tell you more about that if you want to, but we are in progress. Behind the meter side of things, there are companies out there that now will sell you storage, you

know, 5/10 kilowatt hours that might allow you to generate power from your solar system at your house during the day and then use that to power your house at night or to——

Mr. FORTENBERRY. Or just through the accounting methodology?

Mr. ORR. Well, yeah. And, again, if it involves time of day pricing there would be incentives to be able to shift your load there. So it will be very interesting to see how the market values these things and how this plays out. But the technology pieces are starting to be there.

Mr. FORTENBERRY. Well, I mentioned this to the Secretary, and I will defer to you in just a moment. I integrated a geothermal into my home. My home is about 25 years old. So I was glad to do that. I want to make advances in this regard. The payback period is probably on the outlying end of the spectrum, 10 years. It might be as early as seven. But this was made possible by tax credits, state loans, as well as rebates from the manufacturer given the timing I put in, and rebate from a local utility. It is complicated frankly.

Mr. ORR. Yeah, yeah.

Mr. FORTENBERRY. And so if you wanted to do this in a much more aggressive way, moving your home toward, in effect, being an energy farm, integrating solar geothermal smart metering, as well as the possibility of micro wind, is complex. Are there models out there in which this is being done successfully? Even in the area of the country where I live?

Mr. ORR. Well, this is a good example, I think, of why we would think about these things as systems. That is something we are trying to do a better job of. But you're absolutely right that reducing that complexity would aid deployment, and I would also argue that we need to continue to work on cost reduction because if the research can help us give you that geothermal heat pump setting at a price that doesn't require the various complex programs to help get them deployed, then that will work too, so we need to work on the cost side. Pat, do you want to add something?

Ms. HOFFMAN. Thank you Congressman, I would just love to add a couple points. I mean, our energy storage program at $44.5 million is looking at reducing the cost of energy storage, but also getting the deployment of energy storage out there, partnering with the states, looking for opportunities of deployment of energy storage whether it is on the grid, but on the distribution level. We also have a $30 million budget line for our smart grid that is looking at microgrids. Looking at the integration of technologies of the distribution system. And I think that is really important as we start optimizing generation. As you have discussed, how do we get a small ecosystem in pulling together technologies?

But in addition to that, we have to work on the institutional issues which is looking at what we are calling distribution level reform to get that, to simplify the complexity.

Mr. FORTENBERRY. Yeah, I will work on that for you. You just get us the technology, okay? I agree.

Mr. ORR. Ok. It is a deal.

Mr. FORTENBERRY. Changing cultures and carrying forward legacy costs, and it is complicated. I get it. But when do you think this technology, I know it is hard to predict, on a larger scale what we

have talked about, being more fully integrated, what is your trajectory? Are we looking at two years? Twenty-five years?

Mr. SIMPSON. You will be dead.

Mr. ORR. We can beat 25 I think for sure. We will have some demonstrations and, for example, in remote communities in some parts of the country microgrids are already functioning for those.

Mr. FORTENBERRY. Without providing too much work on you, would you write up just a brief summary of some of those models that are out there?

Mr. ORR. Sure, sure.

Mr. FORTENBERRY. I appreciate it. Thank you, Mr. Chairman.

Mr. SIMPSON. That is exciting. I want my home to be a place where I come and kick off my shoes and turn on a fire and read a book and do not worry about any of this stuff. And I want to dry my clothes whenever they are wet. Mr. Honda.

Mr. HONDA. Thank you, Mr. Chairman. I have a question about the national network for manufacturing innovation, and then NNMI HUBS. The Department of Energy hosts three of the seven existing HUBS right now. One in Raleigh, another in Knoxville, and one is to be determined, I believe. So being from Silicon Valley I really appreciate how important it is that we focus on advanced manufacturing and potentially game changing technologies to ensure that the next Silicon Valley is right here in the United States.

So I was curious though, what is the current status of DOE's NNMI Centers, and what are some of the successes from these centers? Then how many DOE-led centers do you envision in the full national network of 45 planned HUBS? Then, in your opinion, would these centers develop without seed funding from the agencies?

Mr. ORR. So thank you for an interesting and complicated question, but let me do the specifics first. So, as you observed, we have three in progress. We are working on defining two more for this year, and then we requested in fiscal year 2017 funds for a sixth. So that part is in progress. The question of whether things like this would develop without the kind of initial funding to get them going. I mean, there certainly are some efforts to that effect. I think the experience so far with the advanced composites manufacturing at Oak Ridge and with the wide bandgap semiconductor that one is earlier, and so we have more to do to see how that goes.

If the topics are chosen well and the institutional leadership is good then there really can contribute in interesting ways be bringing people together to work on, largely, the precompetitive kind of things that then can have a much broader impact. And I would just say that the advanced manufacturing area, particularly the additive manufacturing area, is on that because it has both advantages for energy efficiencies, advantages for the quantity of materials that get used, and for the kind of speed of the cycle time of developing some new process or part. All of those are things that really can benefit manufacturing across the whole country. The areas that Pat Hoffman mentioned for the grid kinds of applications are another one where there would be specific national benefits that really do make sense.

So I think that imposes on us the responsibility of doing a good job of thinking through the topics where they make sense, and

where there is an appropriate government role it is not necessarily to do all the commercial activities. It is really to figure out where it makes sense to invest taxpayer funds.

Mr. HONDA. The issue of seed money, so when the President announced his desire to see this thing deploy and grow, it seems like the seed money comes from the different agencies such as Department of Defense had to put up the seed money for the flexible hybrid electronics concept which is beginning to establish itself and create a new arena of technologies. Are we encouraging agencies to put up money also in their own budgets or do they have to see a benefit for their investments by their agencies in order for them to create this bottom line?

Mr. ORR. I am not sure I am the right guy to answer this question, but I think we have been encouraged to think about where they make sense for the kinds of activities that we do. I am less certain about how that has gone for other agencies, but we have definitely been encouraged to think through where we can contribute.

Mr. HONDA. Well, the Department of Defense, they put in $75 million and private industry put in the rest, a quarter of a billion dollars. And I think that they saw a lot of benefits for folks who have solutions to problems that they are looking for, and the DOD has problems for which they are looking for solutions, so that marriage seems to be pretty good in terms of the area of flexible hybrid. Would something like this be applicable to energy storage? Because we are only looking at, it seems like it is only lithium, but there must be other forms of technologies that we have looked at that need some research that we can invite people to come together through a process like this.

Mr. ORR. So there I would say that we actually have some other activities that I think fill that role. We, for example, have an energy storage hub. JCESR at Argonne is the center for energy storage research. It is funded specifically to look at advanced battery chemistries that have higher energy densities and lower weights and good durability.

We also get at the fundamentals of that through quite a number of our energy frontier research centers that look at some combination of electrochemistry and nanostructured materials. So we do have that covered. We have also, actually at the other end of the innovation spectrum, we have funded through the loan programs office some activities with regard to battery manufacturing. So I do not know of anything involving one of the NNMIs, but we do have a lot of activity in the area.

Mr. HONDA. Through DOE you probably help us remain competitive in a global competition in innovation. Is there anything that DOE is focused on on next generation manufacturing?

Mr. ORR. Well, the six centers are manufacturing institutes. The three that we are working on already and the three more that are in our budgets or plans are exactly aimed at those kinds of issues, so we do have that in our portfolio.

Mr. HONDA. So we can talk a little bit more about that later on?

Mr. ORR. You bet.

Mr. HONDA. Ok. Last question, Mr. Chairman. On this topic of weatherization, it seems that there are statutes already in place,

but the statute does not seem to incorporate or encourage the integration of solar. If weatherization is about saving costs to individuals, fixed income folks, poor neighborhoods and places like that, in hardening the building from losing heat, why don't we in this whole discussion of reinventing ourselves, why don't we incorporate the wording that would allow solarization as part of the cost savings for these homes? And at the same time, become more efficient and save the home owners or the users' pocketbook? It seems like they both will do the same thing, but solar would have a larger application cost as a country from east coast to west coast?

Mr. ORR. It is an excellent question, of course. So as I understand it, we already have examples of solar thermal that a solar hot water heater as being included in the weatherization side. And I think it has allowed that any technology where we can show a positive savings over cost is a possibility for inclusion in that. Kathleen, is that correct?

Ms. HOGAN. Yes.

Mr. HONDA. Solar heating for water is through solar uptake or through dark pipes?

Mr. ORR. No, it would be through dark pipes. So it is a question of this balancing of cost and savings to the consumer, and as the costs continue to come down that seems like a real possibility to me.

Mr. HONDA. Not to be argumentative, but it seems like placing solar on these homes would reduce the cost if we maintained certain kinds of credits or helping cap agencies to, you know, put these in on a long term basis. Cost savings to the home owner or the dweller over time it seems it would——

Mr. ORR. And those have to exceed the cost of installing the system, so I think it argues, again, for this idea that continuing to work hard to bring down costs both on the permitting side and the hardware side is a way to make these things more widely available. And that is really true across the energy spectrum.

Mr. HONDA. So do I hear you saying that it is not possible until we can come up with a point where cost savings would be greater than the costs?

Mr. ORR. If I said that I did not mean to.

Mr. HONDA. No, I am just asking.

Mr. ORR. I think it is within the power of these systems now to be able to do what you are suggesting. Now, there might be just the sort of institutional inertia that afflicts all of us, but I think it is possible where the cost targets can be met.

Mr. SIMPSON. Our chairman can help us with that. Thank you.

Mr. ORR. You bet.

Mr. SIMPSON. Ms. Kaptur, do you have anything else?

Ms. KAPTUR. I actually do, Mr. Chairman, I do. I do. I wanted to ask about the offshore wind demonstrations and Dr. Orr, could you give us an update on the status of those?

Mr. ORR. Sure.

Ms. KAPTUR. And when we could expect a decision on advancing some of the proposals.

Mr. ORR. Yes, we have five offshore wind projects that are in various stages of working through their milestones and requirements. The next three are in the second period of that and two more are

alternates and are in the primary period. We will evaluate all of those this spring and we expect the next decision point is in May.

Ms. KAPTUR. All right. I thank you for that clarification. On regional energy innovation partnerships, how do you see these partnerships coalescing?

Mr. ORR. So partnerships, well we are imagining a competition that in a particular region that a variety of institutions, it could be industry, it could be universities, it could be a national lab would band together to create an entity, probably a 501(c)3, that would organize the research program, manage the funds, get them out, would not be a research provider but rather would be a research organizer. That we would select them competitively and then they would select competitive proposals which could be by members of the consortium, but with appropriate attention to conflict of interests of course along the way. But these would be focused on areas of regional interests and innovation at the regional scale. But at the same time would take advantage of the intellectual assets that exist in the area.

Ms. KAPTUR. And you would have to wait for your 2017 budget in order to implement that? There is nothing in the 2016?

Mr. ORR. Yeah, that is right.

Ms. KAPTUR. Ok. On vehicle technologies, let me ask, do you have examples of where, successful examples of where natural gas has been integrated now into major fleets, truck fleets and are they cost competitive?

Mr. ORR. I know there is quite a bit of, there are truck fleets around that do that now. Rueben, do you want to say a word about that?

Mr. SARKAR. Rueben Sarkar, yes, through our Clean Cities program and through our national Clean Fleet partnerships, where we have partnered with a number of large corporations like Frito-Lay, Coca-Cola, and others, we have seen a considerable amount of natural gas deployment and have done a number of case studies to demonstrate the benefits of natural gas deployment. I don't have the exact numbers offhand, but we do track how much natural gas penetration we have had through our efforts, and how much petroleum displacement we have achieved. And we continue to do a lot of activity on the deployment side of the equation. We also do a lot of research and demonstration on the dual fuel side in the Class A truck space to see where we can displace additional diesel through implementation of dual fuel technologies as well.

Ms. KAPTUR. All right. What about public fleets, bus systems, or post office vehicles? Do you have any—is there any activity there on the natural gas side conversion?

Mr. SARKAR. We have not done as much on the deployment side in the public transit sector. That normally goes to DOT. We do provide technical assistance, case studies and information that a lot of people make good decisions about adoption of alternative fuels, but not as much deployment and research on public transit. And then your second part of the question was on——

Ms. KAPTUR. Post office vehicles.

Mr. SARKAR. Post office. We engage with the post office to advise them on technology adoption as part of their RFP proposals. But we do not direct it. We generally provide them a basis for informa-

tion, whether it is alternative fuels for electrification or natural gas. But we don't actually fund deployment activities with the U.S. Postal Service.

Ms. KAPTUR. Does your legislation not allow it?

Mr. SARKAR. I would have to check on that. Normally, we are in an advisory capacity and that the U.S. Postal Service does their own separate RFPs the way it is structured, and all we do is provide assistance and guidance.

Ms. KAPTUR. Ok. I appreciate that very much, and my final question will be Dr. Smith, or Secretary Smith has sat there today and has not been asked very many questions.

Mr. SIMPSON. I know he is disappointed by that.

Ms. KAPTUR. And in view of the emphasis that is being placed in other places in the budget, what can you tell us about fossil fuels and your priorities in this budget?

Mr. SMITH. Well, thank you for the question. So the center of our research and development budget is on carbon capture and sequestration, which we think is still a very important part of the challenge of ensuring that all of our sources of domestic energy including coal and natural gas are relevant in future energy systems. Our budget has a slight increase from last year, going from $869 million up to $878 million. The coal capture systems are also going up slightly, total capture budget for coal going from $131 million to $139 million.

In addition to the coal capture budget, we have added a line for capture for natural gas systems and would like to point out that that indeed is in addition to the existing budget for coal capture systems. So we have maintained our focus on coal capture and in addition, we will be doing some additional research and development on capturing CO_2 from natural gas fired systems. That will benefit our understanding of how to reduce emissions from coal as well. So that's the center of our program for——

Ms. KAPTUR. Where are the majority of those coal capture systems installed? Where are they?

Mr. SMITH. Well, so this is a new area of innovation in terms of deployment. There is a couple of major demonstrations that the department is working on, one in Mississippi and one down in Texas. There are of course coal fired power plants throughout the United States which will be the candidates for retrofitting so that you can take those systems and reduce the greenhouse gas emissions that are coming out of the coal fired systems. So there will be coal fired power plants throughout the United States that will be candidates for this technology.

Ms. KAPTUR. I thought of one other question, Mr. Chair. Does the Department of Energy have a list, by state or region, of waste heat, facilities generating a great deal of waste heat and what type of waste heat it is.

Mr. ORR. Good question. I do not know if we have it by waste heat, but we certainly do have a nationwide list of big CO_2 sources and they are pretty likely to be connected. So it wouldn't be hard to get you, actually EPA maintains a list of the—and we do have a list. I am sure we have a list of all the power plants around the country. So they would be a primary location to go look for thermal energy that was not being captured.

Ms. KAPTUR. And what about steel plants?

Mr. ORR. Steel plants would also be candidates there. I am sure——

Ms. KAPTUR. What about refineries?

Mr. ORR. Your refineries, well, we certainly know where they are. The refineries, because they use so much energy internally, they tend to be more organized around making sure that they can use the waste heat that they generate.

Ms. KAPTUR. What about 100 megawatt natural gas plant?

Mr. ORR. Sure, there is a lot of thermal, sort of low-grade thermal energy that comes out of the cooling of the downstream end of the steam turbines.

Ms. KAPTUR. I am very interested in—this is very hard information to obtain, I would like to let you know. And it is very important for our region's economic growth to know where these waste heat sources are. But where does one go? Do you have to call every company?

Mr. ORR. I bet that EIA, the Energy Information Administration, they must be able to estimate——

Ms. KAPTUR. Where they might be.

Mr. ORR. Yeah, I would think so.

Ms. KAPTUR. All right. Thank you.

Mr. ORR. We will have to do some checking to make sure I am not promising something I cannot deliver, but let us look at that.

Ms. KAPTUR. All right. Thank you so very much. Thank you, Mr. Chair.

Mr. SIMPSON. You bet. One source of heat waste is that hamburger waiting in my office. I am going to have to reheat that. Didn't the INL just convert all their fleet to natural gas or haven't they done that? Last year your office, John, developed the GAIN Initiative to make it easier for industry to utilize the department's state of the art infrastructure in order to help commercialize advanced nuclear technologies. Can you update the committee on those efforts in the previous year and what kind of activities will be supported in 2017?

Mr. KOTEK. Yes, thank you, sir. And that initiative, I should point out, grew out of some really good work done by the Idaho National Lab, I think as I taught Alan back there, who led an effort to work with Oakridge and some of the other labs and universities to work with this community of innovators in advanced nuclear that has grown up over the last several years. You may have seen their recent reports talking about dozens of small companies capitalized to the tune of more than $1.5 billion in private money and is now trying to work both fission and fusion concepts towards commercialization.

The input we received from those companies was that the thing they needed the most out of DOE was the ability to access the capabilities that exist within the system, the reactors, the hot cells, the data and the codes and the brainpower that exists within the DOE system. And so GAIN was set up to establish a very convenient, streamlined way for these companies to access that series of capabilities. So what has been happening over the last several months is building on the work that we did through our nuclear science user facilities where university researchers and others can

come in through a single portal and access capabilities around the system, we are now working to build that to make it easier for industry to use.

Because of course when you bring industry in you have got more challenges, like intellectual property protections that you have got to deal with. So we are building on that. The Idaho National Lab, Oakridge and Argonne are kind of at the core of this and are working together to get in place a series of agreements that we need to have so that we can provide rapid access into the system for these private companies.

Now, we are also hearing interest from international partners. And of course we do a lot of collaborative R&D. Other countries are coming to us and saying hey, we have got capabilities that may help fill in gaps in the U.S. capabilities, maybe we can come up with some sort of international arrangement. So we're trying to round that out. In the budget specifically, we have got a million and a half that is tied just for GAIN administration. We have got another couple of million dollars that we would assign for the continuation of this voucher program. You may have seen just yesterday we announced the first round of availability of funding. Just a couple million dollars, we expect to award maybe ten vouchers. But maybe $200,000 apiece roughly speaking, provide these companies some funding again to serve as the lab side of the project so they bring $50,000, we bring $200,000 and all of a sudden they've got $250,000 worth of access to the labs, an idea which I should say really EERE and Dave Danielson's shop pioneered. We just learned from it. It has been really through the coordination efforts that Dr. Orr's office has gotten us all engaged in.

So those are the types of things we will do under the '17 budget to try and help some of these companies get to the point where they can commercialize some of these advanced designs. So pretty exciting times.

Mr. SIMPSON. Great. Thank you all for being here today. Let me tell you just briefly the challenges we are going to face in this committee and I explained this to the Secretary yesterday, is that the budget submission by the administration calls for about a $650 million increase over last year. But in the energy and water environment that we have to deal with here, they use some, for lack of a better term, gimmicks to get the $650 million increase.

I am not saying it is unique to what they have done. I have seen it happen time and time again with every budget submission from every administration and every governor that I have ever seen and that is kind of the way it works. But we have to deal with it in reality when we put the budget together. So we are going to have difficulty there.

Second, the Mission Innovation Initiative has a 21 percent increase or a couple billion dollars and then they underfunded, the Army Corps of Engineers by over a billion dollars, which we are going to have to find somewhere. They know that they can underfund it because we are going to plus it back up because Congress is not going to sit still while it goes down a billion dollars.

That is the challenge we face in trying to address both the overall budget and address this Mission Innovation Initiative and try to find the resources for that. Within our committee, I am certain

that there is going to be some rebalancing of how those funds go in this Mission Innovation Initiative as we put this budget together. We look forward to working with you to address that. Pass our best along to Mr. Danielson. We wish him and his family the best. We know that there are more important things in this world than being here before the committee. So we certainly understand that and wish him the best. And lastly, John, I would not say this if Mr. Fleischmann's staff was not here. When he says to look at NE's budget and how much of it goes to Oak Ridge, remember they have the Science budget. So do not be taking too much of that and sending it to Oak Ridge. Oak Ridge is a great place, a great laboratory. It does great work. Years ago, I was sitting in a presentation by one of our weapons laboratories and they were going through their budget over the last 20 years and how it used to be funded by weapons activities almost 100 percent. Over the years, as weapons activities money had decreased, they had increased funding from Science. They were very proud of that, and I am going wait just a minute. You are taking that money from other laboratories when they do not have access to the weapons money that you have. So it is a challenge between the laboratories, but it is a good challenge. Be real careful there. Thank you all for being here and thank you for the work you do. It's both challenging and excited. So we look forward to working with you as we put this budget together. We're adjourned.

QUESTIONS FOR THE RECORD

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
HOUSE COMMITTEE ON APPROPRIATIONS

Hearing on the 2017 Budget Request for Energy Efficiency and Renewable Energy
Electricity Delivery and Energy Reliability
Nuclear Energy
Fossil Energy Research and Development

Wednesday, March 2, 2016

NUCLEAR ENERGY EERE COLLABORATION

Subcommittee. Dr. Orr and Mr. Kotek, the past few years this Committee has put forward funding for a program to facilitate collaborations between the nuclear and renewable energy sectors. How to combine and integrate clean energy generation, baseload sources, and distributed energy is an important question this country will have to address in the coming years as technologies like Small Modular Reactors and increasing solar installations come online.

When will we be able to see the numbers regarding potential of nuclear-renewable integration and what will be required to realize the full potential of these clean energy sources?

Can you discuss where these collaborations would be most successful and how strategic coordination would play to each of the EERE and NE Office's strengths?

Dr. Orr. The Office of Energy Efficiency and Renewable Energy and the Office of Nuclear Energy have complementary strengths in the areas of integrated energy expertise from their respective primary national laboratories. The National Renewable Energy Laboratory has extensive analytical experience and data resources in the area of the national electricity grid and how renewable energy sources currently interface with the grid. Idaho National Laboratory has performed extensive analyses on how thermal energy from Small Modular Reactors and other advanced reactor technologies can be utilized for both clean electricity production and in industrial applications that currently require high temperature process heat. The Office of the Under Secretary for Energy and Science has been working to break down the technology silos and strengthen coordination across applied energy programs. Specific to nuclear-renewable hybrid energy systems, preliminary analyses have indicated the potential for successful operation, providing a stable electricity source and marketable industrial products. Sensitivity studies in the coming year will examine additional specific examples and will seek to determine the conditions under which utilities would be most likely to take full advantage of these systems. Broader issues of integrating high penetrations of renewable and nuclear energy may also be examined. DOE hopes to be able to provide preliminary data in the coming year regarding the results of its initial analysis on the potential of nuclear-renewable integration.

CONSENT BASED SITING ACTIVITIES

Subcommittee. Mr. Kotek, a portion of the consent based siting activities request is for selecting a site for a defense waste repository. However, the majority of the consent based siting activities account is for the purpose of establishing what the process for "consent based" actually means.

Would the defense repository not be selected using a consent based process?

Mr. Kotek. The Department plans to use the consent-based siting process to site all nuclear waste repositories including a defense waste repository.

Subcommittee. How can you begin selecting sites when the consent based process hasn't reached a working definition?

Mr. Kotek. The Department does not plan to begin the site selection process before developing a consent-based siting process that is built on collaboration with the public, stakeholders, and government entities at the local, state, and tribal levels. The Department believes that a key element for a durable solution is to build a partnership with interested host communities. The first phase engages with the public and interested groups to learn what elements are important to consider when designing a consent-based siting process. The next phase will document a consent-based siting process to serve as a framework for collaborating with potentially interested host communities. Finally, the Department will use the resultant consent-based process to work closely with interested communities, States, and Tribes and begin siting facilities.

This process will apply to interim storage facilities, as well as a repository for defense radioactive waste and a common repository, and possible deep borehole disposal.

Subcommittee. The Department conducted an analysis in 2014 that looked at the feasibility of constructing separate defense and commercial waste repositories. For geologic storage, the cost estimate stated that it could increase costs by up to $47 billion more than just focusing on a single repository. Is that still the estimate for pursuing separate repositories?

Mr. Kotek. The Assessment of Disposal Options for DOE-Managed High-Level Radioactive Waste and Spent Nuclear Fuel, prepared by the Office of Nuclear Energy, contained rough order of magnitude estimates for design, construction, operation, and closure of a defense-only repository, depending upon the geology selected.

Since the Department is in the early stages of planning and evaluating alternatives for this concept, definitive plans, alternatives analyses and risk analyses have not yet been conducted. The cost for disposal of radioactive waste in a geologic repository is influenced by numerous variables including the geologic medium, the quantity of waste, the emplacement method and configuration, how heat-dissipation is managed, and the depth of the repository.

Siting a defense repository would follow a consent based process that has not yet been established. It is reasonable to assume that interested host communities will want a say in what materials are accepted for disposal in a defense repository, which may accelerate the process when a willing and informed host community steps forward.

Subcommittee. Any separate repository seems prohibitive in cost according to these estimates. Why is the Department still pursuing this as an option?

Mr. Kotek. The Department is evaluating the concept of a separate repository for defense waste because it offers the flexibility to begin to deal with these waste streams sooner while not postponing efforts to deal with commercial nuclear waste. The Department will move on a parallel track to address storage and disposal of commercial spent fuel.

Separate disposal of defense waste could allow greater flexibility in selection of geologic media. For that reason, the incremental cost of an additional repository could be mitigated when compared to overall repository costs.

Developing a separate repository for defense waste represents an opportunity to move forward with disposal of some defense waste streams, some of which are already packaged and ready for disposal. The availability of a defense repository would represent significant progress toward completing

DOE's cleanup mission and addressing the federal government's Cold War legacy.

A defense repository presents an important opportunity to demonstrate the feasibility of a phased, adaptive, consent-based approach and adopt lessons learned with respect to consent-based siting, stakeholder consultation, and regulatory compliance that could ease the siting and development of a subsequent repository.

ADVANCED MANUFACTURING PROGRAM

WATER DESALINATION HUB REQUEST

Subcommittee. Dr. Orr, the budget request proposes a new Hub focused on Water Desalination in 2017. The request states the Hub would serve as a center of research and development for reducing the cost of desalination to provide clean and safe water.

The request mentions some research is currently underway in the U.S. on this topic but the Hub would best work as a centralized research and development effort. How did EERE develop the research topic for this Hub?

Was there an analysis conducted during this development to ensure that any proposed research does not duplicate water desalination research conducted by other agencies?

Are there plans to coordinate the Hub's research focus with ongoing research activities conducted by other agencies?

Dr. Orr. The Department's June 2014 report, The Water-Energy Nexus: Challenges and Opportunities, discussed the technology research, development, demonstration, and deployment challenges and opportunities associated with a variety of technologies in the energy-water nexus. Specifically, the report identified the opportunity that innovative desalination techniques, particularly those that utilize waste heat, provide with regards to both reducing the energy required to treat water and enabling the economic use of nontraditional water. In addition, the Department held a workshop in the fall of 2015 to begin to refine the technical scope for a potential Energy Innovation Hub through dialog with stakeholders from industry, academic researchers, and national laboratories.

One specific research, development, and demonstration (RD&D) need identified by industry that will be a unique focus of the Energy-Water Desalination Hub is the requirement for new technologies related to water pre-treatment systems, upstream from the reverse osmosis membrane. RD&D on pre-treatment systems will address corrosion resistance and antifouling, as well as other technical issues.

While preliminary research is currently underway on these topics, the proposed Energy-Water Desalination Hub will serve as a significant first-of-a-kind centralized critical mass research and development effort on new technologies for cost-effective desalination. DOE is coordinating with the Bureau of Reclamation (BOR) to better understand the extent of their previous and on-going RD&D efforts and active desalination projects – primarily located in the Southwestern U.S. – to ensure strong synergy between the BOR and the Department's proposed Energy-Water Desalination Hub. As envisioned, the Hub will establish a central pillar in DOE and the nation's RD&D efforts in this critically important and highly multi-disciplinary field, and will examine low-carbon, low-energy, low-cost desalination system approaches, enabling technologies and foundational science advances that may support production of municipal drinking water, production of agricultural water supplies, and treatment of nontraditional water sources, such as produced water from oil and gas extraction.

CLEAN ENERGY MANUFACTURING INNOVATION INSTITUTES

Subcommittee. Dr. Orr, the first Clean Energy Manufacturing Initiative Institute, focused on Power Electronics, was funded by this Subcommittee in 2013. The eventual goal of these institutes is to be financially independent without federal support by the end of each institute's five year term.

The first institute meets that time frame in 2017, will it be financially independent?

How is EERE planning for the conversion of these institutes to a financially independent business model? Will this require a location change for each Institute?

Dr. Orr. Yes, FY 2017 represents the fifth and final year of a planned $70 million commitment to support the Next Generation Power Electronics Manufacturing Innovation Institute, or Power America. Pending the availability of appropriations, the Department's FY 2017 request will complete DOE's planned investment in this Institute.

The Department anticipates all DOE-supported Institutes will transition to become self-sustaining beyond the original federal funding after five years. DOE works with each Institute to establish firm research, development, and demonstration milestones for the five-year DOE commitment. The Department has metrics with each Institute to assure that within 5 years of launch each Institute will be financially independent and sustainable. It is not anticipated for any DOE-supported Institute that the end of the Department's planned five-year commitment will require a change of location.

BIOENERGY TECHNOLOGIES

COORDINATION OF BIOFUELS EFFORTS AND THE SYNTHETIC BIOLOGY FOUNDRY

Subcommittee. Dr. Orr, the request for Bioenergy Technologies contains support for an initiative called the Synthetic Biology Foundry. The Synthetic Biology Foundry hopes to connect distributed biotechnology capabilities across the National Labs and other partners with the ultimate goal of improving biofuel efficiencies and enabling the adoption of biofuels. I understand this won't be an actual physical building but there has to be some centralized headquarters for the coordination activities to take place.

Would this effort be managed at a single National Lab or facility?

Dr. Orr. The exact organization of the effort will be informed by an effort in FY 2016 focused on road mapping and stakeholder engagement. The Labs have infrastructure needed for this work, including: the Integrated Biorefinery Research Facility at the National Renewable Energy Laboratory, the Advanced Biofuels Process Demonstration Unit at Lawrence Berkeley National Laboratory, the Environmental Molecular Sciences Lab at Pacific Northwest National Laboratory, the Center for Integrated Nanotechnologies at Sandia National Laboratory, state-of-the-art greenhouses at Oak Ridge National Laboratory, and many other capabilities from nanoscience to high-performance computing to industrial microbiology. Currently, it is envisioned as a multi-lab, virtual, public system that leverages existing assets as much as possible.

Subcommittee. How will this effort complement or be coordinated with the biofuel research conducted by the Office of Science?

Dr. Orr. The development of a Synthetic Biology Foundry effort, a key subprogram activity in 2017, will leverage recently developed synthetic biology tools (ways of redesigning biological processes and systems) to enable the biotechnology industry to achieve substantial improvements in conversion efficiencies and the scale-up of biological processes with lower development costs and lead-times. These new technical innovations will be easily transferrable to industrial applications and significantly enhance industry efforts to commercialize advanced bioenergy technologies.

Currently, the industrial biotechnology sector scales up processes on a case-by-case basis, without tools that can be extrapolated to multiple host organisms, pathways, and applications. The Synthetic Biology Foundry will connect distributed capabilities across multiple National Laboratories and other partners with biofuel and biochemical manufacturers to develop processes for predictable scale-up, improved systems capability, and standards by establishing a robust biomanufacturing set of principles, which would use standardized DNA elements and commercially relevant and optimized host organisms. These tools would dramatically reduce design, construction, lead-time, and cost for developing biological systems. The Foundry will produce a set of tools and organism development packages that would be easily transferred to the biotechnology industry, enabling the scaling of multiple, high-impact chemicals in multiple industrially-relevant host organisms. The Foundry will function as a multi-lab effort leveraging both existing and newly acquired world-class resources within the national laboratories while working with external stakeholders through competitive grant awards, cooperative agreements, and work for others, enabling partners to leverage the effort's synthetic biology tools and expertise, ultimately expediting industrial adoption of the technology.

DOE's Office of Science (SC) already funds some tool development related to this concept, but it is very fundamental in nature and not aimed at engineering an industrial organism in the near-term or at specific industrial markets. As part of this effort, Office of Science research focuses on development of the next generation of tools, as well as a basic understanding of the next generation of chassis organisms that could ensure that the Foundry stayed on the cutting edge. Partnership on continued basic tool development would allow SC and the Office of Energy Efficiency and Renewable Energy to play to their respective strengths. Coordination between the synthetic biology efforts ensures that the basic science tools developed will have ready access to testing and can incorporate lessons learned. SC participation will result in significant synergies for the continued incorporation of new tools.

BUILDING TECHNOLOGIES

METROPOLITAN SYSTEMS RESEARCH AND DEVELOPMENT

Subcommittee. Dr. Orr, a new activity in the Building Technologies Office, Metropolitan Systems, seeks to fund research and development to enable better energy planning for metro areas.

In this context, what does "metro area" mean?

Is there a size requirement or a specific type of city envisioned for these funds?

Would rural areas compete for this?

Dr. Orr. For this project, DOE considers a metro area to include a city and the immediate surrounding area, since the city has influence and is influenced by the population and infrastructure beyond the city borders. There are also clusters of cities with strongly connected economic and transportation networks that would benefit from coordinated energy planning and could be considered a metro area for this program.

DOE has not yet determined the type or size of city to target for this. The Department is planning to host a stakeholder workshop to get market feedback on options to refine and focus this opportunity, including whether DOE should include any population, population density, or other requirements for city eligibility.

DOE anticipates that many of the proposed models and tools that would be developed under this program would be scalable in size, from buildings and blocks to neighborhoods, districts, and full city-wide metro areas. This resolution would ensure that the tools developed could be used within specific sectors of metro areas, but also means that many of the tools developed could be used by smaller cities or towns located in more rural areas.

SOLAR ENERGY

WATER DESALINATION RESEARCH IN THE SOLAR ENERGY OFFICE

Subcommittee. Dr. Orr, the Solar Energy Technologies Office is proposing to research water desalination as it relates to the production of energy from a concentrating solar power plant.

Has EERE ever done this research before?

Dr. Orr. The Department has previously made investments in exploring the intersection renewably-powered desalination technologies. The Solar Energy Technologies Office (SETO) in FY 2015 released a Small Business Innovation Research (SBIR) topic on coupling solar thermal energy to desalination technology, which resulted in one award. The Geothermal Technologies Office has funded and currently funds projects (through SBIR and in partnership with DOE National Laboratories) exploring the use of low-temperature geothermal heat for desalination. In DOE's FY 2016 SBIR solicitation, the Advanced Manufacturing Office currently has a topic on modular, renewable energy powered desalination. Moreover, analysis of concentrating solar power technology currently funded by SETO at the National Renewable Energy Laboratory is developing technical and market models for solar thermal powered desalination.

Subcommittee. What, precisely is the question you believe must be answered?

Dr. Orr. The purpose of the proposed program is to develop integrated system solutions to use concentrating solar thermal technology for desalination applications. The anticipated projects that will be funded will take advantage of state-of-the-art developments in solar thermal collection, thermal energy storage and heat transfer technologies—many of which have been developed through SETO-funded research—and optimize the interface of those technologies with appropriate thermal desalination technologies. While several desalination technologies exist (both thermal and pressure-driven, at various technology readiness levels), one of the key challenges this effort will address is which of those technologies is best suited to be integrated with a solar energy resource. Technical challenges include the

system-level design and integration of solar thermal collectors with desalination technologies (including both thermal and pressure-driven technologies), low cost solar collectors appropriate for desalination temperature regimes, optimization of systems for both electricity and/or fresh water production, and design of solar thermal systems to cost-effectively manage brine waste. While analysis performed to date indicates that solar-thermal-powered desalination can provide a cost-effective method of increasing fresh water supply within the United States, the experimental work to be funded by this program is ultimately required to provide a comprehensive answer. Particularly in water stressed regions with poor electrical infrastructure but available saline-brine aquifers, such as the desert southwest of West Texas, concentrating solar power-based desalination has the potential to provide safe clean water from renewable sources.

Subcommittee. Have you conducted an analysis on how these efforts would complement or supplant current water desalination research done by other agencies?

Dr. Orr. Yes. In addition to the typical due diligence and standard review of the scientific literature, DOE has been engaged in stakeholder outreach with both the technical leaders in this field as well as relevant Federal agencies. A two-day workshop organized and led by the Office of Energy Efficiency and Renewable Energy (EERE), held in November 2015 in San Francisco, California, brought together technologists as well as representatives from the Bureau of Reclamation, the Environmental Protection Agency, and the National Science Foundation, among others, to address DOE's potential contributions to desalination research. In addition, DOE technical staff have been in regular communication with the Bureau of Reclamation to share information, avoid any redundant efforts, and identify opportunities for productive collaboration on desalination technology research and development across the Federal government. Finally, EERE will also be represented at an upcoming meeting of a Federal Water Treatment working group, hosted by the Bureau of Reclamation and U.S. Army Tank Automotive Research, Development and Engineering Center, which will similarly facilitate information sharing across all Federal agencies with relevant interests.

WIND ENERGY

CONVERSION OF DOE USER FACILITIES TO A FEE-BASED BUSINESS MODEL

Subcommittee. Dr. Orr, one of the stated long terms goals of the wind energy program office is to plan for the eventual conversion to a fee-based business model, rather than federal funding, for user facilities that support the wind energy technologies office.

Could user facilities support themselves entirely by user fees right now?

What is the time frame for accomplishing this goal?

Dr. Orr. Wind Program test facilities could not entirely support themselves by user fees. Wind Program test facilities are primarily used to support the program's wind research and development activities. If available, the Wind Program test facilities may be used by industry for component testing. When that is the case, the industry partner is required to cover the cost of testing staff and test specific hardware. Primarily, however, commercial testing is the purview of facilities such as the Massachusetts Wind Turbine Testing Center for wind blade testing or the Clemson University Research Institute for wind turbine drive train testing and electrical component testing.

Given the research and development focus of the Wind Program test facilities, there is no plan to convert the facilities to a completely fee-based business model where the facilities are supported entirely by non-federal funds. The commercial testing facilities at Massachusetts and Clemson are both operating using a fee-based business model, and are not reliant on federal funds for long-term continued facility operations.

ELECTRICITY DELIVERY AND ENERGY RELIABILITY

ENERGY STORAGE AND GRID INTEGRATION

Subcommittee. Ms. Hoffman, your office requests nearly double the current level of funding for energy storage technologies. The request is proposed for demonstrating energy storage models into planning tools for use by commercial grid operators.

Can you describe the current efforts of utilities to incorporate energy storage into the grid?

Are you seeing most of this work occur in states where energy storage is mandated by law or are all commercial operators incorporating energy storage technology into their planning models?

Ms. Hoffman. The value and effectiveness of energy storage in supporting a cleaner, more resilient future grid are being validated through numerous field demonstrations and analyses in partnership with industry and states. Information from these demonstrations provides valuable input toward development of the engineering planning tools necessary for seamlessly integrating energy storage into the grid. Current design tools utilized by many utilities do not possess the flexibility or fidelity to select the optimal storage technology type and size to return the greatest benefit. New design tools enabling utilities to evaluate an entire suite of distributed energy resources, including energy storage, within a distribution system, are needed to maximize the reliability and economics of the system. Additionally, energy storage system values are not well captured in the traditional utility integrated resource plans (IRPs) or other regulatory justifications for new investments, making it difficult to justify highly beneficial investments. Future design tools must include both utility and ratepayer benefits (such as outage mitigation) to facilitate adoption of energy storage. Most of the early work in new design tools has occurred in regions where energy storage is not mandated and has been done in close collaboration with state energy agencies, regulators, and local utilities.

RESEARCH AND DEVELOPMENT

FUTURE OF NUCLEAR POWER

Subcommittee. Dr. Orr and Mr. Kotek, can you provide the Subcommittee with your assessment on where the nuclear industry is headed in the next 10 years?

Where does nuclear power fit in with the new mix of energy generation the nation is currently experiencing?

What role will the Department play in advancing the technological demonstration of non-light water reactors?

Dr. Orr. As a zero-carbon baseload energy source, nuclear energy plays a vital role in helping the Nation meet its low-carbon and energy-security needs; currently accounting for about 20% of the Nation's electricity and approximately 60% of its non-greenhouse gas emitting electricity. Given the need to reduce carbon emissions while providing reliable baseload electricity, most estimates identify the need to sustain this level of generation and in some projections, a need to almost double nuclear generation. The next 10 years will be a critical period for nuclear generation.

Although many realize the importance of nuclear energy as a supplier of reliable clean energy and for its energy security and national security benefits, nuclear plants are facing increasing economic pressure to close in some restructured electricity markets as a result of low electricity prices. Losing these plants will have long-term implications, on the Nation's emission profile. Current stresses on nuclear plants include: flat or even decreasing electricity demand; very low natural gas prices; and other market conditions. Market conditions have led (or have helped to lead) five reactors to shut down prematurely, while three more early closures have been announced; several more reactors are at risk of closure before the end of their license period.

There are currently four new reactors under construction in the Southeast (plus completion of a fifth reactor that entered construction in the 1970s). Additionally, some utilities are considering the pursuit of a second license renewal to extend operation of their plants from 60 up to 80 years. In fact, Dominion and Exelon recently announced that they will pursue a second

license renewal for their Surry and Peach Bottom Power Stations respectively. Without license extensions, most of the Nation's current fleet will begin reaching the end of their 60 year operating licenses in 2030.

Moving beyond the current nuclear fleet, the Department expects to see increasing interest and innovation focused on the development and deployment of advanced nuclear technologies. The next ten years may see the continued deployment of large (1000 mega-watt electric (MWe)) light water reactors (LWRs), like those under construction in the Southeast, and the first deployments of a new generation of LWR-based small modular reactors (SMRS), as well as the continued development of advanced non-water based Generation-IV reactors.

In the medium-term, the Department is working closely with private industry to support the development and licensing of SMRs, which offer the advantage of lower initial capital investment, scalability, and siting flexibility. They also have the potential for enhanced safety and security. In 2016, the Department entered the fifth year of a six-year SMR Licensing and Technical Support program. Current program efforts focus on design development, engineering, and certification of NuScale Power's SMR technology. In 2016, NuScale is expected to submit their design certification application to the Nuclear Regulatory Commission (NRC), with the goal of a 2023 deployment. The Department is also supporting site characterization work for the first deployments of SMRs with the Tennessee Valley Authority and NuScale's partner, Utah Associated Municipal Power Systems (UAMPS). A number of additional customers have expressed interest in pursuing SMRs to meet their energy and environmental needs.

The development and deployment of advanced reactor technologies represents the longer-term, with initial deployment goals in the mid-2030. These advanced reactors use innovative fuels and alternative coolants like molten salt, high temperature gas or liquid metal instead of water. A new generation of engineers, entrepreneurs and investors, along with several established nuclear companies, is working to commercialize advanced nuclear reactor technologies. Given the complexity, high cost, and need for unique capabilities to develop nuclear technologies, the Department is working aggressively to establish effective public-private partnerships with this new generation of innovators. One of the greatest assets the Department has available are its world-class facilities and often one-of-a-kind

capabilities (e.g., test reactors and radiological facilities, expertise, materials, and data).

Given the need to address climate change and provide reliable clean energy to a growing market, it is important to make available multiple nuclear energy options, including advanced reactors, as quickly as possible. In order to realize this goal, the Office of Nuclear Energy (NE) launched the Gateway for Accelerated Innovation in Nuclear (GAIN) in November 2015 – the nuclear energy component of the Department's Clean Energy Investment Center. GAIN will provide the nuclear community with a single point of access to the broad range of capabilities – people, facilities, materials, and data – across the DOE complex and its National Lab capabilities. Focused research opportunities and dedicated industry engagement will also be important components of GAIN, ensuring that DOE-sponsored activities are impactful to companies working to realize the full potential of nuclear energy. Furthermore, as NRC prepares for the licensing of promising advanced nuclear energy technologies, NE will provide assistance and NE continues to engage the private sector to identify and pursue economic opportunities and/or financial incentives.

In 2016, the Department will complete an ongoing planning study for future advanced test/demonstration reactor capabilities and continue efforts to resume nuclear reactor transient testing capabilities through the refurbishment and restart of the Transient Reactor Test Facility (TREAT).

ADVANCED REACTOR DEMONSTRATION PLANNING STUDY

Subcommittee. Mr. Kotek, this Committee directed your Office to conduct a study on planning for a demonstration reactor and the results of that work should be completed this year.

Can you provide a preview to the Subcommittee of what your office has found?

Does this concept fit within the future goals of your office?

Mr. Kotek. The requested study is evaluating advanced reactor technology options, capabilities, and requirements to address national needs and public policy to support innovation in nuclear energy. The study is on track to be completed this year and has completed six-point designs that are being evaluated against goals, criteria, and metrics established by the study team, which consists of individuals from DOE national laboratories, U.S. universities and industries. The Nuclear Energy Advisory Committee subcommittee on Nuclear Reactor Technology provides oversight of the study. Because the study report is being drafted and requires further review, preliminary results are not available.

NUCLEAR ENERGY INFRASTRUCTURE AND NUCLEAR WASTE DISPOSAL

DEEP BOREHOLE FIELD TEST IN NORTH DAKOTA

Subcommittee. Mr. Kotek, the request contains $25 million to continue the Deep Borehole Field Test in Pierce County, North Dakota. However, recent news articles seem to indicate that the Department's plans are currently on hold due to local resident concerns.

What is the Department doing to address those concerns and how does this affect the current plan for conducting the field test?

Mr. Kotek. On January 5, 2016, the Department announced that the Deep Borehole Field Test contract had been awarded to a team led by the Battelle Memorial Institute and that the contractor proposed test site was near Rugby, in Pierce County, North Dakota.

The Department, along with its Battelle contractor team, worked with State and local officials in North Dakota, including Pierce County Commissioners and local residents, to address their questions and concerns raised after the contract announcement. This outreach included attending County Commission meetings, holding a public open house in the local community, and working individually with local officials and residents.

Despite these efforts, a letter received from the Pierce County Board of Commissioners dated March 1, 2016 and addressed to the University of North Dakota Energy and Environmental Research Center (EERC), a team partner with Battelle requested that the EERC, Battelle, and the Department cease consideration of anywhere in Pierce County, North Dakota, as a site for the field test.

To honor the request of the Pierce County Board of Commissioners, the Department has ceased consideration of the proposed test site near Rugby, as well as pursuit of any other site in North Dakota. Battelle is currently exploring options for an alternative test site outside of North Dakota, as allowed for under the existing contract.

The impact, if any, on the Department's planned field test schedule is not yet known.

FOSSIL ENERGY

NATURAL GAS EMISSIONS QUANTIFICATION

Subcommittee. Mr. Smith, the Natural Gas program within your office is requesting to continue the program to quantify natural gas emissions from existing natural gas infrastructure. Last year's request for this activity stated that this program would work with the Environmental Protection Agency to ensure that data is compatible with the national Greenhouse Gas Inventory.

The Environmental Protection Agency also announced plans to improve their reporting and quantification of emissions from natural gas production infrastructure last year. Can you update the Committee on your coordination efforts with EPA?

Mr. Smith. Analysis conducted for the Quadrennial Energy Review found that new research is needed to update available emissions measurement data in order to improve EPA's GHG Inventory estimates of methane emissions from natural gas systems. Findings from DOE analysis identified specific areas for improvement in the inventory, which we confirmed through meetings with EPA.

Subcommittee. Did EPA also conduct similar research quantifying emissions from natural gas infrastructure?

Mr. Smith. Questions about EPA research should be directed to EPA.

THE HONORABLE CHUCK FLEISCHMANN

WASTE TREATMENT

Mr. Fleischmann. The Oak Ridge National Lab's nuclear activities generate low volumes of liquid radioactive waste. This waste is processed by the Office of Environmental Management as part legacy waste management on the Oak Ridge Reservation. The systems used to process this waste will be decommissioned and this will require ORNL to develop and operate a new radioactive liquid waste treatment system. If this system is not operational by 2020, ORNL's nuclear missions are at risk due to the lack of a waste disposal capability. What is the Department's plan to deal with this problem?

Dr. Orr. The Office of Science is currently evaluating alternatives for a long-term treatment solution to the small volume of radioactive waste that is generated by ORNL during research and isotope production operations. The Office of Environmental Management (EM) currently manages the infrastructure and storage system for the waste generated from these activities. The Office of Science will continue to work closely with EM as their plans to complete treatment of the legacy waste in the Melton Valley tanks mature, to ensure that there is no gap in waste treatment capability that would impact the nuclear operations at ORNL.

THE HONORABLE MARCY KAPTUR

INDUSTRIAL ASSESSMENT CENTERS

Ms. Kaptur. Mr. Orr, I am glad to see the ongoing support for the Industrial Assessment Centers (IACs) as they continue to do good work on conducting energy efficiency and productivity improvement assessments for small-and medium-sized manufacturers. I further appreciate the decision to focus this work more on energy management systems and water-related issues.

What is your office doing to make sure the recommendations from the assessments are translated to actual market place activity?

Dr. Orr. The Department, in conjunction with U.S. manufacturers, plays an important technical assistance role that is critical to the deployment of existing and future advanced energy efficiency technologies and practices. The Department has delivered technical assistance to thousands of U.S. industrial plants, which is saving industry billions of dollars and cutting carbon emissions by millions of tons.

One example of these efforts is Industrial Assessment Centers (IACs). IACs help small- and medium-sized U.S. manufacturers save energy and become more competitive, while also educating and training the next generation of manufacturing sector workers. The IACs, currently located across the country at 24 major universities, conduct energy efficiency, productivity improvement, and waste-reduction assessments for small- and medium-sized manufacturers at no cost to them. This effort provides the opportunity to take advantage of promising advanced energy-saving technologies and approaches to small- and medium-sized manufacturers with no professional in-house staff the ability to perform such energy-saving assessments and creates the opportunity for them to take advantage of promising advanced energy saving technologies and approaches.

Recommendations from IAC assessments are implemented voluntarily by the private sector partners (small and medium sized firms). After an IAC performs a detailed process analysis of a manufacturing facility to generate specific recommendations with estimates of costs, performance, and payback times, the manufacturer is provided a confidential report detailing the analysis, findings, and recommendations. As a follow-up, the IAC

program verifies with the company what recommendations have been implemented. Typically, approximately 30% of the recommendations are implemented by the small business within one year, with an increasing number of recommendations implemented over time.

One new focus for the IAC program is to increase the implementation rate. Many States and Localities provide business assistance to address the up-front costs for the implementation of energy savings investments, particularly for small businesses. As a result, the Department is encouraging IACs to increase partnerships with these State and Local programs to leverage complementary resources for the implementation of the IAC provided energy efficiency and productivity recommendations.

In FY 2017, the Department will continue to support IACs, with an increased emphasis on energy management systems and water-related issues. Based on feedback from Congress, the Advanced Manufacturing Office will be including the need for greater measures for the adoption of recommendations through state and local partners in future efforts. In particular, the IACs will expand their existing coordination with the Environmental Protection Agency Regional Offices and state agencies on water-related activities, as well as the National Institute of Standards and Technology's Manufacturing Extension Partnerships, Tennessee Valley Authority, state energy offices, and numerous electric, natural gas and water utilities to maximize the energy efficiency and productivity savings potential for the small- and medium-sized clients.

One of the most effective and low cost ways for manufacturers to realize energy savings is by instituting an Energy Management System (EnMS) that delivers continual improvement in energy performance. This translates into increased competiveness and reduced waste by changing culture and reducing energy year after year. DOE has developed a new tool (eGuide) that helps companies implement an EnMS on a number of levels – ranging from foundational to advanced. DOE is engaging five of its IACs to help introduce eGuide to small and medium-sized manufacturers, including:

- Indiana University - Purdue University Indianapolis
- North Carolina State University
- Oklahoma State University
- University of Massachusetts – Amherst
- University of Wisconsin - Milwaukee

ENERGY – WATER NEXUS

Ms. Kaptur. Dr. Orr, last year we discussed the Department's 2014 report on the Energy-Water Nexus. Can you summarize what progress the Department has made in the last year on this topic and given Dr. Danielson is not here speak to EERE more specifically?

Ms. Hoffman, Mr. Smith would you like to elaborate on what the budget proposes for your respective programs in 2017?

Dr. Orr. In the last year the Department has made good progress in understanding and addressing various challenges of the energy-water nexus in an integrated fashion. During 2015, DOE held a series of six roundtables, jointly organized by several of the DOE offices, that brought together perspectives from industry, academia, non-profits, and regulators on energy-water nexus areas of shared interest, including fuels production, electricity generation, energy issues in water infrastructure, and systems integration challenges.

In addition, the various EERE offices have advanced unique energy water-related initiatives. The National Renewable Energy Laboratory (NREL) has developed a series of maps highlighting geothermal resource quality and the availability of multiple types of water (fresh surface water, fresh groundwater, municipal wastewater, brackish groundwater) that could be used in geothermal operations at a high spatial resolution. The Bioenergy Technologies Office has convened a series of workshops and initiated a resource assessment to identify the availability and geographic distribution of wet waste streams, including biosolids, animal wastes, residential and commercial food wastes, organic industrial wastes and wastewaters, as well as biogas produced from any of these sources. DOE's Advanced Manufacturing and Geothermal Technologies Offices have initiated studies of existing and new techniques for accomplishing desalination of water at lower cost and in greater quantities. The Solar technologies Office has identified the opportunity to utilize high temperatures from CSP to help drive advanced desalination technologies.

In FY 2016, the Department will continue these and other efforts. For example, the Department held a desalination workshop in late 2015 to begin to refine the technical scope for a potential Energy Innovation Hub through dialog with stakeholders from industry, academic researchers and national

laboratories. Additionally, DOE will field a prototype of advanced energy-efficient hybrid desalination membrane systems for industrial water reuse. Also in FY 2016, the Department will incorporate results from NREL's integrated assessment and life cycle analysis of geothermal water use into the Geothermal Vision Study. Finally, DOE will build off of the Bioenergy Technologies program's workshop series from FY 2015 to produce a waste-to-energy roadmap, including quantitative targets for at least two pathways, which will in turn inform research and development directions in FY 2017.

Additionally, DOE's Office of Electricity Delivery and Energy Reliability (OE) continues to further develop an energy-water decision support tool that was initially created by Sandia National Laboratories as part of Recovery Act-funded transmission planning activities for the Western and Electric Reliability Council of Texas (ERCOT) Interconnections, expanding the tools capabilities to the Eastern Interconnection. OE has also been incorporating the underlying water resource data from the energy-water decision support tool into the Energy Zones Mapping Tool (EZMT) to enhance the capabilities of the EZMT for users which include state energy regulators and policymakers.

OFFSHORE WIND DEMONSTRATIONS

Ms. Kaptur. Dr. Orr, could you give an update on the status of the offshore wind program? When can we expect a decision on advancing some of the proposals?

Dr. Orr. With over 4,000 GW of wind generating capacity potential (equivalent to four times the nation's current annual electricity production) located within 50 miles of U.S. coasts, offshore wind has the potential to become a major source of clean energy for the coastal and Great Lakes states, which account for nearly 80 percent of U.S. electric demand. Through targeted investment in research, development, and demonstration, the Department of Energy is working to address energy challenges and promote the responsible development of a world-class offshore wind industry in the United States.

All three of the current Offshore Wind Advanced Technology Demonstration Projects are expected to offer results that will be valuable to the nascent offshore wind industry in the United States. These engineering, design, and deployment projects are partnerships working together to support some of the nation's most innovative offshore installations in state and federal waters. The demonstrations are some of the first of their kind making their way through complex permitting, approval, and grid interconnection processes, and they will help pave the way for future deployments.

Currently, all three demonstration projects – Dominion, Fishermen's Energy, and Principle Power – are in the second phase out of five total phases. Between each phase, the Department performs a rigorous review of each team, including the use of a third-party, independent engineer, to substantively review design and engineering work. Following the fall 2015 review, the Department provided each of the three demonstration projects with a six-month extension through May 2016 in order to provide the projects with an opportunity to succeed in achieving rigorous milestones, set by the Department, before moving to the next phase of their awards. The Department has also committed to support the two alternate projects – the University of Maine and the Lake Erie Energy Development Corporation – with $3.7 million each to continue their offshore wind research and development progress.

After evaluating the status of all five projects in the Offshore Wind Advanced Technology Demonstration program, including the three demonstration projects and two alternate projects, the Department will decide in 2016 whether DOE funding of any of the demonstration projects will be discontinued and whether as a result one or both alternates may be on-boarded into the demo program.

REGIONAL ENERGY INNOVATION PARTNERSHIPS

Ms. Kaptur. Dr. Orr, the budget request includes funding for a new competition for Regional Energy Innovation Partnerships.

How do you see these partnerships coalescing?

How to do you envision the regions taking shape, do you already have a conceptual idea of what areas of the country these regions would occupy?

Dr. Orr. Current Department of Energy RD&D programs typically target funding at well-defined scientific and engineering challenges, not geographic regions. Under this proposal, the Regional Partnerships would be geographically-focused to fund RD&D to address clean energy challenges considering regional differences in energy resources, infrastructures, economies, market structures, and innovation ecosystems, including research universities, laboratories, industries and workforces.

Through the proposed Regional Energy Innovation Partnerships, federal research funding can be leveraged to create synergies among disparate regional stakeholders that may currently lack the resources and/or incentive for robust and long-term, multi-party collaboration. The National Research Council 2012 Report, Rising to the Challenge, noted that:

- "Historically, federally funded R&D has not been connected to state and regional industrial development. Bridging that gap can create the local talent and technology base needed to convert these U.S. investments into domestic companies, industries, and jobs."
- "Private businesses and local education institutions and economic-development agencies are in the best position to identify opportunities, gauge competitive strengths, and mobilize wide community support for regional cluster initiatives."
- "Regional innovation cluster initiatives should be built upon existing knowledge clusters and comparative strengths of a geographic region."

Options for the Regional Partnerships' operating principles are under consideration, with careful program design, stakeholder input, and analysis needed to determine the relative roles and interactions between the geographic regions, RD&D performers and the Federal government. The

following represents options for how the program could be administered, and, thus, how partnerships may coalesce.

Through a competitive process, DOE could award Regional Clean Energy Innovation Partnership funding to self-organized non-profit consortia that represent a diversity of energy stakeholders from within a region, many of whom may not have previously received DOE support or coordinated on energy projects. Other regional partnership structures are possible and would be considered as well. DOE could consider a range of potential criteria such as proposed programmatic focus areas; demonstrated capacity for regional energy systems analysis and planning; capacity to identify cutting edge technologies through universities, laboratories, or other experts; extensive knowledge of the energy investment community and the capacity to attract matching funds from investors; commitments of co-funding from non-federal sources; strength of the governance structure and management personnel; and track records with technology transfer.

Regional Partnerships would be expected to draw upon the strengths of a region's innovation ecosystem, serving as forums for end-to-end coordination across the scope of a region's energy innovation constituencies including industry, utilities, entrepreneurs, academia, state and local governments, tribal and native Alaskan communities, non-governmental and economic development organizations, the financial sector, project developers, and energy producers and consumers. Optimally, a regionally-focused approach to innovation could attract energy stakeholders and RD&D performers not typically engaged through other government-funded research or technical assistance programs.

The Department utilizes a range of innovation models that target major scientific and engineering challenges and the entities that can most effectively and efficiently overcome these challenges. With some flexibility, RD&D programs are managed within budget control points focused on specific areas. Under this proposal, the Regional Partnerships themselves would identify the challenges and priorities, propose activities to DOE, coordinate with other regional stakeholders, and manage activities that address their region's energy resources, needs and innovation capabilities. The Department's competition would be open to Partnerships proposing a range of activities within the clean energy RD&D space.

It is not expected that a Partnerships itself would perform the RD&D, though entities within the consortium could potentially be performers, subject to rigorous conflict-of-interest protections. DOE funding would be matched via non-federal cost share as outlined in the EPAct 2005 section 988 and used for RD&D costs. Funding would not go to "bricks-and-mortar" and be very limited in its use for administrative/overhead expenses. To ensure sufficient oversight, disbursement of awards could be contingent upon approval of a Regional Partnership's annual plan that describes the ongoing and prospective activities and there would be regular reviews of performance.

The regions are not currently defined, but any such delineation would take into account rigorous analysis on an array of regional characteristics that could include factors such as: grid interconnections and regulatory boundaries; proximity to National Laboratories and research universities; geographical and topographical features; geographical continuity/linkage; general alignment to market/energy regions; similarity and differences of energy uses and resources; and commonality of industry/economic characteristics, demographics, and/or infrastructure.

Ms. Kaptur. I understand you intend these partnerships to be fuel neutral, yet they are included within the Energy Efficiency and Renewable Energy appropriations, thereby limiting them to renewable energy by definition. Does the Department have a proposal to address this limitation?

Dr. Orr. The budget proposed a 'new' crosscutting line item within the EERE appropriation as an initial start towards a full-fledged technology-neutral program that supports the goals of Mission Innovation and other Administration clean energy priorities. The Department fully intends to make awards to Regional Partnerships based on a range of considerations and will ensure funding is used as appropriated. The Partnerships would have broad latitude to set priorities across all clean energy technologies within the bounds of the appropriation based on regional needs, opportunities, and R&D capabilities.

THE HONORABLE JAIME HERRERA BEUTLER

HYDROPOWER

Ms. Herrera Beutler. In Southwest Washington, hydropower has been a staple of our energy supply since the early 1940's, and the Columbia River Basin now provides more than 40% of all hydroelectric power generated in the United States. Hydropower is an affordable, clean, and reliable source of energy with abundant opportunities, particularly in the Pacific Northwest. What opportunities does your FY17 budget request provide for further developing and promoting hydropower projects?

Dr. Orr. The national challenge to expanding hydropower's role in the U.S. clean energy portfolio is to develop hydropower resources in a sustainable and environmentally responsible manner. To address this challenge, in FY 2015 the Hydropower Technologies subprogram developed and launched a first-of-its-kind comprehensive strategy, the HydroNEXT Initiative. HydroNEXT employs science and technology innovation and widespread stakeholder engagement to address technology development challenges and critical environmental and market barrier concerns that new hydropower development encounters.

In FY 2017, the Hydropower subprogram will competitively fund new research and development projects for new stream reach development for innovative hydropower designs and construction methods that mitigate challenges from traditional construction methods, such as economic, operational, or environmental (e.g., blockage of fish migration, or fish habitat fragmentation) factors. These efforts build on FY 2015 competitively selected projects focused on modular civil infrastructure and advanced powertrain components to enable reduced construction costs and minimized environmental footprints for hydropower-related construction. Activities will leverage these advances and will include innovative advanced tunneling methods and water diversion techniques that could capture hydropower potential from undeveloped streams without using a major dam or impoundment, which would support broad-scale development of new hydropower.

In addition, the Hydropower subprogram will continue its multiyear efforts to develop metrics for evaluating the environmental performance of new and existing hydropower projects in the United States. Successful outcomes

could support future development of more advanced environmental standards and/or low-impact certifications for hydropower projects, resulting in accelerated project permitting and qualification under state or regional energy development plans. In partnership with other Federal agencies, the subprogram will complete development of the Renewable Energy Application and Permitting Desktop (RAPID) toolkit for hydropower, with the goal of increasing transparency and access to information about hydropower regulatory processes, ultimately reducing the time and complexity associated with permitting new projects.

In FY 2017, the results of an FY 2016 test facility feasibility effort will be leveraged to support competitively selected front-end engineering and design concepts, and cost-benefit analysis for a potential hydropower test site.

Finally, in FY 2017, the Hydropower subprogram will finalize analytic results of small modular applications of pumped storage hydropower (m-PSH) technologies and issue a report capturing the feasibility and economic value proposition of m-PSH.

THE HONORABLE DAVID VALADAO

LIGHTWEIGHT COMPOSITES R&D – PPG INDUSTRIES

Mr. Valadao. Last year, the House included report language for Energy Efficiency and Renewable Energy – Vehicle Technologies Office, that stated "applied research is needed to develop coatings, adhesives, high-strength fiber glass, and other advanced materials to effectively join mixed materials, prevent corrosion, reduce costs, and address consumer requirements such as noise mitigation and appearance." I understand that industry agrees with an "all of the above approach" to achieving light-weighting targets at a price point that is capable of being implemented.

The FY16 Funding Opportunity Announcement issued by the Vehicle Technologies Office included opportunities for a range of lightweight metals such as steel, aluminum, and magnesium, but limits lightweight composites to only those reinforced with carbon fiber. Could VTO explain why it has restricted the nature of eligible composites while other EERE offices have investigated a wide range of composite technologies to their benefit, regardless of reinforcing fiber type?

Dr. Orr. The Fiscal Year 2016 Vehicle Technologies Program-Wide Funding Opportunity Announcement topic focuses on maturation of joining technologies to enable maximum weight reduction potential in the body-in-white, which is a stiffness-dominated structure. As such, carbon fiber composites could enable approximately a 60% weight reduction, while, for example, glass fiber composites would enable only a 25% weight reduction. The Department's prior work indicates that it is necessary to incorporate substantial structural carbon fiber composites in the body-in-white to achieve greater weight reduction.[1]

In addition, previously-funded work has successfully demonstrated glass fiber composites. The Multimaterial Lightweight Vehicle project successfully demonstrated the use of glass fiber composite front coil springs saving 57% weight compared to that of a 2013 Ford Fusion in this strength

[1] Multi-Material Lightweight Vehicles: Mach-II Design, Tim Skszek, Jeff Conklin, Vehma International Matt Zaluzec, David Wagner, Ford Motor Co. June 17, 2014, DOE VTO Annual Merit Review Presentation, slide 9 http://energy.gov/sites/prod/files/2014/07/f17/lm088_skszek_2014_o.pdf

and fatigue resistance dominated application.[2] Moreover, these coil springs remained intact after the crash test.[3]

[2] The Multimaterial Lightweight Vehicle Project, SAE International, 2015-06-05, David Wagner, Matthew Zaluzek, Timothy W. Skszek, Jeff L. Conklin, pp 43-51. http://books.sae.org/pt-170/

[3] The Multimaterial Lightweight Vehicle Project, SAE International, 2015-06-05, David Wagner, Matthew Zaluzek, Timothy W. Skszek, Jeff L. Conklin, pp 102. http://books.sae.org/pt-170/

ENERGY TECHNOLOGY INNOVATION ACCELERATORS – BERKELEY LAB

Mr. Valadao. It is important to ensure that there is a return on our investment on the dollars we spend to fund research and development at our national labs. I believe fostering the public-private partnership is a good way to ensure that exploration at the labs can result in meaningful discovery. I understand the EERE's new "Energy Technology Innovation Accelerator" program will focus on better utilizing the world-class technical assets and facilities of DOE's National Labs in conjunction with the private sector by encouraging interest and investment by American entrepreneurs in order to move cutting-edge technologies from the lab to the marketplace.

Expanding programs like this could be a catalyst in driving ideas to the market.

What does EERE hope to accomplish with the new Energy Technology Innovation Accelerator initiative?

Dr. Orr. The Energy Technology Innovation Accelerators (ETIA) effort will leverage the technical assets and facilities of the National Laboratories to enable American entrepreneurs to conduct research, development, and demonstration (RD&D) that enables the creation of new clean energy businesses. The Accelerators will couple the talent and commitment of early-stage clean energy technology entrepreneurs with the world-class tools and expertise of the National Labs through RD&D projects that encourage mentorship and network support leading to new company creation and the development of successful commercialization strategies. Significant drops in early-stage clean energy innovation support from the U.S. venture capital community risk the creation of a "lost generation" of clean energy entrepreneurs from our nation's world leading research institutions. The ETIA program will competitively identify and support the next generation of these clean energy entrepreneurs by embedding them into clean energy RD&D project teams at the Nation's world class National Laboratories on a term-limited basis. In Fiscal Year 2017, ETIA will establish Energy Technology Innovation Accelerators at approximately 5 National Laboratories and support more than 50 clean energy technology entrepreneurs through RD&D projects. DOE's Office of Technology Transfer (OTT) provides support in communicating EERE (and other Program Offices') efforts to DOE leadership and to other DOE Program

Offices, and serves a critical coordination and reporting relationship around new innovation approaches such as ETIA. For instance, OTT helped EERE expand EERE's successful Lab-Corps program to include participation from the Nuclear Energy office of DOE. However, ETIA will be funded by EERE and executed by EERE staff. There is no similar program being funded or executed by OTT. OTT's Clean Energy Investment Center (CEIC) may develop a database of DOE-funded projects for reference by investors, which could include projects funded under the ETIA initiative.

Mr. Valadao. How can technology-to-market programs like this engage the private sector and support the American economy?

Dr. Orr. The Department has already seen the promise of these kinds of tech-to-market programs. For example, Cyclotron Road, a pilot program supported by EERE's Advanced Manufacturing Office and Lawrence Berkeley National Laboratory, focuses on the gap between early-stage energy technology invention and high-impact commercial outcomes by offering a home for top entrepreneurial researchers to advance technologies until they can succeed beyond the research laboratory. Cyclotron Road's goal is to create a partnership between public and private sectors that serves early-stage innovators and provides them access to state-of-the-art facilities and mentorship. Through its public-private partnership, Cyclotron Road has also received funding from non-governmental sources, including Berkeley Labs' Royalties Fund; CalCEF Innovations, a nonprofit venture capital fund; Schmidt Family Foundation's 11th Hour Project, which in part promotes responsible uses of energy resources; and the law firm, Jones Day. These non-governmental funds support business accelerator services for each project team.

With EERE support and non-governmental support, Cyclotron Road's first cohort of research has already formed its first privately-funded spin out, Mosaic Materials, focused on a new class of energy-efficient chemical separations, and has expanded its impact by selecting and funding its second cohort in February 2016. In recognition of the continued need to engage the private sector, Cyclotron Road has defined success metrics that include the amount of follow-on project funding and the private-sector appetite to participate in Cyclotron Road through sponsorship and investment. Promising initiatives such as Cyclotron Road will be evaluated for their potential to be implemented on a larger scale.

HYDROGEN FUEL CELL APPLIED RESEARCH

Mr. Valadao. Dr. Orr and Mr. Smith, both EERE and Fossil Energy support fuel cell technological research and development. Mr. Smith, your office focuses on the efficient generation and module development of fuel cells while EERE focuses on their incorporation into the transportation sector.

Can you describe how your efforts on fuel cell research and development are coordinated?

Dr. Orr. The Office of Energy Efficiency and Renewable Energy (EERE) and the Office of Fossil Energy (FE) focus on research, development and demonstration of different types of fuel cells. FE focuses on high temperature solid oxide fuel cells that are applicable for large scale power generation. EERE focuses on all other types of fuel cells and primarily on polymer electrolyte membrane (PEM) fuel cells which operate at lower temperatures and are more suitable for transportation applications. EERE and FE actively coordinate activities in planning, execution and evaluation of their fuel cell programs. For example, the relevant program managers hold monthly fuel cell and hydrogen working group meetings, quarterly technical meetings, and monthly interagency working group meetings, where activities, results, and plans are discussed. In addition, the offices participate in joint workshops and provide technical reviewers for proposals and project merit reviews from their respective programs to leverage efforts as applicable and ensure no duplication.

Mr. Valadao. Ms. Hoffman, does your office plan to utilize this research as a potential energy storage technology?

Ms. Hoffman. The Office of Electricity Delivery and Energy Reliability (OE) continues to coordinate our research programs with those of other applied energy offices, including EERE and FE, as well as with the Office of Science but is not currently planning any activities specific to fuel-cell-based grid-scale energy storage. Information from other DOE applied energy R&D programs is used to inform program planning within OE.

WEDNESDAY, MARCH 2, 2016.

DEPARTMENT OF ENERGY, SCIENCE

WITNESSES

FRANKLIN ORR, UNDER SECRETARY FOR SCIENCE AND ENERGY, DEPARTMENT OF ENERGY

CHERRY MURRAY, DIRECTOR OF THE OFFICE OF SCIENCE, DEPARTMENT OF ENERGY

Mr. FLEISCHMANN. Good afternoon. Mr. Simpson has asked me to get things started for today's hearing. So I want to welcome everyone. I would like to welcome all the witnesses. Dr. Franklin Orr, Under Secretary for Science and Energy, and Dr. Cherry Murray, Director of the Department of Energy's Office of Science. Dr. Orr, it is good to see you again. It was great to participate with you at Lab Day on the Hill last fall. What a great turnout we had to see firsthand the great work our national labs are doing to solve so many tough national and international problems.

Dr. Murray, thank you for coming by to meet with me in January. I appreciated that so much. It is great to have you here. This is your first appearance, I believe, before our subcommittee, and thank you both and welcome.

Dr. Orr and Dr. Murray, the budget request provides $5.6 billion for the Office of Science, a 4 percent increase over last year's level. The Office of Science has helped usher in some of the most important scientific breakthroughs in the 20th century and will continue to support important innovations in the future. However, the balance between supporting core research activities that maintain U.S. leadership in energy sciences while also planning for new experiments will be one of the major challenges you face as we move into the next phase of scientific discovery.

The request assumes that the Office of Science Research, Operation and Construction goals can be met, but increasing budgets are not a given. Your challenge is to ensure that the new facilities don't come at the expense of your research mission. I look forward to discussing with you both how the Office of Science will make these hard choices and continue to ensure our country's leadership in the scientific community.

Dr. Murray, please ensure that the hearing record questions for the record and any supporting information requested by the subcommittee are delivered in final form to us no later than four weeks from the time you receive them. Members who have additional questions for the record will have until the close of business Friday to provide them to the subcommittee office. With that, I will turn to our ranking member, Ms. Kaptur, for her opening statement. Ms. Kaptur.

[The information follows:]

Opening Statement
Mr. Fleischmann
Hearing on the Department of Energy's
Science account
1:30pm, March 2, 2016

The hearing will come to order.

Good Afternoon, Mr. Simpson has asked me to get things started for today's hearing.

I'd like to welcome our witnesses, Dr. Franklin Orr, Under Secretary for Science and Energy, and Dr. Cherry Murray, Director of the Department of Energy's Office of Science.

Dr. Orr and Dr. Murray, the budget request provides $5.6 billion for the Office of Science, a four percent increase over last year's level. The Office of Science has helped usher in some of the most important scientific breakthroughs in the twentieth century and will continue to support important innovations in the future. However, the balance between supporting core research activities that maintain US leadership in the energy sciences while also planning for new experiments will be one of the major challenges you face as we move into the next phase of scientific discovery. The request assumes that the Office of Science's research, operation, and construction goals can be met but increasing budgets are not a given. Your challenge is to ensure that new facilities don't come at the expense of your research mission.

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With that, I'll turn to Ranking Member Kaptur for her opening statement.

Ms. KAPTUR. Thank you very much, Mr. Chairman. You look good in that position. And we want to welcome back Dr. Orr and Dr. Murray for being with us today and for the very laudable job that you both do.

The United States is known and respected around the world as a leader in innovation. Scientific research continues to yield important discoveries that have changed the way we live and work from cell phones to high yield props to biotech medicines. At the United Nations Climate Change Conference in Paris, President Obama joined world leaders from 19 other countries to launch Mission Innovation. The initiative seeks to double Federal clean energy, research, and development investments government wide over the next 5 years.

As part of this effort the Office of Science receives an increase of $276 million from this year's funding levels. I hope you will share your thoughts on how this effort will support innovation in the public sphere. We must harness the work of our best and brightest to drive domestic growth and help make American manufacturing globally competitive. While the value of funding scientific and other research is well-established, Federal resources remain limited and will remain so for the near term, it appears. Research, especially in science, can provide enormous value, but it is a long term and sometimes indirect investment that is too easily sacrificed for short term concerns. It would be helpful to hear from you about the long term consequences of this kind of underinvesting in science and research. We need to understand the tradeoffs that we are making in the name of budget scarcity.

Scientific exploration can sometimes provide opportunities for immediate benefit. In certain cases tools and equipment designed for research can be applied to manufacturing processes to increase efficiency or improve product quality.

Advanced devices and computers can help advance our understanding of basic science and help companies find solutions to challenging technical hurdles. With this in mind, I want touch briefly on the National Labs which are rightly viewed as a National Asset, and aren't they that.

Coming from an area without a National Lab, as most members do, I continue to wrestle with how the labs can play a significant transformational role for organizations beyond their boundaries and help jump start American innovation, including in manufacturing, but not solely there, in other parts of the country. I hope you will share your thoughts on this and the other questions I posed, and I look forward to your insight, and I thank you, Mr. Chairman, for the time.

Mr. FLEISCHMANN. Thank you, Ranking Member Kaptur. Dr. Orr, your opening statement.

Dr. ORR. Thank you very much Representative Fleischmann. I appreciate a chance to talk to you and others of the subcommittee again this afternoon. I will just thank the subcommittee for the support you provided. As I said earlier, at the Applied Energy hearing, for the support you provided in the budget this year. We are working hard on that, and we look forward to working with you as we work on this next budget.

So I am glad to have Cherry Murray with me today. She is the confirmed Director of the Office of Science, confirmed in December, and I can tell you that based on a year of experience in office there is more than enough for all of us to do, so I am very glad to have her with us. The Office of Science, of course, if the labs are a crown jewel for the country, the Office of Science is really the keeper of the crown jewel, and indeed, a tremendous asset to the Nation.

It supports research on the frontiers of science to enhance our understanding of nature, and also to advance the energy, economic, and national security of the United States. We stored in the Office of Science ten of the 17 national labs, as I know you know, and 28 state of the art national science user facilities. This enterprise supports more than 24,000 researchers at 300 institutions across the Nation, including some in Ohio. I will note that you folks are definitely users of the national labs. These are really fundamentally not only to the science enterprise, but also to our industry.

The ability to use the x-ray light sources, for example, to characterize materials at the smallest scale, the Spallation Neutron Source at Oak ridge. There are facilities that allow us to evaluate materials for the most advanced energy applications. A favorite example for me is the little turbine blades made by additive manufacturing. You can use the Spallation Neutron Source to image the residual stresses that are in those little turbine blades, and if those are appropriately handled that turban blades will hold together in the aircraft engine the way it is supposed to. Really, the science facilities have plenty of applications in industry as well.

The President's request, as Chairman said, is $5.672 billion, and we have that as a 6.1 percent increase from the fiscal year 2016 enacted level. The request takes the first step in fulfilling the government's Mission Innovation pledge. As the ranking member observed, an initiative across 20 nations to double public clean energy research and development over the next 5 years. The effort is complemented by commitments from private investors through the Breakthrough Energy Coalition. And no doubt, other investors as well.

To continue global momentum and accelerate clean energy technology development, the Department's requests aims to further accelerate the Office of Science's innovative work that puts America at the forefront of the global clean energy race.

Basic research supported by the Department's Office of Science will be crucial to enabling that transition to a low carbon secure energy future. Fundamental research is the key to developing truly transformative technologies that could radically change the energy landscape. It provides the scientific foundations for clean energy innovation through use inspired fundamental research on energy production, conversion, storage, transmission, and use. And actually many of the things that we talked about in the hearing this morning trace their origins to fundamental work that was supported by the Office of Science in its earliest days.

The increased investments as part of Mission Innovation will support a broad-based strategy for accelerating the innovation process. The strategy emphasized investments targeted to support innovative platforms for early stage research and technology development. An example of this would be the successful Energy Frontier

Research Centers. We have 32 of those, if I remember correctly now, but this will enable us to fully fund up to five new awards in the area of subsurface science with an emphasis on advancing imaging of geophysical and geochemical signals. The subsurface plays important roles across the energy spectrum, so that would be a value there.

The request also sustains DOE's role as the largest Federal sponsor of basic research in the physical sciences. DOE supports fundamental research and scientific user facilities in a variety of scientific disciplines, from nuclear and high energy physics, to basic energy and biological research. The research conducted in these areas helps us achieved predictive understanding of matter and energy on microscopic scales, as well as complex phenomena such as the plants, climate, and biological systems.

In funding this cutting edge research the request continues science's tradition of successfully building and operating world class facilities that enable researchers from across the country and the globe to conduct groundbreaking research. This includes design for a reconfigured, international long base line neutrino facility hosted at Fermilab. Initial construction for the Deep Underground Neutrino Experiment in South Dakota, and continued construction of the Facility for Rare Isotope Beams. The request also builds on the success of the Bioenergy Research Centers with additional funds to expand technology transfer activities during the last year of the tenured program.

An area of priority for all of us with relevance across the whole innovation chain is high performance computing. U.S. leadership in science and industry is, of course, crucial to sustaining American economic competitiveness and developing new technologies in energy and other fields. In line with the President's national—strategic computing initiative our goal is to produce an exascale super computing environment capable of meeting 21st century scientific challenges by the mid-2020s.

Finally, I will mention that my job as Under Secretary is to foster productive links between the science and energy programs. And one way we have done this is by establishing cross cutting initiatives to accelerate progress on key national priorities. The expertise in the Office of Science provides the scientific underpinnings for several of these cross cuts including the energy water nexus, exascale computing, and subsurface science. This year there is an additional cross cutting effort proposed on advanced materials for energy innovation.

So altogether, the Office of Science's budget supports path breaking discovery while advancing American competitiveness and leadership in scientific research. Thank you for the opportunity to talk here today and to answer questions, if we can do so.

[The information follows:]

Statement of Under Secretary for Science and Energy Franklin Orr
U.S. Department of Energy
Before the
House Committee on Appropriations
Subcommittee on Energy and Water Development
March 2, 2016

Chairman Simpson, Ranking Member Kaptur, and Members of the Subcommittee, thank you for the opportunity to testify on the President's Fiscal Year 2017 Budget Request for the U.S. Department of Energy's (DOE's) science and energy programs. Before I begin I would like to thank you for your support of the Consolidated Appropriations Act, 2016, which we are now implementing.

The Office of Science's (SC) mission is twofold, to support and deliver scientific discoveries, and to build and operate major scientific tools and facilities. The goal is to enhance our understanding of nature and advance the energy, economic, and national security of the United States. SC is the Nation's largest Federal sponsor of basic research in the physical sciences and the lead Federal agency supporting fundamental scientific research for our Nation's energy future.

The President's Request for the Office of Science is $5.672B, a 6.1% increase from the FY 2016 Enacted level of $5.347B. The FY 2017 Budget Request contains important investments across our six major programs. The SC Request is part of the $12.9B FY 2017 Budget Request for Science and Energy, $2.8B above the FY 2016 Enacted level. The Science and Energy Request supports DOE's missions of enabling the transition to a clean energy future with low-cost, all-of-the-above energy technologies; supporting a secure, modern, and resilient energy infrastructure; and providing the scientific backbone for discovery and innovation for America's future prosperity.

The Request takes the first step in fulfilling the U.S. Government's pledge to Mission Innovation, an unprecedented global initiative across 20 nations to double public clean energy research and development (R&D) over the next five years, in conjunction with commitments for private investments led by a coalition of 28 private investors from ten countries. Together, these initiatives will drive innovation essential for economic growth enabled by affordable and reliable energy, for energy security, for U.S. competitiveness, and for a transition to a low carbon energy future. The Office of Science's FY 2017 Request supports $100M in new Mission Innovation activities.

Our Nation stands at an important point in the transition to a low-carbon economy. I believe we'll look back on this period as one of significant acceleration in innovation that will have made a clean energy future possible. In just the last seven years, the deployment of clean energy

technologies has increased dramatically, in large part due to foundational basic research made possible through the world-leading capabilities of the scientific user facilities and National Laboratories stewarded by SC. To continue global momentum and accelerate clean energy technology development, the Department's FY2017 Budget Request aims to further accelerate SC's innovative work that puts this Nation at the front of the global clean energy race. It also builds on the work of the 2015 Quadrennial Technology Review (QTR) by investing in key scientific opportunities, such as a need for advanced materials science research, and wider availability of high performance computing.

Priorities for the Office of Science in FY 2017

As we enter the final year of this administration, I want to update you on recent developments and share our priorities for the Office of Science.

Dr. Cherry Murray was confirmed as Director of the Office of Science last December. She has a distinguished background as a leader in scientific research, having worked at Bell Laboratories and most recently as a professor of technology, public policy, and physics at Harvard University.

Research must be balanced against facility operations and construction. Over 31,000 scientists and students use Office of Science user facilities each year. The FY 2017 Budget for the Office of Science continues our tradition of successfully building and operating world-class facilities that enable researchers from across the country and globe to conduct groundbreaking research.

The FY 2017 Budget Request maintains a healthy balance between our research funding modalities. New methods of funding, like the Energy Frontier Research Centers (EFRCs), have been successful in fostering collaborative research by multidisciplinary teams to address complex scientific questions. Their success was built upon a long-term core of base funding in Basic Energy Sciences for individual principal investigators.

The FY 2017 Budget Request supports high performance computing, which is vital to every area of science. The Office of Science has a key role to play in the president's National Strategic Computing Initiative. Our goal is to produce an exascale supercomputing environment, by the mid-2020s, capable of meeting 21st century scientific challenges. This means close collaboration with industry in order to co-design software and hardware to ensure that new computational tools and applications can take advantage of DOE's exascale platform.

Finally, the FY 2017 Budget Request continues our support for basic research to advance clean energy. Fundamental research is the key to developing truly transformative technologies that could radically change the energy landscape. The Office of Science has a long and proud history of engaging the scientific community in workshops and other forums to identify key scientific opportunities for investment.

Overview of the Office of Science FY 2017 Budget Request

The Office of Science supports research probing the frontiers of science, in an attempt to answer the most fundamental disciplinary and interdisciplinary questions, from discovering nature's mysteries through the study of sub-atomic particles, atoms, molecules, and emergent phenomena that are the building blocks of the cosmos to the DNA, genetic codes, proteins, cells, biological systems and earth sciences that are the building blocks of life and the environment relevant to energy.

SC designs, builds, and operates the majority of large U.S. world-class scientific user facilities. Access to the facilities is competitively awarded and free of cost for researchers conducting non-proprietary work who intend to publish in scientific literature, and at cost for those who conduct proprietary research.

The Office of Science operates 28 state-of-the-art national scientific user facilities that put the U.S. at the forefront of science, technology and innovation. These include synchrotron and laser X-ray light sources, neutron scattering facilities, nanoscience centers, plasma fusion devices, high energy physics and nuclear physics accelerators and detectors, facilities for genomic and environmental science, and high performance computers. These facilities also provide a unique platform to advance high-priority national missions in partnership with other agencies.

In FY 2016, the enacted budget for the Office of Science has a healthy ratio of 42% support for direct research, 38% facility operations, and 14% construction and major items of equipment.

The Office of Science also provides the scientific foundations to enable the transition to a low-carbon, secure energy future with low-cost clean energy technologies. It advances a clean energy agenda through use-inspired fundamental research on energy production, conversion, storage, transmission, and use. It also advances our understanding of the earth and its climate.

The focus areas for this use-inspired fundamental research, which accounts for 32% of the non-construction budget in FY 2016, are determined in partnership with the applied energy and national security offices, and include 32 Energy Frontier Research Centers (EFRCs), two Energy Innovation Hubs, three Bioenergy Research Centers (BRCs), and Office of Science contributions to five of the Department's R&D crosscuts.

The FY 2017 Budget Request maintains this balance of about a third use-inspired research, and adds five new EFRCs, expands industry linkages of the BRCs, and supports an enhanced role for the Office of Science in the Department's crosscut programs, providing the scientific and analytical foundation to inform applied technology investments. The Request includes $100M for new use-inspired research to support the President's Mission Innovation Initiative.

As the steward of ten of the DOE laboratories, SC provides direct funding support competitively to over 24,000 investigators at all of the 17 DOE labs and over 300 U.S. research institutions.

Over the last decade, the support of universities, determined competitively each year, has varied between 35% - 40% of the total direct research budget. In the FY 2017 Budget Request, support of academic research is proposed to increase over FY 2016 levels by nearly 10% with the authorization of $100M of mandatory spending for competitively awarded university grants in an open call for proposals in all fields supported by the Office of Science. In addition, a third of the proposed FY 2017 line item construction budget, or another $100M, will go to academia to maintain the optimal schedule and cost of the Facility for Rare Isotope Beams (FRIB) project at Michigan State University. Nearly three-quarters of the scientists who do research at SC user facilities are from academia. The value of user facility operations is the equivalent of well over an additional $1B of support to university research.

The DOE Office of Science is an established leader of the U.S. scientific discovery and innovation enterprise. We fund over 43% of physical sciences research; making us the largest supporter of the physical sciences in the U.S.[1]

DOE has supported the work of more than 100 Nobel Prize recipients over 70 years. In 2016, the Nobel Prize in physics was given to two teams of neutrino experimentalists from Canada and Japan, both of which included US researchers with strong DOE support. Just this past year, researchers at the DOE National Laboratories won 33 out of 100 R&D 100 Awards given by R&D Magazine.

Highlights of the Office of Science FY 2017 Budget Request by Program

Advanced Scientific Computing Research (ASCR) supports research to discover, develop and deploy computational and networking capabilities to analyze, model, simulate and predict complex phenomena important to the U.S.

The FY 2017 Budget Request for ASCR is $663M is an increase of $42.2M, or 6.8% over the FY 2016 Enacted level. The increase supports research on the linked challenges of exascale computing capability and data-intensive science and computational partnerships under the Scientific Discovery through Advanced Computing (SciDAC) program to support clean energy.

ASCR's support for the Exascale Computing Initiative will be transitioned to a formal SC Exascale Computing Project following DOE project management guidelines with the goal to design, research, and plan the procurement of a capable exascale machine by mid-2020s. The FY 2017 Budget Request includes $154M in ASCR for the Office of Science coordinated with NNSA's budget of $95M for ASCR's exascale project activities include only those required for

[1] National Science Board 2016 Science and technology Indicators

the delivery of exascale computers. Additional exascale funding for the development of exascale applications resides in SC program offices: $26 million in Basic Energy Sciences and $10 million in Biological and Environmental Research. The four focus areas of the project are hardware technology R&D, system software technology R&D, application development and system engineering for exascale systems.

With the creation of a new line item, funds are incorporated from existing applied mathematics, computer science, computational partnerships and research and evaluation prototypes subprograms of the ASCR budget. Funding in these areas relevant to exascale computing has been moved into the project.

The FY 2017 Budget Request also supports preparations at the two leadership computing facilities at Argonne (ANL) and Oak Ridge National Laboratory (ORNL) for 75-200 petaflop upgrades at each facility by 2018-2019. The National Energy Research Scientific Computation Center (NERSC) at Lawrence Berkeley National Laboratory will take delivery of the NERSC-8 supercomputer, expanding the capacity of the facility to 10-40 petaflops to address growing demand. ESnet is increased by $7M to $45M in FY 2017 to provide increases in bandwidth for the growing data requirements of SC facilities.

Basic Energy Sciences (BES) supports fundamental research to understand, predict and ultimately control matter and energy at the electronic, atomic, and molecular scales. This work will provide foundations for new energy technologies. The FY 2017 Budget Request for BES of $1.937B is an increase of $87.7 M or 4.7% over the FY 2016 Enacted level.

The FY 2017 Budget Request increases funding for core research and the EFRCs in key areas related to Departmental priorities, such as the Subsurface Technology and Engineering RD&D ($41.3M), and the Advanced Materials crosscutting initiatives ($17.6M). A new activity is initiated in Computational Chemical Sciences ($14M) to advance U.S. leadership in computational chemistry codes in preparation for exascale computing and supports the Exascale Computing Initiative.

The Request continues support for two hubs: the Joint Center for Artificial Photosynthesis (led by LBNL and Cal Tech), and the Joint Center for Energy Storage Research led by Argonne National Laboratory (ANL). The FY 2017 Budget Request also provides for the optimal operations of five synchrotron light sources, five nanoscale research centers, and two neutron scattering centers. The Request continues to support construction of the Linac Coherent Light Source-II (LCLS-II), and it continues funding the Advanced Photon Source (APS) Upgrade Major Item of Equipment (MIE) at ANL.

Biological and Environmental Research (BER) supports fundamental research and scientific user facilities to achieve a predictive understanding of complex biological, climatic, and environmental systems for a secure and sustainable energy future. The FY 2017 Budget Request for BER of $661.9M is an increase of $52.9M or 8.7 percent above the FY 2016 Enacted level.

The FY 2017 Budget Request continues to support core research in Genomic Science and the three DOE Bioenergy Research Centers (BRCs), and it increases support for research to understand microbiome interactions in diverse environments (+$10M). The Request also continues to support core research to understand climate-relevant atmospheric and ecosystem processes, and requests increased support (+$12.5M) for the development of a layered energy-water data system and to establish regional-scale data, modeling, and analysis test beds to support analysis of dynamic energy-water systems. The Request supports the optimal operations of BER's three scientific user facilities: the DOE Joint Genome Institute managed by LBNL, the Environmental Molecular Sciences Laboratory at Pacific Northwest National Laboratory, and the Atmospheric Radiation Measurement Climate Research Facility.

Fusion Energy Sciences (FES) supports research to expand the fundamental understanding of matter at very high temperatures and densities and to build the scientific foundation for fusion energy. The FY 2017 Budget Request for FES of $398.2M decreases by $39.8M or 9.1 percent from the FY 2016 Enacted level. The Request supports continued progress on the U.S. Contributions to ITER Project of $125M and core research in burning plasma science. DOE is committed to following Congressional direction in the FY 2016 Consolidated Appropriations Act to produce a report and recommendation on future participation in ITER by May 2.

The FY 2017 Budget Request includes increased funding for the operation of the National Spherical Torus Experiment Upgrade (NSTX-U) at Princeton Plasmas Physics Laboratory to support 16 weeks of run time and to conduct high priority plasma-materials interaction research. DIII-D (located in San Diego) operations funding supports 560 hours of operation and the Request includes an increase to provide for targeted enhancements to the facility. Funding for research at both DIII-D and NSTX-U will support research in areas identified as priorities by the research community and for enhanced collaborations with MIT research staff. The Request supports targeted facility enhancements for DIII-D. FY2016 was the planned final year of funding for the MIT Alcator C-mod facility. The Request supports international collaborations on facilities such as the new W-7X stellarator in Germany, the EAST tokamak in China, and the KSTAR tokamak in Korea.

High Energy Physics (HEP) supports research to understand how the universe works at its most fundamental level by discovering the most elementary constituents of matter and energy, probing the interactions among them, and exploring the basic nature of space and time itself. The FY 2017 Budget Request for HEP of $817.9M is an increase of $22.9M or 2.9 percent above the FY 2016 Enacted level.

The Request continues to implement the recommendations of the 2014 Particle Physics Project Prioritization Panel (P5) Report issued by the High Energy Physics Advisory Panel. The FY 2017 Budget Request supports full operation of existing major HEP facilities and experiments, including optimal operations for the upgraded Neutrinos at the Main Injector (NuMI) beamline located at Fermi National Accelerator Laboratory (FNAL), part of the NOvA Experiment (detectors located in Minnesota). The construction of the Muon to Electron Conversion Experiment (Mu2e), also at FNAL, continues, consistent with the planned construction funding profile. MIEs for the Large Hadron Collider (LHC) at CERN in Switzerland continue, supporting upgrades the ATLAS (A Large Toroidal LHC Apparatus) and Compact Muon Solenoid detectors.

Consistent with the P5 Report recommendations, the FY 2017 Budget Request enhances support for technical design and construction associated with the Long Baseline Neutrino Facility (LBNF)/Deep Underground Neutrino Experiment (DUNE) project ($45.0M) at FNAL, and continued construction of three MIEs for next generation dark-energy and dark-matter experiments ($23.5M). LBNF/DUNE's underground detectors will be located in South Dakota.

The Request includes funding for one new MIE, the Facility for Advanced Accelerator Experimental Tests II (FACET-II, +$5M) at LBNL and SLAC, and for research and conceptual design of the Proton Improvement Plan II (PIP-II) project ($15.2M) at FNAL. Funding increases for the fabrication of the Large Synoptic Survey Telescope (a collaboration with the National Science Foundation) MIE according to the planned profile. Core research increases slightly to provide support for high priority efforts.

Nuclear Physics (NP) supports experimental and theoretical research to discover, explore, and understand all forms of nuclear matter. The FY 2017 Budget Request for NP of $635.7M is an increase of $18.6M or 3.0 percent relative to the FY 2016 Enacted level, and consistent with the recommendations of the Nuclear Science Advisory Committee 2015 Long Range Plan. The Request provides for modest increases in core research at universities and DOE national laboratories to support high priority research of the nuclear physics community, as well as the development of cutting edge approaches for producing isotopes critical to the Nation.

It also supports the continued construction of the Facility for Rare Isotope Beams (FRIB) at Michigan State University at $100M, which will provide world-leading capabilities for nuclear structure and astrophysics research. The 12 GeV Upgrade for the Continuous Electron Beam Accelerator Facility at Thomas Jefferson Accelerator Laboratory will be completed in FY 2017, and the full 12 GeV scientific program initiated, enabling groundbreaking searches for exotic particles and new physics.

The FY 2017 Budget Request also provides for increased operations of the Relativistic Heavy Ion Collider at Brookhaven National Laboratory (+4 weeks, 24 weeks total in FY 2017) for explorations of spin physics and intriguing new phenomena observed in quark gluon plasma formation, and for operations of the Argonne Tandem Linac Accelerator System (ATLAS) utilizing newly completed instrumentation. Two new MIEs are initiated in FY 2017: the Gamma-Ray Energy Tracking Array detector led by LBNL (+$0.5M) to exploit the world-leading science capabilities of FRIB, and the Stable Isotope Production Facility (+$2.5M) at ORNL to establish a domestic capability for the production of a broad range of enriched stable isotopes for research and applications.

Science and Lab Infrastructure (SLI)

Ongoing construction projects that will provide new laboratory buildings, renovated facilities, and upgraded utilities are proceeding towards on-time completion within budget. While significant improvements to SC infrastructure have been made, it is important to maintain a strong level of investment and continue renewing the SC national laboratory complex. The FY 2017 Budget Request of $130M is $16.4M, or 14.4 percent, over the FY 2016 Enacted level and provides funding for three on-going and two new line-item construction projects.

The FY 2017 Budget Request continues funding for the Materials Design Laboratory project at Argonne National Laboratory, the Photon Science Laboratory Building project at SLAC National Accelerator Laboratory, and the Integrative Genomics Building project at Lawrence Berkeley National Laboratory. New funding is requested to start the Integrated Engineering Research Center at Fermi National Accelerator Laboratory and the Core Facility Revitalization project at Brookhaven National Laboratory.

In addition, the Request continues to focus on Secretary Moniz's priority of addressing basic needs in core general purpose infrastructure as identified through the enterprise-wide Laboratory Operations Board assessments to reduce deferred maintenance. General Plant project funding requested in FY 2017 will enhance and update HVAC systems and controls at LBNL, support electrical distribution upgrades at SLAC, upgrade cryogenics infrastructure at Thomas Jefferson National Accelerator Laboratory and will replace and upgrade electrical distribution systems at Ames Laboratory.

Conclusion

I appreciate the opportunity to discuss how the President's FY 2017 Budget Request advances the Department's mission in delivering fundamental scientific research and accelerating the development of clean energy technologies. The Department of Energy is focused on investing across the innovation chain to secure America's energy future and enhance American

competitiveness. The Fiscal Year 2017 Budget Request aims to continue and advance this pursuit.

Mr. FLEISCHMANN. Thank you, Dr. Orr. I know that many of the members have questions for both of you all. I am going to begin by recognizing Ranking Member Kaptur for 5 minutes.

Ms. KAPTUR. Thank you so much, Mr. Chairman. This committee has been ensuring support for American manufacturing for a number of years, and the department's budget request continues to have a significant emphasis on this area. Drs. Orr and Murray, how do the major science facilities, such as Light Sources, support American manufacturing, and have you made any changes since last year to increase support for American industry?

Dr. ORR. So thank you for that question. I actually was thinking about some version of that question as I mentioned the idea of using the x-ray light sources to characterize advance materials of all kinds. If you think about the energy systems, what they do is they convert some primary energy resource, could be wind, could be sun, could be fossil or nuclear resources into energy services like electricity or heat or transportation.

Almost every one of those, if you think about the process of building more efficient energy conversion methods, at their heart, they are fundamentally material sciences processes. They might require higher temperatures or pressures. They might require standing up under other harsh environments. They need to last a long time. They need to be cheap to produce, and they need to perform successfully.

So one of the ways that we can get there is to use our ability now to control material structures at very small scale, so nanostructured materials are one version of that. When you couple that with understanding material properties of being able, for example, to design catalysts that are everywhere in chemical processing, and batteries, and fuel cells, and to predict those properties computationally when we can do those things effectively then we can design new materials that will serve us well, and figure out how to do that with cycle times that are shorter than the might otherwise be.

So the fundamental science that goes with these things is an essential component of being able to get to advance manufacturing methods. Now, there is lots to do in between, and of course, that is the variety of our programs. In the end, the ability to use the user facilities to characterize all kinds of systems and to study their properties at the smallest scale, those enable practically everything else.

Ms. KAPTUR. I am going to push you a little bit, Doctor. The question related to your reply here is what thoughts do you have on how the Department of Energy and the National Labs can improve their interaction with industry? I am going to give you a real life example of what happened.

Dr. ORR. Ok.

Ms. KAPTUR. Because I attempted to work with your labs. I will not say which ones, and I come from part of the country, as I said in the prior session, with a massive manufacturing. Massive. But we also have agriculture. And as I looked at the amount of jobs that have been outsourced from our region. Actually, in Indianapolis Carrier just announced it is moving to Monterrey, Mexico,

2,100 jobs. I thought how are we going to grow jobs here? One area where we can is in agriculture, but industrial agriculture.

So, 2 years ago I went to one of the labs and I said, look, I need your help. Here is an example of an industry where we need material science to develop a better four season canopy, more energy efficient, more light sensitive in the sense the wave lengths matter, frequencies matter in the production of plants. And I said, so I want you to help me design a new envelope because for us to be successful we cannot have a third to a half of the bottom line being energy. We have got to figure out how to control the energy issue, and we have got to have robust plant life in there, and we have got to cut the carbon footprint because we cannot keep shipping half our fruits and vegetables from California. We have got to empower other parts of the country, and we can do it because we have the water.

It took almost a year and three quarters, and one of your famous labs got back to me and said, this is not our job. This is the Department of Agriculture's job. Well, I was very disappointed because the Department of Agriculture is using old technology. But what happened was the private sector did something incredible. They just invested $200 million or $175 million, a company from Canada in our region, to build a state of the art, not new material science, but using the materials we have rather well, and the waste heat off of a steel company called North Star, CO_2, 200 acre greenhouse undercover. It is going to supply Kroeger Company which just bought Harris Teeter about a year and a half ago.

That one place is going to expand exponentially because of what is going on in the environment. But I sort of look back at that experience with DOE and think to myself, and I am not blaming you. I am not blaming anybody. Again, it is a resistance to place and to dealing with reality on the ground, trying to apply this high science to real production, and I still place the challenge out there for my region of the company. Help us cut the energy use in these industrial agriculture facilities from one-third to half to less than 10 percent. How do we do that and measure the nutrients, water? Work with light rays in a manner that is off the charts, so that we target a certain type of ray to a certain type of plant?

I ask myself, do we really need light permeable coverings or could we do this in rooms like this. There is a lot of LED lighting going on now that we are using for plant production in some of our cities. So I really want DEO involved in this. I think it could help to give rebirth to the Great Lakes. So I am not being selfish here. I am trying to be innovative, but that is a real thing that happened with DOE, and now we are saying can DOE and DOA work together? Why should we waste 2 years on this? I mean, what a waste of time. We should have had cooperation like that. And so I point that out as a concern to mine. So my question is, what questions do you have on how the Department of Energy and the National Labs can improve their interaction with industry?

Dr. ORR. Yes, so I am sorry. I meant to answer that the first time around, but I got off on nanostructure materials. One of the things we actually are part of doing as part of my office is to work on better ways to do that. So we established a new Office of Technology Transitions, for example, and we are implementing a re-

quirement of the Energy Policy Act to establish a Technology Commercialization Fund that will help provide some support for interactions like this with the National Labs.

And then we have also just created a Clean Energy Investment Center that is a way to help industries see more quickly into the National Lab system for ideas that they might want to engage upon. And also to streamline the cooperative research agreements that we use to foster these kinds of interactions when it makes sense to do so. So we recognize that the process of dealing with industry is slower than it should be and we are working to try to change that.

Ms. KAPTUR. Well, I would just make a formal request. When you are ready, hopefully it will not take 2 years, to find a way for your agency to interact with our major growers in our part of the country. And by the way, that particular corridor stretches from Erie, Pennsylvania to Kalamazoo, Michigan to all of Northern Ohio. It is a massive production platform with fresh water, and we need four season solutions because of what is happening with climate.

And then earlier, I had asked about the automotive platform, the manufacturing. If you could find the right people within the department somewhere I would bring everybody together who cares about energy in the industrial agriculture field, and in vehicular manufacturing to see how they could relate to you. Because we do not have a lab in our area.

Dr. ORR. Well, we talked about this some this morning, but we do, in fact, have quite a lot of interaction with the vehicle manufacturers. Again, part of it through the light weighting kinds of activities. Partly in all things like SuperTruck and various efficiency moves and so on, so we do work with the automotive manufacturers, the vehicle manufacturers quite a bit in a variety of ways.

Ms. KAPTUR. I will just end with this, Mr. Chairman. One of the automotive plants I represent which is a big one, the North American president of that operation I was with him at a ribbon cutting. I said, what can I do to help you? He goes, help me figure out what to do about energy in this particular plant. So I just put that out there.

Dr. ORR. Yes, it is your right.

Ms. KAPTUR. A practical request.

Dr. ORR. It is a good opportunity to the extent that energy reduction can be achieved they often payback very quickly. It was not in your district, but I visited a plant, a General Mills plant in Ohio that makes Cheerios, and I could observe that they contribute usually to national sanity because anybody that has a toddler, you put them in the high chair in the restaurant with a batch of Cheerios, and then everything is okay for a while.

Anyway, but they managed to reduce their energy use in the plant by doing the kinds of things that you talked about. Waste heat recovery, using waste heat in one part of the plant somewhere else, reduce their energy use by about 25 percent. Some if it was lighting. There were a variety of things that they did, but by paying careful attention they could make substantial reductions, and so that is a good thing to do.

Ms. KAPTUR. Thank you very, very much. Thank you, Mr. Chairman.

Mr. FLEISCHMANN. Thank you, Ms. Kaptur. I am going to have a question for Dr. Orr and then a question for Dr. Murray, and then we will continue with our other members. Dr. Orr, several years ago short-sighted changes were made to the management structure at the Department of Energy Oak Ridge Federal office. These problems have removed incentives for the many Department of Energy program offices to work together in an integrated way.

The program offices actually like this setup because it is easier for them to focus on their own priorities. But this works against the best interest of the tax payers, and stifles the kind of innovation and integration that the department strives to foster in its management emphasis. The changes have also resulted in serious conflicts with elected officials on top Department of Energy priorities.

Yesterday, I asked Secretary Moniz to take a close look to find an incremental solution to reconnect these important program offices. My request of you, sir, is I ask you to join in this effort to work with me to find a solution. Will you do that, sir?

Dr. ORR. Sure. I am happy to do that.

Mr. FLEISCHMANN. Dr. Murray we heard Dr. Orr refer to high performance computing in his open remarks and I thank you for your prioritization. I was very pleased to see the Department of Energy's budget request includes continued investments to advance exascale computing and that the department has created a more rigorous project management structure to keep this effort on track to develop and deploy an exascale system by the mid 2020s. I know the department has a program called CORAL to jointly purchase a next generation of leadership class computing systems that will deliver capabilities and better energy efficiency which are key milestones on the path to exascale. What will it take to make sure that CORAL systems are the fastest and most powerful super computers in the world when they come online in 2018? How many petaflops will they need in order to be the best in the world's systems?

Dr. MURRAY. Thank you for the question. Of course exascale computing is absolutely essential for our national security and our economic security as well as putting us at number one in science. So it is a very high priority for the country and certainly the department. One of the things that it will take to put CORAL machines at a very high level of performance is what we have in place now which is a collaboration with industry, a collaboration between NNSA the national security part of the Department and Office of Science together working with industry to develop these machines. This is not just a purchase of a machine it is actually codevelopment. One of the things that is going to be critical and you of course know that the first CORAL machine is slated to go into Oak Ridge.

Mr. FLEISCHMANN. Yes, ma'am.

Dr. MURRAY. Which I would say is one of our flagship office of science facilities. The three laboratories who are working on this machine are Oak Ridge, Argonne and Lawrence Livermore. As you may be aware I was Deputy Director at Lawrence Livermore back some years ago so I know the capabilities of the people in the NNSA. These machines are critically important for our stockpile

stewardship mission. They are also critically important for doing the best science and as Dr. Orr said we can have much better understanding from the atomic scale up to the size of a turbine blade in our materials simulation where we can simulate them in conditions that we do not wish to have in the laboratory such as turbine blades blowing apart for example and in order to do this we need to have the project mindset and a goal in mind. The goal for the CORAL machine that is going into Oak Ridge will be around 200 petaflops and that will put it as a world class. As you are all aware we are in a neck-to-neck fight with the Chinese on machine speeds. We want capable machines that do not just do flops but actually run programs that are dealing with big data as more and more of our science and more and more of what industry needs is big data which means machine learning and it probably means new architectures. So I am very, very—it is one of my highest priorities is to make sure that this stays on track and this is why we are projectizing it.

Mr. FLEISCHMANN. Thank you Dr. Murray, Mr. Visclosky.

Mr. VISCLOSKY. Thank you very much Mr. Chairman. For either witness, if you could tell me what a crosscut program is for the department?

Dr. ORR. Sure, I can do that. These work on problems that really demand expertise that come all the way across the whole department to have a variety of applications that do not just fit in those specific organizational approach that we have. And an example would be our grid modernization effort. On the one hand it is about how the transmission and distribution system works but it also involves the fundamentals of high performance computing in optimization kinds of setting and simulation is a very complex phenomenon. Another would be there are water and energy nexus because water gets used in all kinds of energy applications and at the same time it also we use lots of energy to move water around. Forty per cent of the water that is withdrawn from our lakes and rivers goes to the downstream end of a power plant for example.

Mr. VISCLOSKY. I appreciate that explanation. According to the testimony in the office, there are 32 energy Frontier Research Centers, two Energy Innovative Hubs, three bioengineering research centers, and five crosscut programs. In the 2017 budget, apparently there will be five more energy frontier research centers added, industry linkages for the bio energy research centers will be expanded, and there will be an enhanced role for the crosscut programs in the office.

Dr. ORR. That is correct.

Mr. VISCLOSKY. That is a lot of irons in the fire. Who coordinates the priorities as far as research and the consistency of research given that you are at the Department of Energy? So there are lots of things going on here.

Dr. ORR. There are a lot of things going on and we would argue that is a good thing. In the Office of Science, for example, the energy frontier research centers are a mechanism that we have used to bring together teams of people to work on use-inspired applications. The example I used earlier was the material science side of things——

Mr. VISCLOSKY. When you say "use inspire" what does that mean?

Dr. ORR. Well, that means a place—so I will give you an example. I mentioned earlier that catalysts appear in all kinds of devices: the fuel cells, batteries, chemical process industries and those kinds of things and so a use-inspired effort would be one where we develop our ability to go from absolutely first principles and calculate the performance of some exotic combination of metals or some configuration of the catalyst that make it more effective so to go from first principles to do that. Now it is use inspired in the sense that once you can do that then you can design all kinds of things for specific uses.

Mr. VISCLOSKY. So who ends up coming up with those ideas and who is coordinating that pure if you would and applied research and how often at some point do you say this is not working out and we have a finite number of dollars in our budget and we are going to cease and desist?

Dr. ORR. Well, the Office of Science, and I am putting words in Cherry's mouth here, but the Office of Science evaluates Energy Frontier Research Centers periodically, sometimes they are extended and sometimes they are not so that is one version of this and they think hard about the priorities going forward and where there are good opportunities for new ones.

Mr. VISCLOSKY. Is there one office someplace that looks at all of these?

Dr. MURRAY. Well, that would be me I think or actually Pat. So the Office of Science has a prioritization method which is tried and true that it has used for at least 20 years when I was on one of their—in fact it was Pat's basic energy sciences advisory committee. So they have Federal advisory committees, they report to me on every one of our programs. We—the programs charge the basic energy sciences for the energy frontier research centers with the prioritization of what is important, what are the scientific gaps. So we do not do applied research, we do a fundamental research.

Mr. VISCLOSKY. So it is your office. There is a proposal on the ledger for five more projects. Were people sending requests in, was it internally generated where there were 20 proposals and you picked five?

Dr. MURRAY. No everything that we do is competed, and everything that we do is carefully thought out with either subcommittees of these advisory committees holding a large number of workshops. For example the basic research needs workshops are now probably about 40 of them and from those workshops there was one on subterranean. What is it that we as the industry or science or anybody in the world cannot do in the subsurface right now? A large number of workshops then written up with the priorities of the scientific community including industry coming in. From that we provide a funding opportunity announcement that says here is what was found at this workshop, we cannot do the imaging of subsurface well enough, give us your proposals. A bunch of proposals will then come in and then a panel of scientists will make a selection and then we review them annually.

Mr. FLEISCHMANN. Thank you Mr. Visclosky. Before I go to Mr. Fortenberry, Dr. Dehmer it is good to see you again, thank you for being with us today. Mr. Fortenberry.

Mr. FORTENBERRY. Thank you. We are in the final phase of the Bioenergy Research Center funding what has been the outcome?

Dr. ORR. Well, I would say of the ones that I have visited they each have very interesting results and a lot of positive contributions. There is the Great Lakes Center that has worked on a variety of plant systems there is the UC-Berkeley Lawrence Berkeley effort that has worked on various bioenergy systems really quite a lot has been accomplished and maybe I will ask——

Dr. MURRAY. I was just going to look up my statistics but as I recall there have been something on the order of 800 invention disclosures, two hundred and some to industry, nine companies spun off and more coming. There have been engineered microbes that are now in the industry. There are new processes and new software for simulating how to do bioreactors.

Mr. FORTENBERRY. Are there plans to propose continuing this funding?

Dr. MURRAY. The funding in fiscal year 2017 it will be the last year of these bioengineering research centers the tenth year and the intention is in that year to recompete new bioenergy but also biomanufacturing centers. The centers could propose to continue I mean they could certainly enter the competition but the thought is that a new competition is right for it now.

Mr. FORTENBERRY. Define biomanufacturing.

Dr. MURRAY. For example, it would be wonderful if we could engineer microbes to manufacture polymers. So right now we use oil. We are going to run out of oil at some point. If we could use corn stover instead and use yeast that is manufactured or one of the really interesting science tidbits is someone is actually manufactured diatoms in the sea to be part of a manufacturing process starting with methane and adding OH to it. If we can figure out how to acquire life forms that can manufacture for us because frankly if you look at things like spider silk they do a really good job of manufacturing really strong materials so that is the idea.

Mr. FORTENBERRY. So we can call it spider competition.

Dr. MURRAY. Exactly.

Mr. FORTENBERRY. How much has been spent on the ITER Project?

Dr. ORR. I will have to get back to you with the exact number we have but it is not currently lodged in my brain.

Mr. FORTENBERRY. Well it is a big number. It has had its problems. What is its potential?

Dr. ORR. So maybe I can just say a word about where we are in that process. As you observed there have been some issues of schedule and cost. They have a new director who has put in place some new systems to look at all that. They have a new proposed time scale as being reviewed by the member countries and——

Mr. FORTENBERRY. How is the coordinating entity, who is the coordinating entity?

Dr. ORR. It is the ITER organization.

Mr. FORTENBERRY. So how much do we refine or impact that culture?

Dr. ORR. Well I think we had a lot to do with arguing for significant changes in the way it operated and a much more rigorous cost estimation and time estimation process and we also asked for an independent review of both of those things which is underway now.

Mr. FORTENBERRY. So you know the difficulties of design by committee and then add on that design by international committee and you have a recipe for potential stagnation. And then it is an unknown outcome here I recognize it is experimental on frontier type research but it has been going on a long time and it does not seem to have produce any positive results.

Dr. ORR. Well they are definitely under construction of the facility and the United States is well along the way in meeting our commitments.

Mr. FORTENBERRY. Well let me ask you about our own domestic experiments—are they showing any promise in this area?

Dr. ORR. Yes we continue to work hard on the fundamentals of behavior of high density, high temperature plasmas and those are part of building the understanding it will take to design future machines. I think it is still true in terms of getting to the DT burn the deuterium tritium reaction ITER is still the best opportunity out there to get to that but it is a big hard problem and a big complicated machine to do that so our strategy so far has been to try to add some rigor to that whole process and do what you said which is to build a project management culture as part of that that will deliver that on time and with stable costs.

Mr. FORTENBERRY. And what are the projections for or the timeline for completion for experiments and potential outcomes?

Dr. ORR. Yeah, mid-current projection for timeline is first plasma by mid-2020s so say 2025 and then DT burn in the 2030s range.

Mr. FORTENBERRY. All right thank you.

Mr. SIMPSON. Mr. Valadao. You were here first.

Mr. VALADAO. Thank you, Chairman. Thank you. Good afternoon. Dr. Murray, the Office of Science supports five light sources located across the country at four national labs. Last year the acting director said it was a high priority of the Office of Science, and the department, to maintain U.S. leadership in the light source capabilities such as those at the Berkeley Lab, which I was able to see last year. Can you describe what makes these light sources different from each other, and do we have five light sources to keep up with demand, or are there scientific capabilities that make each of these light sources unique?

Dr. MURRAY. Thank you for the question. That's actually a very easy question to answer. The answer is yes.

Mr. VALADAO. There's follow up.

Dr. MURRAY. They are unique. The ALS is our lowest wavelength light source. It has unique properties where you can actually go in—first of all, if you're going to look for what's called soft matter, otherwise known as living things, or polymers or liquid crystals, that is exactly the wavelength range you want to use. Also you can hit resonances with various chemicals or various atomic structures that you can't with higher x-rays. So if you want to do a certain type of experiment, you would want to go to ALS. As you are probably aware because they probably told you, they wish to do an upgrade to stay at the, you know, world class. And actually I will say

we wish that all of our light sources remain at world class. Each of them has from 3,000 to 5,000 users and they are oversubscribed by at least a factor of 3. We have to turn people away.

Mr. VALADAO. All right. So then what is U.S. position relative to other countries when it comes to light sources and what is the Office of Science's plan to moving forward to meet scientific needs in the future?

Dr. MURRAY. So we are I would say competing with Europe and Japan and China for the best light source facilities. Currently we are in good shape, but we need to make sure that we have the upgrades that all of the light sources need, and they are upgraded on a schedule so that they do remain world class.

We currently have in a charge to the Basic Energy Sciences, which runs the light sources, Advisory Committee to look at all the proposed upgrades in basic energy science and ask the question, is it world-class science? Will these provide world-class science? And second, are they ready for an upgrade now? Have they worked out the engineering parts enough so that we could consider putting them in line for an upgrade?

Our plan is to, of course, balance research with facility construction, but we have to have world-class facilities. So our plan would be to do upgrades in a rolling fashion just as we rolling fashion to upgrade our computers.

Mr. VALADAO. Ok. And for Dr. Orr, it is clear that from increases provided in the Office of Science that construction increases, excess computing, optimal facility operations are the highest priorities for this account. However, tradeoffs between running facilities at full capacity, research support, and construction of new technologies will have to be made in the coming years. Can you discuss the strategic future of the Office of Science given a flat budget scenario? And what are the Office of Science's greatest strengths, and how can we improve them in light of flat funding scenarios?

Dr. ORR. Well, I would say that given my vantage point of looking across all the programs that research programs in science and energy at DOE, the Office of Science I think actually has the most rigorous process for thinking about what priorities are and in trying hard to balance the needs for the facilities, but also to have the support of the research communities that make use of them.

Dr. Murray also mentioned that we make careful use of the Science Advisory Committees to help us think through where the research opportunities are, where the highest priority investment should be made, and we will absolutely continue to use that mechanism going forward as we make the tough tradeoffs.

In some sense assembly of every budget is one where you ask the question of balance, of investment across the portfolio, but also where can we invest the next dollar for the highest scientific return for the country. So we're absolutely committed to do that in whatever funding environment we find ourselves in.

Mr. VALADAO. Thank you. Thank you, Chairman. I yield back.

Mr. SIMPSON. Mr. Honda.

Mr. HONDA. Thank you, Mr. Chairman. And thank you Dr. Orr and Dr. Murray. I wanted to go into the advanced scientific computing area that's been already spoken of. It has been clear that

it is a priority and it is important, just as the discussion around the issue of the light source discussion you had with Mr. Valadao.

So with those two in mind, in light of the budget request proposals, there is an increase for advanced scientific computing research within the Office of Science. And we know that the national labs have an incredible computing resource and we are part of the top 10 most capable supercomputers in the world. But every sector of our society has become dependent on growth in a computing performance in order to continue to drive innovation in science and technology, but our Nation's leadership in advanced computing is increasingly been challenged as you have said by other countries.

So how will this proposed budget be used to keep the U.S. at the forefront of computing technology?

And then if you can provide us with an update on development of the plans in terms of moving the DOE to provide a report on the plan that develops the exascale computing systems. So we need that kind of information in order to just sustain the increase in budget, but there is always that problem like you described balancing your budget and trying to find that priority.

Dr. ORR. Yeah, let me start and then I will ask Dr. Murray to chime in here. If you look back at the history of big advances in computing in this country DoE has actually been in the lead for a number of them. The one that sticks in my mind was at the time we agreed to stop testing nuclear weapons and we wanted to be able to simulate what happens as those devices operate in a way that we could assure ourselves that the stockpile was maintained in an appropriate way and that the deterrents would be there. The need for that advance in computing led to a big investment which led to a quantum leap in computing power. Once that was available, of course the scientific community said, well, heck, we can use this to do all kinds of cool stuff that we could not do before.

This time around the question you asked about the leadership in computing, we recognize that leadership in many fields fundamentally makes use of the highest performance scientific computing and, therefore, we are leading the way in the Office of Science with this investment.

Now, it does have important applications in the weapons side of things, so there is a substantial commitment from NNSA as well. But the intent there is that we will continue to lead the world and we will do that both by the speed of the machine, by the communications, because as you add processors and so on the communication links matter. And in the energy-efficiency side because the power consumption, if it just goes up linearly with the number of processors, you soon need one of those small modular reactors next to each machine.

So the net result is that this is hugely important for us and for the Nation and for everything we do.

Mr. HONDA. So the bottom line is really what you have in our budget, if it is cut or if it is diminished, our ability to stay in front, our ability to complete, our ability to keep improving our computing power, will be diminished?

Dr. ORR. I think that if we invest less, we get less.

Ms. MURRAY. Yes, I would add that what is in the budget for the next 4 years is research and development with industry to try to

figure out what is it that is going to be the next, call it quantum leap, but it's really 12 order of magnitude that the stockpile stewardship program attained. They did not do it by themselves sitting in a room, they actually brought in U.S. industry, including semiconductor industry, the IBMs of the world, for example.

And I just turned to a page in the book of my cheat sheet which shows the plan for how we would get to exascale through developing bigger and bigger machines that are going to go to Oak Ridge, then Argonne and Livermore, then Los Alamos, then Oak Ridge, then Argonne, and so forth. And Berkeley will be—the NERSC machine is upgraded regularly. Berkeley will have 30 petaflops, which is way beyond what we have today, by the end of 2016. And then it will be upgraded with the machines that then we go to like 200 petaflops at Oak Ridge by 2018 timeframe, and then we need to go to exascale. But we learn by getting bigger and bigger computers.

One of the things that is going to be different this time is that what was developed and what has been developed so far in the industry and DOE are machines that are kind of I call them vanilla. That is to say they can do everything. They can do simulations, they can look at data sets, whatever. As we are going to exascale we probably will need to have different architectures for different problems. And so the use-inspired machine development will be, for example, Large Synoptic Survey Telescope will have petaflops of data coming in per day. And so how do we deal with that is an extremely good and very interesting question that is part of this effort.

Dr. ORR. The DOE, we asked the DOE to provide a report on the plan, on developing the exascale computing system, and it was supposed to be developed within 180 days. So where are we on that report?

Dr. MURRAY. I did not know about that.

Mr. HONDA. Ok. Can we get an update on that?

Dr. ORR. We will get back to you on that.

Dr. MURRAY. We will get back to you.

Dr. ORR. I'm not sure either, so.

Mr. HONDA. Ok.

Dr. MURRAY. Ok.

Mr. HONDA. Thank you. And do I have time, Mr. Chairman?

Mr. SIMPSON. Sure. You have a petaflop.

Mr. HONDA. Ok. Thirty petaflops. This is about 1 year ago I was one of the lead authors of the National Nanotechnology Research and Advancement Development Act that paved the way for Federal Government's increased investments in nanotechnology. And that was a result of President Bush in his State of the Union message when he mentioned nanotechnology. So I had the pleasure of working with Chairman Balart in developing that bill. And then it went over to the Senate and got passed at the Senate with about $3.7 billion worth of grants back in '03. And I had the pleasure of attending the groundbreaking dedication of the Molecular Foundry at Berkeley Lab, and I will be joining them again celebrating their 10-year anniversary. And it looks like nanoresearch, some have said, made great progress in our enabling revolutionary science along with computing powers.

Could you describe how these national scientific user facilities are benefiting our understanding of nanoscience and benefiting the economy, and what does the future look like for these centers and for nanoscale science at the DOE generally? And what can Congress do to—these are all softball questions—support DOE's downscale science research centers.

Dr. MURRAY. Yeah, the thing that is a little bit different about the nanoscale research centers from our other user facilities is that there are scientists at the research centers that actually collaborate with the users that come in. And that is incredibly important, not only for the graduate students who don't know how to use the machines, but also for industry. So there are tremendous collaborations with industry. We cannot do exascale without the nanocenters. For example, because things, and particularly things in energy technologies, happen at the nanoscale, it is materials, it is chemistry, and they are truly essential. They are also oversubscribed. Right now they are just flourishing and I think—I am not absolutely certain, I might ask Pat, how many users there are, but I will hazard a guess that they are in the thousands, including quite a bit—yes? Thirty thousand——

Dr. DEHMER. No, about 2,000.

Dr. MURRAY. Thirty thousand across the user facilities for Office of Science. But they are absolutely essential.

So one of the things that a nanocenter did recently that I thought was incredibly cool, and this is like why didn't I think of that, is reducing the wasted heat of an ordinary light bulb. And that was an Energy Frontier Research Center as well as the Molecular Foundry, by putting nanoscale—call it photonic bandgap structures—around the tungsten filament that reflect the infrared light back to the tungsten. So they have reduced the energy loss of a light bulb to better than what an LED is. That is really cool.

Mr. HONDA. And it extends its life, also, does it?

Dr. MURRAY. Don't know if it extends its life because the tungsten filament probably burns out a lot faster. However, this is using fancy photonic bandgap science and nanocenters to do something that is—you know, could affect a huge number of people.

Mr. HONDA. Mr. Chairman, if I could ask one more question. Using these——

Mr. SIMPSON. Wait one second before you ask one more question. I am still trying to understand this. Why is this a benefit? Just out of curiosity, if the filament burns out sooner, so you replace it sooner. I mean, you have reflected heat back, but big deal. It used to warm up my house, now I have got to have my electric heater running more to warm up my house because now that heat isn't going into my house with all of the lights being on. I'm curious as to what the benefit is that we reflect it back to the filament?

Dr. MURRAY. So I will answer that you live in Idaho.

Mr. SIMPSON. Yeah.

Dr. MURRAY. If you happen to live in Florida, you would have a great benefit because you would not have to put your air-conditioning on.

Mr. SIMPSON. Well, that would be a mistake living in Florida instead of Idaho. Go ahead.

Dr. ORR. Could I just jump in here as long as you are poking fun at this?

Mr. SIMPSON. Yes. I mean, I am not saying it is not cool.

Dr. MURRAY. No, I just thought it was——

Dr. ORR. You know what is cool about it is that it increases the overall efficiency of how much electricity it takes to make light that gets out into the room.

Mr. SIMPSON. So it takes less electricity to light one of these light bulbs than it does a——

Dr. ORR. Yeah, or you get more light for the same amount of electricity. That is the idea. Now cost, of course, is an issue here.

Mr. SIMPSON. Sure.

Dr. ORR. And these are fancy materials. But it tells you the opportunities that fundamental science can have for these kinds of hybrid interactions that really might pay off in a real way even if we don't use it exactly in that form.

Mr. SIMPSON. Yeah, yeah.

Mr. HONDA. That was pretty cool. You probably could cook potatoes faster, too.

Mr. SIMPSON. It doesn't take as much energy to cook a French fry.

Mr. HONDA. The other question I had was kind of off subject, but using these technologies, supercomputing, nanoscale, how close can we get or how close are we in replicating photosynthesis? If we can do that it seems to me that we could really move towards creating fuel without having to go through the process of the billions and billions of years that takes for——

Dr. MURRAY. That certainly is a grand challenge. We are not there yet. Life over billions of years has managed to do things that we don't know how to do yet. We do have an energy hub on exactly that, which is can we take light from the sun and create fuels out of it. It is, I would say—I would hazard a guess, 20 years out. But as we study how life actually does this and the same thing for a biofactory, we can either make things that look like life, biomimicry, or we can take things that are alive, such as yeast cells, and have them begin manufacturing things.

Mr. HONDA. But taking these computational powers and going down to nanoscale, merging together with the light source that Mr. Valadao was talking about, it seems that we could compress that time.

Dr. MURRAY. You are right.

Mr. HONDA. But we need research monies. But the investment will return much higher it seems to me.

Dr. MURRAY. I agree. It is a grand challenge. Actually a challenge of mimicking what life has been able to do is another grand challenge, not just, for example, creating fuels, but all sorts of things. Self-replicating, for example, and we are on it. That is an important challenge for science.

Mr. HONDA. Thank you, Mr. Chairman.

Mr. SIMPSON. I am tempted to ask if we are even close to a perpetual motion machine, but I won't.

I am frankly inadequate to sit in a hearing with this stuff because most of it I don't understand. It is fascinating stuff and it is good to go look at and I really get excited about science just for

science's sake, but it is way above my comprehension level to a large degree.

Let me ask you this, seldom do we think about the Department of Energy when somebody wants to talk about the biological sciences. Usually you think of Labor-HHS, NIH, CDC, etc. You have been included in the BRAIN Initiative, the President's BRAIN Initiative and the President's Cancer Moonshot.

Explain to me how the Department of Energy is going to be involved in what are fundamentally biological sciences here?

Dr. ORR. Well, I would just start by saying that we actually have been a long-term player in the biological interactions of some sort, mostly through the earliest work on radiation and what that did to living things. So we have had a very long effort there. In some ways that is what led to the human genome, because as we tried to figure out what kind of bad things could happen when radiation damaged the molecules, it was clear that one of the ways that you could cause damage was by damaging the genetic material. So that led to efforts to figure out what was there, and it got changed, and of course, now that, in turn, is what makes so much of what is called precision possible.

Now, the medicine part of that, definitely NIH, but with regard to things like, how do we understand very complex interconnected neuron systems like the brain, that has a big computing element to it, and how do we understand huge datasets that involve genomic information, and images, and patient history, and all kinds of things, how can we pull those together and use advanced computing and sort of unsupervised-machine learning to——

Mr. SIMPSON. Explain unsupervised machinery——

Dr. ORR. Well, in other words, tell the built software that can go look at all this data and extract patterns out of it, and help us figure out ways to make use of information we gather about parents, for example, to help just add, how to treat a particular cancer, or how to avoid the conditions that led to it in the first place.

Mr. SIMPSON. So these are machines that can teach themselves essentially?

Dr. ORR. That is a part of the—and because this is a classic problem that actually goes much broader than just biological implications, it creates an opportunity for us to learn how to do some things as part of the advanced computing, an exascale exercise that will aid our whole exascale effort in the first place. So there is a legitimate role in here to do some things together with NIH, that neither agency can pull off as well on their own, and so that is the part that we are looking for, is that.

Mr. SIMPSON. A lot of the facilities that the Department has are user-friendly facilities, but are they usually paid for under work for others, a lot of the activities?

Dr. ORR. Some are. We provide the fundamental—the basic facility, but in some cases, for example, NIH comes in and we built the synchrotron, and they have built some end stations that work on their kind of biological systems.

Dr. MURRAY. If I can interrupt for a bit. We provide competitively, so the users have to compete to use the facility. But once they are deemed scientifically competitive, the facility use is provided free. That is true for everyone except those who do not want

to publish any open literature and want proprietary information. You know, so businesses actually have to pay the cost of using the facility, but NIH researchers do not have to pay the cost of the facility.

Mr. SIMPSON. Because it is the government solely? I mean government organization.

Dr. MURRAY. Because we provided it through their—you know, they are doing good science. They do have to pay the cost—NIH has to pay the researchers their time, we do not do that, but the facilities, including the computational facilities, are free of charge.

Mr. SIMPSON. Ok. Marcy.

Ms. KAPTUR. Yes. As I am listening to all this, Mr. Chairman, I keep looking at the budget request of $5.672 billion. It is not a small budget.

Mr. SIMPSON. True.

Ms. KAPTUR. And I think about the panel we had earlier in the week when we asked, what do you consider to be your major challenges, in addition to the work you do, and basically it was, those that will follow us. And how do we make science of interest to the next generation.

And I keep rolling that over in my mind and looking at your budget, and thinking to myself, can the Department of Energy be more relevant to the next generation than it currently is? Not that you are irrelevant, you are not, because you have internships and you bring up labs, and so forth, but I thought I would just put this in, because I find Secretary Moniz most captivating, and he was up here before the committee the other day, and he is quite able to communicate. He has a very special gift.

So I am asking you to be messengers back to the Department of Energy, thinking about all of your labs, and how can we create programming that would be shared with our science centers. Cleveland has the Great Lakes Science Center; Toledo has Imagination Station, there are science centers around the country, or with public television. Does the Department of Energy have any role to play?

Now I have all these images of Dr. Moniz being a part of programming, like, there was a DVD called "Finding Nemo" a few years ago. It was the best-selling DVD of all time. And it was the two highest grossing G-rated films ever in our country, so I guess I could say, Finding Ernie, or Traveling with Ernie, and I could see part of this budget, part of this budget, and he would like to be inside the internal combustion engine that I saw in one of your labs in California, trying to figure out how propulsion really works.

That registers in my part of the country where, you know, you have drugs, drips, and cars are made and all. But you could make it fun, you could task each one of your labs, you have got all these labs, 2 dozen labs every year, each of them would have to come up with two ideas that could be put to film, right. So, we then find him inside of algae in Lake Erie, and maybe going down with a snorkel and those things you put on your feet, what do you call those, when you swim.

Mr. SIMPSON. Flippers.

Ms. KAPTUR. Flippers, flippers, right. So he is down there, then I think about the laser beam projects that I have seen, and can you

imagine, you know, up on a wind turbine up there at NREL. I mean, there are all kinds of places you could be finding Ernie or traveling with Ernie, and we need a modern day Mr. Wizard. I was sort of auditioning you, Dr. Orr, and you have a wonderful voice, and you look a little bit like Mr. Wizard when I grew up.

Dr. ORR. I think so, yes.

Ms. KAPTUR. I thought he was a very good-looking man, he used to wear, like tweed jackets, right. But I keep thinking, but how do we reach out, teachers could do this, you would have DVD, you could put, you know, public television could do it, we have to do something to break through the clutter, and you have this vast indecipherable world, it is like a planetary system to its own, but it has such unmapped potential to teach. That is not what you are authorized to do. That is the Department of Education. They are not succeeding in their mission, so they need some help.

And I am not against them, but I see these assets that are not fully operationalized, and you have got intrigue. You have got unbelievable capacity and there is a communications budget at DOE, and it would not take that much. And obviously the secretary, his friends in high places, like at Google, and they hand out all these keyboards and all this stuff, you know. There is really something that can be done. So I just want you to think about it.

Dr. ORR. Yes.

Ms. KAPTUR. Just communicate a message back. That was not really a question. I will be pleased to yield to the gentleman.

Mr. SIMPSON. What you are bringing up is kind of interesting because one of the great shows of all times that got me interested in this stuff was Carl Sagan's "Cosmos," which kind of took it down to almost understandable level with all this stuff, and I mean, I have got it on DVD, I have got it on VHS, I have probably got it on something else that we used to use, probably on disk, or something.

Dr. ORR. A track——

Ms. KAPTUR. He could, out of a battery.

Dr. ORR. I cannot resist saying that I love the idea of all of us sitting around thinking up things for the Secretary to do, and——

Ms. KAPTUR. Well, we could cast people in his like, but I would say, you have a gold mine, and I do not feel that gold mine, I can guarantee you, you talk about usage from Ohio, yeah, we have got usage, but if you look at the number of people that you directly touch at your labs, it is a very small percentage of the American people. But you have a powerhouse inside those labs and inside your department, and the department is a rather—compared to the SBA, you do not meet the ground.

You are into the future, but it is that intrigue that could captivate, I think audiences, and we have platforms to display you, you just do not give yourselves to us in a way that is easily accessible to the American people, and I am just pushing you a little bit to say, think about that. With a $5.67 billion budget I think that we have the capacity to reach deeper into the country, so just, Dr. Murray, you are an educator, you are a researcher, you understand this and we have to reach the next generation in a really fun way.

Dr. ORR. Now, I think you are right, that we need to learn better how to tell stories about, you know, if all of us—I mean, gosh, you

cannot hardly cross the street without using the GPS that is in your cell phone. But there are so many layers and threads of science woven into the ability to do that, that being able to tell stories about the science that we kind of take for granted is actually done, would be a good way to help get kids excited for doing this in the future.

Ms. KAPTUR. I will tell you. When I went out to one of your labs and I saw, based from the nuclear research that the department does, this film, and you could not even see it, but at the end of it, was a nuclear chip that is being developed to use in medical to irradiate bad cells, not the good cells, just the bad cells, and it was, I do not know how many years from development, but I thought imagine if somebody at Cleveland Clinic, which is one of the institutes, imagine if those students could see that.

Imagine if the Great Lakes Science Center in Cleveland could broadcast this, can you imagine the number of—it takes you into the future. And that is what you really do, and I think that is where young people would be attracted if you could somehow put a ring of folks around yourself, to disgorge what is already in your purview, it is just locked up.

And I am going to get a little political now. We talk about 1 percent versus 99 percent, the 99 percent, large numbers of them need to understand why you are relevant. And I think that this is a way to do it, while we do the most important task and that is to raise the next generation to love science, to not be afraid of it, to understand how it relates to their lives, and to see that it is part of the magic that is going to help America and the world.

And right how it is locked up. It is really—I read in one piece of the testimony 31,000 people users or something, these must be direct users of the lab, they have 325 million people now, or something. The way political people look, the way I look at that is, there is a mismatch here, between those that are creating the funds for the $5.67 billion to be transferred to the Department, and those that are directly involved.

So I have made my point. But I want you to think hard about that, and I said that to the prior panel too, we need a modern day Mr. Wizard, we need that face, and if Nemo could do it, certainly, an institution with billions of dollars, and an interest in the future can help our country. So I am just challenging your staff and those who are listening. And I thank you, Mr. Chairman, and members.

Mr. SIMPSON. Mr. Fleischmann.

Mr. FLEISCHMANN. Thank you, Mr. Chairman. I have got a couple of questions. The first question on the isotopes program transition; several years ago the Department of Energy transitioned all isotope production programs to the Office of Science; a transition that was directed by the Congress a number of years prior. Can you briefly provide an update to those efforts?

Dr. ORR. I am going to let Dr. Murray respond to that.

Dr. MURRAY. Ok. I have had one briefing on this, so I will provide this as updated as I can, and I can also give you more information.

Mr. FLEISCHMANN. Thank you.

Dr. MURRAY. But in 2009, Congress directed the Isotope Program to move to nuclear physics. And nuclear physics charged their Ad-

visory Committee with, okay, so now we have the isotope program, what do we do. They have so far created two strategic plans; the Committee has a new updated strategic plan, and has looked at what the Isotope Program is doing in 2015. The outside committee that looked at them was very pleased with the drawing from across the Department, various either reactors or accelerators that can create various isotopes that are needed.

The Isotope Program started from the Atomic Energy Act, so DOE has the mission to provide isotopes to industry or to scientists as needed by the U.S., but in any competition with any industry partner who can create the isotopes themselves. It turns out there are not that many people that do this. You have to have a reactor, or you have to have a very large accelerator.

And so, we are providing the isotopes that are necessary. One of the issues in the program, which you will see is in our fiscal year 2017 budget, a small amount of money to start a facility to make stable isotopes, this is the first facility in 20 years. We have not had the possibility of making stable isotopes.

Mr. FLEISCHMANN. Dr. Cherry, if I may?

Dr. MURRAY. Yes.

Mr. FLEISCHMANN. Is this the facility that is proposed at Oak Ridge?

Dr. MURRAY. Yes. It is.

Mr. FLEISCHMANN. Ok. Very good. If I may, let me ask my follow up.

Dr. MURRAY. Ok.

Mr. FLEISCHMANN. We are on the same page. The request proposed to build a stable isotope production facility at Oak Ridge to produce medical isotopes and to provide inputs for commercial and suppliers of isotopes. Can you, please, explain then, when this new activity is needed, and what this brings to isotope program?

Dr. MURRAY. Yes, absolutely. So as it turns out, for the last 20 years we have not had the capability in the U.S. to make stable isotopes. This turns out to be okay for the last 20 years, kind of okay, because we could either get them from Russia or we had them in a little drawers in Oak Ridge. We are running out of things and drawers in Oak Ridge, and we are relying on Russia for our stable isotopes.

One of them is kind of important. It is Lithium-7. It is used in nuclear reactor coolants, and our industry needs it and we cannot make it. So that is an issue.

This facility will also make the isotopes that are around the Molybdenun-98 or Molybdenum-100, which are used by NNSA, which is the agency that is responsible for the Moly-99 isotope. It is the one isotope that we do not create or provide.

In order to actually get Moly-99, you have to start from somewhere, and one way of doing that is Moly-98 or Moly-100. This isotope is used for pretty much all cancer treatment and radiation therapy in hospitals.

Mr. FLEISCHMANN. Thank you. Thank you very much. Dr. Murray, we have touched on this earlier, but it is very important. The scientific user facility supported by the Department of Energy, Office of Science, provides some of the most unique, powerful, cutting-

edge tools to over 30,000 university, industry, and government scientists from all over the country.

Given the importance of these user facilities to the Department of Energy's overall science mission, this committee directed the Basic Energy Science Advisory Committee to prioritize the next three to five major user facility upgrades or construction projects within the Basis Energy Science Program. What is the current status of this effort, and has DOE provided any further direction or guidance to BESAC about implementing this requirement?

Dr. MURRAY. Yes. I provided, I think it was my first day of work, a letter to the chairman of BESAC with the charge, and the chairman of BESAC has created a subcommittee of BESAC to look at the charge. And the charge is exactly the same charge that we use for our use for our project management of any major projects, including upgrades, which is, is this upgrade—they are looking at five different proposed upgrades, are these upgrades—is this upgrade going to produce world-class science? Do they have a good science case?

And second, is this upgrade ready to go? Do they understand all of the engineering that they have to do, and have they thought through the design well enough that they could start actually doing real designs? That committee will report out in June. So I am looking forward to that report.

Mr. FLEISCHMANN. Thank you very much. Mr. Chairman, I yield back.

Mr. SIMPSON. Mr. Visclosky.

Mr. VISCLOSKY. Mr. Chairman, I understand in my absence there was a discussion about the issue of new facilities coming online and the problem of making sure you can pay for their operation.

I would just associate myself with that conversation. I do not know if it got specific enough as to whether or not the agency is going to provide a 5-year plan to show how this is going to work out as far as the operation of these new facilities. I do not think that is a bad idea either to put that into context.

So thank you very much, Mr. Chairman.

Mr. SIMPSON. Mr. Honda.

Mr. HONDA. Mr. Chairman, I want to talk a little bit about tech transfer to Cyclotron Road.

Our national labs are really an amazing resource to this country, both in the facilities that they house and in the quality of the scientific talent that they attract, and we need better use of these resources to drive development in the private sector and make an impact on the energy industry.

There is an innovate program at Lawrence Lab called the Cyclotron Road. The Cyclotron Road is combining the best elements and Silicon Valley startups with top talent, sense of urgency, and an all-in attitude and commitment, with the tools and expertise of Berkeley Lab to help these technology entrepreneurs to develop their cutting-edge clean energy technologies. And this is a type of partnership and innovation that we need to reinvigorate our energy innovation and accelerate the commercialization of these new technologies.

So what is the department's current plans for this program at Berkeley Lab? And what is being done to expand the Cyclotron Road program to other facilities and other national labs?

Dr. ORR. Ok, well, let me start and Dr. Murray can join in if she wishes.

This has been an experiment that provides modest resources to let startups or small companies make use of the facilities, link up with the scientists at the lab that has an interest in the area, and make use of some of the incredible facilities that we have at the lab. So it is a little different from the transfer stuff out of the lab, but rather to create a conversation that we hope will be productive.

I happened to be out for a meeting at Lawrence Berkeley here not too long back, and I had breakfast with a bunch of the young folks who were working on this scheme. And they were uniformly enthusiastic about both the scientific opportunity, but the chance to put some interesting questions in front of the scientists at the lab, who, of course, got interested in what they are doing, and so a good interchange all the way around.

I know that the other lab directors are looking over the fence to see where something like that might work at their labs as well, and that is a conversation we are trying to encourage as part of our broader discussions with the Office of Technology Transition.

So experiment in progress, conversation underway, and I think you will see more of that going forward.

Mr. HONDA. You will keep us updated on that. Thank you, Mr. Chairman.

Mr. SIMPSON. If there are no other questions, Dr. Orr, we have taken your whole day.

Dr. ORR. I think that is what I get paid for.

Mr. SIMPSON. We apologize for taking your whole day, but you guys all do exciting work. Like I say, I wish I was smart enough to ask some questions because you do really need stuff. It is fascinating to go out and see what you do and have it explained to me when I am there, even though an hour later I am kind of going now what the heck was that?

But I am glad there are smart people like you in the world that are making advances to make the world a better place for all of us. And like I say, sometimes I just want to sit down by a fire with a good book and forget about all this stuff.

Dr. ORR. I do that, too.

Mr. SIMPSON. I tell my wife all the time I am glad I am not going to live too much longer because the world is changing so rapidly, I am not sure I could keep up with it.

I look at a kid going to high school today, or grade school today, what is going to change in their lifetime? How are they going to keep up with it? You know, it is fascinating stuff. I love the commercial on TV where the grandkids stop by the grandfolks' house, and they rush out to welcome them with the trays of all of their appliances, and hand it to them and say these do not work, you know. It is for the kids to fix them. That is kind of the way I am, at this these do not work anymore stage.

I appreciate all you do, and it is good to work with you, and we look forward to working with you on putting together this year's budget, so keep up the good work. Thank you for being here today.

Dr. ORR. Thank you.
Dr. MURRAY. Thank you.
Mr. SIMPSON. Thank you very much.
We are adjourned.

QUESTIONS – SUBCOMMITTEE SET

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
HOUSE COMMITTEE ON APPROPRIATIONS

Hearing
Department of Energy
Office of Science
Wednesday, March 2, 2016

PRESIDENTIAL INITIATIVES SUPPORT BY THE OFFICE OF SCIENCE

Subcommittee. Dr. Orr and Dr. Murray, while they were not envisioned for this purpose, the light sources have advanced our understanding of biosciences and the high performance computing capabilities have been used by many health researchers to analyze complex problems. This year's budget request has a new spin on these activities, however, and proposes funds for the Office of Science to support the BRAIN Initiative and the President's Cancer Moonshot initiative.

While the supercomputers and light sources have many uses, their principal mission is to support basic energy sciences. This doesn't mean other agencies, organizations, or companies can't use the user facilities when they don't serve an energy purpose. This just means that these users pay for the use of these machines through the Work For Others mechanism. That said, why is the Department requesting funds for an activity that would otherwise be requested within the Work For Others category?

Dr. Orr. The Office of Science national scientific user facilities provide researchers with the most advanced tools of modern science; they are used by more than 31,000 researchers each year from academia, industry, and government laboratories, spanning all fifty states and the District of Columbia. Allocation of facility resources is determined by merit review of the proposed work, and fees are not charged for non-proprietary work if the user intends to publish the research results in the open literature. Full cost recovery is required only for proprietary work. One of the hallmarks of the facilities is their wide disciplinary use, particularly the supercomputers and light sources. For example, in FY 2017, the light sources will be used by the National Institutes of Health (NIH) for the Brain Research through Advancing Innovative Neurotechnologies® (BRAIN) Initiative. DOE would also benefit because this new initiative will drive advancement in instrument capabilities in imaging, sensing, and data analytics. For that reason, the Department is requesting dedicated funding for this effort. It is also true that DOE and the National Cancer Institute (NCI) have launched a partnership to advance cancer research and high performance computing in the U.S., called the Joint Design of Advanced Computing Solutions for Cancer. Though no program funding is requested

by DOE for this effort, the Office of Science Advanced Scientific Computing Research Program will allocate dedicated high performance computing time for use in the joint DOE-NCI pilot projects.

Subcommittee. Has the Department spoken to and coordinated with the other agencies involved in the BRAIN Initiative and the Cancer Moonshot to analyze their resources and establish a plan in support of these initiatives?

Dr. Orr. DOE has been in communication and coordination with the other agencies involved in the BRAIN Initiative and the Cancer Moonshot. DOE and NIH held a joint workshop at Argonne National Laboratory (ANL) in October 2015 that explored the scientific potential of interagency collaboration on BRAIN. The participants discussed the fundamentally new technologies required to achieve the BRAIN 2025 goals. The overarching conclusion of the workshop was that closely interacting teams of neuroscientists and DOE physical and computational scientists could provide a substantial contribution to and acceleration of the BRAIN initiative.

Subcommittee. Have the other agencies made similar funding proposals in their budget requests?

Dr. Orr. Other agencies have made explicit FY 2017 funding requests for the BRAIN Initiative, including an National Science Foundation (NSF) request of $74 million (https://www.nsf.gov/news/news_summ.jsp) and an NIH request of $45 million in new funding (https://officeofbudget.od.nih.gov/pdfs/FY17/31-Overview.pdf -- see page 10).

STRATEGY AND PROGRAM MANAGEMENT

NEW FACILITIES COMING ONLINE

Subcommittee. Dr. Orr and Dr. Murray, several major facilities or upgrades are under construction and slated to come online in the next several years. These facilities promise cutting-edge science capabilities, but also will require hundreds of millions of dollars to operate.

Can you give us an overview of the new facilities coming online in the next few years, how they position our programs globally, and what scientifically they'll let our researchers and industries do?

Dr. Orr. The FY 2017 Budget Request supports investments in several new user facilities and major upgrades to existing facilities:

In Advanced Scientific Computing Research (ASCR), the FY 2017 Request supports both near term and long term investments that will maintain the U.S.'s global leadership in scientific computing. The Request includes preparations at the two Leadership Computing Facilities for 75–200 petaflop upgrades at each facility in the 2018–2019 timeframe, and funds for the National Energy Research Scientific Computing Center (NERSC) to take delivery of the NERSC-8 supercomputer, which will expand the capacity of the facility to 10–40 petaflops to address growing demand. Our long term strategy is embodied in the Exascale Computing Initiative (ECI), which has as its goal the delivery of an exascale computing platform by the mid-2020s. In the FY 2017 Request the Office of Science (SC) component of the ECI is contained in a new line item, the Office of Science Exascale Computing Project (SC-ECP). Exascale computing will provide a major capability improvement that promises to transform numerous fields with deep relevance to the Department's missions. In FY 2017, the Energy Science Network (ESnet) will increase bandwidth to address the growing data requirements of SC facilities, such as the light sources, neutron sources, and particle accelerators at CERN. This includes upgrading high-traffic links to 400 gigabits per second (gbps).

In Nuclear Physics (NP), the Request supports the construction profile for the Facility for Rare Isotope Beams (FRIB) project at Michigan State University. FRIB will provide intense beams of rare isotopes for research in

nuclear structure and nuclear astrophysics. The 12 GeV Upgrade project at the Continuous Electron Beam Accelerator Facility is nearing completion at Thomas Jefferson National Accelerator Facility. This upgrade will provide unprecedented capability to illuminate the physical nature and internal structure of nucleons. Two new Major Items of Equipment (MIEs) are initiated in FY 2017 the Gamma-Ray Energy Tracking Array (GRETA) detector to exploit the world-leading science capabilities of FRIB and the Stable Isotope Production Facility (SIPF) to establish a domestic capability for the production of a broad range of enriched stable isotopes for research and applications. Together these investments will place the U.S. nuclear physics enterprise in a strong position for many years.

In Basic Energy Sciences, the FY 2017 Request provides support for two major projects: the Linac Coherent Light Source-II (LCLS-II) upgrade project at Stanford Linear Accelerator Center National Accelerator Laboratory (SLAC) and the Advanced Photon Source Upgrade (APS-U) project at Argonne National Laboratory. LCLS-II will expand the capabilities and capacity of the world's first x-ray free electron laser, extending U.S. leadership well into the next decade. The APS-U project will ensure that the U.S. has a world-leading hard x-ray source in an area of intense international competition. These tools enable a wide range of research supported by numerous government, industrial, and academic sponsors across a diversity of scientific disciplines.

In High Energy Physics, the FY 2017 Request continues to implement the recommendations of the 2014 High Energy Physics Advisory Panel (HEPAP) Particle Physics Project Prioritization Panel (P5) Report. The Request supports construction of the Muon to Electron Conversion Experiment (Mu2e), consistent with the planned construction funding profile, and the MIEs for the Large Hadron Collider (LHC) upgrades, and the ATLAS (A Large Toroidal LHC Apparatus) and Compact Muon Solenoid (CMS) detectors. Consistent with the P5 Report recommendations, the FY 2017 Request enhances support for technical design and construction associated with the Long Baseline Neutrino Facility (LBNF)/Deep Underground Neutrino Experiment (DUNE) project, and continued construction of three MIEs for next-generation dark-energy and dark-matter experiments: the LUX-ZEPLIN project that will search for dark matter particles known as weakly interacting massive particles (WIMPs); the

SuperCDMS-SNOLab project, which will partner with LUX-ZEPLIN in detecting low-mass WIMPs; and the Dark Energy Spectroscopic Instrument (DESI), which will measure the effect of dark energy on the expansion of the universe. The Request includes funding for one new MIE, the Facility for Advanced Accelerator Experimental Tests II (FACET-II), and for research and conceptual design of the Proton Improvement Plan II (PIP-II) construction project. Funding also increases for the fabrication of the Large Synoptic Survey Telescope MIE according to the planned profile.

Subcommittee. As these facilities come online, you will likely be under a flat budget. Where will you find savings to pay for these new operating budgets?

Dr. Orr. The decades-long history of the Office of Science shows that both research programs and facilities have been terminated in order to pursue the most promising new investments in research, tools, and major facilities. Such transitions are made in both flat and increasing budgets. Recent budget requests demonstrate the Office of Science's willingness to make the difficult decisions to close long-running user facilities in order to realize new investments. In recent years the Office of Science closed the Tevatron at Fermilab, the Holifield Radioactive Ion Beam Facility at Oak Ridge National Laboratory, the Intense Pulsed Neutron Source at Argonne National Laboratory, the National Synchrotron Light Source at Brookhaven National Laboratory, and the Manuel Lujan Center for Neutron Scattering at Los Alamos National Laboratory; Alcator C-Mod at the Massachusetts Institute of Technology will close at the end of FY 2016. However, we believe that budgets with modest growth as reflected in the FY 2017 Budget, would provide the resources for the Office of Science to successfully deliver our highest priority investments in new and upgraded user facilities while continuing to serve today's mission needs.

Subcommittee. As budgets have tightened, it's become increasingly difficult over the last several years to meet all of the construction and operating budget needs for facilities across the Office of Science. It is especially difficult for us to make wise decisions when we have little context with which to analyze your budget proposal. Can we expect to see a five-year plan from the Department with its future construction needs?

Dr. Orr. In formulating its budgets annually, the Office of Science considers the long-range—5-to-10 year—impacts of facility construction and operations in a variety of budget scenarios. Maintaining balance among research, facility construction, and facility operations in the outyears is an important consideration as the Office of Science budget is developed.

FUSION ENERGY SCIENCES

FUTURE OF FUSION

Subcommittee. Dr. Murray, fusion research has historically relied upon large machines capable of creating the magnetic fields required to contain the plasmas we are trying to study and control. Recent news reports have focused on new methods to create magnetic fields that don't require the large machines your Office has utilized in the past.

Can you briefly take a moment to discuss what your Office has done to engage with these new efforts and innovative technologies?

Dr. Murray. The Fusion Energy Sciences (FES) program has a longstanding activity to assess innovative technologies. An example is a new technology to create magnetic fields through the use of high-temperature superconductors. FES has been supporting a research effort in this area for several years. Innovative technologies relevant to fusion are also supported with FES program funding through the Small Business Innovation Research (SBIR) program.

Subcommittee. Has your Office looked at how to incorporate these new efforts into the future vision of the Fusion Energy Sciences program? If so, how will they play a role? If not, why?

Dr. Murray. High-temperature superconductor magnets show promise, but our assessment is that they are not close to being ready for use with fusion confinement facilities and will require signification development work over many years to achieve cost effective manufacturing and performance.

Subcommittee. Considering the request cuts the fusion program by fifteen percent from last year's enacted level, would that prevent the domestic fusion program from studying these new approaches to creating and containing plasma?

Dr. Murray. Under the FY 2017 Budget Request, FES would continue to support the existing research effort on high-temperature superconductor magnets for fusion applications.

INTERNATIONAL FUSION SUPPORT

Subcommittee. Dr. Murray, the World's largest stellerator fusion device, the W7-X in Germany, successfully began producing plasma in December of last year. This year's request would significantly decrease the U.S. participation in the second experimental run of the machine and many important concepts related to the future of fusion as a commercial power plant would be lost.

This device represents the best test of how a stellerator can be used to produce fusion at a commercial power plant. Why are we limiting our participation?

Dr. Murray. In recent years, we have worked to establish robust collaborations for U.S. researchers at the new superconducting stellarators and tokamaks in Asia and Europe. Indeed, our participation at W7-X by a research team comprised of national lab and university researchers, including students, has already been impactful. The funding requested in FY 2017 for research in long pulse stellarators will enable U.S. scientists to continue to contribute vigorously to this program and to have access to some of the leading stellarator-related science the world has to offer.

Subcommittee. The U.S. also supports fusion efforts in the United Kingdom, Korea, and China. How do these facilities fit into the global effort with or without ITER?

Dr. Murray. These facilities play a complementary role to that of ITER, and their scientific missions are also broadly important to fusion with or without consideration of ITER's status. The experiments in China and South Korea both use low-temperature superconducting magnets, enabling a study of the science of very long pulses of fusion fuel, which are not possible in the U.S. Developing the science and technology of long pulse plasma operation on these devices are important for learning how to extend the duration of plasma pulses on any tokamak device as well as for strengthening our understanding of how to operate ITER successfully. The Joint European Torus (JET) experiment in the UK is the facility in the world that is closest in scale to ITER. JET has a new plasma-facing wall that is similar in materials and design to that of ITER, and that is also relevant to most future reactor concepts. Also, JET is the only experiment in the world

that is equipped to operate with a 50/50 mix of deuterium and tritium, the fuel mix that ITER or any future reactor will use. These characteristics make it valuable in developing the operating scenarios that will ultimately be used on ITER, as well as for establishing the scientific basis for any future tokamak burning plasma experiment or reactor.

BASIC ENERGY SCIENCES

FLAT BUDGET SCENARIO

Subcommittee. The Basic Energy Sciences [BES] program budget consists of funding for research, the operation of existing user facilities, and the construction of new facilities and equipment. The long-term success of the BES program hinges on striking a careful balance among these three areas. However, the increasing level of research commitments, higher operating costs, and new construction make it difficult to adequately fund all three components within existing budget constraints. This is especially true considering that the ongoing upgrades will result in higher operations costs in the near term.

Dr. Murray, with these competing costs in mind, what are the priorities for BES?

Dr. Murray. The highest priority for the Basic Energy Sciences (BES) program is construction of the Linac Coherent Light Source-II (LCLS-II) at SLAC National Accelerator Laboratory. LCLS-II is a key component of the BES strategy to advance its mission through construction and operation of world-class light sources. It will provide unprecedented x-ray properties for temporal control and energy resolution that will enable groundbreaking research in a wide range of scientific disciplines. LCLS-II will not just benefit a single field; it will advance a host of science beginning with advanced materials to energy to life sciences. The ongoing BES Advisory Committee (BESAC) facilities prioritization study, with a report due in June 2016, will assist the Office of Science and BES in setting priorities for other construction and upgrade projects.

Subcommittee. In a flat budget scenario, what would you propose to cut within BES?

Dr. Murray. The FY 2017 President's Request for the BES program supports a balanced portfolio of (1) forefront research in condensed matter and materials sciences, chemical sciences, geosciences, and biosciences, and (2) the operation, upgrade, and construction of world-leading scientific user facilities comprising x-ray photons, neutrons, and electron materials probes as well as tools for nanoscale science. Each facet of this portfolio is essential

to maintaining international competitiveness in new materials discovery and chemical processes, which are the foundation for many applications of potential societal benefit. Under a flat funding scenario in FY 2017, (a reduction of over $87M from the FY 2017 Budget Request), staff would be reduced in research and at user facilities across the portfolio – i.e., at both DOE laboratories and universities.

ADVANCED SCIENTIFIC COMPUTING RESEARCH

HIGH PERFORMANCE COMPUTING EFFORTS AT OTHER AGENCIES

Subcommittee. Dr. Murray, while exascale and quantum computing are different concepts, they both attempt to solve problems at a faster rate and provide technological breakthroughs in the high performance computing world. Can you outline why the Office of Science is focused on exascale rather than quantum computing machines? Can each machine solve the same types of problems or do they address different challenges?

The President's announcement of a National Strategic Computing Initiative emphasizes that many agencies expect to compete for time on the Department's high performance computing machines. How will the Office of Science plan for this?

Dr. Murray. The Department is requesting funds in FY 2017 to explore the potential of alternative technologies, such as quantum and neuromorphic computing to advance DOE applications. These technologies are emerging and will not be able to deliver the capabilities of exascale computing in the same timeframe. They are also disruptive, because the software, algorithms, libraries and tools that our current applications rely upon, and were developed over several decades, simply will not work on quantum or neuromorphic computing systems.

Approximately 60% of the resources in the Office of Science Leadership Computing facilities are open to all researchers, including those funded by other agencies through the Innovative and Novel Computational Impact on Theory and Experiment (INCITE) allocation program. The INCITE awards are selected through a peer reviewed process that also determines the readiness of the proposed application to make effective use of the resources.

HIGH PERFORMANCE COMPUTING EXPERIMENT PRIORITIZATION

Subcommittee. This year's budget request notes that the Office of Science's high performance computing is expected to support the BRAIN Initiative, a seismic simulation partnership with NNSA, and various partnerships supporting new clean energy initiatives proposed in fiscal year 2017.

Dr. Murray, is the Office of Science prioritizing time spent in support of these initiatives over the normal research process used to allocate the use of these machines?

Dr. Murray. No. These efforts will follow the normal, peer reviewed allocation process.

Subcommittee. How does the Office ensure that only the most high priority research gets access to the high performance computing machines?

Dr. Murray. Allocations through the Innovative and Novel Computational Impact on Theory and Experiment (INCITE) are made based entirely on application readiness and peer review. Allocations through the Advanced Scientific Computing Research Leadership Computing Challenges are based on peer review and program priority, including growing the community.

HIGH ENERGY PHYSICS

HIGH ENERGY PHYSICS EXPERIMENTS AND FACILITIES

Subcommittee. The Cosmic Frontier of the High Energy Physics program has produced significant contributions to experimental physics made possible by the unique capabilities offered by our national labs. The goal of the Cosmic Frontier subprogram is to reveal the hidden nature of dark energy and dark matter, which make up almost 95 percent of our universe.

There are many planned facilities and international projects that seek to discover dark energy and dark matter. Can you take a moment to discuss the U.S. involvement in these efforts both here at home and abroad?

Dr. Orr. The Cosmic Frontier supports an exciting suite of complementary, state of the art projects that will advance understanding of these phenomena. Each project is well aligned with the priorities identified in the Particle Physics Project Prioritization Panel (P5) report. These projects are led by the U.S. and are located at the best possible sites within and outside the U.S. to optimize their scientific impact. Collaborations of scientists, and in most cases partnerships of U.S. and international agencies and institutions, are engaged in all phases of these experiments, from construction to science results.

To study dark energy, two premier projects are being developed—the Large Synoptic Survey Telescope (LSST) and the Dark Energy Spectroscopic Instrument (DESI). LSST will make repeated, movie-like images of cosmic structure and supernovae; DESI will use spectroscopy to build up three-dimensional maps of the evolution of structure in the universe through 10 billion years of cosmic history. LSST is sited in Chile, with the National Science Foundation (NSF) as the lead agency and DOE's Stanford Linear Accelerator Center National Accelerator Laboratory responsible for fabrication of its 3.2 gigapixel camera. DESI is a DOE led project, managed by Lawrence Berkeley National Laboratory, and is sited in New Mexico, using the Mayall telescope leased from NSF.

To study dark matter, a suite of three "Generation 2" direct detection projects are in development, supported by DOE and NSF. They will be

located at the University of Washington and at sites deep underground in South Dakota and Canada. The suite of dark matter experiments uses complementary technologies to search for different postulated types of dark matter.

Subcommittee. What do we gain from investigating these questions?

Dr. Orr. Today, ordinary matter—including all stars, planets, interstellar gas, and all living things—accounts for only five percent of the known universe, while the remaining 95% is composed of dark matter and dark energy. Each portion of this dark universe has played a key role in the history of our universe with dark matter dominating the formation of galaxies and galaxy structure and dark energy driving the accelerating expansion of our universe today.

The Cosmic Frontier research advances some of the most compelling lines of inquiry that can be pursued in particle physics, as recognized by the Nobel Prizes in Physics. George Smoot, from Lawrence Berkeley National Laboratory (LBNL), shared the 2006 Nobel Prize for the discovery of anisotropic patterns in the cosmic microwave background. Saul Perlmutter, from LBNL, shared the 2011 Nobel Prize for the discovery of the accelerating expansion of the universe through observations of distant supernovae. Cosmic Frontier investments aim to continue this legacy of discovery and transform our understanding of the universe.

NUCLEAR PHYSICS

FACILITY FOR RARE ISOTOPE BEAMS AT MICHIGAN STATE UNIVERSITY

Subcommittee. Dr. Murray, the largest construction project within the Nuclear Physics program is the Facility for Rare Isotope Beams (F-RIB). Once completed, F-RIB will enable a better understanding of the origination of elements and the cosmos.

Can you provide an international context to FRIB? Does anyone else have this capability or will FRIB be unique?

Dr. Murray. Following a charge from the DOE and NSF, the National Research Council of the National Academies' Board on Physics and Astronomy published a 2007 report, "Scientific Opportunities with a Rare-Isotope Facility in the United States." This report concluded that in the context of international efforts, the Facility for Rare Isotope Beams (FRIB) would provide capabilities unmatched elsewhere. Since this publication, the 2015 Long Range Plan for Nuclear Science, "Reaching for the Horizon," confirmed that FRIB's capabilities remain unchallenged with the statement: "FRIB, under construction at Michigan State University, will be the world's most powerful radioactive beam facility, making nearly 80% of the isotopes predicted to exist for elements below uranium. The high beam power level, and consequent intensity and reach, is unmatched at other existing facilities, or those now under construction or planned, around the world."

Subcommittee. Is FRIB's cooperative agreement and direct cost share with Michigan State a model that the Office of Science will seek to emulate for future construction projects?

Dr. Murray. A cooperative agreement is used for FRIB because it is being constructed at a university. The use of a cooperative agreement is not appropriate for national laboratories where the majority of the large projects are constructed. We will continue to use cooperative agreements, as appropriate, for major activities with non-FFRDCs.

Subcommittee. Will this project operate differently than user facilities that are currently sited at the National Labs?

Dr. Murray. At the time that FRIB becomes operational, the current cooperative agreement stipulates that FRIB will operate as a scientific user facility. We therefore intend to operate FRIB like those sited at the national labs, with the only major difference being the contractual arrangements since operation will be at a university versus a national laboratory.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

CLIMATE SCIENCE USER FACILITIES

Subcommittee. Dr. Murray, the Biological and Environmental Research program supports multiple sites and facilities that feed into the Atmospheric Radiation Measurement Climate Research Facility (ARM) to provide continuous field measurements of atmospheric data. The delivery of this research goes toward projection models that provide a better picture of Earth systems science.

This research seems to focus on data that's often collected by weather services all across the country. How are the activities of ARM different?

Dr. Murray. The Atmospheric Radiation Measurement Climate Research Facility (ARM) observations provide a unique vertical picture of the atmosphere. Unlike monitoring data used by weather services, ARM is a research facility dedicated to the collection of field observations to understand the physics of clouds, aerosols, precipitation, and radiative transfer. Because the science is so complex, the ARM facility involves heavily instrumented sites, including aerosol optical and chemistry measurements; turbulent fluxes; shortwave, longwave, and microwave radiometers; lidars; and cloud and precipitation radars. These types of instruments are not routine in weather service observations, yet are needed to advance the science of cloud and aerosol physics and validate and drive advanced modeling.

Subcommittee. Who else collaborates on these research activities with the Office of Science? How are the different sites where data is collected chosen?

Dr. Murray. The Office of Science's Atmospheric Radiation Measurement Climate Research Facility (ARM) collaborates primarily with the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the National Science Foundation (NSF) on atmospheric measurement activities that support different types of science research questions involving clouds, aerosols, and radiative transfer.

THE HONORABLE CHUCK FLEISCHMANN

ISOTOPES PROGRAM TRANSITION TO OFFICE OF SCIENCE

Mr. Fleischmann. Several years ago, the Department of Energy transitioned all isotope production programs to the Office of Science—a transition that was directed by the Congress a number of years prior.

Can you briefly provide an update to those efforts? Have all the activities transitioned?

Dr. Orr. Yes, all isotope production activities have been transferred to the Office of Science as required by Public Law 111-8, the Omnibus Appropriations Act, 2009. Subsequent to the transfer, the Office of Science took action to ensure that all isotope production activities are conducted under the auspices of the DOE Isotope Program as required by Public Law 101-101, the 1990 Energy and Water Development Appropriations Act. Specifically, this included ensuring that isotope production was not conducted outside the Isotope Program under national laboratory Work for Others projects, and establishing Isotope Program points-of-contact at all DOE national laboratories engaged in isotope production. These contacts ensure that those activities are being done under the authority of the Isotope Program. The Office of Science also updated the Secretarial delegation memo to transfer authority for the Isotope Program from the Office of Nuclear Energy to the Office of Nuclear Physics within the Office of Science.

Mr. Fleischmann. Is the Office of Science working to ensure that commercial isotope producers have a direct working relationship with user facilities on day-to-day operational matters as it continues its effort to coordinate isotope production activities across the DOE complex?

Dr. Orr. Yes, the Office of Science continues to ensure that commercial customers are engaged in operational matters to the extent necessary to assure successful delivery of products to those customers. Primarily this involves engaging customers in planning irradiations to deliver finished products as desired by those customers. The level of engagement also recognizes the contractual obligation of national laboratory contractors to be responsible for management of their facilities.

Mr. Fleischmann. The request proposes to build a Stable Isotope Production Facility at Oak Ridge to produce medical isotopes and provide inputs for commercial suppliers of isotopes. Can you explain why this new activity is needed and what this brings to the isotope program?

Dr. Orr. The DOE Isotope Program has exhausted its inventory of several enriched stable isotopes at Oak Ridge National Laboratory (ORNL) over the past decades. Therefore, DOE is reestablishing a domestic capability to produce small research quantities of enriched stable isotopes through an R&D prototype capability that is slated to be completed at ORNL and commence operations in 2016. The objective of the R&D prototype is to produce small quantities of stable isotopes required to support domestic R&D in medicine, research, commercial manufacturing, and national security, including modest amounts of enriched Mo-98 and Mo-100 that may be required for continued demonstration of some Mo-99 production methods in support of the NNSA effort to establish domestic production of Mo-99 without the use of highly enriched uranium. The President's Budget Request also includes a request for a Stable Isotope Production Facility (SIPF) Major Item of Equipment (MIE) starting in FY 2017. The SIPF will cost-effectively provide a domestic capability for production of enriched stable isotopes for basic research, medical and industrial applications and help mitigate dependence on foreign suppliers by expanding the annual stable isotope production capacity of the prototype capability to a kilogram or more for several selected isotopes, including Mo-98 and Mo-100. The Nuclear Science Advisory Committee (NSAC) subcommittee on Isotopes in 2009 identified the development of a stable isotope separation technology as a high priority; the subcommittee reaffirmed its recommendation in the 2015 Long Range Plan for the DOE-NP Isotope Program.

THE HONORABLE LUCILLE ROYBAL-ALLARD

WORKFORCE DEVELOPMENT FOR TEACHERS AND SCIENTISTS (WDTS)

Ms. Roybal-Allard. According to the FY2017 budget justification, "WDTS activities rely significantly on DOE's 17 laboratories." How does the office ensure that the benefits of this program are available to students and teachers in regions, such as Southern California, that are not adjacent to one of the 17 DOE national laboratories?

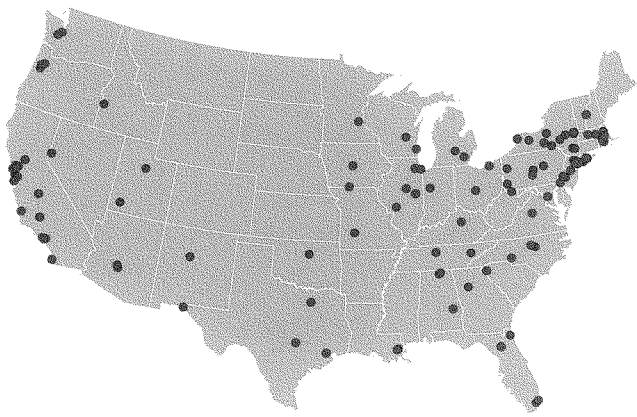
Dr. Orr. Roughly 70% of Workforce Development for Teachers and Scientists (WDTS) support is for science, technology, engineering, and mathematics (STEM) undergraduate internships, for STEM graduate student thesis research projects, and for STEM visiting faculty from institutions historically underrepresented in Department of Energy (DOE) research support. These STEM research experience opportunity programs place participants in paid science and engineering research activity appointments at DOE laboratories where they work directly with laboratory staff scientists and engineers on projects related to ongoing DOE research programs. To help make the world-class scientific resources of the DOE laboratory complex broadly available, WDTS-sponsored programs are operated in a manner to encourage, and make available, placement opportunities irrespective of an applicant's proximity to DOE host laboratories or facilities. Having geographically diverse participant cohorts is a recognized necessity for our national programs.

To promote its programs, WDTS engages in national outreach activities, such as webinars, and also supports outreach that are made by DOE host labs on behalf of WDTS. Additionally, host labs also engage in their own STEM outreach, often at events targeting underrepresented groups or populations.

Regarding participant placements, in the case of WDTS undergraduate internships programs, the applicant decides which two DOE host labs interest the most, and these two labs are the ones that consider the individual's application. The applicant's decision on host labs is informed by the scope of the research opportunities available at a given host lab, noting that some labs have a more focused science mission than others (*e.g.*, Fermi

National Accelerator Laboratory being primarily a high energy physics lab, *vs*. Oak Ridge National Laboratory being a multi-disciplinary research lab). To relieve any distance-associated financial burden, participants are offered support for travel to and from their DOE host lab, as well as housing assistance. This support is in addition to a weekly stipend.

As an illustration of the geographic diversity of the participants in the DOE laboratory-based WDTS program, below is an example of the Science Undergraduate Laboratory Internships (SULI) program participants at two representative large participant cohort host DOE labs, Lawrence Berkeley National Laboratory (LBNL) in Berkeley, CA, and Brookhaven National Laboratory (BNL) in Upton, NY, during a recent summer SULI term. The home institutions of SULI students interning at LBNL are identified by red dots and SULI students at BNL are identified by blue dots.



An analysis of SULI program data since 2013 reveals that there have been six past SULI program participants whose permanent/home addresses is within the 40th Congressional District. Based upon the total number of U.S. Congressional Districts, and the total number of SULI participants since 2013, six participants per Congressional District is about average. These six particular SULI program alumni were placed at Argonne, Lawrence

Berkeley (2), Lawrence Livermore, and Pacific Northwest National Laboratories, and at the National Renewable Energy Laboratory.

Ms. Roybal-Allard. In recent years, the Administration has reorganized and consolidated science, technology, engineering, and mathematics (STEM) education programs at a number of federal agencies. How have these changes affected the WDTS program?

Dr. Orr. The WDTS program has maintained strong support from the Administration during the STEM education consolidation effort that began in FY 2014. In the years prior to this Administration effort, the Office of Science commissioned an extensive external review of the WDTS program activities through a Committee of Visitors (COV) review. As a result of that review, WDTS undertook several actions to: 1) strengthen programs that reviewed well and terminate programs that were not highly reviewed, 2) ensure programs were aligned with the SC and DOE scientific workforce training needs and leveraged the unique assets of DOE, and 3) establish the infrastructure for ongoing program evaluation.

The WDTS program activities are viewed to be well managed, do not overlap with the STEM education programs supported by other Federal agencies, and are coordinated with those other Federal agencies through the White House's National Science and Technology Council's Committee on STEM Education (CoSTEM) and informal interagency working groups. As such, the WDTS programs were not a subject of the Administration's STEM education consolidation effort. WDTS management and staff continue to engage with other agencies through the CoSTEM efforts to build collaborations and collective knowledge of best practices in program management, execution, and evaluation.

ITER FUSION PROJECT

Ms. Roybal-Allard. A substantial portion of the budget of the Fusion Energy Sciences program, $125 million out of $398 million in the FY2017 request, supports U.S. contributions to ITER.

How have activities in the domestic portion of the Fusion Energy Sciences program, such as DIII-D in San Diego, been affected by the need to expend resources on ITER? How does the agency anticipate they will be affected in the future?

The FY 2017 Budget Request will support research and operations on DIII-D and also on National Spherical Torus Experiment Upgrade (NSTX-U) at the Princeton Plasma Physics Laboratory and will enable a highly productive experimental run period along with a substantial investment in facility enhancements. The Department is committed to vigorous experimental research operations on these major, world-class user facilities in the outyears.

If the cost of U.S. participation in ITER rises in future years, how will DOE ensure that adequate resources continue to be available for DIII-D and other domestic fusion activities?

Dr. Orr. The Department is committed to a vigorous, well-balanced research program in the fusion energy sciences that emphasizes these five priorities: 1) massively parallel computing with the goal of validated whole-fusion-device modeling will enable a transformation in predictive power, which is required to minimize risk in future fusion energy development steps; 2) materials science as it relates to plasma and fusion sciences, which will provide the scientific foundations for greatly improved plasma confinement and heat exhaust; 3) research in the prediction and control of transient events that can be deleterious to toroidal fusion plasma confinement, which will provide greater confidence in machine designs and operation with stable plasmas; 4) continued stewardship of discovery in plasma science that is not expressly driven by the energy goal, which will address frontier science issues underpinning great mysteries of the visible universe and help attract and retain a new generation of plasma/fusion science leaders; and. 5) Fusion Energy Sciences (FES) user facilities that will be kept world-leading.

THE HONORABLE RODNEY FRELINGHUYSEN

DOMESTIC FUSION BUDGET

Mr. Frelinghuysen. The Administration proposes a 15 percent cut to the domestic fusion program despite the overall increase for the Office of Science and in every other program within the Office. As you know, this Committee has repeatedly endorsed moving forward in the area of fusion energy. The proposed decreases would inevitably delay some of the progress we are making in this exciting field. Have you consulted with laboratory directors and universities about the specific impact to their operations? If not, have you done an internal analysis of the impact of the proposed cuts? The rest of the world is moving forward to develop fusion energy. How do these cuts impact the United States' ability to stay competitive?

Dr. Orr. During the budget development process each year, DOE considers input from national laboratory, university program directors, and other research leaders regarding the potential impacts of several budget scenarios. The FY 2017 President's Budget Request takes this input into consideration and advances a U.S. fusion program that will remain at the global leading edge by pursuing research investments that emphasize priorities articulated in the recent report to Congress on strategic planning that are grounded in years of community input and assessment. The Request will enable U.S. researchers, including university students, to have the opportunity to engage and lead in answering the world's most pressing questions in fusion energy science.

PRINCETON NSTX RUNTIME

Mr. Frelinghuysen. Of course, New Jersey is the proud home to the Princeton Plasma Physics Lab (PPPL). We were pleased that the National Spherical Torus Experiment Upgrade (NSTX-U) was funded to completion last year. While the budget proposal would allow 16 weeks of "run-time" for this newly upgraded machine, it is my understanding that the proposed "run-time" is two weeks shorter than in FY 2016. Is DOE committed to multi-year operation of NSTX-U so that we can reap the full benefit of its upgrade? Can we expect to see more optimal run-times for this machine in the future?

Dr. Orr. Robust operations of our two major fusion user facilities, National Spherical Torus Experiment Upgrade (NSTX-U) and DIII-D, whose mission is to establish the scientific basis for the optimization of the tokamak approach to fusion energy production, is a high priority for the Department in FY 2017 and the outyears. The research and operations funds recommended in the FY 2017 Request for NSTX-U research and operations are at very nearly the level that Congress enacted for FY 2016. The proposed split between run time and maintenance, which includes activities to further enhance NSTX-U capabilities, is optimal.

TUESDAY, MARCH 15, 2016.

DEPARTMENT OF ENERGY, ENVIRONMENTAL MANAGEMENT

WITNESS

DR. MONICA REGALBUTO, ASSISTANT SECRETARY FOR ENVIRONMENTAL MANAGEMENT, DEPARTMENT OF ENERGY

Mr. SIMPSON. I would like to call the hearing to order. Good morning, everyone. Welcome to what is the last official hearing this year of the Energy & Water Subcommittee. We saved the best for last. I would like to welcome Dr. Monica Regalbuto to her first appearance before the Subcommittee. This is the first time since March of 2011 that we have had a Senate-confirmed Assistant Secretary for Environmental Management testify before the Subcommittee. So congratulations on getting through the Senate. We look forward to your testimony today and to hearing more about your plans to lead the environmental cleanup program through its many challenges.

The purpose of today's hearing is to discuss the President's Budget Request for the Department of Energy's Office of Environmental Management. That request totals $5.4 billion, a reduction of $773 million below fiscal year 2016. Instead of requesting enough funding to keep all of the cleanup sites operating, the Administration has proposed to shift spending for the cleanup of Paducah, Portsmouth, and Oak Ridge to mandatory accounts. The Department includes these mandatory funds in their budget totals, but they are not the jurisdiction of the Appropriations Committee. Rather, this proposal to expand the authority of USEC Privatization Fund is ultimately under the purview of the authorizing committees. This budgeting gimmick allowed the Administration to push to the side the cost of these cleanup activities and use that money for some other initiative that they wanted to highlight. This is simply irresponsible and risks hundreds if not thousands of cleanup jobs. Once again it will be the work of this Subcommittee to put forth a responsible funding plan that will keep these and other programs of the Department of Energy functioning.

Please ensure that the hearing record, responses to the questions for the record, and any supporting information requested by this subcommittee are delivered in final form to us no later than 4 weeks from the time you receive them. I also ask members to submit any additional questions for the record to the subcommittee by close of business tomorrow.

With those opening comments I would like to yield to our ranking member, Ms. Kaptur, for any comments that she would like to make.

[The information follows:]

OPENING STATEMENT
The Honorable Mike Simpson
Chairman, Energy and Water Development Subcommittee
House Committee on Appropriations

Budget Hearing on Environmental Management Programs
FY 2017 Budget
March 15, 2016

I'd like to call this hearing to order. Good morning, everyone.

I'd like to welcome Dr. Monica Regalbuto to her first appearance before this Subcommittee. This is the first time since March of 2011 that we've had a Senate-confirmed Assistance Secretary for Environmental Management testify before the Subcommittee. We look forward to your testimony today and to hearing more about your plans to lead the environmental cleanup program through its many challenges.

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With those opening comments, I would like to yield to our ranking member, Ms. Kaptur, for any opening comments that she would like to make.

Ms. KAPTUR. Thank you, Mr. Chairman. Dr. Regalbuto, welcome to the subcommittee and thank you for taking time this morning to discuss the Environmental Management Program.

The program faces massive challenges. You surely know that; we thank you for taking on this responsibility. The legacy of the Manhattan Project is an obligation we as a country must address. The continued issues at the waste isolation plant and at Hanford are illustrative of not only the dangers posed by the remaining materials, but also the technical and budgetary challenges that further complicate the eventual success of the Department's efforts.

The budgetary challenges this year are exacerbated by the ill-conceived movement of a portion of the program to mandatory funding. There remain lingering concerns about the Department's safety culture. With such a critical mission the work environment at your sites must ensure employee concerns are addressed in a timely manner and without fear of retribution. Given the constrained fiscal environment it will be crucial that all resources are employed to their fullest potential. Therefore, issues of project management and corporate governance are increasingly vital to the success of the Department's mission. The Department must follow through with strong leadership and fundamental management reform. And failing to do so will significantly inhibit the execution of this mission as well as the Department's credibility.

Finally, I would like to reiterate the budget hurdles posed by the use of mandatory funding and uranium sales to fund this important work. While I appreciate the Department is working with me to address concerns at the Portsmouth site, your budget effectively requests no funding for the uranium enrichment D&D fund. Though the Portsmouth site is one of three primary sites funded by this account, and is not in my district though it is in my State, and it is one of the highest unemployment counties in our country. Additional job losses and job uncertainty send harmful waves throughout the local economies of these sites. I hope we can continue working together to minimize instability and ultimately complete the important cleanup work at the site and find a way to transition workers who may be losing their positions.

Thank you, Mr. Chairman, for the time.

Mr. SIMPSON. Thank you. We are looking forward to your opening testimony.

Ms. REGALBUTO. Good morning, Chairman Simpson, Ranking Member Kaptur, and members of the subcommittee. I am pleased to be here today to represent the Department of Energy's Office of Environmental Management and to discuss the work that we have already successfully accomplished and what we plan to accomplish under the President's fiscal 2017 budget request.

The total budget request for the EM program is $6.1 billion, which includes $5.4 billion of new appropriations, and $674 million of proposed mandatory spending as you correctly mentioned. The request will allow EM to maintain a safe and secure posture across the complex. We are maximizing our work on compliance activities.

I would like to take this opportunity to briefly highlight a number of EM's recent accomplishments. Earlier this month, on a schedule with agreement with the State of Washington, workers started pumping tank waste from AY-102, one of our oldest double-

shield tanks at the Hanford Site. This is a huge accomplishment by our workers, as you know that they are working in very, very challenging conditions. At the Savannah River site, the 4,000th canister radioactive glass was recently poured. Achieving this milestone enabled us to close the seven high level waste tanks at the site. And at Moab Site half of the estimated 60 million tons of uranium mill tailings have been removed and shipped to an engineering disposal cell.

The fiscal 2017 budget request will allow us to continue to make progress in our ongoing cleanup priorities. Among EM's top priorities is the safe reopening of WIPP. EM continues to support recovery from two incidents at the facility that interrupted the national program for the disposal of transuranic waste. The request will support initiating waste emplacement operations by December of 2016, if it is safe to do so. In Idaho, the request will support the Integrated Waste Treatment Unit. This facility is planned to treat approximately 900,000 gallons of sodium-bearing tank waste. At the Savannah River Site we will complete construction and ramp up commissioning activities at the salt Waste Processing Facility which will significantly increase our ability to treat tank waste. In addition, we will also continue to receive, store, and process spent nuclear reactor fuel. At the Hanford Office of River Protection the request supports continued construction of the low activity waste facility, balance of plant, and outfitting of the analytical laboratory, which are the centerpieces of the Department's plan to begin the direct feed of low activity waste as soon as 2022.

The requests at Richland allow us to continue important work on the central plateau and to complete the demolition of Hanford's Plutonium Finishing Plant, once one of the most dangerous buildings in the complex.

At Oak Ridge the request supports continuing design of the Outfall 200 Mercury Treatment Facility at the Y–12 National Security Complex and complete the demolition of Building K–27, the last gaseous diffusion enrichment processing building. It will mark the first time that a gaseous diffusion enrichment site has been completely decommissioned.

With the most challenging cleanup remaining we understand importance of technology development in reducing life cycle costs and enhancing our effectiveness. To help address many of the technical challenges involved the request reflects a total investment in technology development of $33 million. The funding will allow us to continue to integrate robotics technology into our efforts to help improve overall work and quality of life by easing the performance of physically demanding tasks.

In closing, I am deeply honored to be here today representing the Office of Environmental Management. We are committed to achieve our mission and will continue to apply innovating strategies to complete our mission safely.

Thank you very much for having me here today and I will be happy to answer any of your questions.

[The information follows:]

Written Statement of Dr. Monica Regalbuto

Assistant Secretary for Environmental Management United States Department of Energy

Before the Subcommittee on Energy and Water Development Committee on Appropriations

United States House of Representatives

March 15, 2016

Good morning Chairman Simpson, Ranking Member Kaptur, and Members of the Subcommittee. I am pleased to be here today to represent the Department of Energy's (DOE) Office of Environmental Management (EM). I would like to provide you with an overview of the EM program, key accomplishments during the past year and what we plan to accomplish under the President's $6,119,099,000 Fiscal Year (FY) 2017 budget request, which includes $673,749,000 of proposed mandatory funding.

Overview of the EM Mission

EM supports the Department's Strategic Plan to position the DOE to meet the challenges of the 21st century and the Nation's Manhattan Project and Cold War legacy responsibilities. The Department will leverage past experience, applying best practices and lessons learned; identify, develop, and deploy practical technological solutions derived from scientific research; and look for innovative and sustainable practices that make cleanup more efficient.

The EM program was established in 1989 and is responsible for the cleanup of millions of gallons of radioactive waste, the management of thousands of tons of spent nuclear fuel and special nuclear material, disposition of large volumes of transuranic and mixed/low-level waste, huge quantities of contaminated soil and water, and deactivation and decommissioning of thousands of excess facilities. This environmental cleanup responsibility results from five decades of nuclear weapons development and production and Government-sponsored nuclear energy research and development. It involves some of the most dangerous materials known to mankind. EM has completed cleanup activities at 91 sites in 30 states; EM is responsible for the remaining cleanup at 16 sites in 11 states.

Since 1989, the EM footprint has reduced significantly. For example, the Fernald site in Ohio and the Rocky Flats site in Colorado, both of which once housed large industrial complexes, are now wildlife refuges that are also available for recreational use. At the Idaho National Laboratory, we have decommissioned and demolished more than two million square feet of

excess facilities, and removed all EM special nuclear material (e.g., highly enriched uranium) from the state.

There is less than 300 square miles remaining to be cleaned up across the EM complex and progress continues. The remaining cleanup work presents some of the greatest challenges.

EM Cleanup Objectives and Priorities

EM's first priority is worker safety and we continue to pursue cleanup objectives with that in mind. Taking many variables into account, such as risk reduction and compliance agreements, EM has generally prioritized its cleanup activities as follows:

- Ensuring that activities are performed safely while providing the necessary security framework;
- Radioactive tank waste stabilization, treatment, and disposition;
- Spent nuclear fuel receipt and management;
- Special nuclear material consolidation, stabilization, and disposition;
- Transuranic and mixed/low-level waste disposition;
- Soil and groundwater remediation; and
- Excess facilities deactivation and decommissioning.

In particular, the FY 2017 budget request will allow EM to:

- Complete activities necessary for resumption of waste emplacement operations at the Waste Isolation Pilot Plant;
- Commence startup testing and commissioning activities at the Salt Waste Processing Facility to support initiation of radioactive operations in 2018; and
- Continue construction on the Waste Treatment and Immobilization Plant to support direct feed of low activity waste by end of 2022.

Most importantly, EM will continue to discharge its responsibilities by conducting cleanup within a "Safe Performance of Work" culture that integrates environmental, safety, and health requirements and controls into all work activities. This ensures protection for the workers, public, and the environment

Key Recent and Near-Term Accomplishments

I would like to take this opportunity to highlight a number of EM's most recent accomplishments. Recently, the 4,000th canister of radioactive glass was poured at the Savannah River Site Defense Waste Processing Facility. Achieving this milestone, along with other processing activities, enabled the closure of the seventh high-level waste storage tank at Savannah River with closure of

the eighth tank in progress. At the Moab Site, half of the estimated 16 million tons of uranium mill tailings has been removed and shipped to an engineered disposal cell. At Hanford, we have completed cleanup of the bulk of the River Corridor, including more than 500 facilities and 1,000 remediation sites. At Oak Ridge, we are continuing design and critical decision reviews for the Outfall 200 Mercury Treatment Facility. The budget request enables EM to continue progress in completing buried waste exhumation at the Idaho National Laboratory under the Accelerated Retrieval Project.

Highlights of the FY 2017 Budget Request

The FY 2017 budget request for EM is $6,119,099,000. The budget request for EM is comprised of $5,382,050,000 for defense environmental cleanup activities, $218,400,000 for non-defense environmental cleanup activities, and proposes $673,749,000 in mandatory funding for Uranium Enrichment Decontamination and Decommissioning Fund cleanup activities. The request will allow EM to maintain a safe and secure posture across the complex, while maximizing work on compliance activities. The budget request supports the continued construction of two unique and complex tank waste processing plants at the Savannah River Site, South Carolina, and the Office of River Protection, Washington. We are working to ensure these facilities will operate safely and efficiently. These two facilities are projected to treat tens of millions of gallons of radioactive tank waste for disposal.

Among EM's top priorities is the safe re-opening of the Waste Isolation Pilot Plant (WIPP) outside of Carlsbad, New Mexico. EM continues to support recovery from two 2014 incidents at the facility that interrupted the nationwide program for the disposition of transuranic waste resulting from atomic energy defense activities. Since opening WIPP, EM has sent more than 11,800 shipments of transuranic waste for disposal, safely emplacing nearly 90,000 cubic meters of waste. The FY 2017 budget request will allow the continuation of corrective actions and safety activities to support WIPP, regulatory and environmental compliance actions, the Central Characterization Project and transportation activities, and the resumption of waste emplacement operations by December 2016.

In FY 2017, cleanup progress will continue to be made across the rest of the complex. At the Idaho National Laboratory, the FY 2017 request will support the Integrated Waste Treatment Unit. This facility is planned to treat approximately 900,000 gallons of sodium bearing tank waste. The request also enables the continuation of exhumations at the Subsurface Disposal Area, treatment of legacy contact-handled and remote-handled transuranic and mixed low-level waste, and the safe, secure management of spent nuclear fuel.

At the Savannah River Site, the FY 2017 request supports continued production of canisters of vitrified high-level waste, and the construction of an additional on-site disposal unit for saltstone, the separated and treated low-activity fraction component of tank waste. The FY 2017 request also supports the planned commissioning and start-up of the Salt Waste Processing Facility in 2018. In addition, the request supports the safe and secure operation of the H Canyon/ HB-Line for the purpose of processing aluminum-clad spent nuclear fuel and down-blending EM-owned plutonium, ensuring the availability of space in K- and L-Areas for the future receipt of materials returned under national security agreements.

At the Office of River Protection, the FY 2017 request supports continuing construction of the Low-Activity Waste (LAW) Facility, Balance of Facilities, and outfitting of the Analytical Laboratory of the Waste Treatment and Immobilization Plant (WTP), facilities which are the centerpiece of the Department's plan to begin the direct feed of low activity waste (DFLAW) to the LAW facility as soon as the end of 2022. It will also simultaneously support ongoing efforts to resolve the technical issues associated with the WTP Pretreatment Facility and the WTP High-Level Waste Facility. The FY 2017 request is designed to achieve the immobilization of low activity waste as soon as practicable while resolution of technical issues continues. In support of DFLAW, the request includes funds for engineering scale testing and final design of the Low Activity Waste Pretreatment System, which will remove cesium and solids from the tank waste and provide feed directly to the Low Activity Waste Facility.

Ongoing cleanup efforts continue at Richland. The FY 2017 request supports the completion of the Plutonium Finishing Plant Facility transition and certain disposition activities in order to achieve slab-on-grade and completion of a cap over the site. The FY 2017 request also supports continued remediation of the 618-10 Vertical Pipe Units and planning and technology maturation for the remediation of the 324 hot cell facility located over the 300-296 waste site.

At Oak Ridge, the FY 2017 request will maintain EM facilities in a safe, compliant, and secure manner; complete the demolition of Building K-27, the last gaseous diffusion plant at the East Tennessee Technology Park; and support continuing design and critical decision reviews for the Outfall 200 Mercury Treatment Facility at the Y-12 National Security Complex. The processing of contact-handled and remote-handled transuranic waste debris will continue at the Transuranic Waste Processing Center while technology maturation and planning continues for the Sludge Processing Facility Buildout project. Additionally, the budget request supports continued direct disposition of Consolidated Edison Uranium Solidification Project material from Building 3019.

With the most challenging cleanup sites before EM, we understand the importance of technology development in reducing life cycle costs and enhancing our effectiveness. To help address many of the technical challenges involved with the most challenging cleanup activities, the FY 2017 request reflects an investment in technology development of $33,000,000. The FY 2017 budget supports testing multiple technologies to solidify/stabilize mercury in soil and building materials

to minimize the potential of mercury releases to the environment when decontamination and decommissioning of excess facilities at the Oak Ridge site. EM will also invest in characterization of and treatment options for Technetium-99, a key radioactive constituent in tank waste and in soils at sites across the complex; robotics and semi-autonomous systems required for remote access to nuclear, chemical and other high-hazard facilities that are inaccessible or restricted to human entry; and the development of test beds for the demonstration of treatment technologies, innovative tooling, and other technical solutions.

Budget Authority and Planned Accomplishments by Site

Office of River Protection, Washington (Dollars in Thousands)

FY 2016 Enacted	FY 2017 Request
$1,414,000	$1,499,965

Key Accomplishments Planned for FY 2017

- Maintain scheduled construction activities for the Low Activity Waste Facility, Analytical Laboratory, and Balance of Facilities to support the Direct Feed Low Activity Waste (DFLAW) initiative;
- Initiate single-shell tank retrievals in AX Tank Farm;
- Complete retrieval of AY-102 double-shell tank;
- Complete Low Activity Waste Pretreatment System (LAWPS) preliminary design to a design maturity of 90%; and
- Continue resolution of technical issues associated with potential criticality; hydrogen gas in vessels; and erosion/corrosion at the Pretreatment Facility.

Savannah River Site, South Carolina (Dollars in Thousands)

FY 2016 Current	FY 2017 Request
$1,336,566	$1,448,000

Key Accomplishments Planned for FY 2017

- Package 100 to 110 canisters of vitrified high-level waste at the Defense Waste Processing Facility;

- Operate Actinide Removal Process and Modular Caustic Side Solvent Extraction Unit to process 1.7 million gallons of salt waste;
- Support construction, commissioning, and start-up activities for the Salt Waste Processing Facility;
- Complete construction of Saltstone Disposal Unit #6;
- Continue to receive foreign research and domestic research reactor spent nuclear fuel for safe storage and management;
- Disposition spent nuclear fuel in H-Canyon by processing; and
- Activities to support implementation plan activities for the Defense Nuclear Facilities Safety Board Recommendation 2012-1 to mitigate and remedy safety issues at 235-F.

Carlsbad Field Office, New Mexico (Dollars in Thousands)

FY 2016 Enacted	FY 2017 Request
$304,838	$271,000

Key Accomplishments Planned for FY 2017

- Complete activities necessary for resumption of waste emplacement operations at the Waste Isolation Pilot Plant by December 2016; and
- Continue design and permitting actions for a new ventilation shaft and on-site storage projects.

Los Alamos National Laboratory, New Mexico (Dollars in Thousands)

FY 2016 Enacted	FY 2017 Request
$185,000	$189,000

Key Accomplishments Planned for FY 2017

- Address the nitrate salt bearing transuranic wastes;
- Remediation of town site (TA-43) cleanup of solid waste management units from the 1940s and 1950s production sites; and
- Complete the investigation of hexavalent chromium contamination of the groundwater beneath Mortandad and Sandia Canyons including field and bench-scale testing and plume control interim measures.

Idaho National Laboratory, Idaho (Dollars in Thousands)

FY 2016 Enacted	FY 2017 Request
$401,919	$370,088

Key Accomplishments Planned for FY 2017

- Continue treatment of sodium bearing waste in the Integrated Waste Treatment Unit;
- Characterize, package, certify, and temporarily store exhumed waste on site pending the resumption of operations at and shipments to the Waste Isolation Pilot Plant;
- Complete exhumation of targeted buried waste at the Accelerated Retrieval Project VIII facility; and
- Continue safe storage of spent (used) nuclear fuel.

Oak Ridge Site, Tennessee (Dollars in Thousands)

FY 2016 Current	FY 2017 Request
$468,407	$391,407[1]

Key Accomplishments Planned for FY 2017

- Complete demolition of the K-27 building at the East Tennessee Technology Park;
- Continue planning design and preparation of regulatory documentation and Critical Decision reviews for the Outfall 200 Mercury Treatment Facility;
- Continue processing transuranic waste debris at the Transuranic Waste Processing Center; and
- Continue offsite disposition of select Oak Ridge waste streams.

[1] This amount includes $178,188 of proposed mandatory funding from the United States Enrichment Corporation Fund.

Richland Operations Office, Washington (Dollars in Thousands)

FY 2016 Current	FY 2017 Request
$990,653	$800,000

Key Accomplishments Planned for FY 2017

- Complete Plutonium Finishing Plant Facility transition and selected disposition activities in order to achieve slab-on-grade including completion of a cap over the site;
- Begin planning for dry storage options for the cesium and strontium capsules currently stored at the Waste Storage Encapsulation Facility;
- Planning and technology maturation for the remediation of the highly radioactive waste site 300-296 located beneath the 324 Building; and
- Continue remediation of the 618-10 Vertical Pipe Units.

Nevada National Security Site, Nevada (Dollars in Thousands)

FY 2016 Enacted	FY 2017 Request
$62,385	$62,176

Key Accomplishments Planned for FY 2017

- Complete closure activities for 9 soil corrective action sites; and
- Support safe disposal of approximately 34,000 cubic meters of low-level and mixed low-level radioactive waste.

Portsmouth Gaseous Diffusion Plant, Ohio (Dollars in Thousands)

FY 2016 Current	FY 2017 Request
$288,970	$322,653[2]

Key Accomplishments Planned for FY 2017

- Complete deactivation of a process building (X-326) in order to prepare it for demolition;
- Complete Phase I Infrastructure activities for the On-Site Waste Disposal Facility; and
- Continue steady state operations of the Depleted Uranium Hexafluoride (DUF_6) conversion facility.

Paducah Gaseous Diffusion Plant, Kentucky (Dollars in Thousands)

FY 2016 Current	FY 2017 Request
$268,402	$272,310[3]

Key Accomplishments Planned for FY 2017

- Continue steady state operations of the Depleted Uranium Hexafluoride (DUF6) conversion facility.
- Continue uranium deposit removal in the C-337 process building and initiate deposit removal in C-333 process building.

[2] This amount includes $257,645 of proposed mandatory funding from the United States Enrichment Corporation Fund.

[3] This amount includes $207,916 of proposed mandatory funding from the United States Enrichment Corporation Fund.

West Valley Demonstration Project, New York (Dollars in Thousands)

FY 2016 Current	FY 2017 Request
$61,804	$63,628

Key Accomplishments Planned for FY 2017

- Continue the relocation of high-level waste canisters to new on-site storage facility; and
- Continue deactivation of the Main Plant Process Building.

Moab, Utah (Dollars in Thousands)

FY 2016 Enacted	FY 2017 Request
$38,644	$34,784

Key Accomplishments Planned for FY 2017

- Continue tailings excavation and placement of tailings in the disposal cell; and
- Continue interim remedial action for contaminated groundwater along the Colorado River aquifer.

ETEC, California (Dollars in Thousands)

FY 2016 Enacted	FY 2017 Request
$10,459	$10,459

Key Accomplishments Planned for FY 2017

- Initiate decontamination and decommissioning of remaining structures and soil remediation based on the Record of Decision; and
- Continue site environmental monitoring, surveillance and maintenance.

Conclusion

Mr. Chairman, Ranking Member Kaptur, and Members of the Subcommittee, I am honored to be here today representing the over 20,000 men and women that carry out our Office of Environmental Management mission. We are committed to achieving our mission and will continue to apply innovative environmental cleanup strategies to complete work safely and efficiently. All of this work will, first and foremost, be done safely, within a framework of best business practices. I am pleased to answer any questions you may have.

Mr. SIMPSON. Thank you. Ms. Kaptur

Ms. KAPTUR. Thank you, Mr. Chairman. Doctor, in order to give the public a sense of how much has been accomplished and what remains to be accomplished, you stated in your testimony there is about 300 square miles left of various types of cleanup. Put that in context for the American people, how much has been expended to take care of how many square miles? You say in your testimony what is remaining is some of the most daunting cleanup. Could you explain where we are on a platform here to finish this? Put it in a context.

Ms. REGALBUTO. I would be happy to do so. Thank you very much for your question. The Department of Energy Office of Environmental Management breaks down the projects into a number of different categories. One is material disposition and spent fuel disposition, the other one is sold waste, followed by soil and groundwater and facility activation, and then the most challenging one, which is liquid waste.

In the area of nuclear material disposition and spent nuclear fuel disposition, we pretty much are complete with that task and we have successful consolidated and packaged those materials and they are ready to go once a disposal facility is available. So those we have completed. And, I am sorry, let me give you this for the record.

[The information follows:]

OFFICE OF ENVIRONMENTAL MANAGEMENT

Environmental Cleanup Progress – A Snapshot

Mission Area	Est. End Date	Remaining Cost*	Metric Name	Progress To Date	Remaining Units of Total Life Cycle
Nuclear Materials Disp.	2034	$4.8B	Pu metal or oxide packaged for long term storage		0 of 5,089 containers
			Pu or uranium residues packaged for disposition		0 of 107,828 kg of bulk
			Enriched uranium packaged for disposition		587 of 8,603 containers
			Material Access Areas eliminated		1 of 35 MAAs eliminated
Spent Nuclear Fuel Disp.	2037	$9.7B	SNF packaged for final disposition		15 of 2,451 MTHM
Geographic Sites	2070	N/A	Geographic sites eliminated		16 of 107 Geographic sites
Solid Waste Disp.	2066	$16.9B	LLW and M/LLW disposed		243,213 of 1,573,667 m^3
			CH-TRU dispositioned		42,367 of 1,573,667 m^3
			RH-TRU dispositioned		6,937 of 7,286 m^3
Soil and Groundwater Remediation / Facility Deactivation & Decommissioning	2075	$21.5B	Remediation completions		2,506 of 10,874 release sites
			Radioactive Facility completions		2,008 of 4,137 Industrial Facilities
			Industrial Facility completions		396 of 982 Radioactive Facilities
			Nuclear Facility completions		325 of 489 Nuclear Facilities
Liquid Tank Waste Disp.	2050	$80.5B	HLW packaged for final disposition		19,387 of 23,890 HLW canisters
			Liquid waste in inventory eliminated		82,305,000 of 90,814,000 gallons
			Liquid waste tanks closed		224 of 239 tanks
Depleted Uranium Disp.	2038	$4.1B	Depleted and other uranium packaged for disposition		631,061 of 737,408 metric tons

0% 25% 50% 75% 100%

Progress through FY15 | FY16 through FY17 Planned Progress | Remaining

* EM calculates both a low and high cost estimate that incorporates different levels of risk contingency. The figure displayed represents the high cost estimate.

Metric Name and Unit Legend:
Contact Handled
RH = Remote Handled
CH =
MTHM = Metric Tons of Heavy Metal
TRU = Transuranic Waste
LLW = Low Level Waste
M/LLW = Mixed and Low Level Waste
HLW = High Level Waste
Pu = Plutonium

Targets for the metrics:
- CH-TRU dispositioned; and
- RH-TRU dispositioned

cannot be provided at this time due to the suspension of WIPP operations and the ongoing recovery efforts.

Ms. KAPTUR. Ok. Thank you very much.

Ms. REGALBUTO. I am sorry.

Ms. KAPTUR. So these are all the sites?

Ms. REGALBUTO. These are all the sites and they are lumped by the level of risk and difficulty that we face. So the first two categories, which is nuclear material disposition and spent fuel, we pretty much have completed—and you can see that by the blue bars, almost all the ones to the right hand side. And we have a number of containers and the bulk of the material. So once a disposal facility is available those are ready to go.

The next category I would like to highlight is solid waste disposal. And let me focus your attention to contact-handled, which is the low level waste, the mixed low level waste and the transuranic waste. Those are roughly about anywhere between 75 and 80 percent completed. But clearly the transuranic waste that is remote-handled is still in just initiating. And we only initiated that at Idaho with terms of packing and the like. So it is the first site that we are actually doing this is in a very extensive form.

In terms of soil, groundwater remediation, that is about 75 percent. This is where we actually do a lot of pump and treat. And I would like to emphasize that this is the area, even though it says estimated end date is 2075, this is where when we invest technology we can actually have a significant reduction on to-go cost. So what happens right now is doing pump and treat and we are trying to in the future move into bioremediation so we don't have to spend all that energy and different ionic exchange resins and the material that goes into doing this, mechanically pumping and treating. So there are a number of other technologies in the future as we move forward that require bioremediation that are more passive and actually will decrease that to go cost. And we started doing some of that at Savannah River, so we are in the process of testing.

So that is where, in my opinion, investing some technology money really will pay in the future. So we are looking forward to those results.

Ms. KAPTUR. In terms of the number of square miles already completed.

Ms. REGALBUTO. Yes.

Ms. KAPTUR. If there are 300 left how many—is it really the square miles or is it the amount of material?

Ms. REGALBUTO. It is more the amount of material.

Ms. KAPTUR. Material. So on a scale of 1 to 100 are we 25 percent done, 50 percent done?

Ms. REGALBUTO. For groundwater?

Ms. KAPTUR. The whole cleanup project.

Ms. REGALBUTO. Ok, so if we don't account for the tank wastes, because the tank waste is by gallons versus by footprint, right.

Ms. KAPTUR. Right.

Ms. REGALBUTO. If you don't account for that I would say we are about 60 percent.

Ms. KAPTUR. Ok. All right. A very straightforward answer. And at a level of close to $6 billion a year, then how many years would it take us to complete this work?

Ms. REGALBUTO. Without tank waste, 25 years. With tank years, 50.

Ms. KAPTUR. All right. Thank you very much. That is a good way to begin this hearing. Thank you, Doctor.

Mr. SIMPSON. Mr. Fleischmann.

Mr. FLEISCHMANN. Thank you, Mr. Chairman. Madam Secretary, good morning.

Ms. REGALBUTO. Good morning, sir.

Mr. FLEISCHMANN. Good to see you today.

MS. REGALBUTO. Thank you.

Mr. FLEISCHMANN. I wanted to begin my questions with the high-risk excess facilities. Secretary Moniz named a panel to find solutions to the pressing problem of high-risk excess facilities. What were the panel's findings and what is your plan and timeline for reducing the risks and taking down these buildings?

Ms. REGALBUTO. Thank you for your question. The Secretary's Infrastructure Panel or Excess Facility Panel is something that we all collectively collaborated. So it was Office of Science, NNSA, some of the smaller offices of DOE and Environmental Management. We have a report that is scheduled to be published. I believe it is at the beginning of the summer. But we certainly have enough information to do a briefing at any time that you may be available, or the committee will be available.

Basically what it has done is it has ranked the different excess facilities in terms of risk. So what are the most high-risk facilities, and associated I would say a predetermined cost next to each of those facilities. So, for example, the Y-12 facilities are already on the list and I think many of you know that. There are also some facilities that currently are not on the list that belong to Office of Science. And there is the caveat of some small universities and the likes.

So that integrated list will be available once the report comes out. And I can find out exactly the date when the report will be out, but we will be happy to come back and brief you just specifically on the findings of that report.

Mr. FLEISCHMANN. Thank you, Madam Secretary. If I can follow up in that regard. The first House nuclear cleanup caucus event this year is scheduled for April the 20th. As you know we worked very hard last year with your cooperation and participation to make the Nuclear Cleanup Caucus a tremendous caucus with tremendous bipartisan support. Very thankful for that. You have alluded to the report. It would be so beneficial to have that before April the 20th. Will the Department release the report before that date so that we can have an open discussion and build support for our challenges ahead?

Ms. REGALBUTO. I appreciate the opportunity for the cleanup caucus to review this report and I will find out exactly the date that it is available, but if it is not available by the date, I believe it is April 20, for the caucus, we will be happy to still keep it on the agenda and give an informative briefing to the people participating because we do welcome their feedback. So regardless if the report is in final concurrence, because it has to go through a lot of desks, we will be happy to report on the findings.

Mr. FLEISCHMANN. Thank you.

Ms. REGALBUTO. So more than happy to facilitate that.

Mr. FLEISCHMANN. Thank you. If I can segue into historic preservation. Several years ago, the Department of Energy entered into an agreement with the State of Tennessee and several other parties on historic preservation in order to proceed with cleaning up the contaminated buildings at the East Tennessee Technology Park. For the past two years funding for the agreement has been zeroed out in the administration's budget. As chairman of the House Nuclear Cleanup Caucus stakeholders and contractors have complained to me of the distrust that is created when the Department fails to follow through on its commitments. Why does the Department sign agreements that the administration will not allow to be met?

Ms. REGALBUTO. Thank you for your question and interest. We are committed to meeting the consent agreement with the State of Tennessee for the historic preservation. In fiscal 2016 we received, and thank you for all of your support, $6 million which we are currently using those funds to meet our commitment for the visitor center for K–25. So we are using the funds that we receive in 2016 and continue to do and fulfill our agreements with the Historic Preservation Office. I understand there is a viewing tower in the visitor center planned with that money.

Mr. FLEISCHMANN. Thank you. On a related issue, recently I had the opportunity to tour the Oak Ridge water plant, which was transferred to the city about a decade and a half ago, on the premise that it was a valuable asset that could be run more efficiently by local government. It has turned out to be a cash drain on the city due to very serious infrastructure problems. Many in the community want the city to tie Federal assistance on the water plan to future cleanup work. I would rather see the Department of Energy become a better partner with its host communities which are strapped by a low tax base from Federal land ownership, substandard housing from the Manhattan era, and an aging population living on low pensions. It does not help when the Department centralizes decision-making in Washington on complex issues where there is sometimes a lack of experience and knowledge about the major sacrifices that these atomic cities have made.

I was interested in your comments on this.

Ms. REGALBUTO. Thank you very much. I am very familiar with the Oak Ridge site as I started my career back in 1988, and I have seen the town, as you mentioned, really not blooming anymore. I still remember driving to the mall and the mall was closed.

Mr. FLEISCHMANN. Yeah.

Ms. REGALBUTO. And that really has a big impact, at least to me, when I used to be able to go and walk around after work and just get a little exercise. I do recognize that a lot of this is an impact to your local government. And the water plant, the details of that water plant and in what condition it is and when was this transferred, is something that I will have to go back and look at it. And I would be happy to work with you and the committee related to these issues.

I do personally recognize that sometimes when decisions are made the exact impact of the well being of that facility is not truly known.

Mr. FLEISCHMANN. Thank you.

Ms. REGALBUTO. So we understand that.

Mr. FLEISCHMANN. It was really eye opening for me to see the dilapidated condition in the infrastructure, and really the decay that is at that facility. So I do appreciate your assistance in that regard.

Mr. Chairman, I have one more question in this round, if I may?

Last week, Madam Secretary, I visited Protomet, a very successful company that started out of the Department of Energy system. It has requested a land transfer of adjacent property that is no longer needed by the government. But the lengthy process may cost this homegrown business to move out of Oak Ridge. It has become apparent that the process needs to be streamlined. I am told that there are multiple and duplicative approval points in the process with no time limits for review. How can we work together to streamline and shorten the land transfer process that is so important to several Department of Energy communities?

Ms. REGALBUTO. Thank you for your question. I do share your frustration on this land transfer. Unfortunately, as you mentioned, there are a number of agencies that have to be involved in all of this review process, and each of them have a set of days that they have to go through. So we are committed to try to streamline anything that is within our control, so anything within, inside DOE we can expedite and control that. Once it gets to interagency, it requires a little bit more difficulty. For example, the last transfer that we did for the Metropolitan Knoxville Laboratory Station for the airport had to go through endless steps, including signing by EPA, the Governor's Office, Department of Energy, transfer to the GSA, and eventually transfer to the city. So those are the number of things that we are required to do in order to transfer land, and I recognize that it is a very tedious process.

On the positive side, we did send the committee yesterday afternoon a letter regarding a transfer in the ownership of K-31 and K-33 to Oak Ridge Economic Development Organization, so it may be working down the committee, and so that puts you 60 days away for getting 280 acres. So we are very excited about that. We are very excited, actually, with working with your community to do this, and during my business to Portsmouth and Paducah, I have set Oak Ridge and the model that you have for economic redevelopment as an example. So one of the things that we are going to be working with the unions and the community members at Portsmouth and Paducah is to bring Sue to come in and brief them, and also invite some of your community organizers to come in and teach them how they change from going from gaseous diffusion into an economic redevelopment area. So we are very happy and it was very well received by both Portsmouth and Paducah, because we have done this once already.

Unfortunately, we know how much this costs, too, which is significant, but we also know some of the headaches that you mentioned and some of the lessons learned, so, hopefully, communities like Portsmouth and Paducah can benefit for the same type of turning gaseous diffusion plants into more economic development areas. And I certainly hope that your small business does not leave, because we do champion small business communities, and we actu-

ally try to do our best to promote that and increase that at the local level.

Mr. FLEISCHMANN. Madam Secretary, thank you for your hard work on this issue, and I appreciate the very good news on the land transfers.

Ms. REGALBUTO. Yes, we are very happy.

Mr. FLEISCHMANN. Mr. Chairman, I yield back.

Mr. SIMPSON. Thank you, Doctor. A Federal judge has set new deadlines for the Hanford Vitrification Plant requiring this utility to come online and by 2036. How will the judge's ruling impact DOE's plans at Hanford? And does your budget request support the new deadlines or are we going to expect an amended budget request once you have had a chance to fully review the judge's decision?

I notice that DOE proposed sliding milestones. I find that interesting, sliding—I am not sure if those are like sliding wedding vows or what, but ultimately, the court rejected those. What will happen if DOE is not going to meet a deadline?

And finally, EM has been operating for years without a formal performance baseline for the Waste Treatment Plant against which progress could be measured. What will be done to improve the transparency of DOE's management of the project so that we can monitor DOE's progress?

Ms. REGALBUTO. Thank you, Mr. Chairman. As you mentioned, the District Court of Eastern Washington's ruling was last Friday, late on Friday, and the Department is in the process of reviewing all the legal paperwork regarding the court order and the consent decree amendment. With that, I would be happy to come back and once they dissect all of that and the 30-day period of communication is over, I would be happy to come back and brief you specifically on the impacts of the court order decision.

With that said, the Department remains committed to initiating glass as early as 2022, and that is with the Direct Feed Law. We have requested sufficient funding to initiate operations by 2022; that includes the Low Activity Waste Facility, the balance of plant, which is all the infrastructure necessary to maintain that facility, and the Analytical Laboratory where we go and make sure that the quality of the product is good.

Regarding the issue of the project cost, because this piece was carved out of the contract, so the contract was for the whole thing and we are committed to do this on a phase approach, which is, in our opinion, a more efficient way to chunk it in pieces. As the Secretary has put in his views regarding project management, it is easier to address a smaller portion than these huge capital projects. So we are following the Secretary's lead, and in that case, we are in the process of negotiating CLIN 1, which is basically doing what I described to you, and we should be getting very close to getting a baseline for that.

Regarding the other facilities, that will be impacted by the court ruling, and we will be back to do that.

In terms of project management, as you clearly pointed out, this facility has struggled over the years, and we have done a number of things regarding these facilities. Some of them are lessons learned from others. One of the recommendations has been to get

an owner's rep, and we did hire an owner's rep, which is Parsons. We are already working with them, and they are walking through this facility. We do not have to wait until a year out before commissioning to find out any surprises. So we are walking very systematically through the plant and making sure that we address anything going forward. So we are taking a lot of modifications.

There was also a GAO report regarding the tracking system of the issues that have been determined by the contractor or DOE, and we have gone back to them and made sure that the tracking system actually captures every single thing, and so that has been revamped. Also, the accountability to the contractor has been revamped, so we have put in a lot of effort in that. I think you know Kevin Smith, and I will say, in the last three years, Kevin has done a magnificent job just to make sure that that transparency is there for you and all the taxpayers to see.

Mr. SIMPSON. Ok. This is a huge facility, billions of dollars, many years to operate to complete. I look at the IWTU in Idaho. In comparison, very small compared to the Waste Treatment Plant. I have to tell you in all honesty, I seriously wonder if WTP will ever be able to operate given the problems that we have had at the IWTU and trying to get it operating. I look at that huge facility and wonder if this will actually ever work. What do you think?

Ms. REGALBUTO. So let me address that. IWTU has a first of a kind technology, which is really the most challenging thing. Traditionally, we use either solvent extraction or ion exchange to do any of the separations of any of the materials, and then we either vitrify or grout. Those two technologies, vitrification and grout, are already being used every single day at Savannah National Lab and throughout facilities throughout the rest of the world. Hanford has the vitrification technology for the low activity waste. At least we do not have any of the dark cells, which have been really the issue of some of the technical issue resolutions, and we do not have any of the pulse jet mixers, also, which is another reason where those are new in this enterprise. So LAW has paddle mixers and traditional mixers that we use at Savannah River. It has ion exchange, filtration, similar technology that we used before.

On the other hand, IWTU, unfortunately, when the technology was selected, they selected one that is not used commonly for environmental remediation. It is used in the pharmaceutical industry, and it is also used in some cases in the gas and oil industry for basically the catalytic converters where you increase your yield of gasoline. Those are projects that, in just my personal opinion, all of them make money on their product, so they can afford an exotic technology. In our case, we do not make money from our product. Our product is waste that is going to be disposed, so that has been the main challenge in IWTU, but we cannot correlate that to WTP, because it is a completely different technology. WTP correlates better with Savannah River because the technologies are the same.

Mr. SIMPSON. Ok. Let me ask you about WIPP. WIPP funding is down from last year's level, partially due to the completion of the summer recovery activities. There is also a decrease associated with lower levels of construction project funding for the two projects that must be completed. In addition, part of the operating funding will now be used to provide funds to the State of New Mex-

ico for road improvements. DOE did not request a specific amount for these costs, but rolled them into the overall funds for WIPP, and there are discrepancies in just how much the WIPP funding will be diverted to pay for these road improvements in the agreement.

Last April, the Department of Energy recently agreed to provide the State of New Mexico $34 million in economic assistance to build roads in New Mexico as part of the settlement agreement with the State for the events that led to the closure of WIPP. Economic assistance payments were previously authorized under the WIPP Land Withdrawal Act and appropriated by Congress, but that particular spending authority expired after 15 years. Reinstating those economic assistance payments, which totaled about $20 million per year, has been a major goal of the State. Last year, the Secretary of Energy testified that WIPP would be reopened in March 2016 and resume full operation some time in 2018. The date for initial limited operations has now been pushed back to December and the Department has not released any new estimates for achieving full recovery.

Is there a possibility that reopening WIPP to limited operations could be delayed beyond December? When exactly is WIPP scheduled to be returned to pre-2014 operational levels, and can you speak to the short and long-term challenges to resuming operations? Do you anticipate challenges in permitting or demonstrating safety operations with the regulators? And talk a little bit, if you would, about the money going to economic assistance or road development or improvement in New Mexico out of the operating costs of WIPP rather than out of a special line for economic assistance.

Ms. REGALBUTO. Thank you for your interest in WIPP. WIPP is, as you know, our highest priority. It does have an effect throughout the complex, and their inability to move waste has significantly affected the rest of the sites and our ability to meet the commitments with the other States. So it is critically very important for us.

We are on target to reinitiate operations at the end of this year, December of 2016, provided it is safe to do so, we will never put safety ahead of a schedule, but right now, we are on target. We have got three activities, main activities, that need to be completed for us to reinitiate waste and placement operations.

One is the DSA approval, which we are in the process to do so. We are working with the regulators and we are working with the Defense Board and all the interest stakeholders. We have been very transparent through our recovery process. We have town hall meetings, and we keep a website with every single piece of information we generate so the community knows exactly what we are doing, and also the regulators. So we will have the DSA approval, which is followed by an operation readiness review; one is done by the contractor, one is done by DOE, and other people are observers during this. Once we have that, we are ready to initiate operations.

At the same time, there are a number of permit modifications that we are working with the State of New Mexico, and we are on target to complete our permit modifications as the schedule requires. So going back to the delay on the schedule, the original schedule that was published was published before the second Acci-

dent Investigation Board report was released. Once the second Accident Investigation Board report was released, it was clear that there were a significant number of things that needed to be done before we restart operations, and the most important one was—and I can briefly summarize it as—WIPP had to be a more demanding customer. So, in other words, we have to expand our boundaries all the way to the waste generators, because in order to protect our facility, we have to protect the start before the waste initiates. So that has caused some delays in the thinking, including some of the DSA and also a delay from the contractor—was also delayed by a number of months. So that caused the shift to December.

Regarding funding, there was a decrease this year for $33 million, and that is really just a signal of we are making progress. Regarding funding to support the SEPs, and I am not a lawyer, so I will have to refer you back to general counsel, just a little engineer here, but it is my understanding from the attorneys that there is authorization under the Land Withdrawal Act to do this type of activities, but I would be happy to go back and take this as an action and get back to the committee. In essence, I really do not have the personal knowledge on that. What I can tell you is that the request includes for 2017, $18.4 million, and that is on PBS CB 0080, which is really our operating disposal of facilities, and the total for that PBS is $196.3 million, of which $18.4 are specifically for roads and operations.

Mr. SIMPSON. Why not put that in a special line when you request it for 2017? I can understand trying to find another area to fund it out of in 2016 when you are looking at trying to meet agreement with the State of New Mexico and you do not have that line item available, but if that is going to be ongoing, why not create that line item instead of putting it in the operations budget?

Ms. REGALBUTO. I will follow up on why they did not create a new line item. Personally, I do not know the answer. What I can tell you is that it is not an ongoing cost, it is a one-time use of the money. It is almost like a grant that goes to the State and then the State manages multiyears. But I do not know the answer why they did not create a line item, and I would be happy to go back and get an answer for the committee.

[The information follows:]

The Department submitted to Congress on April 5, 2016, an amendment to increase by $8.4 million the appropriation request for the Defense Environmental Cleanup account to fund a portion of the settlement costs to resolve the New Mexico Environment Department claims against the Department of Energy (DOE) related to the February 2014 incidents at the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico, including the associated activities at Los Alamos National Laboratory. The additional $8.4 million will allow DOE Office of Environmental Management to pay a total of $26.8 million in Fiscal Year 2017 to the State of New Mexico for necessary repairs to its roads needed for transportation of DOE shipments of transuranic waste to WIPP.

Mr. SIMPSON. Ok. Marcy.

Ms. KAPTUR. Thank you, Mr. Chairman. Dr. Regalbuto, the Department of Energy has failed to reach a number of cleanup milestones, most of which are part of an agreement with the State; some, like Hanford and Idaho, are subject to fines and penalties through the courts. How does DOE pay fines when they are assessed by the States or the courts, and do these come from the

judgment fund, as many people believe, or must they be paid from appropriations?

Ms. REGALBUTO. Thank you for your question. We try not to miss milestones. That is a number one priority. When we see a milestone that is at risk, we engage with the State and EPA and the other agencies, and in some of our agreements, we have the opportunity to have a dialogue and change the dates as needed, so usually, that is the first thing we do. It is only when we cannot reach an agreement with the State or tri-parties or the stakeholders that we end up in an unfortunate litigation path. I personally prefer not to be there, because I will have to use my best engineers to start doing the positions on litigation when they should be doing cleanup. So, unfortunately, it is a big distraction for everybody, including the State and the Department of Energy and taxpayers at the end of the day. So that normally goes through a litigation process, which is held by the Department of Justice. It is not done by DOE, so Department of Justice does that. I will tell you that appropriated funds are not used to pay fines. We do not have that authority.

Ms. KAPTUR. Ok.

Ms. REGALBUTO. That at least has been what counsel has mentioned to me.

Ms. KAPTUR. All right. I want to go back to my original question about how much we have done and how much remains ahead, and you said, in most of the most serious categories, we have cleaned up about 60 percent of all material?

Ms. REGALBUTO. Yes.

Ms. KAPTUR. That excludes the water and the items that are in—the quantities that are in tanks?

Ms. REGALBUTO. Yes.

Ms. KAPTUR. Ok. So that is what remains. If we are expending $6 billion a year and we will not be finished for 50 to 75 years, going back to the start of this program, can you estimate how much we have spent to date cumulatively on all cleanup dating back to what year?

Ms. REGALBUTO. I don't have the exact number, but let me try. I think it is about $150 billion. So $150 billion since 1988.

Ms. KAPTUR. Since 1988.

Ms. REGALBUTO. When Department of Energy created the Office of Environmental Management. There was a big spike during American Recovery Act, as you probably remember where the funding almost doubled. That was since 1988. But we have gone from 104 sites to 16 sites.

Ms. KAPTUR. How many?

Ms. REGALBUTO. One hundred and four to 16 remaining sites. So that has been the footprint reduction—is huge. Rocky Flats and Mound were two huge industrial complexes that are gone. And when people say what impresses you the most, we say is what I don't see anymore, right, when you don't see this big industrial complex. So, you know, truly they are really like little mini cities that were built with complete infrastructure needs to be knocked out.

So in terms of our disposition of the facilities, one of our main goals is to decrease the hotel costs. So some of our investments, for

example, in the gaseous diffusion plants are to consolidate a lot of the switch yards. Those were very energy intense facilities. They tend to have four different switch yards to feed the facility. We eliminate all of them except for one so we can continue having electricity and the like for our D&D activities, but we don't need to support all other ones.

We also do the material consolidation because material consolidation requires a high cost on safeguards and security and we are down to pretty much one, when we started with, you know, every site had everything. So now we are consolidating in that. So tried to, as much as to the extent possible, use our funding in a balanced approach where we tried to bring down hotel costs because that is money spend ahead of time.

We also like to forecast what is coming ahead. So, for example, even though the Y–12 facilities haven't been transferred to us, eventually they will. I hope with some funding too, right. And we know already that there is a mercury problem associated with all of the COLEX facilities which used to, at the time, they separated lithium and they used mercury in the liquid phase as a catalyst. So it is all over the place, and it is in the groundwater, it is in the soil, it is in metallic form, it is everywhere in the Y–12 facilities.

So knowing that, we are spending some technology dollars on that already and the purpose of doing that is we don't have to wait until they transfer those facilities. We can proactively start thinking how to invest in what is going to come ahead.

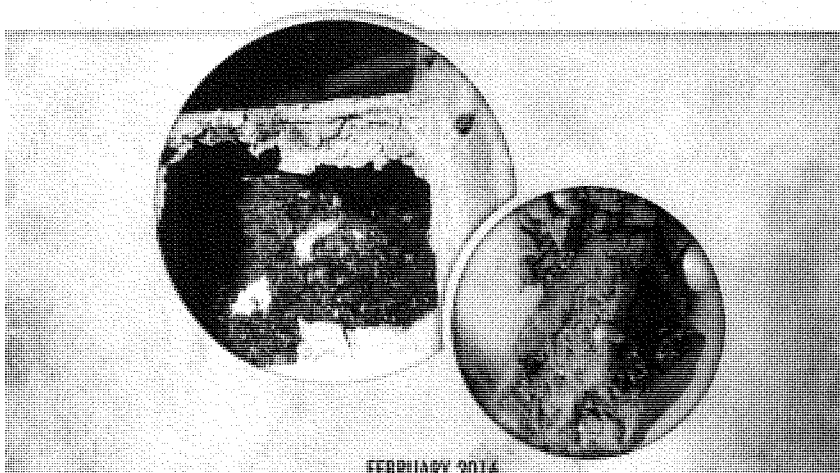
Ms. KAPTUR. I think in one of the facilities you closed and cleaned up Fernald, gaseous diffusion in Ohio, we are very glad to see that gone.

Ms. REGALBUTO. Yes, we are very happy and we are going to have a little ceremony in Tennessee when we finish that one and we would be happy if any of you could come to this end of the gaseous diffusion plant. It really is, it is a big win for us.

So I have a little mercury plan. This is in general for doing the cleanup of Y–12s that I will pass for the record if the committee would like to take a look at.

[The information follows:]

TECHNOLOGY PLAN TO ADDRESS THE EM MERCURY CHALLENGE



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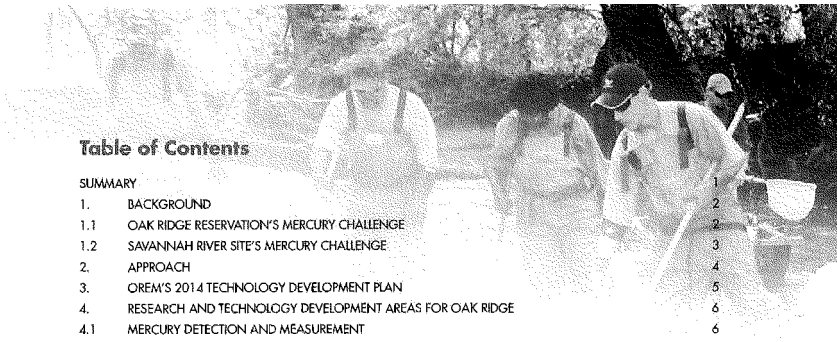
Technology Plan to Address the EM Mercury Challenge

FEBRUARY 2016



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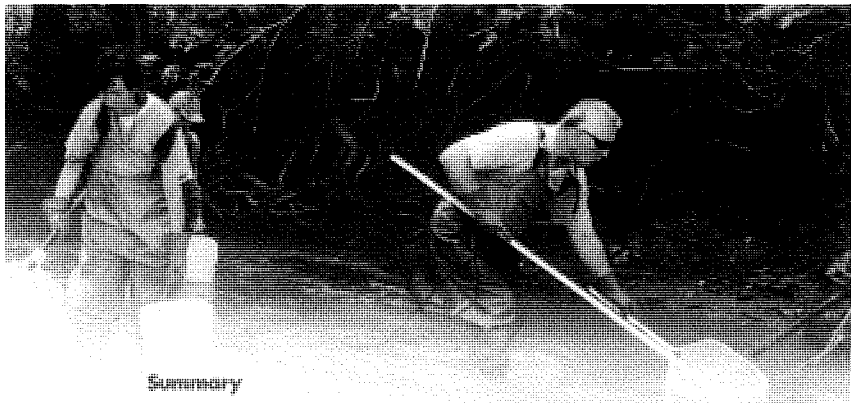


Summary

Mercury contamination poses a unique, high priority challenge to the cleanup mission of the US Department of Energy's Office of Environmental Management (EM), particularly at the Oak Ridge Reservation (ORR) and Savannah River Site (SRS). This plan identifies mercury-related research and technology development (TD) to resolve key technical uncertainties in three EM mission areas: environmental remediation, facility deactivation and decommissioning (D&D), and tank waste processing. Recommendations for the first two areas include developing rapid screening methods as well as sensitive, quantitative analyses for mercury in environmental and infrastructure samples; assessing decontamination approaches for D&D; developing in situ stabilization for mercury-contaminated soil; refining site-specific environmental mercury models; and mitigating mercury in creek ecosystems through source zone stabilization, water chemistry modification, and ecological management. Recommendations for research related to tank waste include improving capabilities for mercury analysis and species determination in high level waste liquids and sludges; developing processes for the controlled conversion of mercury from one species to another (i.e., between organic, inorganic ionic, and elemental forms); developing mercury sorbents for removing organomercury from alkaline waste solutions; and pursuing fundamental science to improve understanding of mercury speciation and reaction mechanisms in chemically complex radioactive tank waste. Two crosscutting research topics are also recommended: grout formulation for mercury-bearing wastes and alternative assessments of waste form leachability. Finally, EM should form a technical working group to formalize and strengthen synergies and information sharing among agencies, institutions, and industries engaged in mercury research, TD, and operations.

1. Background

Mercury (Hg) is a toxic, persistent element that occurs both naturally and as an anthropogenic pollutant. It is present at more than 3,000 contaminated sites worldwide (Kocman et al. 2003) and is also found globally in environments that may not be discernably polluted. The United Nations Environment Programme (UNEP 2013) recently highlighted the risk of mercury contamination to human and ecological health. Methylmercury (MeHg), an organic form of the element, is especially toxic. It damages the nervous system, is quickly absorbed but slowly excreted from living organisms, and biomagnifies in the food chain. Appendix A provides a summary of mercury's biogeochemistry in the environment.

Mercury is released from a variety of anthropogenic sources, including fossil fuel (e.g., coal-fired power plants); mining, including artisanal and small-scale gold mining; smelting and metal production; cement production; oil refining; and a number of industrial production processes that use mercury as a catalyst. Examples of such industrial processes include the electrolytic Castner–Kellner process, which uses elemental mercury to produce chlorine and alkali hydroxide (UNEP 2013), and the Chissa process, which uses mercury salts to convert acetylene to acetaldehyde (a precursor for plastics) (Othmer et al. 1956). One of the world's most notorious instances of mercury poisoning resulted from methylmercury discharges to Minamata Bay in Japan by an industrial facility using the Chissa process.

Mercury contamination is particularly important at two US Department of Energy (DOE) legacy waste sites that used mercury in industrial-scale processes, namely lithium isotope separations at the ORR and dissolution of spent fuel aluminum cladding at SRS. The unique mercury-related challenges at these two sites are described below.

1.1 OAK RIDGE RESERVATION'S MERCURY CHALLENGE

DOE's ORR in Oak Ridge, Tennessee, houses the Y-12 National Security Complex (Y-12), which used large amounts of mercury from the early 1950s through the 1970s (Brooks and Southworth 2011). During peak usage (1950–63), approximately 11 million kg of mercury were used, and about 3% of this mercury (330,000 kg) was released to the surrounding environment. Ongoing mercury abatement and remediation efforts that began in the 1980s have targeted soil and sediment contamination within Y-12 as well as in and near East Fork Poplar Creek (EFPC), a stream with headwaters at Outfall 200 that flows from Y-12 through the city of Oak Ridge (DOE 2014). These remediation activities have significantly decreased overall mercury releases to the environment, but elevated concentrations remain in infrastructure (e.g., at four former mercury use facilities), water, and soil within Y-12. Mercury concentrations in stream water exiting the Y-12 site boundary at Station 17 continue to exceed the emerging regulatory limit (Tennessee's Ambient Water Quality Criterion for mercury, 51 ng/L) and the interim remediation goal (200 ng/L). Additionally, all major Oak Ridge watersheds exceed the current fish-based water quality criterion for mercury, 0.3 mg/kg in fish tissue. Thus, Y-12 mercury contamination has impacts well beyond the ORR.

The overarching mercury challenges at Oak Ridge include remediation of the large quantity of residual elemental mercury still present in shallow source zones adjacent to and beneath former mercury use facilities, potential mobilization of mercury during planned deactivation and decommissioning (D&D) of large mercury-contaminated facilities and associated infrastructure overlying potential mercury sources, potential mobilization of other contaminants, and the

persistence and bioaccumulation of methylmercury in the EFPC watershed despite remediation efforts. The estimated cost for mercury remediation at Y-12 is between $1 billion and $3 billion.

1.2 SAVANNAH RIVER SITE'S MERCURY CHALLENGE

Mercury has been used for decades at SRS as a catalyst in the dissolution of aluminum cladding from irradiated targets in nuclear separation processes in the canyon facilities and as a precipitating agent to remove chlorides. Following cladding dissolution, waste solutions were discharged to the high level waste (HLW) tanks for storage and ultimate disposition. The current estimate of mercury distributed in the Liquid Waste System (LWS) is approximately 60,000 kg. This mercury has been isolated within the LWS process vessels and HLW tanks, with minimal releases to the surrounding environment to date. Recent analytical data from HLW tank samples indicate that mercury currently is being recycled and concentrated back in the HLW tanks as waste sludge is processed into glass at the Defense Waste Processing Facility (DWPF). Consequently, mercury concentrations are increasing in the LWS and in low-temperature waste forms such as saltstone. An overview of recent findings concerning mercury in the LWS is presented in Appendix B.

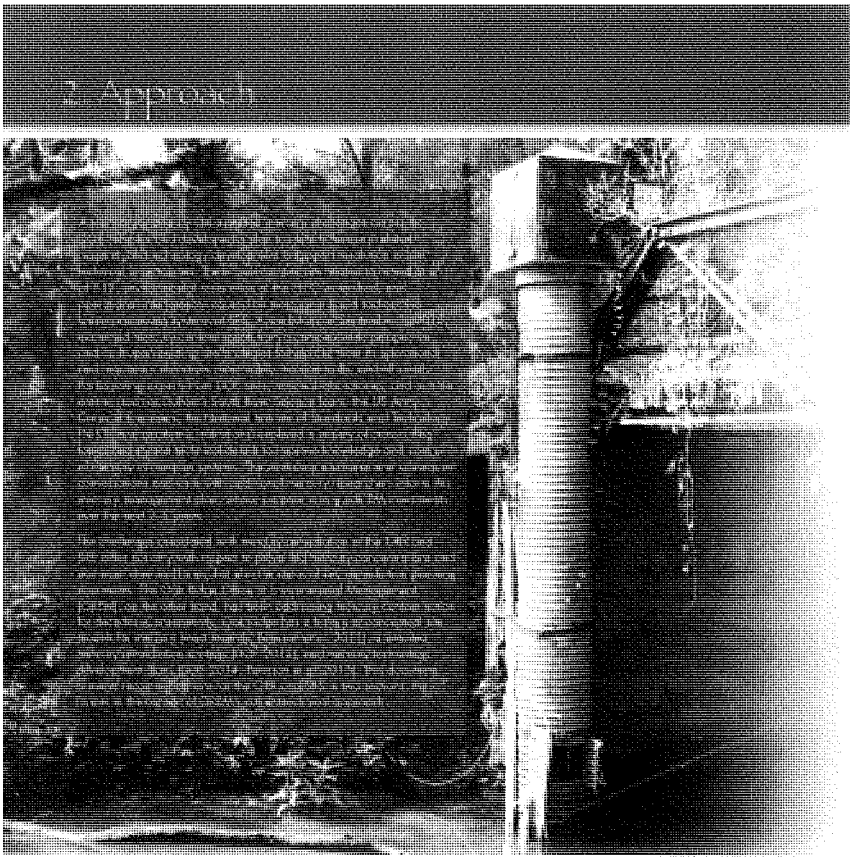
High level waste containing a significant quantity of mercury is being stored in waste tanks and managed in the LWS. The typical concentration of total mercury in the LWS is orders of magnitude higher than the concentrations that have been studied in aqueous environmental systems. This, coupled with the very complex and concentrated composition of the HLW solutions, results in significant differences in mercury behavior.

Chemical residues from fuel reprocessing operations are made strongly alkaline (pH 13+) before transfer into HLW storage tanks. Under these high pH conditions, almost all of the metallic ions precipitate as metal hydroxides or hydrous metal oxides that settle by gravity into a layer referred to as sludge. HLW supernatants, on the other hand, are high ionic-strength solutions composed principally of sodium salts of oxoanions (such as nitrate, nitrite, sulfate, carbonate, aluminate, and phosphate), as well as other inorganic and organic constituents from fuel reprocessing. Minimization of HLW supernatant volume is achieved by evaporating the liquid and cooling the concentrated supernatant to produce crystalline salts referred to as saltcake. Historically, organic-based antifoaming agents were used during evaporation in the LWS evaporators and in the DWPF, although their use in the evaporators has been discontinued.

Mercury reactions in the complex, alkaline chemical environment of HLW have resulted in the presence or formation of solid phases, liquid (elemental) mercury, and dissolved aqueous species. Inorganic mercury species present in HLW include elemental mercury, mercury oxides and hydroxides, and ionic mercury and complexes. The recent data indicate that some HLW tanks also contain significant levels of organomercury, predominantly methylmercury cation. Organic mercury is the predominant form in Tank 50.

The presence of organomercury species in the system reduces the effectiveness of the mercury removal operations built into the existing flowsheet. As a result, mercury concentrations in the LWS are increasing as the waste sludge is processed into glass at the DWPF. This directly affects the composition of salt batches, which were expected to contain only low levels of mercury (mostly soluble mercury); the concentration of mercury in the salt batches has increased significantly. Furthermore, the data suggest that organomercury species are more leachable than inorganic mercury species are, potentially altering the effectiveness of mercury immobilization in saltstone. Mercury levels in the LWS are projected to continue to increase because of the processing of sludges that originated from operations at SRS's H-Canyon facility, where larger quantities of mercury were used. The complex and dynamic chemistry of tank waste, the limited information on mercury speciation and transformation in this waste, and the rigorous regulatory and schedule requirements for waste processing pose significant challenges for SRS.

Because more mercury than expected is being collected in the LWS evaporator system, and because higher than expected levels of MeHg were discovered in the Tank 50 feed to saltstone in 2014–2015, DOE asked Savannah River Remediation (SRR) to evaluate the movement, monitoring, and collection of mercury through the entire LWS in an integrated, systematic manner (Falk 2015). As part of this effort, mercury speciation activities were performed on the various process streams that feed into Tank 50. Additional mercury speciation activities were performed around the DWPF Chemical Processing Cell (CPC), the Modular Caustic Side Solvent Extraction Unit (MCU), and the 2H and 3H evaporators to understand mercury processing behavior (Jain et al. 2015). Two system engineering evaluations (SEEs) were also performed for DWPF and tank farm systems (Winship et al. 2015a, 2015b).



3 OREM's 2014 Technology Development Plan

OREM's mercury technology development plan identified technology needs linked to the remediation objectives in its "Strategic Plan for Mercury Remediation at the Y-12 National Security Complex" (DOE 2014). The technology development plan sought to

- identify key technology needs for mercury remediation,
- select promising technologies and technical approaches for meeting key needs and assess the readiness of each,
- recommend technology development activities to evaluate and refine the selected technologies and approaches, and
- propose a sequence and preliminary schedule for the recommendations and provide a basis for prioritizing technology development activities.

OREM considered a TD portfolio that encompassed mercury detection and measurement, Y-12 site cleanup, and EFPC in-stream remediation. Technologies and technical processes were evaluated with respect to need, maturity, current usage, and investment recommendations. Table 1 summarizes the results of this evaluation, which identifies the technology categories that OREM is funding or intends to fund. OREM expressed interest in tracking future developments in nearly all of these technology areas, regardless of whether it intends to commit its own TD funding.

Table 1. Summary of Oak Ridge Office of Environmental Management's (OREM's) 2014 technology assessment

	Technology development (TD) needed	OREM TD funding recommended? (✓ or no)	Mature technologies
Mercury detection and measurement	Mercury sensor for water analysis	No	Soil gas measurements
	Remote sensing of mercury in equipment, walls, floors	No	Soil mercury probe
			Rapid field analysis of soil, sediment, solid waste
Y-12 National Security Complex site cleanup	Material/debris decontamination	✓	Predemolition
	Material/debris encapsulation	✓	Demolition
	Thermal desorption, in situ	✓	Thermal desorption, ex situ
	Soil washing/mercury extraction, in situ	No	Soil washing, ex situ (immature technology, unsuited for Y-12 application)
	Soil stabilization, in situ	✓	Soil stabilization, ex situ
	Waste disposal	✓	
East Fork Poplar Creek remediation	In-stream soil/sediment source zone stabilization and isolation	✓	
	In-stream water chemistry manipulation	✓	
	In-stream food chain modification	✓	

4. Research and Technology Development Areas for Oak Ridge

This section incorporates OREM's recommendations into a broader set of EM-recommended research and TD activities. It highlights the complementary nature of multiple DOE efforts contributing to mercury research, including OREM-supported programs, EM Headquarters' Applied Field Research Initiative for Remediation of Mercury and Industrial Contaminants, and the Office of Science's Mercury Science Focus Area (SFA). The TD categories include Mercury Detection and Measurement, Y-12 Site Cleanup, EFPC In-stream TD, and Modeling.

4.1 MERCURY DETECTION AND MEASUREMENT

Rapid field analysis in water, soil, sediment, and solid waste. Among the immature technologies OREM identified as necessary, but did not recommend for funding itself, was instrumentation for mercury detection in water. OREM noted that field-deployable instruments that can achieve part-per-trillion level detection limits would be extremely useful, although they are not currently available. A number of entities are conducting development work in this area, including a team funded through the Small Business Innovation Research (SBIR) program. The US Army Corps of Engineers (USACE) also has considerable experience developing rugged sensors and analytical instrumentation for field applications (e.g., at forward operating bases). Continued discussions between EM and USACE are recommended to determine whether a partnership in the

area of rapid, highly sensitive mercury detection in water would be beneficial. OREM also surveyed the state of technology for rapid field analysis (i.e., for soil, sediment, and solid waste) and found it to be mature, citing examples of regulator-approved full-scale application of x-ray fluorescence systems and portable atomic absorption instruments (DOE 2014). OREM did not recommend additional TD investments. However, the uniqueness and enormity of OREM's future D&D of mercury-use buildings and infrastructure likely would benefit from tailored screening tools that allow decisions to be made quickly and confidently in the field in support of D&D and remediation activities, particularly in the face of unforeseen obstacles or concerns.

Mercury isotope analysis. EM and national laboratory representatives held a preliminary discussion with mercury subject matter experts from NIST on September 23, 2015, to learn about NIST's capabilities in mercury analysis. NIST is a scientific leader in using isotopic analysis and isotope fractionation measurements to elucidate mercury transformation processes and sources and to support environmental compliance. Additional discussions with NIST are recommended to determine whether a partnership in this area would be beneficial.

Mercury detection in soil gas and soil. From 2009 to 2014, EM Headquarters and OREM supported the development of methods for detecting elemental mercury in soil gas and soil, resulting in successful technology demonstrations at Y-12. Shallow soil gas surveys developed and conducted by Oak Ridge National Laboratory (ORNL) were used to locate and delineate subsurface sources of elemental mercury at Y-12 (Watson et al. 2014). A cone penetrometer-deployed membrane interface probe (MIP), developed from commercially available technology by Savannah River National Laboratory (SRNL), also was tested successfully at Y-12 by SRNL and ORNL. The heated MIP desorbs and volatilizes elemental mercury from the solid phase (Jackson et al. 2013). Both technologies are available to OREM and its contractors and can be used to delineate mercury source zones and reduce uncertainty in estimates of mercury-contaminated debris that will require treatment and disposal. Given the successful demonstration of these applications at field scale, additional TD funding in this area is not recommended. On the other hand, remote detection of elemental mercury in the subsurface using geophysical techniques, particularly in inaccessible locations, has not been pursued and may be a worthwhile topic for applied research at ORR.

Remote sensing of mercury in equipment, walls, and floors. Remote sensing and quantification of mercury in infrastructure has potential applicability for D&D of former mercury use buildings at Y-12. However, OREM noted the lack of literature or ongoing research on this topic and recommended monitoring developments and funding field trials if they become feasible. This plan additionally recommends that EM's Robotics Initiative be followed for potential partnership and development opportunities in remote sensing.

4.2 Y-12 SITE CLEANUP

OREM's 2013 Mercury Remediation Strategy assumes that most of the low-level and mixed (low-level and hazardous) waste from Y-12 D&D activities will be disposed of at the on-site Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) facility, the Environmental Management Waste Management Facility (EMWMF), provided waste acceptance criteria (WAC) are met. The EMWMF is projected to reach capacity in fiscal years 2020–21, after which wastes will be disposed of in a future CERCLA facility. WACs (concentrations of mercury and other contaminants, debris size, and waste forms) and other characteristics of this future landfill have not yet been established by OREM and its regulators.

Handling and disposing of D&D materials as nonhazardous waste is often preferred to reduce costs and consume less space in CERCLA facilities. Nonhazardous, nonradioactive waste generated during Y-12 D&D and remediation activities will be disposed of at ORR industrial landfills, which should have sufficient capacity for Y-12 cleanup efforts. ORR landfills are OREM's preferred disposal pathway for non-LLW mercury-contaminated wastes (debris and soil) that have been treated to meet land disposal restrictions and the landfills' WAC.

Predemolition and demolition. Predemolition includes contaminant characterization, identification and removal of hazardous materials, and targeted decontamination or stabilization of materials. OREM recently assessed demolition practices for mercury-contaminated infrastructure (e.g., in the chloralkali industry) and anticipates that its demolition of mercury-contaminated facilities will be conducted appropriately using conventional methods. Decommissioning experience in the chloralkali industry has shown that volatile elemental mercury permeates many types of material, from steel to concrete. Thus,

segregation and disposal of noncontaminated materials will depend on the availability of mercury detection methods that are demonstrably rapid and field-applicable and that produce results commensurate with the Toxicity Characteristic Leaching Procedure (TCLP) for distinguishing hazardous waste.

Material/debris decontamination. Decontamination of D&D debris permits handling and disposal of materials as non-hazardous waste, reducing the capacity consumed in CERCLA disposal cells. Rigorous cost-benefit analysis can show whether decontamination offers economic and worker safety advantages compared with hazardous waste disposal, particularly at sites with existing CERCLA cell space. Such an analysis is recommended for the ORR to assess the need for decontamination TD. Decontamination methods vary widely and include, for example, strippable coatings, abrasives, and thermal and chemical technologies. OREM recently sponsored a review of mercury decontamination methods, and OREM's contractor, URS | CH2M Oak Ridge LLC (UCOR), stated at EM's mercury workshop on September 1, 2015, that new field-based technologies would be needed to remove mercury more effectively both surficially and at depth from a variety of materials, including porous materials (concrete, transite), nonporous nonmetal materials, steel, and other metals. Ideally, removal would achieve the mercury land disposal restriction concentration of 0.2 mg/L in TCLP tests. EM Headquarters is funding a project through the SBIR program on strippable coatings for removing mercury and other contaminants of concern. UCOR has proposed to use the West COLEX area of the Alpha 4 building at Y-12 as a site to evaluate elemental mercury removal from equipment and building structures under realistic working conditions and for the evaluation of sampling and characterization technologies.

Material and debris encapsulation/waste disposal. Encapsulation of debris from D&D activities allows for safe disposal of contaminated materials and mitigates dust and vapors during handling. OREM cited evaluation of in-cell macroencapsulation for disposal of mercury-contaminated debris as an Oak Ridge need in its 2014 TD plan and during the mercury meeting at EM Headquarters on September 1, 2015. OREM plans to support a review of available encapsulation technologies for large quantities of D&D materials and to perform encapsulation tests at the West COLEX area of Y-12. In-cell macroencapsulation should be evaluated as a TD effort to support the disposal of mercury-contaminated materials. This should include formulation and testing of new grout mixtures for stabilizing mercury-bearing material. These activities may benefit from collaboration with USACE.

Thermal desorption. Ex situ thermal desorption is the US Environmental Protection Agency's (EPA's) preferred or mandated treatment technology for mercury at TCLP levels greater than 260 parts per million. This mature technology is thought to be inappropriate for large-scale application at Y-12 because of its expense and licensing requirements. However, France-based AREVA recently completed removal of mercury in soil at a decommissioned lithium production facility in Spain using thermal desorption combined with other processing methods. It is recommended that OREM consult with AREVA regarding its recent implementation of thermal desorption. A related immature technology, in situ thermal desorption combined with soil vapor extraction, may have limited application within Y-12. OREM recommended that related technology development be included in its program.

Ex situ soil washing. This technology was determined to be inappropriate for ORR waste types. Technology development is not recommended.

Ex situ soil stabilization. This technology was deemed by OREM to be mature. Two vendors and Brookhaven National Laboratory tested three different stabilization approaches using mercury-spiked Y-12 soils in 2012. All three met the TCLP target for mercury. OREM did not recommend further technology development.

In situ soil washing or mercury extraction. In situ soil washing is an immature technology with technical considerations that likely preclude its field-scale use at Y-12. Mercury sulfide found in contaminated Y-12 soil has low solubility and would require the use of strong lixiviants for in situ extraction. Uncontrolled flushing or incomplete recovery of mobilized mercury in the heterogeneous subsurface could increase rather than mitigate mercury transport. This technology is therefore not recommended for future TD funding.

In situ soil stabilization. If successfully immobilized in situ, mercury is not subject to land disposal restrictions, thus reducing the need for soil excavation, ex situ treatment, and disposal in landfills. Given the significant potential cost savings offered by in situ stabilization, OREM identified TD support in this area as key. Past research efforts reported in the literature focused on immobilization amendments such as iron sulfide nanoparticles, elemental sulfur, or heated sulfur vapor. EM Headquarters is currently funding ORNL's development, testing, and upscaling of calcium polysulfide-based in situ stabilization methods for mercury-contaminated soil. This effort is recommended for continuation in fiscal year 2017. Future work must address the presence of commingled mercury species

(elemental, ionic, and organic-bound) and effective subsurface delivery methods to ensure that amendments access and react completely with mercury contamination. Testing and verification of the long-term stability of resulting in situ waste forms also will be required; this ties into the assessment of appropriate methods of leachability testing as described in the "Recommendations" section under "Crosscutting Topics."

4.3 EAST FORK POPLAR CREEK REMEDIATION

The in-stream remediation approaches identified below aid in avoiding large-scale excavation of stream sediments and contaminated floodplain soils, which would be costly, environmentally disruptive, and possibly ineffective in meeting remediation objectives. Upper EFPC (UEFPC) is defined as the 2-km stretch of the creek that originates at Y-12 and ends at Station 17, a monitoring station at the ORR boundary. Lower EFPC (LEFPC) is the stretch of creek extending for approximately 23 km downstream of Station 17. LEFPC flows outside of the ORR boundary for about 15 km and passes through the city of Oak Ridge before reentering the ORR.

Soil/sediment source zone stabilization and isolation. Erosion, scouring, and other disruptions to the floodplains, banks, and sediments of UEFPC and LEFPC contribute to the elevated mercury concentrations found in stream water and biota. Cost-effective methods to stabilize contaminated stream banks and beds are desirable to decrease mercury flux into the waterway. OREM and its collaborators have looked to the analogous South River system in southwest Virginia for examples of research and remediation approaches that may have application at the ORR. DuPont used mercury at its rayon production facility in Waynesboro, Virginia, from 1929 to 1950. The company discovered mercury in soil at the site in 1976 and shortly thereafter began examining mercury impacts to nearby river systems. Fish of the South River, South Fork Shenandoah River, and part of the Shenandoah River continue to exhibit elevated mercury levels, much as they do at the ORR.

DuPont established the South River Science Team (http://southriversciencateam.org/) in 2001 with partners in local, state, and federal governments; academic institutions; and stakeholder organizations to elucidate mercury's persistence in biota and to develop remediation approaches for this ecosystem. The team's work has been documented in more than 100 research publications. OREM and ORNL are actively leveraging the team's research and TD outcomes to improve knowledge of and environmental management for the EFPC watershed.

The South River Science Team identified four mechanisms responsible for mercury's persistence in South River fish:

- Continued small mercury releases from the former DuPont facility
- Erosion of legacy mercury from riverbanks into the river
- Mercury flux from deep riverbed sediment into the overlying water column
- Rates of fresh sediment deposition that are insufficient to bury legacy mercury and thus reduce exposure

DuPont has attempted to address the last three phenomena by using bank stabilization and sediment amendments along sections of the South River to limit erosion and mercury flux. OREM has recommended similar approaches and complementary technology development for the ORR because effective isolation or in situ treatment strategies can offer major cost benefits over baseline excavation and disposal options. Research and TD should, for example, address the long-term effectiveness of sediment amendments; develop and demonstrate new materials for in situ reactive caps, liners, mats, and sorbents; and improve understanding of the spatial and temporal variability of stream erosion (including during storm events) and groundwater seeps and their associated mercury releases.

Water chemistry manipulation. The headwaters of UEFPC are located at Outfall 200, where cooling water originating from Y-12 dominates creek influent during dry weather. Cooling water discharges contain the dechlorination agent bisulfite as well as corrosion inhibitors. Research is needed to understand any impacts these additives have on mercury methylation in the creek and whether other water additives could be used safely to mitigate mercury methylation and bioaccumulation. OREM-supported water chemistry manipulation research will be conducted under realistic field conditions at the planned LEFPC Field Research Station, a test bed site. Complementary research is being conducted through the Mercury SFA to identify natural biogeochemical factors that affect mercury methylation in EFPC.

Food chain modification. Mercury methylation and bioaccumulation in EFPC are complex and depend on physical, chemical, and biological processes as well as on the total quantity

of mercury present in the stream. OREM currently is using its own technology development funds to support investigation and implementation of ecosystem management actions that reduce mercury bioaccumulation or physically remove mercury. Proposed actions include (1) replacing current fish populations with species that bioaccumulate mercury to a lesser extent and (2) cultivating and harvesting mussels that consume methylmercury-accumulating periphyton to reduce mercury that is bioavailable to fish. These activities would constitute only one aspect of OREM's "adaptive management" approach to mercury remediation and would require careful monitoring to establish their overall contribution to mercury mitigation in LEFPC. Collaboration with USACE may be beneficial in this area.

4.4 MODELING

Conceptual models or industrial flowsheets enable consolidation of complex data and knowledge of system behavior into structured, accessible forms that highlight key processes and relationships. Such models should be treated as dynamic and should be updated or expanded as new information becomes available from research advancements and data collected during system operation, testing, characterization, and monitoring. Comprehensive conceptual models can support the development of powerful and intuitive insights useful for informing critical decisions. They also can guide research direction and the development and application of predictive numerical models. OREM has used such models to represent mercury-contaminated Oak Ridge facilities and source areas, as well as downstream impacts, for many years (Peterson et al. 2011).

OREM's models are supported by its investigations of the relative contributions of mercury from ongoing facility discharges, contaminated streambank soil and sediment, floodplain surface soils, and other sources. A recently developed conceptual model was used to identify major mercury sources, transport pathways, and flux at the Y-12 facility and UEFPC (Peterson et al. 2011). OREM used this model to inform its 2013 mercury remediation strategy and 2014 technology development plans. Concurrently over 2013–2016, a CERCLA Five Year Review (FYR) Action Plan study was conducted to assess the role of downstream mercury sources and the entire hydrologic system. As part of that study, conceptual modeling was used to define field, laboratory, and quantitative modeling needs in the LEFPC system.

During fiscal year 2016, the conceptual model for LEFPC will be refined further by the OREM FYR project and EM's Applied Field Research Initiative for the Remediation of Mercury and Industrial Contaminants, with the goal of incorporating new data from compliance monitoring efforts, mercury technology development studies, and other fundamental and applied research. Conceptual models will need to be updated continually as knowledge of key mercury fate and transport processes changes.

Robust numerical models also are essential to represent, select, and optimize remediation actions and to identify expected outcomes. This is particularly important for OREM's adaptive management approach to mercury remediation, which depends on evaluating environmental responses to sequential actions. Recently a greater emphasis has been placed on creating a preliminary semiquantitative model of mercury uptake through the aquatic food chain culminating in fish tissue. A multicompartmental watershed scale model of mercury transport and bioaccumulation was developed for the LEFPC watershed as part of the FYR study. Critical modeling components included surface water flow, mercury transport (e.g., sedimentation, storm flux, groundwater–surface water interactions); reactivity (e.g., methylation); and trophic transfer. Next steps for the OREM model will improve representations of flow and sediment transport in the EFPC floodway, which to date have been hampered by the lack of high accuracy terrain and channel morphology models. Recently the US Geological Survey acquired LIDAR data for the ORR as part of a regional mapping program. When the processed data from that mapping become available, it may be feasible to create a more quantitative flow and sediment transport module for LEFPC.

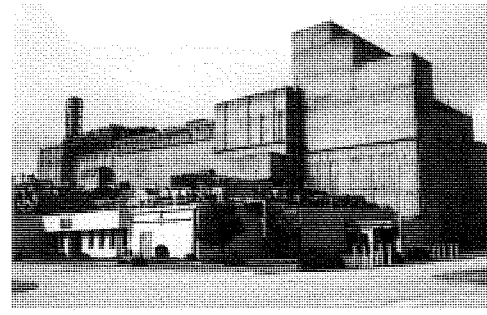
OREM recognizes the benefit of continuing tandem support for its applied site model and the basic research model being developed by the Mercury SFA program. During the next 3 years, SFA model development will center on obtaining a detailed mechanistic, biogeochemical understanding of mercury stream processes. This "bottom-up" approach, which in the future could be used in conjunction with other models including OREM decision-support modeling tools (e.g., the FYR model), can aid OREM in gaining a multiscale understanding of mercury fate and transport.

Inadequate understanding of mercury speciation in the SRS liquid waste system poses a significant operational challenge to effective and efficient mercury management at SRS. It is believed that organomercury reduces the effectiveness of the mercury

3. Research and Technology Development Needs for the Savannah River Site

removal system in the DWPF, limits the quantity of mercury removed in the LWS system evaporators, and increases the leachability of mercury from saltstone. Focused basic and applied science investments are needed to understand solution and vapor phase mercury chemistry and to develop the technical basis for practical and cost-effective strategies to address mercury in the LWS sustainably. Target strategies should provide quantifiable and controlled mercury removal from the LWS; generate acceptable mercury waste forms that do not adversely affect the surrounding environment; and support timely processing of HLW into glass and cementitious waste forms.

The data that signaled the urgency and significance of the mercury challenge at SRS were generated during the past few years, particularly in 2015 when additional mercury speciation activities were initiated around specific flowsheet operations (e.g., DWPF CPC sludge preparation unit operations, MCU processing, salt batch feed preparation, and 2H/3H evaporator operations) to understand mercury behavior (Jain et al. 2015). DOE, along with its operating contractor at SRS, SRR, and its technical support organization, SRNL, are responding to the emerging information with a number of strategic planning activities. Along with mercury speciation around the different processes, two SEEs were performed for DWPF (Winship et al. 2015b) and for the remainder of the LWS for mercury removal or mitigation (Winship et al. 2015a). The SEEs were established to elicit creative ideas from a diverse group of experts and to identify potential process modifications and solutions. Key emerging themes from these reviews will form the basis of the SRS mercury strategic plan.



Both SEE teams investigated cost-effective opportunities in three areas: removal of mercury (any form) from the liquid waste system at a rate that would maintain or reduce mercury concentrations in the LWS, alteration of mercury speciation to control its behavior, and improvement in the ability of saltstone to sequester mercury and limit the potential for leaching. The teams identified target tanks within the LWS/DWPF and potentially applicable technologies. They also considered the quantity and characteristics of mercury-containing wastes, taking into account waste streams that are protective of the environment and those that are already permitted with existing disposal paths. The results will assist DOE and SRR in planning and executing the processing of HLW into stable and environmentally protective waste forms.

The emerging plan to address mercury in the LWS includes currently funded or future baseline operational scope, near-term to midterm applied science activities, and relevant basic science topics, as shown in Table 2. Basic science needs include understanding the mechanism and kinetics of the transformation of inorganic mercury species into organomercury compounds, conversion of organomercury compounds into inorganic mercury, and vapor phase mercury

chemistry as it relates to corrosion of tank farm and processing facilities. The proposed applied science activities highlighted in the table are described below.

The results of the LWS evaluation were documented recently (Winship et al. 2015). Twenty potential options to remove or mitigate mercury in the LWS were identified. The 20 options subsequently were reduced to 13 through a screening process. Based on evaluation of the 13 options, the team made three recommendations: (1) deploy methods to remove elemental mercury mechanically from process tanks in the LWS, (2) deploy technology to enhance removal of ionic mercury in the H-area evaporators by the addition of a reducing agent to convert ionic mercury to elemental mercury, and (3) pursue conversion of the organomercury cation (HgR^+) in Tank 50 (feed to saltstone) to ionic and elemental mercury using ultraviolet light and maturing the technology for deployment. Parallel tests were recommended to enhance retention of mercury in saltstone. These recommendations align very closely with the strategic components listed in Table 2 under the heading "applied science and technology development."

More complete descriptions of the applied science and technology components are provided below.

Develop a process to convert organomercury to inorganic mercury. This work would focus initially on the chemical conditions of Tank 50, the low-activity waste feed to the saltstone process. Converting organomercury to inorganic species in this low-activity solution would reduce mercury leachability from the resulting saltstone grout. Sampling results indicate that methyl- and ethylmercury are the main mercury species that leach from the saltstone grout matrix. Previous testing (Langton 1988) showed acceptable performance of grout materials containing nearly 500 mg/L inorganic mercury, such as mercuric ion. Studies would examine potential technologies to oxidize the organic fragment of the organomercury species (e.g., ultraviolet-C photoreactors) to mercuric ions. One or two likely technologies would be selected for initial testing with the goal of selecting one technology for pilot-scale development and demonstration. The technology development activities for Tank 50, if successful, could be considered for other locations in the LWS system (e.g., in the tanks feeding the evaporators) to maximize mercury removal by the evaporators.

Develop a process that converts inorganic mercury to elemental mercury. Sampling results indicate that 2H/3H evaporator feed/drop tanks contain substantial quantities of inorganic mercury. Conversion of this ionic species to elemental mercury would improve the performance of the evaporator's built-in mercury removal system. Mercury would be removed in flasks from the LWS as liquid mercury, a currently recognized waste form. Studies examining chemistries or technical approaches to convert ionic mercury species to elemental mercury in alkaline waste liquids would enable selection of one or two chemical additives (such as $SnCl_2$ or borates). An initial round of

Table 2. Key components of the strategic plan for mercury in the Savannah River Site Liquid Waste System (LWS)

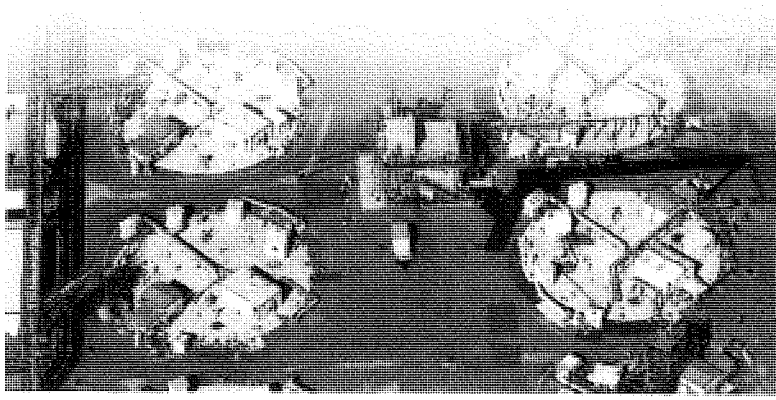
Funded baseline operations activities	• Develop standards, practices, and capabilities for analysis of mercury species in high level waste (HLW) liquids and sludges • Conduct detailed characterization and monitoring of mercury in the LWS • Implement technical modifications to mercury recovery system in the Defense Waste Processing Facility • Develop organic mercury waste acceptance criteria for saltstone grout
High-priority future operations activities	• Develop improved mercury removal or mercury control flowsheet based on applied science results. Install required systems and infrastructure
Applied science and technology development	• Develop process to convert organomercury to inorganic ionic mercury (e.g., ozone or ultraviolet-C photoreactor) • Develop process that reduces inorganic ionic mercury to elemental mercury • Develop mercury "getters" as additives for grout formulations • Develop mercury sorbents focused on removal of organomercury from alkaline waste solutions • Elucidate mercury speciation in sludge solids
Basic science topics	• Understand chemical speciation and transformation of mercury (mechanisms and kinetics) in complex, high-ionic-strength alkaline solutions • Identify vapor phase mercury chemistry (reactions and species) under appropriate HLW tank conditions • Elucidate reaction mechanisms during conversion of organomercury to inorganic mercury (photoreactions, ozone reactions, free radicals, etc.) • Develop information on critical mercury chemistry in HLW (such as organomercury solubility in various HLW matrices)

testing would then be conducted with the goal of selecting one additive for development and demonstration.

Develop mercury "getters" as additives for grout formulations. Organomercury species are far more soluble than ionic mercury species. The use of mercury getters should be explored to enhance organomercury species retention in the saltstone grout matrix. This could offer an alternative or supplementary technology to improve saltstone grout performance without chemically converting organomercury to inorganic mercury. Candidate additives for improving mercury retention must be tested to ensure no harm to other important properties of grout, such as set time and compressive strength. Once additives are shown to improve mercury retention during TCLP testing, testing with actual Tank 50 waste would be conducted.

Refine previous studies on mercury ion exchange in light of organomercury's presence. Previous studies demonstrated that various sorbents or ion exchangers (e.g., GT-73 resin) are stable in alkaline tank wastes and are effective at removing mercury in the form of mercuric ion from a simulated waste matrix. This task would develop the basic data needed to support the design of a mercury removal system that could be deployable at selected locations in the tank farm. Adsorption isotherms would be developed for mixed organomercury species and bench-top ion exchange column testing. Additionally, testing would be conducted to characterize the hazardousness of spent, loaded resin to aid in determining disposal options. Testing with real waste samples would confirm that the isotherms developed with chemical simulants depict the same or nearly the same performance as tank waste supernatants.

Mercury speciation in sludge. Mercury is believed to be in the form of mercury oxide in sludge; however, it is not known whether all mercury is in this form. Elemental mercury, mercuric sulfide, or other species also may be present, each potentially exhibiting different behavior across the DWPF flowsheet. It is proposed that sludge be sequentially extracted to identify specific mercury species. The extraction of as many as 10 different mercury species would be quantified.



6 Recommendations

EM should create a technical working group to formalize and strengthen the synergies among agencies, organizations, and industries engaged in mercury-related research, TD, and operations. This group would advocate the sharing of knowledge and technical advancements, reach out to subject matter experts, identify opportunities and investments to ensure robust responses to EM's mercury challenges, and offer recommendations to EM's managers and technical advisors as requested. EM's leadership through this group must be visible and proactive.

EM also should track the progress and outcomes of its partnership with the DOE Office of Science to address EM's basic research needs. A report on these needs (DOE 2016) recommended fundamental research focused on contaminant fate and transport in geologic environments, waste stream characterization and separations, non-equilibrium speciation and reactivity in complex radioactive wastes, and mechanisms of material degradation in harsh environments, among other areas. Although mercury is not a target for the suggested research, it is reasonable to anticipate that resulting discoveries may be pertinent to EM's mercury management mission.

Additional site-specific and crosscutting recommendations are given below.

Oak Ridge Reservation. The applied research and technology development activities recommended for the ORR in this report are informed by OREM's mercury remediation strategy (DOE 2013); its mercury TD plan (DOE 2014); and the gaps between the technical requirements of EM's cleanup mission and the capabilities of current commercially available technologies. TD topics cover mercury characterization, Y-12 remediation, and offsite restoration of LEFPC, as discussed below.

Remediation of mercury contamination at Oak Ridge will require a multipronged approach that includes (1) constructing and operating the Outfall 200 Mercury Treatment Facility (MTF), (2) enabling disposal of mercury contaminated debris, (3) treating discrete soil source zones in Y-12, and (4) mitigating residual mercury sources in LEFPC. Regarding the first point, the MTF is not a TD activity but rather is a capital project intended to limit future mercury releases. Concerning the second point, the challenges associated with mercury contaminated debris would benefit from applied research and TD focused on developing robust, easily deployable field instruments as well as macroencapsulation to facilitate on-site disposal of debris; off-site waste disposal would be excessively costly. EM should leverage USACE's expertise in developing tools to facilitate real-time mercury detection and quantification. Regarding the third point, EM's current TD focused on Y-12 in situ chemical treatment/stabilization is intended ultimately to reduce waste volumes requiring disposal and minimize the potential for additional mercury releases caused by excavation. The fourth point is being pursued by OREM's TD program and is key to decreasing methylmercury production and bioaccumulation as well as the risks to ecosystem and human health. OREM also has proposed construction of a small research facility along LEFPC as a test bed for other stream-related TD topics, including manipulation of water chemistry and of prevailing aquatic species to mitigate mercury bioaccumulation. All of these efforts will continue to benefit from engaging outside expertise, such as the South River Science Team and various universities. A number of university collaborations are ongoing through EM's Minority Serving Institutions Partnership Program and the Mercury SFA.

Savannah River Site. Research and TD recommended for Savannah River will improve understanding of mercury chemistry and speciation in the Liquid Waste System and will lead to mercury removal methods that support the site's baseline operations. Treatments that convert organomercury to inorganic mercury, and inorganic mercury to elemental mercury, are needed to reduce mercury leachability in saltstone and to improve mercury removal in the 2H/3H evaporator, respectively. Additionally, sorbents or ion exchangers for removing ionic mercury in the presence of organomercury should be tested for removal efficacy and for the hazardousness of the resulting spent material. Finally, studies elucidating the speciation of mercury in sludge are needed to reduce uncertainties about mercury behavior across the DWPF flowsheet.

Crosscutting topics. Mercury-related interests at the ORR and SRS intersect in two main areas: grout formulation and alternative tests for waste form leachability. TD investments are recommended for both, as noted below.

Development and demonstration of grouts that retain predominant mercury species and maintain waste form integrity over expected concentrations and time are important for sequestering organomercury in saltstone at SRS and for encapsulating mercury-bearing soil and debris for on-site disposal at the ORR. As new grouts are developed and tested, information should be shared between sites. The Mercury Issues Coordination Team already formed by the site contractors at Oak Ridge (UCOR) and Savannah River (SRR) is one mechanism by which lessons and information can be exchanged (Weapons Complex Monitor 2016). EM's Cementitious Barriers Partnership is another.

When TCLP is not a regulatory requirement and does not reflect expected disposal conditions (it was developed for municipal solid waste), it may not provide an appropriate technical foundation for waste acceptance criteria or treatment and disposal evaluation and decision-making. Alternative leaching assessments may be more appropriate for mercury species in saltstone or for macroencapsulated mercury-bearing debris from D&D activities. A review of available leaching protocols and possibly development of new protocols for mercury-contaminated wastes under relevant disposal conditions are recommended.

7. Schedule

	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027–43	DOE funding source
Y-12 National Security Complex cleanup activity timeline														
Y-12 process facility D&D														OREM
Y-12 soil remediation														OREM
Outfall 200 Mercury Treatment Facility design and construction														OREM
Outfall 200 Mercury Treatment Facility operations														OREM
Analysis of alternatives for interim remedial action in EFPC														OREM
EFPC interim remedial action (if determined to be necessary)														OREM
EFPC possible long-term remedy														OREM
Research and technology development—Oak Ridge														
Mercury detection and measurement														
Mercury detection in water, soil, sediment, and debris (with USACE)														HQ
Mercury isotope analysis (with NIST)														HQ, SC
Remote sensing of mercury in equipment, walls, and floors														HQ
Y-12 remediation														
Predemolition and demolition: Assessment of efficacy of debris sorting to segregate mercury-bearing waste														OREM
Material/debris decontamination														OREM
Material/debris encapsulation, in-cell macroencapsulation (pilot to engineering scale)														OREM
Development of caps, reactive liners, and chemical amendments for mercury disposal cells														OREM
In situ thermal desorption with soil vapor extraction														OREM
In situ soil stabilization (lab to field tests)														HQ
Grout formulation for in-cell macroencapsulation—*Pertinent to Savannah River Liquid Waste System (with USACE)*														HQ

	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027–43	DOE funding source
Development of leaching test alternatives—*Pertinent to Savannah River Liquid Waste System*			■	■	■									HQ
East Fork Poplar Creek remediation														
Soil/sediment source zone stabilization and isolation	■	■	■	■	■	■	■							OREM
Water chemistry manipulation		■	■	■	■	■	■							OREM
Food chain modification	■	■	■	■	■	■	■							OREM
Modeling														
Refinement of ORR conceptual model for mercury sources, transport, flux		■				■				■				HQ, OREM, SC
Development of site-specific model components for mercury biogeochemistry and multiscale transport	■	■	■	■										SC
Research and technology development—Savannah River														
Develop a process to convert organomercury to inorganic ionic mercury		■	■	■										HQ
Develop a process to convert inorganic ionic mercury to elemental mercury		■	■	■										HQ
Develop mercury getters as additives for grout formulations		■	■	■										HQ
Develop mercury sorbents to remove organomercury from alkaline waste solutions		■	■	■										HQ
Develop methods to measure mercury species in sludge		■	■	■										HQ, SRR
Elucidate the mechanism and kinetics of the transformation of ionic mercury into organomercury compounds in complex waste solutions			■	■	■	■	■							HQ, possibly SC
Elucidate vapor phase reaction chemistry of mercury			■	■	■	■	■							HQ, possibly SC
Elucidate mechanism and kinetics of the conversion of organomercury into inorganic mercury in complex waste solutions			■	■	■	■	■							HQ, possibly SC

Notes: DOE = US Department of Energy; D&D = deactivation and decommissioning; EFPC = East Fork Poplar Creek; FY = fiscal year; HQ = Office of Environmental Management Headquarters; NIST = National Institute of Standards and Technology; OREM = Oak Ridge Office of Environmental Management; SC = US Department of Energy Office of Science; SRR = Savannah River Remediation; USACE = US Army Corps of Engineers; Y-12 = Y-12 National Security Complex.

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APPENDIX A: ENVIRONMENTAL MERCURY BIOGEOCHEMISTRY

Mercury (Hg) is a persistent and chemically complex global pollutant. Because of its unique physicochemical characteristics, mercury is one of the most challenging contaminants in the environment to remediate. The distinctive physicochemical properties of mercury include its liquid state as elemental mercury, Hg(0), at ambient temperature and pressure and its status as one of the few metals that is transported under environmental conditions as a cation, Hg(II), and/or as dissolved or gaseous elemental metal, $Hg_{(g)}$, similar to an organic solvent (Fig. A1). Most importantly, mercury undergoes biogeochemical transformation processes, including aqueous and surface complexation, redox reactions, and atypical methylation reactions, producing the potent neurotoxin methylmercury (Dang et al. 2010, Gu et al. 2011). Mercury exhibits all of the aforementioned characteristics in the heterogeneous, dynamic watershed-scale system of Oak Ridge, which includes the Y-12 National Security Complex boundary and the 23 km of contaminated creek and floodplain downstream.

The high toxicity of methylmercury (MeHg) endangers human health, primarily via fish consumption. Although it is well known that inorganic Hg(II) is transformed into MeHg by natural processes that mostly result from microbial activity in the environment, the environmental drivers for mercury methylation remain poorly understood. Mercury is extremely reactive and readily undergoes chemical, photochemical, and biochemical transformations (He et al. 2014; Morel et al. 1998; Qian et al. 2014; Barkay et al. 2005a, 2005b). As a soft Lewis acid, Hg(II) prefers sulfur atoms (Riccardi et al. 2013a, 2013b), forming strong complexes with both organic thiol groups (e.g., those in dissolved organic matter

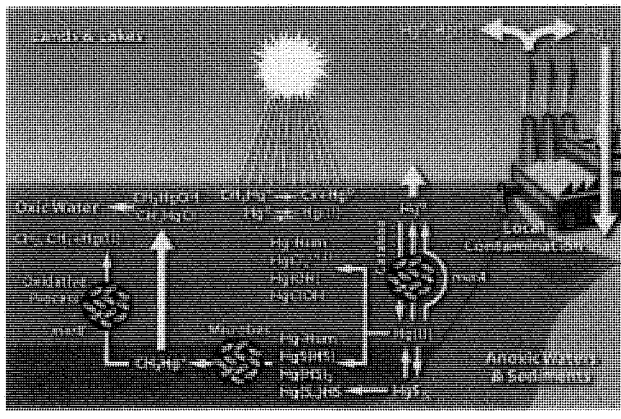

Fig. A1. Mercury sources and biogeochemical cycle in environmental systems. Figure adapted from: Barkay, T., S. M. Miller, and A. O. Summers. 2003. "Bacterial Mercury Resistance from Atoms to Ecosystems." FEMS Microbiol. Rev. 27 (2–3):355–84. doi: 10.1016/S0168-6445(03)00046-9.

[DOM]) and inorganic S(II) ligands (Gu et al. 2011, Dong et al. 2010, Zheng et al. 2012). At the sediment–water interface in streams such as East Fork Poplar Creek (EFPC), chemical and microbiological properties can change significantly, affecting mercury redox transformation and the potential for mercury methylation. These processes are complicated further by the degradation of MeHg (He et al. 2014, Qian et al. 2014), mass transfer, and/or accumulation following downgradient transport along flow paths. As a result, aqueous MeHg concentrations often do not reflect the ecosystem compartments in which the MeHg was produced. The interplay of abiotic mercury reactions that remove or produce mercury species for methylation, the relative rates of methylation and demethylation, and mass transfer all influence MeHg levels in stream systems.

Previous studies have generated extensive data on the relationship between MeHg and dissolved mercury concentrations in lakes, rivers, and water bodies at mining and industrial sites (Brooks and Southworth 2011 and references therein). In general, the total mercury concentration is not a good indicator of MeHg in water, including at EFPC, where the sources of MeHg are not identified clearly. Both field manipulation and laboratory incubation studies suggest that MeHg production is positively linked to certain groups of microorganisms, their activity, and bioavailable Hg(II) (Parks et al. 2013, Gilmour et al. 2013, Hu et al. 2013, Marvin-DiPasquale et al. 2008) as well as to site-specific factors such as hydrology and water chemistry (Hintelmann 2010). For example, recent studies revealed that microorganisms that possess *hgcAB* genes are capable of methylating Hg(II), although their ability to do so can vary widely across microbial groups (Parks et al. 2013, Gilmour et al. 2013). Furthermore, the bioavailability of Hg(II) for uptake and microbial methylation can be affected by many geochemical factors, including suspended particles and water chemistry parameters such as pH, Eh, complexing ligands such as DOM, ionic composition and strength (Gu et al. 2011; Dong et al. 2010; Schaefer et al. 2011; He et al. 2014, 2012; Zheng et al. 2012), and the surface chemistry and biochemistry of microbial cells (Hu et al. 2013; Lin et al. 2014a, 2014b).

Aside from DOM and other geochemical factors, particulate organic matter and minerals also influence mercury partitioning in stream systems (Brooks and Southworth 2011, Gu et al. 2014). Field monitoring and analyses indicate that a large fraction of total mercury is particle-bound. Whether particle-bound mercury is a source for methylation or a sink for dissolved mercury in streams is presently unknown. Furthermore, most studies to date have focused on the chemical or photochemical transformation of mercury and MeHg in homogeneous solutions, whereas reactions on heterogeneous surfaces or suspended particles have been largely overlooked.

Many factors affect mercury speciation in soil/sediment systems, including soil pH, redox potential, soil properties, microbial activity, and the presence of other ligands (Boszke et al. 2003). Mercury species commonly found in contaminated soil and sediment include Hg(0), cinnabar and meta-cinnabar (HgS), mercuric chloride ($HgCl_2$), mercuric oxide (HgO), and methylated compounds (CH_3HgCl and CH_3HgOH) (USEPA 2007). Each species has a different solubility that affects its potential for mercury release. HgS is the least soluble form (4.65×10^{-25} g/L at 25°C), followed by meta-cinnabar (1.04×10^{-24} g/L at 25°C), whereas HgO is one of the most soluble forms (69 g/L at 20°C).

Given the complexities discussed above, cost-effective and sustainable solutions for reducing mercury flux from various primary and secondary contamination sources at Oak Ridge will require focused investments that incorporate fundamental knowledge into applied research to advance EM's capabilities in remediation, characterization, monitoring, and modeling.

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APPENDIX B: MERCURY IN DOE LIQUID WASTE SYSTEMS—OVERVIEW OF RECENT FINDINGS AT THE SAVANNAH RIVER SITE

Mercury in the Savannah River Site (SRS) Liquid Waste System (LWS) originated from decades of radiochemical processing in the "canyon" buildings, where mercury was used to aid reactor fuel dissolution. The resulting mercury is present in a number of chemical forms and is distributed throughout the LWS. The current inventory of mercury in the LWS is approximately 60 metric tons. Mercury has long been a consideration in the LWS, both as a biological hazard and for its impact on processing operations. Occupational exposures and environmental releases to date have been below applicable standards, and waste treatment systems and waste forms have complied with regulatory requirements. Recent data indicate that the mercury removal processes associated with the Defense Waste Processing Facility (DWPF) are underperforming. As a result, a significant fraction of mercury is returned to the LWS as waste is processed into stabilized waste forms such as glass. The net result of recycling mercury while total waste volume is decreasing is an increase in mercury concentrations throughout the LWS. A technical basis for the observed mercury behaviors and trends has been generally identified (complex mercury speciation), along with a number of uncertainties, engineering/process improvement actions, and applied science opportunities.

Figure B1 shows the core functions and objectives of the SRS LWS, DWPF, the Saltstone Production Facility, and the Saltstone Disposal Facility (SDF). The primary mission of these facilities and processes is to convert the legacy high-level radioactive wastes currently being stored in 43[1] waste tanks (each with a capacity of approximately 3.5 million L) into stable and protective waste forms and to safely decommission the tanks. To meet the objectives, the solids (e.g., sludge) and separated radionuclides are vitrified (see [a] in Fig. B1). The resulting glass is sealed in stainless steel canisters that ultimately will contain almost all of the radionuclides from the waste tanks. Contaminated liquids (e.g., salt solutions or "supernates") are concentrated in evaporators, treated to remove radionuclides, and then converted into a solid waste form known as saltstone (see [b] in Fig. B1). Saltstone ultimately will contain <<1% of the radionuclides from the waste tanks. As the waste is processed and waste tanks are emptied, the tanks are cleaned and filled with specialized solid grout mixtures to stabilize the tanks in place and to limit the release of residual

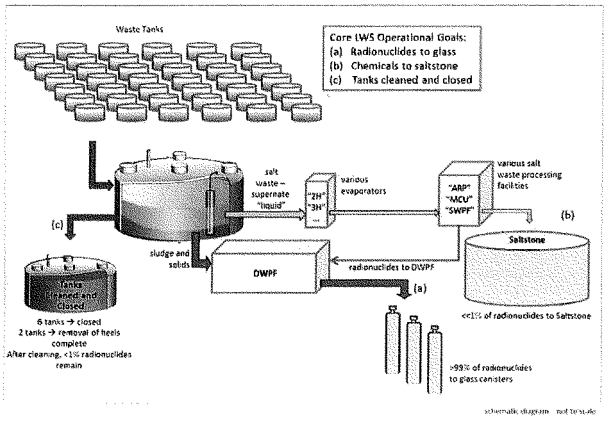

Fig. B1. Simplified depiction of the core functions and processes in the Savannah River Liquid Waste System (LWS), Defense Waste Processing Facility (DWPF), and saltstone systems.

[1] *Originally, the Savannah River Site built and operated 51 waste tanks. As of January 2016, seven of the tanks have been closed, and one tank has been emptied and is being prepared for closure.*

radioactivity (see [c] in Fig. B1). After cleaning and closure, each waste tank will contain <<1% of the original inventory of radionuclides. The operational plan is to continue to treat the waste and clean/close waste tanks until all of the remaining waste tanks have been emptied. Note that Fig. B1 is a highly simplified schematic diagram.

In practice, some of the waste tanks are used to transfer and store liquids as they move from one process to another or to serve as feed and collection tanks for unit operations such as evaporators. The waste chemistry varies somewhat from tank to tank and from area to area (i.e., the wastes in the tanks in F Area are somewhat different from the wastes in the tanks in H Area because of differences in the chemical separation processes). Nonetheless, Fig. B1 provides a synopsis of the core function of the LWS, DWPF, and saltstone facilities toward "closing the circle" on more than a half-century of nuclear materials production at the Savannah River Site.

Figure B2 augments the diagram of the LWS, DWPF, and saltstone systems to include mercury. This figure summarizes mercury treatment goals, identifies mercury fluxes and speciation, indicates the designed locations for mercury removal (i.e., mercury "purge points"), and recaps the baseline data on how these purge points are performing (see [d] in Fig. B2). Mercury information on this diagram is shown in red. The flux arrows provide a rough idea of how much mercury is moving through the system. The dominant mercury specie(s) are shown in bold in each location. Speciation data, recently generated using emerging analytical methods, indicate that organomercury species are dominant in many locations throughout LWS, DWPF, and saltstone facilities, and the primary organomercury species is methylmercury ($HgCH_3^+$).

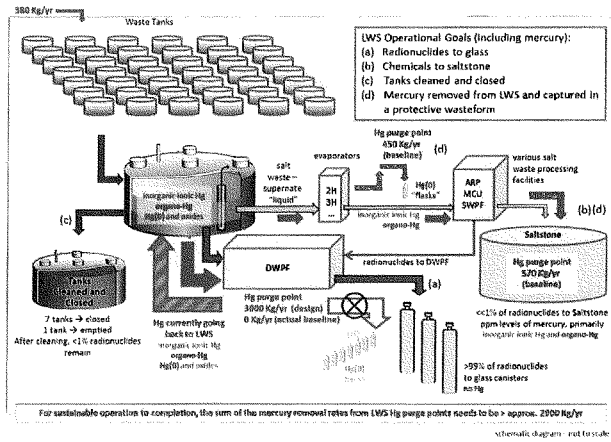

Fig. B2. Simplified depiction of the Savannah River Liquid Waste System (LWS) and Defense Waste Processing Facility (DWPF) showing the general flow of mercury (red) and radionuclides (brown).

The complex chemical compositions in high level waste liquids and sludges and the resulting speciation of mercury affect the performance of the designed mercury purge points. Two of the mercury purge points (the evaporators and saltstone) are removing mercury at the anticipated rates. However, these two purge points remove a relatively small amount of mercury (450 kg/year and 570 kg/year, respectively). As indicated by the largest flux arrows, the primary "designed" mercury purge point is located in the DWPF. This mercury removal system was anticipated to collect approximately 3,000 kg/year, but instead, it removes a minimal amount of mercury, and the bulk of the mercury entering DWPF is "recycled" back to the LWS.

The underperformance of the mercury removal systems in DWPF results in a trend of increasing mercury concentration in the LWS

as the total volume of waste is reduced at a rate faster than that of mercury. In response to this emerging information, DOE along with its support contractor and applied research laboratory (Savannah River Remediation and Savannah River National Laboratory) have initiated activities to (1) re-establish the performance of the mercury removal systems in DWPF to the extent practicable, (2) increase the amount of mercury removed in the LWS purge points (e.g., collect more mercury in the evaporators by altering the speciation of the feed liquids), and (3) identify opportunities for additional mercury purge points or protective actions (e.g., altering speciation to limit the release of mercury from saltstone).

The current strategy seeks to ensure that mercury removal from the LWS and DWPF exceeds 2,900 kg/year. The separated/captured mercury needs to be in waste forms that protect people and environment, that are acceptable to regulators and stakeholders, and that have a disposal path. Resolving technical unknowns and uncertainties will play a key role in the success of these planned activities.

In summary, chemical speciation of mercury has emerged as one of the most important factors controlling its distribution in the LWS, DWPF, and SDF. Organic mercury reduces the effectiveness of the baseline mercury removal systems, limits the quantity of mercury removed in LWS system evaporators, and increases the leachability of mercury from saltstone. The data that signaled the urgency and significance of the mercury challenge at SRS were generated during the past few years with recently developed chemical speciation methods. DOE is responding to the data by developing cost-effective actions to (1) remove mercury from the LWS, providing for sustainable processing of the waste through completion of tank emptying and cleaning, and (2) characterize and control mercury speciation to improve system performance. The overarching functional objective of these efforts is to enhance system safety and robustness by providing reliable purge point(s) for mercury from the LWS and by implementing supplemental actions to reduce flowsheet/personnel risks.

ACRONYMS AND ABBREVIATIONS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CPC	Chemical Processing Cell
D&D	deactivation and decommissioning
DOE	US Department of Energy
DOM	dissolved organic matter
DWPF	Defense Waste Processing Facility
EFPC	East Fork Poplar Creek
EM	Office of Environmental Management
EMWMF	Environmental Management Waste Management Facility
EPA	US Environmental Protection Agency
FYR	Five Year Review
Hg	mercury
Hg(0)	elemental mercury
Hg(II)	mercury cation
Hg_{DG}	dissolved, gaseous elemental mercury
HgO	mercuric oxide
HgS	mercuric sulfide (cinnabar and meta-cinnabar)
HLW	high level waste
LEFPC	lower East Fork Poplar Creek
LLW	low-level waste
LWS	Liquid Waste System
MCU	Modular Caustic Side Solvent Extraction Unit
MeHg	methylmercury
MIP	membrane interface probe
MTF	Mercury Treatment Facility
NIST	National Institute of Standards and Technology
OREM	Oak Ridge Office of Environmental Management
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
SBIR	Small Business Innovation Research
SEE	system engineering evaluation

ACRONYMS AND ABBREVIATIONS *(continued)*

SDF	Saltstone Disposal Facility
SFA	Mercury Science Focus Area of the Office of Science
SRNL	Savannah River National Laboratory
SRR	Savannah River Remediation
SRS	Savannah River Site
TCLP	Toxicity Characteristic Leaching Procedure
TD	technology development
UCOR	URS | CH2M Oak Ridge LLC
UEFPC	upper East Fork Poplar Creek
USACE	US Army Corps of Engineers
WAC	waste acceptance criteria
Y-12	Y-12 National Security Complex

Ms. KAPTUR. All right. I am sure that the chairman would agree. We can put that into the record. Since you mentioned mercury, the export ban was established on mercury in 2008 and was contingent on our country establishing a domestic long-term storage facility. But DOE has made little progress, if any, on getting that facility up and running, so you began discussing that. Could you give us a little bit of an update? You talked about technology, what progress you have made, how soon could a storage facility location be selected. Can storage fees be structured to fully offset the costs of what will be required?

Ms. REGALBUTO. Thank you. The mercury storage facility, we have seen it bubble up, and I personally think it is a great idea because everybody has this orphan material all over the place, right, which is not a good way to manage it. Right now, the purview for the building of the mercury facility relies on the Office of Legacy Management. It is not under our purview. So we have given them forecasts and a number of things that can be done. I know some communities have expressed interest in hosting this facility. But I will have to get back to you with details.

[Additional information follows:]

In December 2008, the Acting Deputy Secretary of Energy assigned responsibility for construction of an operational elemental mercury storage facility to the Office of Environmental Management, and operations of this facility to the Office of Legacy Management.

DOE issued its *Final Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement* in January 2011 and, subsequently, issued a *Final Long-Term Management and Storage of Elemental Mercury Supplemental Environmental Impact Statement* in September 2013.

DOE is currently preparing the Congressional report as required by the Consolidated Appropriations Act of 2016, which will include a rough order of magnitude cost estimate for new construction of a mercury storage facility, and an estimated fee structure to fully recover the costs of operations and/or construction of such a facility. Additionally, DOE has initiated the planning and project management activities in accordance with DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets.*

Ms. KAPTUR. Ok. And what about the storage fees? Are you saying Legacy Management is the one that will take care of that as well?

Ms. REGALBUTO. Yes.

[Additional information follows:]

No. The Office of Environmental Management is preparing the Congressional report which will include an estimated fee structure to fully recover the appropriate costs of operations and/or construction of a facility for long-term storage and management of elemental mercury.

Ms. KAPTUR. Ok. Thank you for that clarification. I have other questions, but I am sure the chairman does as well, and I will.

Mr. SIMPSON. Back to WIPP, we like to jump back and forth and around. It has been stated that when WIPP resumes operations, it will do so slowly, and we have heard there may be as few as five shipments a week for several months or even years. At Idaho in particular, there are hundreds of canisters of waste packaged and ready to be shipped to WIPP. Which waste will go to WIPP first? And with the improvements that you have to make to your packaging procedures, do you anticipate any of the waste at Idaho or other DOE sites will need to be repackaged? How long will it be before DOE catches up on all the true waste commitments, and

particularly, how soon should DOE begin shipping waste out of Idaho to get through the backlog? What is WIPP's planned timeline for returning the pre-2014 rate of shipments?

Ms. REGALBUTO. Thank you for your question. We do take WIPP starting to take care of the backlog very seriously. Let me walk you through a couple of things that are being done.

In 2017, we requested sufficient funds for five shipments a week. That is, to give you a comparison, in our heydays, it was 17 shipments a week. With that, the purpose of doing that, and the reason why we cannot do 17 is because we don't have full ventilation capacity. So this is a slow ramp.

Mr. SIMPSON. So that is what they mean when they say partial——

Ms. REGALBUTO. It is a partial.

Mr. SIMPSON. —opening?

Ms. REGALBUTO. When the full ventilation capacity comes into effect, then we can resume full operations, which is our goal. How do we determine WIPP? So there is a number of things that happens. One is, as part of the accident investigation report, and the fact that we need to go and relook at what is packaged and how we are going to package, we have done a number of scans throughout the complex and see if there is anything in there that could be concerning, right.

So that is ongoing right now. And we have what we call the TRU Corporate Board where all the stakeholders who generate transuranic waste are part of the TRU Corporate Board, and they collectively determine what is the best way to do this. They met about a month ago, about 3 or 4 weeks ago. And the collective recommendation is that we are going to do what we call a weighted average. Basically, those who have the most get the majority of the shipments. Those who have less get the least amount of shipments, and we start moving things from all the sites.

As you mentioned, Idaho has the greatest number of transuranic waste in the complex, so the weighted average is higher for Idaho, basically because of the amount of material that is currently stored. And if we look at the snapshot chart in here, you will see there is a little bit of transuranic waste generated, remote handled, that is all in Idaho. So we will be able to support those.

Our plan is to increase operations as soon as the ventilation is up and running. So we will need to have, for full operations, we do need to have the complete ventilation.

Mr. SIMPSON. Again, will any of these canisters that are already packaged have to be repackaged? Do you know?

Ms. REGALBUTO. From the quick scan that I have seen people doing, it is really more about what we call by waste streams. And also some waste streams in Sandia National Lab does and Los Alamos, also, but none of the other sites. We have a complete inventory of everything and we know exactly what waste stream was what and where it is. So some of them, they are suspicious if you want to call it that way, haven't been packaged. So that is an advantage. There is a small percentage of some that we will be a little more careful and set aside, but they are not in the giant number of dollars.

One thing that we are investing in and we hope this technology pays for us is currently all we do is do an x-ray, and an x-ray just gives you a limited information. But if you ever had a CT scan, and I don't know if you have had the opportunity to, but I have.

Mr. SIMPSON. Yeah, I have enjoyed those.

Ms. REGALBUTO. So a CT scan gives you significantly much more information. And so we already have CT scan technology in Homeland Security for cargoes that go in and out of our ports and we are actually building a prototype to scan our drums using a CT scan. So that will give us one more sense of confidence of what goes in there.

Mr. SIMPSON. Does the ventilation system that currently exists for partial opening, would that be sufficient to address a problem that might arise should another container decide to expand beyond its ability to hold it?

Ms. REGALBUTO. Yes.

Mr. SIMPSON. Explode?

Ms. REGALBUTO. Well, first of all, we hope we don't have that, but our strategy is not based on hope.

Mr. SIMPSON. We hope we didn't have the first one.

Ms. REGALBUTO. Our strategy is not based on hope, it is based on what we have, right. So we are being extremely careful. And I jokingly say I wouldn't want to be the first drum going down the shaft because it is going to be really scrutinized. But that is what needs to happen and the ventilation will take in account.

Now, remember that before the incident, we didn't have the ability to detect radioactive—airborne radiation inside the mine. And all of that has changed. So there is all the instrumentation in place to do that.

Mr. SIMPSON. Ok. NNSA's new proposal to start shipping plutonium to WIPP, will that take up any of the limited shipping capacity? And if it is going to be years before EM catches up on its current TRU waste commitments, how will you prioritize the plutonium shipments? And is there any capacity available for adding an entirely new waste stream to the queue at all? And what exactly has NNSA asked EM to do to support its plans for the MOX alternative?

Ms. REGALBUTO. All right. So let me walk you through plutonium disposition. There are two types of plutonium assays, right, one that is a very low assay, which is waste, and the other one is pit material, which is very high assay. We have already disposed at WIPP low assay plutonium material because it is transuranic waste. So you have uranium on the periodic table and then you move to the right, so plutonium, neptunium, americium, and curium, so there is plutonium there, right.

And that has already been—happened in an assay. They put an environmental impact statement a year ago in April, and they did select the preferred method for 6 metric tons. Again, that is low plutonium assay, which we already have disposed.

If they decide to go on record of decision, and they will have to down blend, terminate safeguards, and package, which will take a number of years, and then they have to go to the queue. So the queue is determined by the stakeholders in the TRU Corporate Board. So unless somebody else is willing to give their spot, right,

so they have to go to the queue as everybody else is in the queue. So that is where we are with the potential situation.

Mr. SIMPSON. So you are saying that with the proposal currently by the Administration to down blend and package this stuff and ship it to WIPP, it won't delay the schedule of things that are already scheduled to go to WIPP?

Ms. REGALBUTO. Right. Those are higher priorities. You have to go to the queue.

Mr. SIMPSON. Ok. Again, what is EM? What has NNSA asked EM to do to support their plans for this MOX alternative? Have they asked anything yet?

Ms. REGALBUTO. No. The MOX alternative right now, they are looking at options, and WIPP is an option, but also, all other repositories are potential facilities, could be an option. We personally are focusing on initiating waste and placement right now. So we have not done any analysis. That will be done by NNSA.

Mr. SIMPSON. Have you reviewed the results of the red teams and the recommendations on the MOX alternative and do you see any issues implementing that alternative? Stanford University called on the Department of Energy to perform a new documented safety analysis, WIPP as a result of the proposed disposal of excessive plutonium at that facility. Also, articles have been published and the Secretary has recently testified that researchers at Sandia National Lab had looked further into the safety issues raised by outside groups concluded the risks were overstated. Have you looked at this?

Ms. REGALBUTO. So let me give you a little bit of background. Regarding the alternatives, I am familiar with the document. I read it a long time ago, so I don't have all the details right now in my mind. But I understand that the proposal is to down blend and dispose as opposed to converting to fuel. When one down blends and dispose, you actually take the plutonium assays and you mix it with a lot of other materials, which is classified, but it is a big mixture, right. And then you package and you dispose.

So I did read in the media the concern regarding criticality. And I can only tell you a couple of things, basing it off of my engineering knowledge. And that is, one, in order for you to have criticality, two things have to occur. One is the plutonium molecules or the—not only the plutonium but the fissile material has to see each other. Ok, so they have to be close by. And second, they have to be a neutron generation. Those two things have to happen. So when you down blend plutonium or any fissile material, I mean it could be HEU for that event, same thing. When you down blend, you sparse the matrix, you know, collapsing or crunching or whatever is really not a separations method. So that would not happen.

In addition, you have sodium chloride, which is one of the best neutron absorbents ever. So you don't have any neutron generation and that is why the accident is not credible. So, you know, from a point of view fissile material going critical, it is not like it is a reactor where everything is assigned to go like that. These are passive facilities.

Mr. SIMPSON. Right. Well, and of course, the one study came out and said the idea of WIPP is that everything does get condensed eventually.

Ms. REGALBUTO. It gets collapsed, not condensed.

Mr. SIMPSON. It gets collapsed?

Ms. REGALBUTO. So condensed means that I will have to take——

Mr. SIMPSON. If it doesn't get condensed, how does it get collapsed.

Ms. REGALBUTO. Yeah. So the same way, we have this bottle right, and we squish it and do whatever we want to do, that doesn't mean we physically separate the oxygen from the hydrogen. That takes a lot of effort. So, that is exactly the argument is you can do a lot of things here, but you really have not separated oxygen from hydrogen. And in this case you don't separate the plutonium from the matrix that it is in. It is very difficult. So it is not done by physical crunching or mechanical things.

Mr. SIMPSON. How can there be so much disagreement on, and I don't know how much disagreement there is, but disagreement between professional individuals as yourself and other people that have made these things that say—I mean they essentially said, listen, it is not a matter of if it goes critical, it is when it goes critical. How can they be that wrong?

Ms. REGALBUTO. They are not wrong. It is just the probability. And, you know, there is a probability of something happening, and the way I can equate it to you is, there is a probability that I can grow 5 inches if I go to Mars, too, like the astronaut, right. But unfortunately, you know, my probability is very low that that will actually happen. But it is feasible that I could grow 5 inches if I go to space for 5 years. I think it was 2 inches per year, so maybe I will need to be there 2½. But this is based on probabilities, and some things are more credible than the others. And I think the Secretary mentioned the scenario was incredible given the circumstances. So it is not like a disagreement on the physics of things, it is really on the probability of that happening that is really the disagreement.

Mr. SIMPSON. Ok. Mr. Fleischmann.

Mr. FLEISCHMANN. Thank you, Mr. Chairman. Madam Secretary, I have got some questions about the Manhattan Project National Park. Last November, the Manhattan Project National Historical Park became a reality, one park at three Department of Energy sites: Oak Ridge, Tennessee; Hanford, Washington; and Los Alamos, New Mexico. The park is now being created jointly by the National Park Service and the Department of Energy. My question is why was there no funding in the DOE budget request? And what is the Department of Energy doing to support opening these legacy sites to the public? Further, are there any security issues or new infrastructures that will need to be built to open these previously secret legacy facilities to the public?

Ms. REGALBUTO. Thank you for your question. We are actually very excited about the Manhattan National Park. In 2015, at the end of 2015, Department of Energy signed the Memorandum of Agreement with the National Park Service, which is part of the Department of Interior. And the Department of Interior manages all the park services for us and we are very happy for that collaboration. There are a couple of steps that we are following.

Number one that has to occur—and this is actually a newer learning for me because I have never been in a situation where a national park is being built, so it is kind of learning for all of us.

First of all, we have to have what they call a foundation document and that will be completed in 2016. Once that foundation document is provided that is what the Department of Interior calls the comprehensive interpretation plan and that is scheduled for 2017. You will see these activities and the funding request will come from the Department of Interior, but what is DOE doing in the process as we are going into this path?

What we are doing is we are continuing to execute maintenance and surveillance of the facilities, but we are also rating the sites so that when these plans start being implemented, our timing of how we allow visitors to come into the areas is done properly. Right now I think you are familiar, one of our open sites already is B Reactor and B Reactor has hosted 60,000 visitors in the last 6 years and that is because we cap it at 10,000; otherwise, we cannot do it. It is run by volunteers and community members and we offered the tickets for free and the minute that they are offered, they are gone. If we offer 20,000, we will get 20,000, so we are very excited. We are using our own funds to make sure that these facilities come out to be released to the public at the right time.

Mr. FLEISCHMANN. Thank you. Final round of questions on the uranium D&D fund, Madame Secretary, the Department recently provided the committee with a report on the status of the uranium D&D fund that was directed by the fiscal year 2015 omnibus. It paints a pretty dire picture of the ability of the D&D fund to address projected cleanup costs. The report estimates that the fund "will have a shortfall up to $19.2 billion" and that "without additional deposits the fund is projected to be exhausted in 2022."

The Department of Energy's proposal to transfer a couple hundred million dollars from one fund to another seems to be a drop in the bucket in comparison to the projected shortfall and certainly not a comprehensive solution. I have three questions. What is the DOE's long-term plan for meeting these cleanup costs? Second, how much cleanup work remains to be accomplished? And thirdly, what costs have been updated since the last report?

Ms. REGALBUTO. Thank you for your question. We do share the same concern regarding the lack of funding for the UED&D as we move forward. We do have one thing that we have learned and that is we are about to complete this year the Gaseous Diffusion Facility at Oak Ridge. Our cost estimate is based on actually a job already being executed, which is a really good number. Our projection is that to finish the job at Portsmouth and Paducah is going to cost between 20 and $22 billion. That is the cost.

Unfortunately, when the contributions to the fund were stopped back in I think it was 2006, I can't remember the exact date, but when the contributions were stopped, we didn't really know the true cost of what this job was going to take. The Secretary has been very interested in making sure that we follow the principles of polluter pays and that is something that he feels very strongly. I understand that the Department will be forthcoming with a proposal to the Authorizing Committee and also will come back and

brief you at a later date related to that, but we do have really solid costs. We finished the job and we know exactly what it is.

These facilities are big industrial sites and not only do they have radioactive hazards, they have a significant amount of chemical hazards that we have to deal with. So those are two main things that we have to look at.

Mr. FLEISCHMANN. Thank you, Madame Secretary. Mr. Chairman, I yield back.

Mr. SIMPSON. Mr. Visclosky.

Mr. VISCLOSKY. Thank you, Mr. Chairman. Doctor, I understand you were confirmed on August 6th. Why did you want the job?

Ms. REGALBUTO. I think I am asking myself the same thing. Actually I have to tell you one thing. I have been very passionate about this type of work. I started my career at Argonne National Laboratory back in 1988, and I had just come out of grad school from the University of Notre Dame and I was pregnant with my third child and I needed a part-time job back then and when I requested a part-time job in industry they looked at me like I came from Mars. That was back in the eighties and those were different times, I understand. But I was very fortunate to be able to get a part-time job at Argonne National Laboratory. And my first job that I ever got was working with tank waste at Hanford. We were working with the transuranic—at the time it was Argonne East and West, so Idaho was part of the mix, and we were working with transuranic waste. And the plan was to take the fraction of low activity waste, high activity waste and then one was grouting, one was with petrified. We worked in the chemical process that did that.

Over the years things change in terms of areas, but I also had the opportunity to work in other projects that have been implemented. For example, I was very fortunate to work with my colleagues at Idaho National Lab, Oak Ridge, Savannah River, and Argonne, too.

Mr. VISCLOSKY. You've got your bases covered.

Ms. REGALBUTO. Yeah. Well, are you all from here? Ok.

Mr. VISCLOSKY. If my——

Ms. REGALBUTO. And we did all the cleanup work that is now the basis for SWPF at Savannah River. So I really believe in these efforts.

Mr. VISCLOSKY. I believe that you do and I appreciate as a Notre Dame grad myself——

Ms. REGALBUTO. Oh, really?

Mr. VISCLOSKY. Yes. She is acting like she did not know.

Ms. REGALBUTO. No, no, I really did not know.

Mr. VISCLOSKY. She is acting like she did not know, Mr. Chairman.

Ms. REGALBUTO. I am going to have to look at your——

Mr. VISCLOSKY. Which explains why you took the job.

Mr. SIMPSON. The next you know she is going to tell us how good the Notre Dame football team is, right?

Mr. VISCLOSKY. No.

Ms. REGALBUTO. No, we do not want to go there. We do not want to go there. No, seriously, I did not realize that.

Mr. VISCLOSKY. Let me—because we have a hearing. But I will tell you, and I am deadly serious, you may have the most difficult job in the United States Government, because I have been on this wonderful subcommittee with great jurisdiction and great member staff for a long time. And I must tell you, every year when we have a hearing on environmental cleanup it is exactly the same hearing.

You reference your time in the 1980s. I have a question on Hanford. I visited Hanford in the last century, and I see the same question here.

I visited those tanks in the last century. On overbudget projects, it is a 5-to-1 ratio as far as those that are not overbudget compared to those that are. On Hanford, again, I see a question on proposed milestones being shifted further to the right when in the last century I visited those tanks and was told this was going along just like sliced bread, which is not your fault, but you are responsible now. I wish you well and trust that you will try to imbue everybody in your Department with a sense of urgency.

I do believe, and we can have a budget conversation all day, that some of this is administration requests and congressional decisions as far as resources. I have had the privilege to be in the chairman's position as well as ranking, that at some point there is a finite amount of dollars. If we do not clean it up this year, we will clean it up this year. Well, I have been saying that since the last century, literally. So I do hope with whatever resources we are allowed to give you—and I know the chairman and ranking are killing themselves to do their very best here, there is no question about that—that you just use every dollar as efficiently as possible.

And I hate to take the commissioner's time. I do have two questions, though.

On Savannah River, on the processing of plutonium, have you looked at the total cost of the investment needed at Savannah River to support the NNSA's plan and the increased operating cost of securing the area? And if so, is the cost one that should be born by your Department or NNSA?

Ms. REGALBUTO. First of all, thank you for your confidence in me on this job and you have my full commitment that we will spend all our money that we are given to the environmental mission job wisely. And just a comment on that is we do not have the luxury of time anymore. Our infrastructure is old and the tanks are getting old. So my sense of urgency does not come from just simply wanting to get this. It is because I understand that we are beyond the point of luxury of time. The tanks are aging and we need to work on that.

Mr. VISCLOSKY. Right. But if I could ask you about the—because I also understand if you are talking about infrastructure that the budget request is a hundred billion below this year's level.

Ms. REGALBUTO. The budget request for EM?

Mr. VISCLOSKY. For deferred maintenance.

Ms. REGALBUTO. For deferred maintenance for us is actually higher. Let me get you the deferred maintenance number. Was that—300, I want to say? Do you have the numbers?

Mr. VISCLOSKY. My understanding is the budget request for deferred maintenance is 100 million below this year's level.

Ms. REGALBUTO. No, let me have them check my number for you.

[The information follows:]

The Environmental Management program manages its deferred maintenance through an integrated facilities and infrastructure budget. Although the integrated facilities and infrastructure budget has several sub-areas that do not address deferred maintenance, overall our integrated facilities and infrastructure crosscut budget request is $15.7 million higher in 2017 than it was in 2016.

Mr. VISCLOSKY. If you could for the record. If we could get back to who should bear the cost.

Ms. REGALBUTO. Yeah, I would be happy to get back to you. I believe ours went up. Specifically, at Savannah River we increased—okay, what is the first—that one went down. Ok. Oh, that is the backlog. So we do have an investment in infrastructure and the investment in infrastructure is half a billion for EM across four sites: Carlsbad, Savannah River, Richland operations, and WTP—well, ORP. So those are the four and it is half a billion. It is 500 million for that. This is the backlog, unfortunately. Unfortunately, the backlog grows every year, which is a sad part.

Mr. VISCLOSKY. Who should bear the cost?

Ms. REGALBUTO. For Savannah River, we added an additional 30 million in infrastructure because we have some finance from the defense board in some of the buildings that were high issues.

Mr. VISCLOSKY. But on Savannah, and I appreciate that, I guess my second question was on deferred maintenance. Do you have an estimate on the increased operating costs? And again, do you believe that is your responsibility going forward if it proceeds or is that NNSA's responsibility?

Ms. REGALBUTO. So anything that is fuel take-back programs and things that NSSA has the purview, it is their responsibility to provide the funding for us to do so.

Mr. VISCLOSKY. For theirs, okay. All right.

Ms. REGALBUTO. Yes, it is.

Mr. VISCLOSKY. Thank you very much. Good luck. Thank you, Mr. Chairman.

Ms. REGALBUTO. Thank you.

Mr. SIMPSON. Ms. Kaptur.

Ms. KAPTUR. Thank you very much, I appreciated Congressman Visclosky's emphasis on the amount of time this is taking. I wanted to ask about the funding for the environmental management program and how many of the milestones or those that you anticipate to miss over the next few years are strictly funding related and how many are due to other issues and could you discuss those issues?

Ms. REGALBUTO. Yes. Thank you very much. As I mentioned, a milestone is something that we take very serious. It is our commitment to the State and the stakeholders. At the point that any milestone is at risk we inform the State and the stakeholders that this will happen. We will enter into a period of negotiation in trying to address it. Some of the milestones are technical issues and some of the milestones are strictly funding, as you mentioned. I will say the majority are funding and to a lesser extent technical issues.

Ms. KAPTUR. I want to ask a question about the reindustrialization of cleanup sites, Doctor. As you make progress on the cleanup of the Manhattan Project sites, we always face the issue of how communities cope with that change and DOE is the primary em-

ployer at most of the cleanup sites, because those sites were initially located far from habitation. What can DOE do to promote future industrial or other uses of these cleanup sites? How early should that planning begin? And are there any examples you can describe where you think DOE has done this or other Departments have done this well?

Ms. REGALBUTO. Yes, we do recognize that we were number one employer, right, during the Manhattan Project and, yes, all these sites tend to be remote because that is how they got picked, right? One of the good examples that we use is Oak Ridge, at least from the EM point of view, where we really have worked with the community through the community reuse organization. Another very good example is Richland in Hanford where we have already released a significant amount of acres of our land to industrial revitalization. I will say the sooner we initiate conversations with the community, the better it becomes.

Also, we do respect that the community sometimes has a desire for us to initiate cleanup in a slightly different sequence because they have a reuse program in mind, and when that happens we work with the community in going to the priorities that allows them to release the land or use the land sooner.

At Oak Ridge, we were still doing D&D for the East Tennessee Technology Park and, at the same time, we have a number of small businesses moving in, so we coordinated that as we work our way out of the demolition jobs.

Ms. KAPTUR. I really appreciate your openness to this and as I said at other meetings, I think one of the greatest weaknesses of the Department of Energy because of the way that it was set up is that it doesn't think about place and I have often wondered whether it does need additional authorities to do that. This Secretary is trying very hard to think that way.

And if I look at Ohio and the Piketon area and the D&D activities that are anticipated there, those are probably the highest unemployment counties in Ohio. So as this ratchets down one of the difficulties DOE really has, in my opinion, is working cross-departmentally, across the Federal establishment, to work with the Department of Labor, let us say, several of the trades that are onsite, looking at some of the new clean energy initiatives. I do not know what those counties would want to do. I don't represent those counties, but I really think that our country could do a much better job of transitioning these people and communities.

We saw this in the coal situation where because of the mothballing of old coal-fired utilities you have entire States, our chairman from Kentucky, Mr. Rogers, experiences this firsthand. And Ohio, southeastern Ohio, is a tragedy in terms of what has happened in that industry, but it seems like we cannot catch up to ourselves. It is like we are too stovepiped at the Federal level.

So as you work through this, if you have recommendations to us on additional authorities you might need, I think you could sign interagency agreements. I am not sure you need any additional authority, but it just seems to me that the Federal Government is too far away from where people live and you have such massive responsibilities just on the technical side, this really is not in your portfolio exactly.

But it sure would be fine to see a way of approaching these communities, as you say, that we plan ahead, we work with the people there, and we do our best to minimize damage to human beings and their livelihoods. So I want to encourage you on in those efforts and I thank you for listening to that.

I wanted to ask one additional question in this round on the Manhattan Project National Park, which is our newest national park authorized by the 2015 Defense Authorization Bill actually, and there was no funding. And my question is what is DOE doing to support opening these legacy sites to the public and are you paying for the cost of the national park? And is this a cost, as we believe it is, of the Department of Energy instead of the cost of the Park Service?

Ms. REGALBUTO. As you mentioned, we reached the agreement with the Department of Interior on the National Park Services in 2015, and actually that was really a great opportunity for us to get kickstarted. I know that many people worked very, very hard over the years to make this happen.

In 2016, we have to combine it and it is led by the Department of Interior. We have to deliver the foundation document. And this is all news to me because I am used to a NEPA process and surplus and whatever, but they do have a process, too.

And after the foundation document is delivered, then they have what they call a comprehensive plan. And in the plan is where it spells out what is going to be needed, the funding, and the likes. This will be part of the Department of Interior.

With that said, we also have responsibilities on the EM side, and that is we continue surveillance, we continue to execute the mission so those parcels of property become ready for public access, and our job really is to coordinate as Interior moves forward to make those pieces of property available.

We also have the responsibility for long-term surveillance of any of the sites because of the type of materials that were present in the past.

I was mentioning before, the B Reactor in Hanford has received already 60,000 visitors in 6 years. That is already open to the public. If we could give more tickets, more people would come. It really is a destination area, and we have busloads of folks coming in who want to see the reactor.

So, that one is already ongoing, and it will be folded into as part of the Manhattan Project National Park, but some areas are already open. We are very happy for that.

Ms. KAPTUR. So, on the Manhattan Project National Park, how is that cost-shared? Is it half and half, if you look at the total cost of operating those?

Ms. REGALBUTO. The cost of operating will have to be negotiated after they have the comprehensive plan, but we are responsible for cleaning the sites. So, what we spend is money that is used to clean up our sites.

Ms. KAPTUR. And what are you paying—what are you asking for this next fiscal year of 2017?

Ms. REGALBUTO. It is not a line item. It is embedded in the operations of Richland, Oak Ridge, and Los Alamos, for whatever pieces we are responsible for. So, if our job is to do surveillance, it would

be embedded in there, but if you would like us to give you some more detail, I will be happy to do that.

[The information follows:]

The Department of Energy is responsible for sites within the Manhattan Project National Historical Park at Richland, WA; Oak Ridge, TN; and Los Alamos, NM. At these sites, the Office of Environmental Management is currently responsible for funding the surveillance and maintenance of the B Reactor at the Hanford Site in Richland and the Graphite Reactor at Oak Ridge. The budget request in FY 2017 for surveillance and maintenance of these facilities is about $2.5 million. This funding covers not only surveillance and maintenance activities, but also facilitates public access for visitors. The Office of Environmental Management has no current responsibilities for maintaining facilities or coordinating visits to Manhattan Project National Park facilities at Los Alamos.

Ms. KAPTUR. I think that would be very helpful to us. Are all those facilities safe for public access?

Ms. REGALBUTO. We do not open the whole site. We only open segments of the sites, and we have to make sure they are available, 100 percent safe for the public to come. Otherwise, we cannot use those facilities.

Ms. KAPTUR. Will you have to build new infrastructure?

Ms. REGALBUTO. No, all is existing. So, if you have a chance to go to B Reactor, you actually get to go to the control room with the original furniture that was in there. Of course, we removed all the radioactive materials and the like, but there is really no cost, and it is usually manned by volunteers who used to work in those facilities. The tours are very good. They are really, really good.

Ms. KAPTUR. Thank you very much.

Mr. SIMPSON. I always ask this question, for the last 15 years or so. How are we progressing about moving facilities to EM that need to be moved to EM and getting them out of the laboratory part of the budget?

You know, I am smart enough to understand that the laboratory people would like to have that moved to EM and have the responsibility go to EM, but the money to stay.

My concern is, I want to know what our total responsibilities are on EM and what our reliabilities are on EM, so I want those things moved to EM that ought to be done by EM.

Over the years, we have been trying to move that process along. How are we doing with that?

Ms. REGALBUTO. So, right now, we have not moved any new facilities to the EM side in the last few years, mainly because of budget constraints. So, once you get into——

Mr. SIMPSON. But the budget constraints—this is paper stuff. It is money that we are spending somewhere right now. What I want to know is what is our liability in the future.

Ms. REGALBUTO. Yes, somebody owns that liability no matter what; yes.

Mr. SIMPSON. Right.

Ms. REGALBUTO. I do not know the exact amount until the report comes out, which will tally out the total liability regardless of who owns it, as to your point. We will come back and brief you on that. That exercise is ongoing, and that was one of the number one priorities, the Secretary wanted to know how much is still there, regardless of what office it does belong.

So, we will have to come back to you, but it is part of this——

Mr. SIMPSON. Ok. Then we can make a determination about where it belongs, so we know what our total liabilities are in the future. That is what we have been trying to accomplish over the last several years.

One final question for a colleague that is not here today, but I am sure I am going to be asked about it by that colleague and others.

The largest reduction in your budget request is for the Richland Site office which is reduced $206 million below last year's. Why such a steep reduction, and can DOE fulfill all of its commitments to clean up the River Corridor at this funding level? DOE recently proposed shifting some clean up milestones for Richland back in order to concentrate on a tank mission at Hanford. Has the State weighed in on these proposals?

Ms. REGALBUTO. Thank you for your question. First, the request is $800 million, which is, you know, $190 million below the appropriated funds from last year. We do have a significant amount of carryover from the bump up we got the year before.

Still remaining in the funding is areas of significant progress that we have done, and in order to do risk reduction, so PFP will be completed to a slab-on-grade this year, it will be done, and as you remember, it was the number one most dangerous building in the whole complex. So, we are very happy to have moved that one off the list.

We also continue to do cesium and strontium capsule packaging in order to get it out of the old building, and the infrastructure is going down, and we will get out of there.

In the same process, we are moving sludge out of the River Corridor, so we are packaging, procuring equipment, and initiating operations in order to start moving that area's sludge into the Central Plateau. So, that is still funded.

We have also the 324 building, we are still working on the technology development for the soil underneath, and that will be done this year, so we can initiate that. The 618–10 burial grounds, we are also working on some of the vertical pipe units. So, that is ongoing.

We recognize it is less than the appropriated funds from last year, but it is not at the expense—we really do look across them, and there are other sites that——

Mr. SIMPSON. So, is it accurate to say you do not anticipate any layoffs at Richland based on this budget?

Ms. REGALBUTO. Not as of today.

Mr. SIMPSON. Let me ask, do other members have questions? Do you have more questions? I have to leave for a meeting. My Vice Chairman is going to take over here. Thank you for being here.

I think what Mr. Visclosky said is absolutely true, you do have the toughest job in the Federal Government. Like most tough jobs, all of us that sit on the sidelines could do it better. That is the way we usually think, you know.

Ms. REGALBUTO. You are welcome to come and help.

Mr. SIMPSON. We are great armchair quarterbacks. Thank you for the work you do, and we look forward to working with you.

Ms. REGALBUTO. Thank you very much. Thank you, sir.

Mr. FLEISCHMANN [presiding]. Madam Secretary, hello again. I am going to defer to the ranking member, Ms. Kaptur.

Ms. KAPTUR. Thank you very much. I think it is important for the record, for those who may be listening to our words, that your request for close to $6 billion this year actually constitutes a very large share of DOE's entire budget, much larger than other programs. I think of weatherization of $270 million. So, this is a very, very important office that you head.

In terms of overbudget projects, it is my understanding that Environmental Management has about $15 billion worth of ongoing projects that are still considered to be either behind schedule or overbudget, and many of those do not have a valid project baseline against which project performance can be measured.

For instance, there have been some references made to this, the Waste Treatment Plant, the most expensive project in the entire Federal Government, was last estimated in 2006 to cost $12.3 billion, and that was before DOE became aware of major design flaws. What is the current estimated cost for completing that project?

Ms. REGALBUTO. Thank you for your question. We do share your concern regarding project management and escalating of costs. This has been something that the Secretary has taken very seriously, and we have a number of initiatives that we are putting forward, including new project oversight, specifically WTP.

We have an owner's rep that was recommended in the past for us to hire, so we hire persons to oversee WTP. We also have a revision in cost estimates and also assessment fees for performance, which is supporting the Secretary's strategy.

Regarding WTP, the cost is still listed as $13 billion, as you correctly pointed out. We are in the process of rebaselining that cost estimate, and that is really because we are taking out of the original contract—which was really all WTP—taking out the phased approach, which includes the Low Activity Waste, the Balance of Plant, meaning the infrastructure needed to support that, and then the labs, so we can initiate that project by 2022.

We are engaged in negotiations with the contractor, we are about to finish those negotiations, and once those negotiations are completed, we will rebaseline and we will provide that information to the committee.

Regarding the rest of——

Ms. KAPTUR. May I ask, why does it take until 2022, just lack of money?

Ms. REGALBUTO. To initiate the facility? To commission the facility, yes, 690 per year. We have to distribute those costs. That is the target date for operations.

Ms. KAPTUR. So, you cannot really state the current estimated cost for completing the project?

Ms. REGALBUTO. Once we finish the negotiations with the contractor, which should be very, very soon, we will come back and provide that information to the committee, but it will be rebaselined, yes.

Ms. KAPTUR. Do you expect it to go up?

Ms. REGALBUTO. Yes.

Ms. KAPTUR. A lot?

Ms. REGALBUTO. Yes.

Ms. KAPTUR. Thank you very much. Let me ask you about replenishing the Uranium Enrichment Decontamination and Decommissioning Fund. The Department recently gave the committee a report on that, and it states that the fund will have a shortfall of up to $19.2 billion, and without additional deposits, the fund is projected to be exhausted in 2022.

Your Department's proposal is to transfer a couple hundred million dollars from one fund to another. It seems to be a drop in the bucket in comparison to the projected shortfall you will be facing. Your proposal does not seem to be a comprehensive solution.

What is DOE's long-term plan for meeting these cleanup costs?

Ms. REGALBUTO. So, thank you for your question, and we do share with you the fact that these costs are significantly higher. One of the areas, as I mentioned, is we will be completed with the first gaseous diffusion facility at Oak Ridge.

So, we now know the true cost of what it takes for these facilities, and then we have Portsmouth and Paducah, which are very similar, all three facilities were almost identical. The to-go cost for those two facilities is anywhere between 20 and $22 billion. This is based on real work that we did at Oak Ridge.

Ms. KAPTUR. All of them?

Ms. REGALBUTO. Yes, the two sites, Portsmouth and Paducah. Recognizing that, unfortunately, when the contributions to the UED&D Fund stopped by the people that use those enrichment facilities, we did not really know the cost of this job. So, we stopped it too soon.

There has been some estimates that it is about a quarter of a million per kilowatt hour, which is really the fair cost of doing the decommissioning of these facilities, and the Secretary has proposed some language, and the department will be forthcoming with these proposals, but basically going back to the principle that the polluter pays.

So, it is a combination of not having the complete costs at the right time when we stopped the contributions to the fund.

I do understand the concern, and once we start moving into this area, I will be very happy to work with you and the committee because we do need a long-term plan for these facilities.

The workforce needs to be stable, and one of the reasons why we are looking at this proposal is to provide some stability and funding at least for a few years until we really fix the big problem, which is the 20 to $22 billion. It is important that we proceed with this.

These are very large complexes, they are almost little cities, the two of them are little cities right now.

Ms. KAPTUR. What was your reference to trained individuals to do the job? Could you expand on that?

Ms. REGALBUTO. Yes. We do have a number of things that we would like to implement, and one is training as the number one priority. We do have a very good workforce and they are coming from other facilities, especially in Ohio, that we can train to do the kind of work that we do.

We also have a very nice initiative which is a robotics initiative, and it is our view that the same way we transfer a lot of the knowledge in robotics from Homeland Security to the police departments, we can do that in the environmental management arena.

So, we are working with some of the employment groups. In fact, we will be visiting Sandia next week, because they were the ones who did this for the police department, so the goal is what we call the "safety of science," but it has to be driven by the workers, not by us, right, because the workers know what tools do and what tools do not benefit them.

There are a number of tools that we have that are really much more modern, and make their quality of life significantly better. What I like the most is it allows them to transfer this knowledge to other areas, so we joined the National Robotics Initiative.

I will give you an example. The same prosthetics that were used and are targeted are used by the National Institutes of Health, because the population is getting older and people have to lift patients and the like, so the same exoskeleton that is used to lift is what we will use to lift a piece of equipment.

Once they are trained in that area, they do not even have to stay with us, although I wish they would, because we pay for them and train them, but they can actually get jobs outside.

Ms. KAPTUR. Does your training account for part of the basic budget or is it a separate account?

Ms. REGALBUTO. It is under technology development. We also joined the National Science Foundation. There is some money there, go directly to universities. The goal is to have a workers, the universities, and the national labs triangle.

Ms. KAPTUR. Is there a way your Department or your office could provide to us the types of workers? How do you categorize the skills or the hiring categories? Are you able to do that, the kinds of workers you need to train?

Ms. REGALBUTO. You know, I am sure we can find that out. I am not familiar with those statistics. I can check for you.

One of my goals is really to remove the amount of hazards that a worker has to face in a single day. So, to give you an example, in the U.K., when you walk into a facility that is contaminated, the first crew has to go and find out where all the hot spots are. That is a risk. Those are the first ones that go in.

In the U.K., they put little drones in and they map the room before they go in. That is the kind of thing that we would like to teach our workers to use themselves in order to go into a facility without putting them in hazards which is unnecessary with technology.

Ms. KAPTUR. Do you know how many of your workers are union workers?

Ms. REGALBUTO. A significant amount of them are.

Ms. KAPTUR. I am interested because one of my interests for the Department as a whole is to get a better relationship between the training academies of these various skilled trades, and what tends to happen with the Department's relationships is they go to community colleges and universities, and I am not against that. However, in our part of the country, we have major training academies, whether you are a plumber and pipefitter, whether you are an electrician, whether you are an ironworker, where they are teaching.

It has been my experience with the Department of Energy that they do not even realize—they do not even have a list of where these academies are. That was shocking to me, particularly in the

area of nuclear power where it was, in fact, these trained workers, not because of the Department of Energy and not because of the local energy company, but because of the building trades that trained these workers, that literally saved thousands of lives in my part of the country because of what they detected in a faulty plant, nuclear plant.

So, somehow we have to figure out a way of at least introducing the Department to the leaders of these academies, and if you are open to that, in terms of your skills training, I would love to find a way for you to meet some of them, where they are actually operating schools, big ones.

Ms. REGALBUTO. I appreciate the comment of the disconnects because we do have periodic meetings with the building trades. I am not sure if you are familiar with HAMMER, our facility in the State of Washington, and the National Training Center. Those we do jointly with the trades.

What we are working on right now, and it will be ready roughly in a month, is one of the things we noted and it has been brought up to us by the building trades, is the ability to move from job to job, and the fact that you have to be qualified, so we are merging those two. And we are going to have the cost of reciprocity, where you reciprocate training that you took in one area to another, so I personally am taking Worker I and II, and so are they.

It also allows us to have a population of workers that are already certified and the skill set is ready.

Ms. KAPTUR. Right.

Ms. REGALBUTO. So, we are working with the unions who are part of the National Training Center and HAMMER. With that, we also recognize that geographically, sometimes it is difficult to go out west or southwest, and they also have themselves some of these other training academies.

We have a very successful program in Aiken with Aiken Community College, where we actually certify people to go work in the nuclear industry. We started that because there was a shortage of workers, because they were all going to work for the reactor operator for the AP–1000.

So, we would train people and they will go work in this other area. We started a center, which has been very successful. We can duplicate this model, obviously with the caveat that every community has different needs, but through the community colleges is a very successful way to do this. A lot of the training can be done there.

We also have for the first time this year what we call a "trainership program," and the Secretary initiated a trainership program. We put it out for competition. The university will be announced. That is also to bring people to work with us that do not have traditional backgrounds.

So, if you were an electrical worker, trained, you will have a background on nuclear, so you understand the hazards, with the understanding that we need mechanics, electricians, everything, not just people in the waste packaging arena.

So, we are expanding because our population is aging, and we are going to need to replenish all our workers in the next 10 years or so.

Ms. KAPTUR. Well, if you are ever flying over Ohio, I would ask you to parachute down, and I would like to introduce you to some incredible workers whose training was amazing in what they did and their bravery in a couple of situations that was historic.

I do not think they get the kind of recognition that they deserve, so it might be really interesting to host a meeting at one of these training academies, I would say probably the electrical, because there are two parts to the electrical union, and one works in nuclear power plants.

Just to put on the record, what motivates me is that they were aware of certain things happening in this particular plant, and ultimately, it was not under your jurisdiction, it was the Nuclear Regulatory Commission, but the plant had to be shut down because the head on the reactor was subject to coming off.

As the NRC began investigating what went wrong, they followed where these workers had stayed in various hotels, and there were nuclear particles in the hotel rooms. These people were carrying nuclear particles themselves.

So, it is the new century—actually, it was at the end of the 20th century, and this is how we continue to treat workers in America. I am really driven on this.

I would just like to watch an interaction between some of your representatives with some of our training academies to see if we cannot do a better job, and giving them a pathway to work with the Department of Energy more directly.

What tends to happen in our area is if the community colleges are involved in training, they hire these people to do the training. I do not sense that there is that direct a connection with the Department of Energy in our region of the country. Maybe it is different in Indiana, maybe it is different in Tennessee, but I would just make that request.

Ms. REGALBUTO. I would be very happy to parachute and come over and visit. We are very sensitive to developing the next generation of the workforce. A very large percentage of our workforce, about 40 percent, can retire today. They will not have the benefit of the training that we had, working in these facilities when they were in production mode.

So, we take very seriously who is going to be here in the next 10 years. I would be more than happy to do that, and there are other people in the department that will be very interested in doing this, too.

Ms. KAPTUR. Thank you. I do not want to inconvenience you, but when you find the right person, please let us know.

Ms. REGALBUTO. Yes, we will definitely put them in touch.

Ms. KAPTUR. Thank you.

Ms. REGALBUTO. Thank you.

Mr. FLEISCHMANN. Thank you, Ranking Member Kaptur. Mr. Visclosky, do you have any questions?

Mr. VISCLOSKY. No, thank you, Mr. Chairman.

Mr. FLEISCHMANN. Madam Secretary, in closing, again I want to thank you for coming before our subcommittee today, appreciate your answers to these difficult questions, and I, too, thank you for approaching this very arduous task that you have. It is very difficult.

Again, I want to welcome you to the Nuclear Cleanup Caucus, April 20. We have communities, business interests, contractors, labor unions. We all come together to work together to try to solve this problem. As a matter of fact, the Nuclear Cleanup Caucus has become somewhat of a model. I know Ranking Member Kaptur is the national co-chair of the Automotive Caucus, and I am a vice chair, and we are actually using this model to try to make that a much more successful caucus.

I look forward to working with you, and of course, with her, and I thank you for being with us today.

Ms. REGALBUTO. Thank you very much. Thank you, sir.

Mr. FLEISCHMANN. The subcommittee is adjourned.

QUESTIONS FOR THE RECORD

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
HOUSE COMMITTEE ON APPROPRIATIONS

Hearing on the Budget for the Office of Environmental Management
March 15, 2016

ENVIRONMENTAL CLEANUP PROGRAM

RELATIONSHIPS WITH THE STATES

Subcommittee. Dr. Regalbuto, the Department has struggled to maintain good relations at several of the local communities. Uneven funding, missed milestones, and lack of transparency create a great deal of stress with the local workforce and state governments.

What are you doing to improve your relationships with state regulators and the communities as you work through these site by site challenges?

Dr. Regalbuto. The Department of Energy (DOE) is committed to working collaboratively and constructively with its regulators and local communities. We routinely engage our regulators, early and often, to discuss priorities, report progress, and find solutions to challenges we face. The Office of Environmental Management (EM) posts much of its cleanup data and status on its webpage and hosts numerous public meetings with regulators, state and local elected officials, tribal nations, and other stakeholders. Our objective is to solicit feedback on cleanup decisions and ensure that stakeholders have an opportunity to understand our processes and how they can engage within them.

Subcommittee. What will be your approach as the new Assistant Secretary in charge of this program?

Dr. Regalbuto. As Assistant Secretary, I affirm the Department's commitment to work constructively with our regulators and communities throughout the cleanup process. Open dialogue with state and federal regulators, tribes and stakeholders is an essential component of our work to ensure successful accomplishment of our cleanup mission.

FUNDING FOR ENVIRONMENTAL MANAGEMENT

Subcommittee. How many of the missed milestones, or those that you anticipate to miss over the next few years, are strictly funding related, and how many are due to other issues? What are those issues?

Dr. Regalbuto. The Department is actively working to meet its commitments. To the extent milestones are delayed, DOE will follow the provisions in its cleanup agreements for making notifications and working with federal and State regulators regarding schedule adjustments if necessary.

PROJECT MANAGEMENT IMPROVEMENTS

Subcommittee. Dr. Regalbuto, when the Government Accountability Office (GAO) released its High Risk List last year, it reported that they did not observe progress in EM's management of its major projects and that your office was still struggling to stay within cost and schedule estimates for most of its major projects.

Are you satisfied with the amount of progress that has been made in managing EM's major projects?

Dr. Regalbuto. We acknowledge EM has significant technical and management challenges in meeting the cost, schedule, and performance baselines. Learning from those challenges, the Department has moved forward over the last several years to implement substantial improvements in many areas of contract and project management.

The Secretary reorganized the Department placing EM under the purview of the Under Secretary for Management and Performance, which brings directly to bear on EM's project management challenges the Department's strongest project management capabilities resident in the Office of Project Management Oversight and Assessment (PM). The Secretary's project management reforms have repositioned the project review function for EM projects into the Office of Project Assessments, which directly reports to the Office of the Under Secretary for Management and Performance. This structure assures the independence of the review teams.

Also, the 2017 Budget proposes to establish a statutory, DOE-wide Office of Cost Estimating and Program Evaluation (CEPE-DOE) in recognition of a gap in DOE's capacity to independently determine accurate costs of programs and acquisitions within DOE. This proposal advances the Secretary's ongoing efforts to improve DOE project management, a key component of which is to adopt best practices equivalent to those implemented by the Department of Defense (DOD).

Subcommittee. What will be your approach to improving project management within the EM organization and have you made any changes since you took over?

Dr. Regalbuto. My approach is to build on the progress to date by ensuring EM implementation of the recent DOE contract and project management policies and principles endorsed by the Secretary and Deputy Secretary. Since starting in this position, I have taken several steps to apply these policies in the management of EM projects.

I put forward our EM Site Managers for designation as Project Owners with the responsibilities to identify requirements and resources needed to successfully meet cost, schedule, and performance goals and to regularly review project progress against approved key milestones. We have engaged with the new Project Management Risk Committee and the strengthened Energy Systems Acquisition Advisory Board for review of several EM projects in preparation for Critical Decisions.

EM has enhanced the process to be more effective in selecting the appropriate approach and technology for the project by using an independent team to conduct an analysis of alternatives using GAO best practices. For example, an independent analysis was employed for the Low Activity Waste Pretreatment System (LAWPS) at the Hanford Site to ensure that the proper technology will be designed into the system. EM will meet higher technology readiness level requirements for major projects or first-of-a-kind technologies prior to selecting the best alternative. Although not a major project or first-of-a-kind project, we plan to have the LAWPS project achieve a technology readiness level with full scale integrated testing to ensure the system is fully functional and ready for startup to support the Waste Treatment Plant's Direct Feed Low Activity Waste (DFLAW). For higher confidence baselines, EM will ensure projects meet or exceed the levels of design maturity consistent with the Secretary's policy prior to baseline approvals.

As we move forward, we expect our efforts will result in a positive trend in successfully completing EM projects within cost, schedule, and performance goals. EM senior leadership will remain committed in pursuit of this outcome.

CLEANUP SITES

REPORT ON URANIUM ENRICHMENT DECONTAMINATION AND DECOMMISSIONING FUND - PADUCAH

Subcommittee. Dr. Regalbuto, in the report provided to the Committee on the status of the UE D&D Fund in February, it states that the Department plans to initiate D&D at Paducah in fiscal year 2017 with cleanup expected to be completed by fiscal year 2040 at an estimated cost between $9.5 billion to $10.5 billion. However, your budget request for Paducah doesn't mention starting D&D.

Does your budget request still fund initiation of D&D at Paducah in fiscal year 2017 as planned in the report you submitted to the Committee?

Dr. Regalbuto. The FY 2017 Budget Request includes funding to support uranium deposit removal activities in the process facilities and deactivation and site utility optimizations. These activities must be completed as part of the decontamination and decommissioning of the Paducah site facilities.

Subcommittee. If not, when and what are the cost increases associated with each year of further delay?

Dr. Regalbuto. DOE is in the process of developing a life-cycle plan for D&D that will incorporate all of the D&D and remediation activities at the site and the associated costs.

Subcommittee. Is this simply a funding issue or are there other reasons to delay? How much additional annual funding would be needed to start and continue D&D at Paducah?

Dr. Regalbuto. The Paducah Gaseous Diffusion Plant (GDP) was officially returned by USEC to the Department in October 2014. The Department's strategy is to update the previous cost and schedule estimates and integrate remedial action activities with D&D requirements. The steps to be completed include, but are not limited to, the following: (1) completion of the regulatory approval process for GDP building D&D and waste disposition; (2) completion of uranium deposit removal activities and

Technetium-99 treatment activities; and (3) characterization of the GDP facilities to quantify the facility hazardous constituents.

HANFORD FUNDING

Subcommittee. Dr. Regalbuto, the largest reduction in your budget request is for the Richland Site Office, which is reduced $206 million below last year's level.

Why such a steep reduction and can DOE fulfill all its commitments to clean up the River Corridor at this funding level?

Dr. Regalbuto. The FY 2017 budget positions the Department to continue progress at Hanford, which will allow EM to complete demolition of the Plutonium Finishing Plant, continue progress in removing the K Basin sludge from near the Columbia River, and continue pump and treat activities to remediate contaminated groundwater. In addition, the Department will also continue to make progress in remediation of trenches and vertical piping units at the 618-10 burial ground.

Subcommittee. DOE recently proposed shifting some cleanup milestones for Richland back in order to concentrate on the tank mission at Hanford. Has the State weighed in on these proposals?

Dr. Regalbuto. The Richland Operations Office has successfully completed additional negotiations with the State of Washington and U.S. Environmental Protection Agency to revise milestones for the ongoing cleanup of Hanford's Central Plateau. The proposed milestones are currently being finalized based on feedback and comments received from stakeholders and Tribal Nations. These revised milestones establish a schedule and activities that support the continued, visible achievement of cleanup work on the Central Plateau while remaining in alignment with the cleanup priorities of the agencies, stakeholders, and Tribal Nations at Hanford.

EM COSTS OF NONPROLIFERATION ACTIVITIES AT SAVANNAH RIVER

Subcommittee. Dr. Regalbuto, the Department issued an amended record of decision to expand operations at H-canyon at Savannah River in order to receive and down-blend fuel from Canada as part of the 2012 Nuclear Security Summit. NNSA recently published an Environmental Impact Statement to ship an additional 900 grams of plutonium to Savannah River as part of the nonproliferation material removal program.

What costs are being assumed by the EM program to store, process, and ultimately dispose of this waste?

Dr. Regalbuto. The materials discussed above are not characterized as waste when they arrive in the United States, but rather nuclear materials.

DOE has entered into two separate contracts with Canada. The fees from these contracts partially offset the cost of receipt and management of this material. The Department is responsible for the storage and disposition of this material.

Canadian Shipment of 1000 fuel assemblies used in National Research Universal and National Research Experimental research reactors (NRU/NRX):

- In March 2012, a contract was established for the receipt of 1000 fuel assemblies used in Canada's NRU/NRX research reactors. In accordance with the fee structure for the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program, the contract will collect $23M in fees to help offset the cost for the receipt and management of this material.

Canadian Shipments of 6,000 gallons of Target Residue Material:

- In September 2012 (subsequently modified in March 2013), a contract was established for $60M for the receipt, processing, and down-blend of approximately 6,000 gallons of HEU, comprising the Target Residue Material, subject to completion of all National Environmental Policy Act requirements for material acceptance. This fee would cover the cost of modifications required for relevant SRS facilities, as well

as for the processing of the Canadian nuclear material for disposition. DOE has received $53M as of May 2016, from Canada for this project, but shipments have not yet initiated, and therefore have not processed any target residues. Please note that $51M of those funds have been expended to modify H-Canyon facility to be able to receive this material and to maintain staff capabilities. The contract allows the Department to collect $3.75M per quarter, if the shipments continue past August 2016, until the last quarter in which the last shipment is completed (currently projected by end of FY 17).

The above-mentioned materials will be co-processed with other aluminum-clad SNF at the Savannah River Site and are covered by the Department's Amended Record of Decision (AROD) signed on March 29, 2013.

900 grams of Pu:

- The amount of plutonium covered by the recently published Environmental Assessment for Gap Material Plutonium – Transport, Receipt, and Processing (December 2015) is 900 kilograms not 900 grams. The Department charges our foreign partners a fee for incremental cost recovery for receipt, handling, characterization, storage and preparatory activities for disposition. This is estimated to be $100,000 per kilogram of fissile material or a minimum of $250,000 per shipment. If the plutonium is in an alloy or mixed form, EM determines the fee on a case-by-case basis based on the characteristics of the material.

Subcommittee. Most of the materials being shipped to Savannah River are from high-income nations. Does their contribution pay for the full costs of these activities?

Dr. Regalbuto. Fees collected for irradiated Spent Nuclear Fuel (SNF) received from "high-income economy" countries participating in the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program are determined by the published fee policy in the Federal Register (77 FR 4807). The fees do not cover the full cost for receipt and management of the SNF received at SRS, but helps DOE/EM offset a portion of its operation costs. The fee policy was developed in 1996 when the program was first established and was updated in 2012. DOE estimates that it has received over $200M from

"high-income economy" countries since the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program was established in 1996.

As noted previously, the fee for plutonium material to be paid by the countries is estimated to be $100,000 per kilogram of fissile material or a minimum of $250,000 per shipment. If the plutonium is in alloy or mixed form, EM determines the fee on a case-by-case basis based on the characteristics of the material.

Subcommittee. How much funding does the NNSA or other countries contribute to these costs?

Dr. Regalbuto. NNSA pays the costs for shipping the SNF from "other than high-income economy" countries participating in the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program. In addition, NNSA has provided EM at the Savannah River Site with over $20M for infrastructure activities such as the purchase of additional storage racks for L-Basin, expansion of plutonium storage at K-Area, and funds to improve reliability of the electrical power to both L-Area and K-Area. For plutonium material receipts, the funding distribution between NNSA and other countries is negotiated with EM, NNSA, and the foreign country based on the quantity of material, the characteristics of the plutonium, and the number of shipments, as described above when addressing plutonium material.

CONTINUED DEFERRED MAINTENANCE

Subcommittee. Dr. Regalbuto, the Secretary of Energy stated his commitment to stemming further growth of deferred maintenance at DOE sites.

How extensive is the deferred maintenance problem for EM's operating facilities?

Dr. Regalbuto. EM's Deferred Maintenance in FY 2016 is estimated at $1.59 billion.

Subcommittee. What is your plan to work off this maintenance backlog?

Dr. Regalbuto. Continued investment is needed to ensure EM's deferred maintenance decreases. EM is focused on the reduction of deferred maintenance and has worked with sites to identify investments needed to achieve the goal. EM's facilities maintenance and repair budget is used to request funding for making progress in slowing the growth in deferred maintenance. This budget request has increased from FY 2015 ($435 million) to FY 2017 ($502 million).

Subcommittee. Your budget request is below last year's level by about $100 million. How much of your budget request is dedicated to working off this backlog?

Dr. Regalbuto. The budget request for integrated facilities and infrastructure maintenance is nearly $16 million higher in FY 2017 than the prior year's appropriations.

URANIUM TRANSFERS

Subcommittee. Dr. Regalbuto, the Department continues to supplement its appropriations for cleanup at Portsmouth by bartering uranium.

How much funding do you intend to generate for cleanup activities through the use of the uranium transfers in this budget request?

Dr. Regalbuto. We intend to receive cleanup services valued between $112M-$154M through the use of uranium transfers. The range is dependent on the price of uranium when the transfer is made.

Subcommittee. How much longer do you anticipate these uranium stocks to last?

Dr. Regalbuto. At the current rate of 1,600 MTU (metric tons of uranium) being transferred per year for cleanup services at Portsmouth the stockpile of excess natural uranium, if all is usable, could last through March 2020. Some of this material was previously cleaned of Technetium-99 ("Tc-99 material") and may be unusable due to residual contamination. If that material becomes usable the inventory will provide barter for the entire calendar year 2019 and the last uranium transfer would take place in the first quarter of calendar year 2020. If the uranium containing residual contamination is determined to be unusable, the last uranium transfer would take place in calendar year 2018.

Subcommittee. What is DOE doing to minimize the impacts on the uranium mining and conversion industries?

Dr. Regalbuto. The Department analyzes potential impacts on the domestic uranium mining, conversion, or enrichment industry and incorporates that analysis into its Secretarial Determination, which sets the timing and amount of uranium that the Department may transfer for specified purposes. The most recent Secretarial Determination for the Sale or Transfer of Uranium covering uranium transfers for cleanup services at Portsmouth was issued on May 1, 2015, and is valid for two years.

WIPP VENTILATION STATUS

Subcommittee. Dr. Regalbuto, air quality alarms recently went off in multiple areas of the WIPP underground, warning of toxic fumes in certain portions of the mine.

What are the ventilation conditions in the underground right now?

Dr. Regalbuto. Current ventilation conditions in the underground are in normal High-Efficiency Particulate Air filtration mode, 60,000 cubic feet per minute airflow, which is safe for workers.

Subcommittee. Is it safe for workers and have there been any medical incidents or work stoppages to date as a result of the ventilation?

Dr. Regalbuto. Air quality in the underground is safe for workers and has been routinely monitored during all Waste Isolation Pilot Plant (WIPP) recovery work. There are a small number of areas at the extreme ends of the underground with no outlet so the airflow historically has been low, even under normal ventilation conditions. In order to address potential poor air quality in these low-flow areas, the Department has established administrative controls that restrict access. These restricted areas can be accessed but only with proper protection, controls, and approval. These controls include extensive pre-planning that includes pre-job ventilation and assessment of air quality conditions before work can be performed.

The WIPP management and operating (M&O) contractor declared a safety pause on February 22, 2016, after workers detected elevated levels of carbon monoxide and volatile organic compounds in two areas at extreme ends of the underground. While several workers may have been briefly exposed to levels that exceeded WIPP volatile organic compound alarm thresholds, these levels are extremely conservative and no medical issues have been identified. It should be noted that WIPP monitoring thresholds for poor air quality are orders of magnitude more conservative than industry guidelines.

The pause allowed time to thoroughly investigate airflow issues while continuing work in the main portions of the WIPP underground that were not affected. On March 22, 2016, the M&O contractor ended the safety pause, and personnel resumed work in the affected areas of the WIPP underground at that time. Lifting of the safety pause was approved by

DOE's Carlsbad Field Office after the M&O contractor completed a corrective action plan that included more than a dozen compensatory actions to ensure issues related to alarm set points on portable air quality monitors were rectified.

The safety pause is a clear indication that WIPP's safety culture continues to improve. The pause allowed additional safety measures to be put in place to ensure workers are protected when they enter areas that have poor air quality. The health and welfare of workers continues to be DOE's top priority as we work towards resuming transuranic waste emplacement operations.

Subcommittee. How long will workers be forced to work in substandard ventilation conditions?

Dr. Regalbuto. Current ventilation conditions in the underground are in normal High-Efficiency Particulate Air filtration mode, 60,000 cubic feet per minute airflow, which is safe for workers.

Subcommittee. What is DOE's plan for completing the upgrades to the ventilation system that are needed at WIPP?

Dr. Regalbuto. The Department will increase ventilation airflow in three phases. The first phase, the Interim Ventilation System (IVS), consists of two High-Efficiency Particulate Air skid and fan units on the WIPP surface that will add 54,000 cubic feet per minute of airflow to the underground, for a total of approximately 114,000 cubic feet per minute. The IVS is required for resumption of operations. It provides air flow at the waste face for disposal operations and increases airflow for ground control and maintenance operations. The IVS is expected to be operational in May 2016. The second phase is the Supplemental Ventilation System (SVS), which consists of an underground fan and a reconfiguration of airflow circuits (e.g., adjustments to bulkheads and airflow regulators). The SVS will increase the total airflow to approximately 180,000 cubic feet per minute. The SVS is not required for resumption of operations, but will be necessary for mining after waste operations resume. The SVS is scheduled to be operational in calendar year 2017. The third phase is the new Permanent Ventilation System, which consists of a Safety Significant Confinement System and a supporting Exhaust Shaft. The new ventilation system will connect to and augment the existing ventilation system, allowing

for increased air flow in the underground repository, which will allow an increased rate of waste emplacement and simultaneous mining operations at WIPP. Critical Decision-1, Approve Alternative Selection and Cost Range, for the permanent ventilation system was approved in December 2015. The Carlsbad Field Office is now in the formal design phase for these ventilation capital asset projects, which is expected to take about eighteen months.

SAFETY OF LONG TERM DISPOSAL IN WIPP – STANFORD RECOMMENDATIONS

Subcommittee. Dr. Regalbuto, the Stanford researchers who published an article in the scientific journal *Nature* recommended that "before expanding WIPP's plutonium inventory, the DOE must examine more carefully its safety assessment for performance" by assessing the safety of storage out to 10,000 years. Their stated concerns were not the severity of the events that led to the shutdown, but the difficulty of predicting what would happen to the waste stored underground over a millennia. There is also the likelihood of future drilling in the area.

There is certainly precedent to this type of long-term analysis - reassessing the safety of waste over a longer period of time caused a certain amount of discussion in the scientific community over Yucca Mountain.

Over how long a period of time were the risks of storing transuranic waste or plutonium in WIPP analyzed?

Dr. Regalbuto. The Environmental Protection Agency (EPA) promulgated disposal standards, Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes (40 CFR 191), to ensure potential releases from a repository would not harm human health or the environment. The compliance period of 40 CFR 191 is 10,000 years. The EPA has repeatedly evaluated the safety case for WIPP over the 10,000 year compliance period, and has determined that the WIPP repository is safe and meets the criteria of 40 CFR Part 191.

Subcommittee. Are you concerned that if the length of time for the safety analysis were to change, there could be different conclusions regarding the safety of storing plutonium there?

Dr. Regalbuto. The compliance period is 10,000 years as promulgated in 40 CFR 191. DOE's evaluations to date have been based on the compliance period set forth in the regulations.

CHANGES TO WIPP WASTE PACKAGING VOLUME

Subcommittee. Dr. Regalbuto, the Final Report of the Plutonium Disposition Red Team contemplates reassessing the volume of waste placed at WIPP by counting the actual volume of emplaced waste instead of the volume of the containers that hold the waste. DOE is assessing this change.

How much additional volume will this create at WIPP?

Dr. Regalbuto. Quantities of transuranic (TRU) waste disposed of at WIPP to date have been based on the volumes of the largest container holding the waste (e.g., 55-gallon drum) and not the actual volume of waste within the container. DOE has not formally estimated the WIPP capacity that would be made available from changing the current method of accounting for waste volume, for both historical and future waste, e.g., it is difficult to project the increase in volume from over-packing newly generated waste in future payload containers. DOE will continue to explore ways to more effectively manage TRU waste.

Subcommittee. Based on your experience with the WIPP regulator, how difficult do you believe such a permitting change would be to achieve?

Dr. Regalbuto. Each permit modification is unique and requires extensive communications with WIPP regulators and coordination with impacted stakeholders.

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