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TRANSPORTING NUCLEAR MATERIALS: DESIGN, LOGISTICS, AND SHIPMENT

HEARING

BEFORE THE

SUBCOMMITTEE ON ENVIRONMENT AND THE ECONOMY

OF THE

COMMITTEE ON ENERGY AND COMMERCE
HOUSE OF REPRESENTATIVES

ONE HUNDRED FOURTEENTH CONGRESS

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TRANSPORTING NUCLEAR MATERIALS: DESIGN, LOGISTICS, AND SHIPMENT

THURSDAY, OCTOBER 1, 2015

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENVIRONMENT AND THE ECONOMY,
COMMITTEE ON ENERGY AND COMMERCE
Washington, DC.

The subcommittee met, pursuant to call, at 10:54 a.m., in room 2123, Rayburn House Office Building, Hon. John Shimkus, (chairman of the subcommittee) presiding.

Present: Representatives Shimkus, Harper, Latta, Johnson, Bucshon, Flores, Tonko, McNerney, and Pallone (ex officio).

Staff Present: Will Batson, Legislative Clerk; Rebecca Card, Staff Assistant; David McCarthy, Chief Counsel, Environment and Economy; Chris Sarley, Policy Coordinator, Environment and Economy; Greg Watson, Legislative Clerk; Andy Zach, Counsel, Environment and Economy; Jacqueline Cohen, Minority Senior Counsel; Tiffany Guarascio, Minority Deputy Staff Director and Chief Health Advisor; Rick Kessler, Minority Senior Advisor and Staff Director, Energy and Environment; Aledander Ratner, Minority Policy Advisor, and Timia Crisp, Minority AAAS Fellow.

OPENING STATEMENT OF HON. JOHN SHIMKUS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF ILLINOIS

Mr. SHIMKUS. If I can get the door closed in the back there, and call this hearing to order and welcome our guests, I will start recognizing myself for 5 minutes for an opening statement.

Good morning, and welcome to today's hearing to examine issues associated with the transportation of nuclear materials. Annually, over three million packages containing radioactive material are transported throughout the United States. Privately shipped items are safely regulated and Federally overseen by both the U.S. Department of Transportation and the Nuclear Regulatory Commission, the NRC. The NRC must approve any package used for shipping nuclear material before shipment. To secure the necessary approval, the package must be shown to withstand a series of accident conditions which are sequentially performed to determine cumulative effects on the package. The rigorous testing and monitoring of these items highlights the lack of technical issues to transport nuclear material.

State authorities also play a key role in the transportation system by identifying highway routes and assuring emergency responders are adequately prepared. Regional organizations such as the Council of State Governments' midwestern office extensively

communicates with the public to prepare communities. They also provide lessons learned from historical nuclear transportation activities to continually improve the radioactive material transportation planning process and public outreach. The successful track record is a testament to the established guidelines and system.

The Federal Government also has a significant experience shipping nuclear material. For example, the Department of Energy ships spent nuclear fuel from Naval ships to Idaho for storage and transports radioactive material across the country for nuclear research and development activities. The DOE has managed thousands of safe shipments of low level radioactive waste for disposal in New Mexico, and even disposes of nuclear material at the Nevada National Security site located directly adjacent to Yucca Mountain.

However, much of the material that is currently shipped is less hazardous and in smaller quantities than high-level radioactive waste, spent nuclear fuel, and defense nuclear waste which must be permanently disposed of. Congress directed DOE to appropriately plan for a transportation campaign to move spent nuclear fuel and high-level radioactive waste for permanent disposal when the Nuclear Waste Policy Act was signed into law in 1982. Yet 33 years later, many nuclear experts recognize transportation may still be the long pole in the tent.

In 2006, the National Academies of Science published a comprehensive report including findings and recommendations to develop and execute a national transportation campaign for spent nuclear fuel disposal.

In 2012, the Obama administration's Blue Ribbon Commission evaluated DOE's implementation of these recommendations and noted much work remains to be accomplished. While DOE has made limited progress, much of the planning has been undone over the last 6 years, and DOE now is treading water by conducting only generic non-site specific planning.

The scale and necessary coordination for shipment will require persistent effort from Federal, state, local, and tribal governments, and the private entities. DOE has planned to transport 3,000 tons of commercial spent nuclear fuel a year, while the fleet of nuclear power plants continues to annually generate about 2,000 tons of spent nuclear fuel. A 2008 life cycle system analysis for the Yucca Mountain project included a $20 billion, 70-year national transportation campaign.

While Congress potentially considers amending the Nuclear Waste Policy Act, we must evaluate whether marginal safety gains from temporary consolidating used fuel justifies the financial cost to transport used fuel twice.

As this committee continues to engage in the conversations with national stakeholders to identify a path forward for permanent disposal of spent nuclear fuel, I hope DOE revisits previous recommendations and lays a foundation for a national campaign.

One constructive step is the recognition to procure a fleet of rail cars to ship spent fuel. In August, DOE signed a contract for the design of a rail car that could meet the Association of American Railroads' requirements for transporting spent fuel and high-level

waste. However, after the prototype rail car is acquired, it still must undergo rigorous testing to demonstrate performance.

DOE estimates that overall timeframe for the development of the entire train system is 7 to 9 years. That lead time is a reminder Congress and the DOE must remain attentive to comprehensive issues associated with used fuel management policy.

Today we will hear from expert stakeholders about the experience we have in moving nuclear fuel, such as engaging with State and local stakeholders to share information, identify routes, and train emergency responders. We will hear DOE's previous activities and discuss the next steps for the Department to implement.

I thank all of our witnesses for being here today, and now I recognize the ranking member, Mr. Tonko, for his open statement.

[The prepared statement of Mr. Shimkus follows:]

PREPARED STATEMENT OF HON. JOHN SHIMKUS

Annually, over three million packages containing radioactive material are transported throughout the United States. Privately shipped items are safely regulated and federally overseen by both the U.S. Department of Transportation and the Nuclear Regulatory Commission (NRC). The NRC must approve any package used for shipping nuclear material before shipment. To secure the necessary approval, the package must be shown to withstand a series of accident conditions which are sequentially performed to determine cumulative effects on the package. The rigorous testing and monitoring of these items highlights the lack of technical issues to transport nuclear material.

State authorities also play a key role in the transportation system by identifying highway routes and assuring emergency responders are adequately prepared Regional organizations, such as the Council of State Governments Midwestern Office, extensively communicates with the public to prepare communities.

They also provide "lessons learned" from historical nuclear transportation activities to continually improve the radioactive material transportation planning process and public outreach. The successful track record is a testament to the established guidelines and system.

The Federal government also has significant experience shipping nuclear material. For example, the Department of Energy (DOE) ships spent nuclear fuel from naval ships to Idaho for storage and transports radioactive material across the country for nuclear research and development activities. DOE has managed thousands of safe shipments of low-level radioactive waste for disposal in New Mexico and even disposes of nuclear material at the Nevada National Security Site, located directly adjacent to the Yucca Mountain site.

However, much of the material that is currently shipped is less hazardous and in smaller quantities than high-level radioactive waste, spent nuclear fuel, and defense nuclear waste which must be permanently disposed of. Congress directed DOE to appropriately plan for a transportation campaign to move spent nuclear fuel and high-level radioactive waste for permanent disposal when the Nuclear Waste Policy Act was signed into law in 1982. Yet 33 years later, many nuclear experts recognize transportation may still be the "long pole in the tent."

In 2006, the National Academies of Science published a comprehensive report, including findings and recommendations, to develop and execute a national transportation campaign for spent nuclear fuel disposal. In 2012, the Obama Administration's Blue Ribbon Commission evaluated DOE's implementation of these recommendations and noted much work remains to be accomplished. While DOE had made limited progress, much of the planning has been undone over the last six years and DOE now is treading water by conducting only generic, nonsite specific planning.

The scale and necessary coordination for shipment will require a persistent effort from Federal, State, local, and tribal governments and private entities. DOE had planned to transport 3,000 tons of commercial spent nuclear fuel a year, while the fleet of nuclear power plants continues to annually generate about 2,000 tons of spent nuclear fuel. A 2008 life cycle system analysis for the Yucca Mountain Project included a $20 billion, 70-year National Transportation Campaign.

While Congress potentially considers amending the Nuclear Waste Policy Act, we must evaluate whether marginal safety gains from temporarily consolidating used

fuel justifies the financial costs to transport used fuel twice. As this Committee continues to engage in conversations with national stakeholders to identify a path forward for permanent disposal of spent nuclear fuel, I hope DOE revisits previous recommendations and lays the foundation for a national campaign.

One constructive step is the recognition to procure a fleet of railcars to ship spent fuel. In August, DOE signed a contract for the design of a railcar that could meet the Association of American Railroads requirements for transporting spent fuel and high-level waste. However, after the prototype railcar is acquired, it still must undergo rigorous testing to demonstrate performance. DOE estimates the overall timeframe for the development of the entire train system is seven to nine years. The lead time is a reminder Congress and DOE must remain attentive to comprehensive issues associated with used fuel management policy.

Today, we will hear from expert stakeholders about the experience we have in moving nuclear material, such as engaging with state and local stakeholders to share information, identify routes, and train emergency responders.

OPENING STATEMENT OF HON. PAUL TONKO, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF NEW YORK

Mr. TONKO. Thank you, Mr. Chair, and good morning. And good morning to our witnesses. Thank you for participating in the hearing this morning. It is valuable input.

Transportation of nuclear waste certainly is a vital component of any long-term storage program. There has been a great deal of discussion about the challenges and the delays of construction of a long-term storage site at Yucca Mountain. But significant challenges remain in the planning for transportation of this waste, both technical and social.

As I understand it, additional work is needed to develop casks that are sufficiently robust to ensure this waste will be transported safely from individual generation facility sites to the permanent storage area.

We have transported nuclear waste. That is true. But I think we will hear today that some of this waste requires special handling over and above what is needed for the waste that moves today. And then there is public acceptance. This is probably an even bigger challenge than the technical matters at hand. I think the current public concern and opposition to the drastic increase in transportation of oil by rail offers a small window into this problem. And we have been transporting oil by rail and by pipeline for a much longer time than we have for spent fuel from nuclear plants.

Many of my constituents, as well as the state and local governments, do not believe that we are taking adequate safety precautions with the transportation of oil. And they are asking for better, safer rail cars for this cargo that is passing through numerous populated areas and vital land and water resources. Their demands for safe transit pathways and secure transport containers will be even more insistent. And I believe they are right in these demands.

Much of the remaining work to devise an acceptable, safe process for moving this waste will fall to the U.S. Department of Transportation. And obviously there is also an ongoing role for our Department of Energy as well. State and local governments will need to be very involved in these discussions as plans move forward also. And all of these tasks need to be done regardless of whether we decide to establish some interim sites or not.

So, the message is we have a lot of work to do. Again, I thank the witnesses for being here this morning. I look forward to your testimony, and hopefully we can move forward.

With that, Mr. Chair, I yield back.

Mr. SHIMKUS. The gentleman yields back his time.

I have a statement for the record that we would submit from the chairman of the committee, Mr. Upton. Without objection, so ordered.

[The prepared statement of Mr. Upton follows:]

PREPARED STATEMENT OF HON. FRED UPTON

Transportation is a critical component of our national responsibility to safely handle and dispose of spent nuclear fuel and high-level nuclear waste from our nuclear national defense programs.

Spent nuclear fuel is stored at 75 sites around the country including on the shoreline of Lake Michigan at both the Cook and Palisades plants. Sixteen of the 80 sites no longer generate electricity and await repurposing for community use or commercial development. Unfortunately, these sites cannot be put to use until the spent fuel has been shipped away.

The experts testifying today bring important perspectives. Among them are the states, which have primary authority for highway safety and community protection; the railroad industry, which develops technical standards for transporting nuclear materials, and understands system capacity limitations; and a former federal official who has literally lived the history of planning for transportation of spent fuel and high-level defense waste.

Whether we authorize temporary away-from-reactor storage, focus on finishing out the permanent repository, or pursue both simultaneously, we must address the underlying transportation issues. There are many issues and questions to take into consideration and we must work to understand them in order to build an efficient and effective transportation system.

How quickly can the federal government start shipping spent fuel? What are the repackaging issues? Is the railroad designed to ship spent nuclear fuel and high-level nuclear waste? What are the state and local stakeholders' primary concerns? Are the obstacles technical, institutional, or political? I hope today's hearing will answer some of these questions.

Mr. SHIMKUS. Does anyone else on the majority side seek time?

Seeing none, the chair now recognizes the ranking member of the full committee, Mr. Pallone, for 5 minutes.

OPENING STATEMENT OF HON. FRANK PALLONE, JR., A REPRESENTATIVE IN CONGRESS FROM THE STATE OF NEW JERSEY

Mr. PALLONE. Thank you, Mr. Chairman.

The Nuclear Waste Policy Act of 1982 made the transportation and long-term storage of nuclear waste the responsibility of the Secretary of Energy. The subcommittee has held several hearings on long-term storage, but has been less focused on transportation issues. No matter what site or combination of sites are eventually chosen for storage, transportation issues will have to be addressed. So I welcome the opportunity to focus on those issues today.

Over the last decades as political fights have brewed over Yucca Mountain and its alternatives, spent nuclear fuel has generally been left onsite at the nuclear power reactors where it has been generated. It is stored in cooling pools and then eventually in dry casks. For many communities around nuclear power plants, this onsite storage raises serious concerns, and as the inventory of spent fuel stored on site grows, so do those concerns.

In New Jersey, we have several operating nuclear reactors that provide carbon-free electricity. This includes Oyster Creek, the Nation's oldest operating plant which will soon stop providing power but will continue to provide a home to spent nuclear fuel until a long-term plan for managing nuclear waste is finalized. Like the challenge of siting permanent and interim repositories, the challenge of transporting nuclear waste involves both technical and societal concerns. Transportation must be done safely with robust protections, even in the case of intentional malevolent acts and exceptional accidents.

Technical issues include the suitability of storage casks for transportation, safety of transporting high burnt-up fuel, and the safety of repackaging spent fuel currently in storage onsite. The Department of Energy and stakeholders must work together to address these technical issues. But addressing the technical concerns is not enough. Transportation must also be done with public acceptance, which can only be built with transparency and outreach. And I think all levels of government, state, local, and tribal, must be involved for these efforts to be successful. And I expect the witnesses on today's panel to agree.

So again, I thank the chairman and our ranking member, Mr. Tonko, for convening this panel, and I look forward to the witnesses.

I yield back.

Mr. SHIMKUS. The gentleman yields back his time.

Now the chair likes to again formally or informally welcome you all to the hearing. We have got a big panel. Your full statement is in the record. You have 5 minutes. We are not going to be, obviously, militant about the time, but when the red light pops up, if you can know to start summing up. And I will just introduce you as your time to speak is.

So, first starting from my left, your right, we have Mr. Christopher Kouts, managing partner of Kouts Consulting. Sir, you are recognized for 5 minutes. Welcome.

STATEMENTS OF CHRISTOPHER KOUTS, MANAGING PARTNER, KOUTS COUNSELING; EDWARD R. HAMBERGER, PRESIDENT AND CHIEF EXECUTIVE OFFICER, ASSOCIATION OF AMERICAN RAILROADS; KELLY HORN, CO-CHAIRMAN, MIDWESTERN RADIOACTIVE MATERIALS TRANSPORTATION COMMITTEE; ROBERT QUINN, VICE PRESIDENT, CASK AND CONTAINER TECHNOLOGY, ENERGYSOLUTIONS; CHAIRMAN, SPENT FUEL TRANSPORTATION TASK FORCE, U.S. NUCLEAR INFRASTRUCTURE COUNCIL; FRANKLIN RUSCO, DIRECTOR, NATURAL RESOURCES AND ENVIRONMENT, U.S. GOVERNMENT ACCOUNTABILITY OFFICE; AND, KEVIN KAMPS, RADIOACTIVE WASTE WATCHDOG, BEYOND NUCLEAR

STATEMENT OF CHRISTOPHER KOUTS

Mr. KOUTS. Thank you, Chairman Shimkus, Ranking Member Tonko, and members of the subcommittee. I am Christopher Kouts, former principal deputy director and acting director of the Department of Energy's Office of Civilian Radioactive Waste Management, OCRWM. I appreciate the invitation to appear before the sub-

committee to provide my perspective on high-level radioactive waste materials transportation planning.

As background, for 25 years I served in various technical and management positions in virtually every program area within OCRWM. In those positions I was responsible for nuclear waste transportation, interim storage, disposal, systems analysis, as well as activities related to the management of the standard contract with nuclear utilities. I became the principal deputy director of the program in 2007, and was the acting director from 2009 until I retired in early 2010 after 35 years of Federal service. The program was terminated later in 2010 by the current administration after nearly 30 years of existence; a program established by the Nuclear Waste Policy Act of 1982, as amended, the NWPA.

The transportation of spent nuclear fuel and high-level radioactive waste materials has been safely undertaken both nationally and internationally for over 40 years. The containers within which the materials are carried are the most robust in the commercial transport world. The designs for transportation casks must be certified by the Nuclear Regulatory Commission, the NRC, to meet rigorous standards that encompass, with safety margins, the envelope of potential accidents that a railway or trail carrier could experience. Over the long history of high-level waste shipments, there have been accidents, but none of those accidents released radioactive materials.

The routing of truck and rail shipments is well understood and well practiced. Truck shipment routing is regulated by the U.S. Department of Transportation, DOT, which requires that the shipments must be routed primarily on the Interstate highway system unless State-designated alternatives are submitted to DOT. Since railway lines are privately owned, railroad carriers coordinate across various rail lines to determine routing between the point of origin and the destination.

Planning for spent fuel transportation campaigns to an interim storage facility or geologic repository will require continued effort for more than a decade before a facility is planned to begin operation. Procuring the necessary transportation casks, rail cars, truck trailers and other equipment will require sustained and adequate funding to assure that the necessary equipment will be available and tested to meet the shipping rates required for the receiving facility.

The greatest challenge regarding transportation planning in the current highly uncertain policy environment is to discern what level of activities are appropriate given the status of the development of the receiving facility. Two of the obvious critical needs of meaningful transportation planning are knowledge of the point of origin and knowledge of the destination point for the shipments.

In this case, the points of origin are well known. Focusing on commercial spent nuclear fuel, approximately 74,000 tons are currently being stored at 73 sites in 33 States. However, no amount of transportation planning can overcome the lack of a definitive destination for these shipments. Until this administration came into office, this Nation had a potential destination for commercial spent fuel and defense high-level radioactive waste that had been under study for over 35 years, Yucca Mountain.

The Yucca Mountain site was developed in accordance with the requirements of the carefully crafted NWPA. The site underwent nearly 20 years of intense scientific site characterization, was recommended to the President in 2002 for further development, and was approved by Congress that same year, overriding the statutorily submitted notice of disapproval by the Governor of Nevada, and was well into the NWPA-mandated 3-year license review process by the NRC when the project was halted.

The administration tells us that a pilot spent fuel interim storage facility will be available for shut-down reactors in 2021, a larger interim storage facility in 2025, and a new geologic repository in 2048. Yet the required legislation for implementing those facilities is not even on the horizon for enactment, making those dates notional at best and fantasy at worst. Over 30 years of experience tells me that the most certain path for the Nation to find an eventual destination for these materials is already in place and has been since 1982. The only ingredients we lack are the leadership and the resolve to make it happen.

Thank you for this opportunity to discuss these issues, and I would be pleased to answer questions the subcommittee might have at this time.

Mr. SHIMKUS. Thank you very much.

[The prepared statement of Mr. Kouts follows:]

Statement of Christopher A. Kouts
Before the Committee on Energy and Commerce
Subcommittee on Environment and the Economy
U.S. House of Representatives
October 1, 2015

Summary

- The transportation of spent nuclear fuel and high-level radioactive waste materials has been safely undertaken both nationally and internationally for over 40 years.

- The routing of truck and rail shipments is well understood and well practiced.

- Over the years, many studies have been undertaken by various organizations regarding the transportation of radioactive materials.

- Planning for spent fuel transportation campaigns to a repository or interim storage facility will require continued effort for more than a decade before a facility is planned to begin operation.

- Given the substantial disparity in cask capacities between truck casks and rail casks, maximizing the use of rail shipments will help minimize shipment numbers. Yet there are facilities that are limited by their infrastructure (size of spent fuel pool, crane capacities, etc.) that will be unable to handle rail cask sizes and weights.

- Throughout the planning process, relationships with regional groups and individual States to disseminate information and receive feedback on planning activities can be helpful to develop public confidence that the shipments will be undertaken in a safe manner.

- The greatest challenge regarding transportation planning in the current highly uncertain policy environment is to discern what level of activities are appropriate, given the status of the development of the receiving facility.

- No amount of transportation planning can overcome the lack of a definitive destination for these shipments, whether that destination is an interim storage facility or a geologic repository.

- Over 30 years of experience tells me that the most certain path for the Nation to find an eventual destination for these materials is already in place and has been since 1982. The only ingredients we lack are the leadership and the resolve to make it happen.

Statement of Christopher A. Kouts
Before the Committee on Energy and Commerce
Subcommittee o Environment and the Economy
U.S. House of Representatives
October 1, 2015

Mr. Chairman and Members of the Subcommittee, I am Christopher A. Kouts, former Principal Deputy Director and Acting Director of the Department of Energy's (DOE's) Office of Civilian Radioactive Waste Management (OCRWM). I appreciate the invitation to appear before the Subcommittee to provide my perspective on nuclear spent fuel and high-level radioactive waste transportation planning.

As background, for 25 years, I served in various technical and management positions in virtually every program area within OCRWM. In those positions I was responsible for disposal, interim storage, nuclear waste transportation, systems analysis, strategic and contingency planning activities as well as activities related to the management of the Standard Contract with Nuclear Utilities. I became the Principal Deputy Director of the program in 2007 and was the Acting Director from January 2009 until I retired in early 2010, after 35 years of Federal Service. The program was subsequently terminated in 2010 by the current Administration after nearly 30 years of existence, a program established by the Nuclear Waste Policy Act of 1982, as amended (NWPA).

The transportation of spent nuclear fuel and high-level radioactive waste materials has been safely undertaken both nationally and internationally for over 40 years. The containers within which the materials are carried are the most robust in the commercial

transport world. Current loaded rail casks weigh between 75-125 tons while loaded truck casks weigh between 25-40 tons. The designs for transportation casks must be certified by the Nuclear Regulatory Commission (NRC) to meet rigorous standards that encompass, with safety margins, the envelope of potential accidents that a railway or truck carrier could experience. That envelope of potential accidents is continually under scrutiny by the NRC and by outside interested parties. Over the long history of high-level waste shipments there have been accidents, but none of those accidents released radioactive materials.

The routing of truck and rail shipments is well understood and well practiced. Truck shipment routing is regulated by the U.S. Department of Transportation (DOT), which requires that the shipments must be routed primarily on the interstate highway system, unless State designated alternatives are submitted to DOT. Those State alternatives must match up with routes from other States so there are no dislocations in potential routing alternatives. Since railway lines are privately owned, railroad carriers coordinate across the various rail lines to determine routing between the point of origin and the destination. Due to the highly radioactive nature of the cargo, Class I track will be used to the maximum extent possible. Class I track crisscrosses the Nation with over 95,000 miles currently in service.

Over the years, many studies have been undertaken by various organizations regarding the transportation of radioactive materials. Most recently, in 2006, the National Academy of Sciences issued their comprehensive report: Going the Distance? The Safe

Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States. The committee chartered to produce the report indicated they "...could identify no fundamental technical barriers to the safe transport of spent fuel and high-level radioactive waste in the United States." The report also indicated that the institutional and social risks to such shipments will need to be forthrightly addressed, and provided several recommendations.

Planning for spent fuel transportation campaigns to a repository or interim storage facility will require continued effort for more than a decade before a facility is planned to begin operation. Procuring the necessary transportation casks (rail and/or truck), railcars, truck trailers and other equipment will require sustained and adequate funding to assure that the necessary equipment will be available and tested to meet shipping rates required for the receiving facility. Selection of potential routes for funding the training of appropriate units of local government and Indian tribes for routine shipment and emergency response purposes should take place three to five years before shipments commence. Throughout the planning process, relationships with regional groups and individual States to disseminate information and receive feedback on planning activities can be helpful to develop public confidence that the shipments will be undertaken in a safe manner.

The greatest challenge regarding transportation planning, in the current highly uncertain policy environment, is to discern what level of activities are appropriate, given the status of the development of the receiving facility. Two of the obvious critical needs for meaningful transportation planning are knowledge of the point of origin and the ultimate

destination of the shipments. In this case, the points of origin are well known. Focusing on commercial spent nuclear fuel, approximately 74,000 metric tons are being stored at 73 sites in 33 States. The infrastructure around those sites will need to be fully evaluated prior to shipment in order to understand which shipping modes are appropriate for the originating facilities. Rail spurs may need to be upgraded around the originating sites or heavy haul options will need to be investigated to assure that rail transport can occur to the maximum extent feasible. Given the substantial disparity in cask capacities between rail casks and truck casks (a rail cask can hold up to nine times the amount of a truck cask), maximizing the use of rail shipments will help minimize shipment numbers. Yet there are facilities that are limited by their infrastructure (size of spent fuel pool, crane capacities, etc.) that will be unable to handle rail cask sizes and weights.

However, no amount of transportation planning can overcome the lack of a definitive destination for these shipments, whether that destination is an interim storage facility or a geologic repository. Until this Administration came into Office, this Nation had a potential destination for commercial spent nuclear fuel and Defense high-level radioactive waste that had been under study for over thirty-five years – Yucca Mountain. The Yucca Mountain site was developed in accordance with the requirements of the carefully crafted NWPA. The site underwent nearly 20 years of intense scientific site characterization, was recommended to the President in 2002, was approved by Congress that same year, overriding the statutorily submitted Notice of Disapproval by the Governor of Nevada, and was well into the NWPA mandated three-year license review process by the NRC when the project was halted.

Having watched the policy environment around the disposition of spent nuclear fuel evolve over the past 30 years, there are no easy answers. History has shown that legislation in this area does not come easily or quickly, and that any new policy path will be contentious and fraught with challenges. The Administration tells us that a new repository will be available by 2048 and a pilot spent fuel interim storage facility will be available for shutdown reactors in 2021. Yet the required legislation for implementing those facilities is not on the horizon for enactment, making those dates notional at best, and fantasy at worst. Over 30 years of experience tells me that the most certain path for the Nation to find an eventual destination for these materials is already in place and has been since 1982. The only ingredients we lack are the leadership and the resolve to make it happen.

Thank you for this opportunity to discuss these issues, and I would be pleased to answer any questions the Subcommittee may have at this time.

Mr. SHIMKUS. Now I would like to turn to Mr. Edward Hamberger?

Mr. HAMBERGER. Yes, sir.

Mr. SHIMKUS. I messed up Kouts' name. So I want to make sure I get that right.

President and chief executive officer of the Association of American Railroads. Again, you are welcome and recognized for 5 minutes.

STATEMENT OF EDWARD R. HAMBERGER

Mr. HAMBERGER. Thank you, Mr. Chairman, Ranking Member Tonko. On behalf of the members of the Association of American Railroads, thank you for the opportunity to be here this morning to discuss the transportation of spent nuclear fuel.

Before I get into my prepared remarks, I would like to thank you, Mr. Chairman, and you, Congressman Flores, for your early co-sponsorship of H.R. 3651, the Positive Train Control Enforcement and Implementation Act of 2015, which I hope will see the House floor perhaps as early as next week. Thank you.

If policymakers determine that it is in the public interest for meaningful amounts of spent nuclear fuel to be transported to one or more repositories, railroads will most likely be called upon to handle most of those movements. The Department of Energy has long indicated its preference for using rail to transport spent nuclear fuel, and the Yucca Mountain project had formally established a mostly rail policy before the program was cancelled.

In 2006, the National Academy of Sciences Committee reaffirmed the preference for using rail, saying that it, "strongly endorses DOE's decisions to ship spent fuel and high-level waste to the Federal repository by mostly rail using dedicated trains." And in January 2012, the Transportation and Storage Subcommittee of the Blue Ribbon Commission on America's nuclear future repeated the National Academy's point to, "mostly rail has clear advantages."

The preference for rail is based predominantly on safety. Nothing is more important to railroads than our safety, and the industry's commitment to safety is reflected in safety statistics from the Federal Railroad Administration. The train accident rate in 2014 was the lowest ever, down 80 percent from 1980, and down 44 percent from 2000. Rail safety extends to hazardous materials as well. In fact, railroads are the safest mode for transporting hazardous materials.

In 2014, 99.999 percent of rail hazmat shipments reached their destination without a release caused by a train accident. Rail hazmat accident rates in 2014 were down 95 percent since 1980, and 66 percent since 2000. Although no firm in any industry can guarantee that it will never suffer an accident, the railroads' overall safety record should give this committee, and hopefully the public, confidence in the rail transport of spent nuclear fuel if policymakers decide that the public interest requires its transportation.

Railroads recognize that public concern over radioactive materials requires that all parties involved in the transport take special measures to ensure safe movement. In particular, the Departments of Energy and Defense, as shippers of the spent nuclear fuel, the NRC and Department of Transportation, as the regulators of the

safety aspects of hazmat transport, and of course the railroads themselves must work together to design the safest possible transportation system for spent nuclear fuel.

That system must include the use of dedicated trains. That is, trains with no other freight than spent nuclear fuel carefully monitored and traveling directly from origin to destination. Dedicated trains offer numerous safety advantages that would reduce the already very small possibility of an accident involving spent nuclear fuel. Advantages of dedicated trains include, eliminating the need to switch the shipments in rail yards, the ability to use cars with special safety features designed to handle the extreme weight of spent nuclear fuel shipments, and reduce time in transit. Dedicated trains can be transported with greater security. Escorts which are required by the Nuclear Regulatory Commission for all spent nuclear fuel movements are able to monitor the spent fuel much more easily on dedicated trains than in general freight service.

Equipment standards for spent nuclear fuel trains are exceedingly stringent. As we have just heard from Mr. Kouts and will later hear from Mr. Quinn, spent fuel requires transport in massive steel casks that are several feet in diameter and are able to withstand a range of extreme forces.

In addition, the AAR has developed a rail car standard with special designed features exclusively for spent nuclear fuel.

Many of the issues surrounding the transportation of spent nuclear fuel and other high-level wastes are controversial. And many issues remain to be resolved. What isn't controversial is that the transportation of spent nuclear fuel requires extreme care. If policymakers determine that a single or several regional repositories for spent nuclear fuel are in the public interest, the railroads stand ready to work with the relevant entities on all issues regarding its transportation.

Railroads are confident they can provide the necessary level of care. But doing so will require close cooperation and extensive planning involving DOE, DOT, state and local governments, and others if safety and security is to be maximized. One example of that is this past summer we were pleased to host the Nuclear Waste Technical Review Board at our transportation technology center in Pueblo, Colorado, where we were able to demonstrate some of the new technologies we are working on to improve safety at our emergency response training center, which would be available for training for spent nuclear fuel as well.

Thank you for the opportunity to be here.

Mr. SHIMKUS. Thank you very much.

[The statement of Mr. Hamberger follows:]

STATEMENT OF

EDWARD R. HAMBERGER
PRESIDENT & CHIEF EXECUTIVE OFFICER
ASSOCIATION OF AMERICAN RAILROADS

BEFORE THE

UNITED STATES HOUSE OF REPRESENTATIVES

COMMITTEE ON ENERGY AND COMMERCE

SUBCOMMITTEE ON ENVIRONMENT AND THE ECONOMY

HEARING ON
THE TRANSPORTATION OF SPENT NUCLEAR FUEL

OCTOBER 1, 2015

Association of American Railroads
425 Third Street SW, Suite 1000
Washington, DC 20024
202-639-2100

The Association of American Railroads (AAR) appreciates this opportunity to address the transportation of spent nuclear fuel (SNF).[1] AAR members account for the vast majority of freight railroad mileage, employees, and traffic in Canada, Mexico, and the United States.

If policymakers determine that it's in the public interest for meaningful amounts of spent nuclear fuel to be transported to one or more repositories, AAR members would probably be called upon to handle many, if not most, of those movements. The Department of Energy (DOE) has long indicated its preference for using rail to transport SNF, and the Yucca Mountain project had formally established a "mostly rail" policy before the program was cancelled. In 2006, a National Academy of Sciences committee reaffirmed the preference for using rail, saying that it "strongly endorses DOE's decisions to ship spent fuel and high-level waste to the federal repository by mostly rail using dedicated trains."[2] And in January 2012, the Transportation and Storage Subcommittee of the Blue Ribbon Commission on America's Nuclear Future repeated the NAS point that "Mostly rail has clear advantages."[3]

The preference for rail is based predominantly on safety. To our knowledge, there has never been a release of radioactive materials in connection with the transportation of SNF by rail. To date, only small volumes of SNF have been transported by rail — from 2000 through 2014, total shipments were 391 carloads. Railroads are confident that they would be able to transport larger volumes of SNF safely and securely, though rigorous measures focused on safety and security would clearly be necessary.

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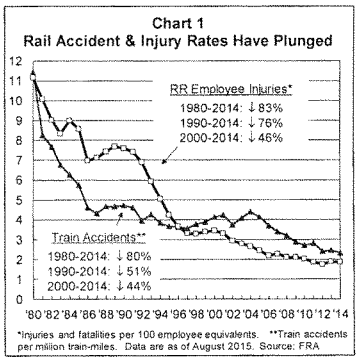
[1] For simplicity, in this testimony "SNF" refers to spent nuclear fuel and similar high-level waste.

[2] National Academy of Sciences, National Research Council, Committee on Transportation of Radioactive Waste, Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States, 2006, p. 4.

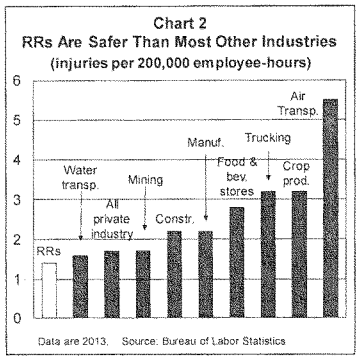
[3] Blue Ribbon Commission on America's Nuclear Future, Transportation and Storage Subcommittee, Report to the Full Commission: Updated Report, January 2012, p. 65.

Overview of Freight Rail Safety

Nothing is more important to railroads than safety, and the industry's commitment to safety is reflected in safety statistics from the Federal Railroad Administration (FRA). The train accident rate in 2014 was the lowest ever, down 80 percent from 1980 and down 44 percent from 2000; the employee injury rate in 2014 was down 83 percent from 1980 and down 46 percent from 2000; and the grade crossing collision rate in 2014 was down 80 percent from 1980 and down 38 percent from 2000 (see Chart 1).



Moreover, according to data from the Bureau of Labor Statistics, railroads today have lower employee injury rates than other transportation modes (including trucks, water transportation, and airlines) and most other major industries, including agriculture, mining, manufacturing, and construction (see Chart 2). Available data also indicate that U.S. railroads have employee injury rates well below those of most major foreign railroads.



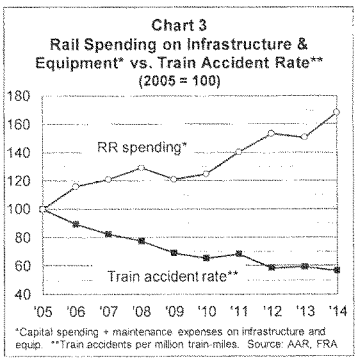
Rail safety extends to hazardous materials as well. U.S. railroads transport approximately two million carloads of hazardous materials each year. In 2014, 99.999 percent of rail hazmat shipments reached their destination without a release caused by a train accident. Rail hazmat accident rates in 2014 were down 95 percent since 1980, down 74 percent since 1990, and down 66 percent since 2000. Although no firm in

any industry can guarantee that it will never suffer an accident, the railroads' overall safety record should give this committee and the public confidence in the rail transport of SNF if policymakers decide that the public interest requires its transportation.

Working to Ensure That Rail Safety Continues to Improve

Railroads devote enormous resources in a multi-pronged strategy to help ensure that rail safety continues to improve.

For example, in recent years, America's freight railroads have been spending more than ever — including $28 billion in 2014 and a projected $29 billion in 2015 — on their infrastructure and equipment, part of more than $575 billion U.S. freight railroads have spent since 1980 to maintain and enhance their networks. The vast majority of this spending has improved rail safety directly or indirectly. In fact, in many cases, improving safety is the primary reason for the spending. The more railroads put back into their systems, the safer they become (see Chart 3).



Railroads are also constantly incorporating new technologies to improve rail safety, including sophisticated detectors along tracks that identify potential defects in passing rail cars and specialized inspection cars that identify defects in tracks. Many technological advancements are developed at the Transportation Technology Center, Inc. (TTCI) in Pueblo, Colorado, a subsidiary of the Association of American Railroads that is widely considered to be the finest rail research facility in the world. In the past, studies involving SNF transportation have taken place at TTCI.

Virtually every aspect of rail operations is subject to oversight by the FRA. Among many other areas, railroads are subject to stringent FRA regulation regarding track and equipment inspections; employee certification; operating speeds; and signaling systems. FRA safety inspectors travel the country evaluating rail facilities and operations. In many states, FRA inspectors are supplemented by state inspectors. Railroads are also subject to safety oversight by a number of other federal agencies, including the Occupational Safety and Health Administration (OSHA), the Pipeline and Hazardous Materials Safety Administration (PHMSA), and the Department of Homeland Security (DHS).

How Can the Safety of SNF Transport be Maximized?

Railroads recognize that public concern over radioactive materials requires that all parties involved in the transport of SNF take special measures to ensure safe movement. In particular, the DOE and Department of Defense (as the shippers of SNF), the Department of Transportation (the regulator of the safety aspects of hazmat transport), and the railroads must work together to design the safest possible transportation system for SNF.

For many years, the rail industry has urged the use of dedicated trains — *i.e.*, trains with no other freight than SNF, carefully monitored and traveling from origin to destination — to transport SNF. Dedicated trains offer numerous safety advantages that would reduce the already very small possibility of an accident involving SNF transport.

First, SNF cars in dedicated trains would not have to be "switched" in and out of trains at rail yards, many of which are located in or near major metropolitan areas. Switching would be required if SNF cars were transported in general freight service. Switching increases the amount of handling a freight car receives. All else equal, the more a freight car has to be handled, the greater the risk of an accident.

Second, because of the extreme weight of SNF cars, it's safer for them to be in dedicated trains. The vast majority of loaded rail cars on the U.S. freight rail network weigh no more than 286,000 pounds.[4] SNF cars, though, would weigh approximately 400,000 pounds. If hauled in general freight service, these extremely heavy SNF cars could generate high in-train forces, such as slack action (the force exerted throughout the train as trains accelerate, decelerate, and operate over undulating and curved terrain) that increases the possibility of a derailment. Slack action is much easier to control in a short, dedicated train than in a long, general service train, especially in trains with extremely heavy cars mixed with other normal-weight cars.

Third, dedicated trains are needed to accommodate the customized rail cars that would be used to carry the casks in which spent nuclear fuel is transported. For example, car wheel assemblies that are specially designed to handle both the weight and the delicacy of this commodity can be incorporated in all rail cars in dedicated SNF trains. These customized designs reduce lateral wheel forces and vertical dynamic impact forces, which can result in derailments. If SNF were transported in general freight service, it is unlikely that other freight cars would have the custom features necessary to properly manage these overweight and delicate loads. More generally, dedicated trains eliminate the possibility of a derailment of an unrelated car having as a side effect the derailment of or damage to a car carrying SNF.

Fourth, dedicated trains minimize the time spent in transportation, an important factor for security. It would take longer (possibly significantly longer) to transport SNF from origin to destination if SNF were transported in mixed-freight trains instead of dedicated trains, because

[4] A small minority of rail cars in general service weigh up to 315,000 pounds. In extremely rare cases (for example, movements of power plant generators), railroads will haul much heavier shipments, but almost always in special train service.

the switching of rail cars in and out of trains takes time and because railroads can more readily schedule dedicated trains to move quickly and smoothly through sensitive areas.

Finally, dedicated SNF trains can be transported with greater security. Escorts, which are required by the Nuclear Regulatory Commission (NRC) for all SNF movements, are able to monitor SNF much more easily in dedicated trains than in general freight service.

The FRA has determined that dedicated trains for the transportation of SNF would reduce accident risks through avoidance of yards, reduced derailment potential, and reduced risk of the involvement of other hazardous materials in an accident.[5] Similarly, the National Academy of Sciences has determined that dedicated train transportation of SNF has operational, safety, security, communications, and planning advantages over transportation in general merchandise trains.[6]

Steps railroads take to enhance rail safety in general, including those discussed earlier — upgrading of infrastructure through new investments, new inspection technologies, and so on — also enhance the safety of hazmat transportation. That said, railroads also have long been taking additional concrete steps to make hazmat transportation in particular safer. Many of these are pertinent to SNF transportation. Some examples:

- Routing model. Several years ago, the rail industry and several federal agencies jointly developed the Rail Corridor Risk Management System (RCRMS), a sophisticated statistical routing model designed to help railroads analyze and identify the overall safest and most secure routes for transporting highly hazardous materials. The model uses a minimum of 27 risk factors — including hazmat volume, trip length, population density along the route, and emergency response capability — to assess the overall safety and security of rail routes. This routing model would be used to ship SNF.
- Chain of custody. Railroads follow stringent Transportation Security Administration "chain of custody" requirements for rail cars carrying toxic-by-inhalation (TIH)

[5] Federal Railroad Administration, Use of Dedicated Trains for Transportation of High-Level Radioactive Waste and Spent Nuclear Fuel: Report to Congress (March 2005).

[6] National Academy of Sciences, Going the Distance?, op. cit.

materials[7]. Transfer of TIH cars from a shipper to a railroad, from one railroad to another, and from a railroad to a receiver must be carefully documented. The same requirements apply to SNF.

- Information sharing. Rail industry personnel are in constant communication with the TSA, other agencies within DHS, the Department of Defense, DOT, the FBI, and state and local law enforcement agencies to share intelligence and security information.
- Inspections. Railroads would conduct at least two comprehensive track geometry inspections each year on main line routes over which SNF trains were moving.[8] Current FRA regulations do not require railroads to perform comprehensive track geometry inspections.
- Emergency response. Railroads have extensive emergency response capabilities. Railroad personnel work in cooperation with federal, state and local governments, to assist communities in the event of an incident involving hazardous materials. All the major railroads have teams of full-time personnel whose primary focus is hazmat safety and emergency response. Teams of environmental, industrial hygiene, and medical professionals are available at all times to provide assistance during hazmat incidents. Each year, railroads actively train well over 20,000 emergency responders throughout the country. This training ranges from general awareness training to much more in-depth offerings.
- Tunnels. If a train carrying SNF were to meet another train carrying loaded tank cars of flammable gas, flammable liquids, or combustible liquids in a single bore double track tunnel, one train will stop outside the tunnel until the other train is completely through the tunnel.

Equipment standards for SNF trains are exceedingly stringent. Spent fuel requires transport in massive steel casks that are several feet in diameter, with walls many inches thick and that contain materials that shield the outside against radioactivity. These casks have to be able to withstand a range of extreme forces, including long drops, a fully engulfing fire, and extensive underwater submersion. To the extent that there is not an adequate supply of these casks to meet transportation needs, they would obviously have to be built and tested before transportation could occur.

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[7] TIH materials are gases or liquids (such as chlorine and anhydrous ammonia) that are especially hazardous if released.

[8] Track geometry includes such parameters as track gauge, curvature, alignment, profile, and the cross level of the two rails. Track geometry inspections are generally performed by sophisticated stand-alone cars that use a variety of sensors, measuring systems, and data management systems to create a representation of the track being inspected.

Conclusion

Many of the issues surrounding the transportation of spent nuclear fuel and other high-level waste are controversial, and many issues remain to be resolved. What isn't controversial is that the transportation of spent nuclear fuel requires extreme care. If policymakers determine that a single or several regional repositories for spent nuclear fuel are in the public interest, the railroads will work with the relevant entities on all issues regarding the transportation of SNF to those repositories. Railroad are confident that they can provide the necessary level of care, but doing so will require close cooperation and extensive planning involving DOE, DOT, and others if safety and security is to be maximized.

Mr. SHIMKUS. The State of Illinois has a new administration. So I think I am welcoming the first member from the new administration in Illinois to testify before a committee in the House of Representatives.

So being from Illinois, I am particularly pleased to welcome Mr. Kelly Horn from the Illinois Emergency Management Agency, co-chairman of the Midwestern Radioactive Materials Transportation Committee, Council of State Governments. We are glad to have you here, and you are recognized for 5 minutes.

STATEMENT OF KELLY HORN

Mr. HORN. Thank you. Chairman Shimkus, Ranking Member Tonko, members of the subcommittee, on behalf of the great State of Illinois and the Council of State Governments, Midwestern Radioactive Materials Transportation Committee, thank you for inviting me to talk about the transportation of spent fuel and the important roles that states have in this matter. My testimony today is strictly for informational purposes.

As a region, the Midwest has a very large stake in the future Federal program to transport spent fuel from commercial nuclear power plants. As noted in my written testimony, we have a large nuclear fleet and a sizeable inventory of spent fuel in storage. In addition, our geographical location makes it likely we will be affected by shipments traveling from other regions to any site for waste management.

Transporting the spent fuel is not a new concept. As a Nation, we have been doing it safely for the past 40 years. The U.S. Department of Transportation and the U.S. Nuclear Regulatory Commission have primary oversight for spent fuel shipments. Under the Nuclear Waste Policy Act, the U.S. Department of Energy is responsible for moving commercial spent fuel to authorized facilities. States are involved because we are co-regulators of transportation. We bear the primary responsibility for protecting the public health, safety, and environment, as well as enforcing State-specific laws with regards to shipments. We are responsible for training emergency personnel and serve as the intermediary between Federal and local governments.

Several States including Illinois have experience with spent fuel shipments on a small scale. However, since 1999, many states have gained firsthand experience with the very large national program to move a different type of radioactive waste, transuranic, or TRU waste, from defense-related facilities. The Department of Energy disposes of TRU waste at its Waste Isolation Pilot Plant, WIPP, outside of Carlsbad, New Mexico. As noted by the National Academies and others, the WIPP transportation program is a good model for a national spent fuel transportation program because it is large, complex, highly successful, and has the support and buy-in of affected states and tribes.

While WIPP is a good model, there are many differences between the TRU waste shipments and spent fuel shipments that go beyond just the type of material being shipped. One critical difference is the Federal assistance available to states and tribes. Section 180(c) of the Nuclear Waste Policy Act, and 16(d) of the Land Withdrawal Act, both require Federal financial and technical assistance for

states and tribes that will be affected by shipments. Section 180(c) refers to this assistance being intended for training, and DOE has interpreted this provision very narrowly.

Grants that may be available someday under Section 180(c) are not likely to allow states to recoup operational costs. In contrast, Section 16(d) of the Land Withdrawal Act refers to transportation programs, thereby allowing states to do more than just train. We have the flexibility to effectively manage and mitigate all impacts we experience from WIPP shipments.

A second difference between TRU waste shipments and spent fuel shipments is that DOE will transport spent fuel mostly by train, whereas WIPP shipments travel solely by highway. For WIPP shipments, the states conduct rigorous safety inspections following the Commercial Vehicle Safety Alliance Level VI enhanced inspection procedure. The DOT-required Level VI inspection identifies the items to be checked, standardizes the process for logging findings and sharing results, and assures accountability from a duly certified state inspector who performs the inspection.

For rail shipments of spent fuel, we do not yet have an enhanced reciprocal inspection program analogous to what we have for trucks. Another impact of mode-related difference is that states have the authority to designate routes for highway shipments of radioactive material, but we do not have the authority over routes for rail.

The states recognize that the public will hold large-scale shipments of spent fuel to a higher standard than that of other DOE shipments. And so we feel strongly DOE must adopt reasonable measures to minimize public risk and maximize public confidence in the transportation program. These measures include, but are not limited to, state involvement in route identification, the development of a reciprocal rail inspection program, and a financial support system for a transportation safety program that is consistent with the WIPP model.

All these elements have DOE's TRU waste transportation program become the model it is today. The states believe DOE will need to implement, at a minimum, the same elements in order to achieve the goal of transporting spent fuel in a manner that is safe, secure, efficient, and merits public confidence.

Mr. Chairman, on behalf of the great State of Illinois and the Council of State Governments, Midwestern Radioactive Materials Transportation Committee, I thank you for hearing my testimony.

Mr. SHIMKUS. Thank you very much.

[The prepared statement of Mr. Horn follows:]

Chairman Shimkus, Ranking Member Tonko, and members of the Subcommittee, on behalf of the state of Illinois and the Midwestern Radioactive Materials Transportation Committee of the Council of State Governments (CSG), thank you for inviting me to talk about the transportation of spent nuclear fuel and high-level radioactive waste and the important role that states have in this matter. My testimony today is strictly for informational purposes to help members of the Subcommittee better understand a vital component of a fully functioning waste management system.

As a state, Illinois' footprint in the nuclear fuel cycle is prominent. Illinois is one of the largest producers of nuclear power in the world, with 11 operating reactors located at six power plants. We currently have one power plant, the Zion Nuclear Power plant located just north of Chicago on the banks of Lake Michigan, which is undergoing decommissioning. Illinois is also the home of GE Morris, the only commercial away-from-reactor spent fuel storage facility in the country. Illinois has a current inventory of 9,630 metric tons of spent nuclear fuel either in spent fuel pools or sitting in dry cask storage.

As a region, the Midwest has 27 operating reactors located at 19 power stations with four power stations either shuttered or undergoing decommissioning: Kewaunee and La Crosse in Wisconsin, Big Rock Point in northern Michigan, and Zion in Illinois. The region has an inventory of 19,320 metric tons of spent nuclear fuel and high-level waste.

With this relatively large amount of spent nuclear fuel in storage and our geographical location relative to where the majority of spent nuclear fuel resides around the nation, it is obvious that Illinois and our Midwestern neighbors will be greatly impacted when it comes time to move spent nuclear fuel to interim storage or a repository. In fact, according to the U.S. Department of

Energy's (DOE) *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada (DOE/EIS-0250)*, Illinois ranks number one in the nation for the number of metric ton units to be shipped. When broken down in terms of number of shipments passing through each state, of the 43 states projected to experience shipments, excluding Nevada , the *EIS* ranks Illinois sixth for highway shipments and fourth for rail shipments.

While transportation is a constant variable of waste management, it is often the most under-emphasized component of the back end of the nuclear fuel cycle. The Department of Energy's former Office of Civilian Radioactive Waste Management (OCRWM) was on the mark when it stated, in its *1986 Transportation Institutional Plan*, that "While each program element has its particular sensitivity, the transportation of the waste to facilities developed under the Nuclear Waste Policy Act may be the most visible element [of the Civilian Radioactive Waste Management System] nationwide."

In its 2003 report, *Strategic Plan for the Safe Transportation of Spent Nuclear Fuel and High-Level Radioactive Waste to Yucca Mountain: A Guide to Stakeholder Interactions*, OCRWM said the mission for the Yucca Mountain program was to "manage, dispose of, and transport spent fuel and high-level waste in a manner that protects public health, safety, and the environment; enhances national and energy security; and merits public confidence." We believe this remains true, regardless of where the spent nuclear fuel is shipped.

The safety and security of spent nuclear fuel shipments is governed by a defined regulatory system. The United States Department of Transportation (DOT) and the United States Nuclear Regulatory Commission (NRC) have primary regulatory oversight for spent nuclear fuel

transportation. These two agencies have entered into a memorandum of understanding that concisely details each agency's regulatory responsibility.

Under Title 49 Code of Federal Regulation for transportation by highway, rail, vessel, and air, DOT's primary responsibility is regulating hazardous materials, the shippers and carriers, conveyance safety, operator qualification and safety, hazard communications, and routing. In accordance with Title 10 Code of Federal Regulation, the NRC's primary role is safety and security of the spent nuclear fuel and package certification.

Under the Nuclear Waste Policy Act (NWPA), as amended, for commercial spent nuclear fuel shipments, DOE will be required to use only NRC approved and certified casks and follow the prescribed NRC notification requirements. DOE, through a memorandum of understanding with both the DOT and NRC, also has committed to following the transportation regulations of both agencies.

Why, you may be wondering, are states involved?

For almost three decades, dating back to the rail shipments of radioactive waste from the accident at Three Mile Island, Illinois and other states have worked independently and collectively to engage with DOE on various transportation campaigns and programs. State agencies protect the health and safety of the public and the environment and they are accountable to state governors and legislatures. Beginning in the late 1980s, DOE started establishing cooperative agreements with multistate organizations to bring states together on a regional basis to work on transportation planning. It is through these agreements that DOE and the states work in a consultative and cooperative fashion to resolve transportation institutional issues related to DOE's shipments of spent nuclear fuel, transuranic waste (material contaminated with

radioactive isotopes that have atomic numbers higher than uranium on the periodic table of elements), and other radioactive waste. The Council of State Governments' (CSG) Midwestern Office is one of the multistate organizations that has a cooperative agreement with DOE. I co-chair the Midwestern Radioactive Materials Transportation Committee, which CSG Midwest organized in 1989 specifically to address regional transportation issues and the potential impacts DOE's shipments might have on the Midwestern states.

States are co-regulators of transportation because we bear the primary responsibility for protecting the health and safety of the public and the environment. So when it comes to the transportation of spent nuclear fuel, responsibility for training emergency response personnel, monitoring shipments, conducting inspections, and providing escorts falls to the states. Because states have well-established working relationships with local community officials, law enforcement, and first responders along shipping routes, we also serve as the intermediary between the federal government and local officials.

Furthermore, many states have established state-specific laws that regulate certain aspects of radioactive material transportation, including spent nuclear fuel. For instance, Illinois requires all shipments of spent nuclear fuel, transuranic waste, and highway route-controlled quantities of radioactive material to be inspected and escorted before they enter into commerce within the state. Other states have permitting requirements, routing requirements, time prohibitions, etc. In the Midwest, for example, Iowa and Nebraska have exercised their authority to designate alternate routes for shipments of highway route-controlled quantity shipments, including spent nuclear fuel.

Because we are co-regulators and because of our long history of working cooperatively with the Department of Energy, states expect to be involved as partners in the planning and implementation of spent nuclear fuel shipments to a repository or to an interim storage facility. It is our sincere hope that the federal government will act in accordance with DOE's early commitment to develop a transportation system that is safe, secure, efficient, and merits public confidence.

George S. Patton once stated, "Prepare for the unknown by studying how others in the past have coped with the unforeseeable and the unpredictable." We feel it is incumbent upon DOE and the federal government to glean as much information from current and past spent nuclear fuel and other radioactive material shipping campaigns for the purpose of preparing for future shipments. This should include best practices and lessons learned as identified by all stakeholders. In the past decade, two major reports have been published on behalf of the federal government that in whole or in part analyzed the transportation of spent nuclear fuel. These reports are the National Academy of Sciences' 2006 report, *Going the Distance? The Safe Transport of Spent Nuclear Fuel and High Level Radioactive Waste in the United States* and the *Blue Ribbon Commission on America's Nuclear Future Report to the Secretary of Energy*, published in 2012. These reports contain pertinent information and recommendations that should be scrutinized and incorporated into DOE's new national transportation plan.

Transportation of spent nuclear fuel is not a new concept. As a nation, for the past 40 years we have successfully transported spent nuclear fuel from university research reactors, foreign research reactors, and commercial facilities. In addition, since 1999, many states have had firsthand experience with shipments of a different type of radioactive waste – transuranic waste – to the Waste Isolation Pilot Plant (WIPP) outside of Carlsbad, New Mexico. The WIPP's

enabling authority is the Waste Isolation Pilot Plant Land Withdrawal Act (LWA). While the WIPP shipments involve transuranic waste, not spent nuclear fuel, the transportation program is a good model for a national spent nuclear fuel transportation program because it is large, complex, highly successful, and has the support of the affected states and Tribes. The Blue Ribbon Commission's report went as far as to state, "DOE's decision to work cooperatively with Carlsbad and the Western Governors' Association to develop a safe transportation program for WIPP was extremely helpful in addressing transportation related concerns." Shipments envisioned as part of the federal program to move spent nuclear fuel and high-level radioactive waste will differ from the aforementioned examples to some extent, but there are enough similarities to warrant borrowing from these successful programs.

One critical difference between WIPP shipments and the national spent nuclear fuel transportation program, as currently envisioned, is the funding mechanism for those states and tribes affected by shipments. In Section 180(c) of the NWPA, Congress requires the Secretary of Energy to provide financial and technical assistance to states and tribes that will be affected by shipments of spent nuclear fuel and high-level radioactive waste to a national repository or other NWPA-mandated facility. The assistance is intended to be used "for training for public safety officials of appropriate units of local government," with training covering "procedures required for safe routine transportation of these materials, as well as procedures for dealing with emergency response situations."

Although Section 180(c) assistance, when implemented, may prove to be an important source of revenue for some states, two major limitations will reduce its effectiveness in preparing state, tribal, and local personnel along shipping routes for their oversight and emergency response roles in connection with shipments to a national repository. First, DOE has interpreted Section 180(c)

assistance as solely intended "for training," and does not allow states to recoup operational costs. For example, a state could use 180(c) assistance to train inspectors, since safety inspections would be part of assuring "safe, routine transportation." But states would not receive any assistance for *conducting* inspections, nor would they receive assistance for escorting shipments. Illinois is one of the states that charges a fee for these services, but many states do not. As a result, because of the way Section 180(c) is currently written and the way DOE interprets the section, state taxpayers may be forced to bear the cost of safety inspections and security escorts that state personnel undertake as part of their duties.

This situation stands in stark contrast with what WIPP provides to states and tribes affected by shipments. Whereas Section 180(c) is intended "for training," Section 16(d) of the WIPP LWA requires the Secretary of Energy to "provide in-kind, financial, technical, and other appropriate assistance to any State or Indian tribe through whose jurisdiction the Secretary plans to transport transuranic waste to or from WIPP, for the purpose of WIPP-specific transportation safety programs not otherwise addressed in this section." DOE provides states the opportunity to comprehensively assess operational impacts as a result of WIPP shipments and does not limit funding strictly to training. The flexibility under the LWA allows states to more effectively manage and mitigate burdens placed on states as a result of these shipments.

The second limitation of Section 180(c) is that it applies only to shipments to facilities mandated by the NWPA; therefore, unless Congress amends the NWPA, the Secretary has no obligation to provide assistance to states and tribes that are affected by shipments to private facilities or to other federal storage locations. This was a concern to states back when the Private Fuel Storage facility was planned for Utah, and it is a concern now that two entities – one in Texas and one in New Mexico – have expressed interest in constructing private storage facilities for spent fuel.

Another notable difference between WIPP shipments of transuranic waste and future shipments of commercial spent nuclear fuel is that, consistent with the National Academy of Science's recommendation in *Going the Distance*, DOE has committed to transporting spent nuclear fuel under the mostly rail transportation scenario using dedicated trains. Rail safety regulations are enforced by the Federal Railroad Administration (FRA) and, through the FRA's State Participation Program, by state rail safety programs. For WIPP shipments, the states conduct rigorous safety inspections of the trucks following the Commercial Vehicle Safety Alliance's (CVSA) Level VI inspection procedure. The CVSA developed the Level VI program with assistance from cooperative agreements with DOE – originally for the purpose of spent nuclear fuel and high-level radioactive waste shipments but later for transuranic waste shipments as well. DOT has codified the standard in 49 CFR 385 and, since 2005, all shipments of these materials are now required to have a CVSA Level VI inspection on the vehicle and packaging prior to departure.

A decade ago, states began working with DOE and the FRA to try to develop a similar program. In order to minimize risk to the greatest extent possible and to garner as much public assurance as possible, they reviewed current rail safety inspection practices with the hope of creating a reciprocal rail inspection program that would accomplish the same goals as the CVSA Level VI inspection program. Because it is a reciprocal program, the CVSA Level VI inspection helps shippers reduce the number of redundant stops for shipments in transit. By relying on standardized procedures, inspectors understand exactly what their counterparts are checking when inspections are conducted in "upstream" states. As a result, they are able to develop a high level of confidence in those previously conducted inspections. The CVSA Level VI inspection

program is rigorous and transparent; therefore, it promotes public confidence in shipments of radioactive waste.

Besides reciprocity, three attributes of the CVSA inspection program stand out as essential to the success of a national inspection program: a detailed listing of items checked and defects found; the ability to pass information along to inspectors in other states in a secure manner; and the signature of duly certified state inspectors who conduct the inspections. This is what we have for truck shipments; we need to have the same assurances for rail shipments – especially since the vast majority of spent nuclear fuel will move by train. DOE's Office of Nuclear Energy, in conjunction with state regional groups and tribal governments, recently formed a Rail/Routing Working Group for spent nuclear fuel. It is our hope that this working group will pick up the work that was begun a decade ago and carry it forward. However, no matter what the working group's final recommendations are, an enhanced reciprocal rail safety inspection program will not become a reality without the support of the FRA and the rail industry.

Routing is yet another dichotomy in regulation and practice. 49 CFR 397 gives states the authority to designate routes for highway shipments of Class 7 (Radioactive) material. From a regulatory standpoint, rail routing of large quantity radioactive materials such as spent nuclear fuel is treated differently from highway routing. States were given highway routing designation authority in part because it is the state's responsibility to protect and serve its citizens. Because of the private ownership of rail lines, states don't have this same authority over rail shipments. States should be included in discussions with DOE and the railroads over which routes will be used for shipments. This is the type of activity that we would expect to be a part of consultative, cooperative transportation planning. As envisioned by the states, a truly cooperative, consultative approach is characterized by highly engaged stakeholders that are committed to

working together to solve a problem. The success of DOE's transuranic waste transportation program is due in large part to the fact that DOE adopted just this type of cooperative, consultative approach to working with affected states and tribes. It should be pointed out that the *TRU Waste Transportation Plan* went above and beyond regulatory requirements for highway shipments of transuranic waste to the WIPP when DOE applied the requirements of 49 CFR Part 397 to all of its shipments. This is another example of why the WIPP transportation program is so successful and receives stakeholder buy-in.

Recognizing that the public will hold large-scale shipments of spent nuclear fuel to a higher standard than that for other DOE shipments, the states feel strongly that DOE must not only meet the standard set by the WIPP program but exceed those requirements by adopting reasonable measures that will minimize public risk and maximize public confidence in the transportation program. These measures include: state involvement in route identification; the development of a reciprocal rail inspection program; and financial support, not just for training, but for state transportation safety programs that are consistent with the WIPP model.

We are working cooperatively with DOE's Nuclear Fuels Storage and Transportation Planning Project, and we're making some progress. The pace of progress will understandably be slow, however, until a definite path forward is identified for the nation's civilian radioactive waste management program.

On behalf of the great state of Illinois and the CSG Midwestern Radioactive Materials Transportation Committee, I thank you for hearing this testimony. We look forward to working with our state, federal, and tribal partners as we endeavor to meet our common goal: the safe,

secure transportation of radioactive material in a manner that protects the health and safety of the public.

Mr. SHIMKUS. Next we will turn to Mr. Robert Quinn, who is vice president, Cask and Container Technology Energy Solutions, chairman of the Spent Fuel Transportation Task Force, U.S. Nuclear Infrastructure Council. You are recognized for 5 minutes. Welcome.

STATEMENT OF ROBERT QUINN

Mr. QUINN. OK. Thank you, and good morning. My name is Bob Quinn. I am the vice president, as you said, of Cask Container Technology at EnergySolutions, which is a U.S.-based internationally operating nuclear services company, specializing in safe recycling, processing, and disposal of nuclear material. And EnergySolutions is a member company of the U.S. Nuclear Infrastructure Council, which is a leading business association advocate for new nuclear energy and global engagement of the U.S. supply chain.

I am currently serving as the chair of the council's spent nuclear fuel transportation task force, and I must note that my statements today reflect the consensus views of the council and the Spent Fuel Transport Task Force, but do not necessarily reflect the specific views of any individual member, company, or organization.

Transportation of nuclear materials, including spent nuclear fuel, is not new or novel, and has, in fact, been done for the last 70 years with an outstanding safety record. And for 40 years of that we have been shipping spent fuel. Nuclear materials are transported on an ongoing basis all over the world by public highway, rail, barge, ocean vessels, and air. About three million packages of radioactive materials are shipped each year in the United States.

Spent fuel shipments from commercial nuclear power plants, research reactors, and the Navy have been made safely for decades. The U.S. Navy has completed about 850 shipments totalling 1.6 million miles of transport. And since the mid-1970s, there have been over 1,300 safe shipments of commercial spent fuel in the United States. Between 1990 and 2012, 60 shipments, including more than 250 transportation casks of foreign research reactor fuel have been shipped to and within the United States by sea, land, and air. Shipments continue today.

Just recently two shipments arrived at Savannah River. There is a long history of safe, successful transportation of spent fuel globally as well. Over 70,000 metric tons of spent fuel have been transported by road, rail, and sea within and among the United Kingdom, France, Germany, Sweden, Japan, and other nations. In all these shipments, there has been no failure of a package and no release of radioactive materials.

Spent fuel is transported in packages which are also often referred to as shipping casks that are designed and fabricated to provide shielding of the radiation that is emitted by the fuel, and also to prevent the release of radioactive material even in severe accidents. The standards for the transportation packages are regulated by Federal law, which is enforced by the U.S. Nuclear Regulatory Commission for domestic shipments.

For international shipments, there are similar regulations that are promulgated by the International Atomic Energy Agency. An independent review of these current international and U.S. standards and regulations performed by the National Academies, as doc-

umented in their 2006 Going the Distance report, concluded that these regulations are adequate and proven to ensure package containment effectiveness during both routine transport and in severe accidents. And the Blue Ribbon Commission on America's nuclear energy future also noted that the standards and regulations for spent fuel transportation are proven and functioning well.

The regulations require that the demonstration of the package meet demanding criteria for normal operating and accident conditions, including impact, fire, submersion, and puncture resistance before the NRC will certify them for use. These prescribed hypothetical accident conditions are challenging and have been demonstrated to be bounding of realistic real world accident scenarios.

Demonstrations that the regulatory requirements are satisfied by a package design is done by detailed computer simulation analyses using state of the art analytical and modeling tools, and by confirmatory testing of specific features or details, scale models, or in some cases, even full scale casks. The NRC review of certification applications for spent fuel transport casks is extremely thorough, and typically takes 1½ to 2 years to complete. And these certificates must be renewed every 5 years.

Resulting spent fuel transportation packages that receive NRC certification are extremely robust, state-of-the-art containers. They are typically comprised of multiple layers of steel and radiation shielding. Current generation spent full casks weigh well in excess of 100 tons. And there have been extreme demonstrations of the robustness of these packages that have been performed in the United States and the United Kingdom showing casks being hit by trains and plowing into solid concrete bunkers at high rates of speed.

In each of these demonstrations, the casks maintained their integrity and suffered only superficial damage. The U.S. Nuclear Infrastructure Council believes that the history of nuclear materials and spent fuel transportation demonstrates a commendable safety record. Transportation of nuclear materials, including spent fuel, is not new or novel. The facts speak for themselves. For more than 70 years of nuclear material transport, and 40 years of spent fuel transport in the U.S. and worldwide, no member of the public has ever been harmed from a radioactive release.

This is a testament to the effectiveness of the regulatory requirements and processes which are adequate and well proven, and the industry's implementation of the regulatory requirements in partnership with regional and local governments. The rigorous engineering methods, manufacturing processes, ongoing operational and periodic maintenance requirements, and implementing procedures have provided and will continue to provide assurance of safety of spent fuel transportation.

Thank you for your time.

Mr. SHIMKUS. Thank you very much.

[The prepared statement of Mr. Quinn follows:]

Testimony of: Robert Quinn
Vice President Cask and Container Technology,
EnergySolutions
and
Chair, U.S. Nuclear Infrastructure Council, Spent Fuel
Transportation Task Force

Before the House Subcommittee on Environment and the Economy
Committee on Energy and Commerce
U.S. House of Representatives

Transporting Nuclear Materials: Design, Logistics, and Shipment

October 1, 2015

Good morning Mr. Chairman and members of the subcommittee. My name is Bob Quinn and I am the vice president of Cask and Container Technology for EnergySolutions, a US based international nuclear services company specializing in the safe recycling, processing and disposal of nuclear material. My company is a member of the U.S. Nuclear Infrastructure Council (USNIC), the leading business association advocate for new nuclear energy and global engagement of the U.S. supply chain. I am currently serving as the Chair of the council's Spent Nuclear Fuel Transportation Task Force. My statements today reflect the consensus views of the council and its Spent Fuel Transport Task Force, but do not necessarily reflect the specific views of individual member companies and organizations.

Transportation of nuclear materials including spent nuclear fuel is not new or novel, and has an outstanding safety record over the past 70 years. Nuclear materials are transported on an ongoing basis all over the world by public highway, rail, barge, ocean vessels and air. Per the U.S. Nuclear

Regulatory Commission (NRC), about 3 million packages of radioactive materials are shipped each year in the United States. Spent fuel shipments from commercial nuclear power plants, research reactors, and the Navy have been safely made for decades. The U.S. Navy has completed around 850 shipments totaling over 1.6 million miles of transport, and since the mid-1970's there have been over 1,300 safe shipments of commercial spent fuel in the United States. Between 1990 and 2012, 60 shipments including more that 250 transportation casks of foreign research reactor fuel and been shipped to and within the United States by sea, land and air. There is also a long history of successful, safe transportation of spent fuel globally; over 70,000 metric tons of spent fuel have been transported by road, rail and sea within and among the United Kingdom, France, Germany, Sweden, Japan, and other nations. Coincidentally, this quantity is approximately the same amount of spent fuel currently in storage at commercial US nuclear power plants. In all of these spent fuel shipments there has been no failure of a package and no release of radioactive materials.

Spent fuel is transported in packages (also referred to as shipping casks) that are designed and fabricated to provide shielding of the radiation that is emitted by the fuel, and also to prevent the release of radioactive material, even in severe accidents. The standards for transportation packages are regulated by Federal law and enforced by the U.S. Nuclear Regulatory Commission (NRC) for domestic shipments. International shipments are governed by similar regulations that are promulgated by the International Atomic Energy Agency (IAEA). An independent review of current international standards and U.S. regulations performed by the National

Academies, as documented in their 2006 "Going the Distance" report, concluded these regulations are adequate and proven to ensure package containment effectiveness during both routine transport and in severe accidents. And the Blue Ribbon Commission on America's Nuclear Future noted that the standards and regulations for spent fuel transportation are proven and well functioning.

The U.S. requirements are contained in Title 10, Code of Federal Regulations, Part 71 (10CFR71) and cover the design, fabrication, operation and maintenance of these packages. The regulations require the demonstration that the package meet demanding criteria for normal operating and accident conditions, including impact, fire, submersion and puncture resistance before NRC will certify them for use. These prescribed hypothetical accident conditions are challenging and have been demonstrated to be bounding of realistic, real world accident scenarios. Demonstration that the regulatory requirements are satisfied by a package design is done by detailed computer simulation analyses using state of the art analytical and modeling tools, and by confirmatory testing of specific features or details, scale models, or in some cases full scale casks. Applicants for certification of packages by NRC must perform the analytical and testing work under an NRC-approved quality assurance program. These safety analysis, and details of the design, fabrication, operation and maintenance requirements for spent fuel packages are documented in a Safety Analysis Report (SAR) that is the basis for an application, which is reviewed in detail by the NRC. The review is extremely thorough and most often results in multiple questions, answers, meetings, and revisions to clarify the application. This thorough process to obtain an NRC Certificate

of Compliance (CoC) typically takes 1-1/2 to 2 years to complete, and certificates must be renewed every 5 years. Moreover, any changes to the design, fabrication, operation or maintenance of the package as described in the SAR or the CoC throughout its lifetime must be approved by NRC and undergo the same review and approval process.

The resulting spent fuel transportation packages that receive NRC certification are extremely robust, state-of-the-art containers comprised of tons of steel and radiation shielding materials. These transportation packages typically are comprised of multiple layers of steel and radiation shielding, and current spent fuel rail casks weigh well over 100 tons. Extreme demonstrations of the robustness of these packages have been performed in the US and UK, showing casks being hit by trains and plowing into solid concrete bunkers at high rates of speed. In each of these demonstrations, the casks maintained their integrity and suffered only superficial damage.

While package design to the regulatory requirements is an integral part of package safety, it does not stop at design. The fabrication of these packages is performed under rigorous manufacturing quality control under an NRC-approved quality assurance program. Validation and certification of materials, welding procedures and qualifications, and measuring and testing equipment calibration are are carefully controlled and thoroughly documented. Fabricators and package fabrication activities are subjected to NRC inspection.

Once fabricated and placed into service, package maintenance, testing and

operational controls are required in accordance with the conditions of the NRC package certification. For example, operating procedures require that package closure seal integrity is tested and verified as meeting the cask certificate of compliance prior to each use, and and radiation levels are checked to confirm compliance with regulatory requirements. Periodic maintenance procedures dictate performance testing of critical container components such as seals and shielding. Performance of all required operations and maintenance activities are a prerequisite for the 5 year recertification of a package for continued use, and package certificate holders and users are subjected to periodic inspections by the NRC to assure that activities are being performed in accordance with the certificate of compliance and regulations.

In summary, USNIC believes that the history of nuclear materials and spent fuel transportation demonstrates a commendable record and history of safety. It is not new or novel. The facts speak for themselves: in more than 70 years of nuclear materials transport in the US and worldwide, no member of the public has ever been harmed from a radioactive release. This is a testament to the effectiveness of the regulatory requirements and processes, which are adequate and well proven, and the industry's implementation of the regulatory requirements in partnership with regional and local governments. The rigorous engineering methods, manufacturing processes, ongoing operational and periodic maintenance requirements and implementing procedures have provided, and will continue to provide, assurance of the safety of spent fuel transportation.

I will be pleased to answer any questions you may have.

Mr. SHIMKUS. Next we will turn to Mr. Franklin Rusco, director, Natural Resources and Environment with U.S. Government Accountability Office. You are recognized for 5 minutes. Welcome.

STATEMENT OF FRANKLIN RUSCO

Mr. RUSCO. Thank you. Chairman Shimkus, Ranking Member Tonko, and members of the subcommittee, I am pleased to be here today to discuss GAO's work on spent nuclear fuel management, and particularly challenges associated with transporting spent fuel.

In our past work we have identified three key challenges to transporting spent nuclear fuel. First, DOE does not have clear legislative authority for either consolidated interim storage or for permanent disposal at a site other than Yucca Mountain. Specifically, provisions in the Nuclear Waste Policy Act of 1982, that authorized DOE to arrange for consolidated interim storage have either expired or are unusable.

For permanent disposal, the amendments to the Nuclear Waste Policy Act of 1982 directed DOE to terminate work on sites other than Yucca Mountain. Without clear authority, DOE cannot site an interim storage or permanent disposal facility and make related site-specific transportation decisions for commercial spent nuclear fuel.

Second, there are multiple technical challenges to safely transporting spent nuclear fuel. These challenges can be resolved, but it will take time and could be costly. Specifically, there are uncertainties about the safety of transporting what is considered to be high burn up spent nuclear fuel, newer fuel that burns longer and at a higher rate than older fuel because of potential degradation while in storage. Also, NRC guidelines for dry storage of spent nuclear fuel allow higher temperatures and external radiation levels than do guidelines for transportation of such fuel. As a result, spent nuclear fuel already in dry storage is not readily transportable without being re-casked.

In addition, the current transportation infrastructure, particularly for a mostly rail option of transportation, which is DOE's preferred mode, may not be adequate without procuring new equipment and costly and time-consuming upgrades on the rail infrastructure.

Third, and perhaps the most daunting challenge, is achieving societal acceptance of any plan to move or store spent nuclear fuel. Specifically, in order for stakeholders and the general public to support any spent nuclear fuel program, particularly one for which a site has not yet been identified, there must be a broad understanding of the issues and risks associated with management of spent nuclear fuel, as well as what can be done to mitigate these risks. Also, some organizations that oppose DOE have effectively used social media and other means to promote their agendas to the public. But DOE has no coordinated outreach strategy to reflect their own views on this.

Given these challenges, it may take many decades to implement a storage strategy and transport the fuel that will almost all be in dry storage by then. So the question is what can DOE and other agencies do to prepare to take possession of spent nuclear fuel as required by law? With regard to building societal consensus around

transport and storage of spent nuclear fuel, we believe DOE has authority and should be doing more public outreach to try to build such consensus.

What else can be done? Can DOE, NRE, and DOT identify spent nuclear fuel dry storage and transportation options that are not dependent on a specific interim or permanent storage strategy, but that will save time and money once the issue of siting an interim or permanent storage site have been resolved? Can they ask Congress for authority to pursue such storage site neutral efforts to resolve technical challenges? Hopefully, this hearing can begin to answer these questions.

Thank you. This ends my statement. I would be happy to answer questions.

Mr. SHIMKUS. Thank you very much.

[The prepared statement of Mr. Rusco follows:]

United States Government Accountability Office

Testimony

Before the Subcommittee on Environment and the Economy, Committee on Energy and Commerce, House of Representatives

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SPENT NUCLEAR FUEL

Legislative, Technical, and Societal Challenges to Its Transportation

Statement of Frank Rusco, Director, Natural Resources and Environment

GAO-16-121T

GAO Highlights

Highlights of GAO-16-121T, a testimony before the Subcommittee on Environment and the Economy, Committee on Energy and Commerce, House of Representatives

October 1, 2015

SPENT NUCLEAR FUEL

Legislative, Technical, and Societal Challenges to Its Transportation

Why GAO Did This Study

Spent nuclear fuel—the used fuel removed from commercial nuclear power reactors—is an extremely harmful substance if not managed properly. The nation's inventory of spent nuclear fuel has grown to about 72,000 metric tons currently stored at 75 sites in 33 states, primarily where it was generated.

Under the Nuclear Waste Policy Act of 1982, DOE was to investigate Yucca Mountain, a site about 100 miles northwest of Las Vegas, Nevada, for the disposal of spent nuclear fuel. DOE terminated its work at Yucca Mountain in 2010 and now plans to transport the spent nuclear fuel to interim storage sites beginning in 2021 and 2024, then to a permanent disposal site by 2048. Transportation of spent nuclear fuel is a major element of any policy adopted to manage and dispose of spent nuclear fuel.

This testimony discusses three key challenges related to transporting spent nuclear fuel: legislative, technical, and societal. It is based on reports GAO issued from November 2009 to October 2014.

What GAO Recommends

GAO is making no new recommendations.

View GAO-16-121T. For more information, contact Frank Rusco at (202) 512-3841 or ruscof@gao.gov.

What GAO Found

Based on its prior work, GAO found three key challenges related to the transportation of spent nuclear fuel: legislative, technical, and societal.

- **Legislative challenges**. As GAO reported in November 2009, August 2012, and October 2014, DOE does not have clear legislative authority for either consolidated interim storage or for permanent disposal at a site other than Yucca Mountain. Specifically, provisions in the Nuclear Waste Policy Act of 1982 that authorized the Department of Energy (DOE) to arrange for consolidated interim storage have either expired or are unusable. For permanent disposal, GAO reported in October 2014 that the amendments to the Nuclear Waste Policy Act of 1982 directed DOE to terminate work on sites other than Yucca Mountain. Without clear authority, DOE cannot site an interim storage or permanent disposal facility and make related transportation decisions for commercial spent nuclear fuel.
- **Technical challenges**. As GAO reported in October 2014, experts identified technical challenges that could affect the transportation of spent nuclear fuel. These challenges could be resolved, but it would take time and could be costly. Specifically, GAO reported that there were uncertainties about the safety of transporting what is considered to be high burn-up spent nuclear fuel—newer fuel that burns longer and at a higher rate than older fuel—because of potential degradation while in storage. GAO also reported that guidelines for storage of spent nuclear fuel allow higher temperatures and external radiation levels than guidelines for transportation, rendering some spent nuclear fuel not readily transportable. In addition, GAO reported that the current transportation infrastructure, particularly for a mostly rail option of transportation—which is DOE's preferred mode—may not be adequate without procuring new equipment and costly and time-consuming upgrades on the infrastructure.
- **Societal challenges**. As GAO reported in October 2014, public acceptance is key for any aspect of a spent nuclear fuel management and disposition program—including transporting it—and maintaining that acceptance over the decades needed to implement a spent fuel management program is challenging. In that regard, GAO reported that in order for stakeholders and the general public to support any spent nuclear fuel program—particularly one for which a site has not been identified—there must be a broad understanding of the issues associated with management of spent nuclear fuel. Also, GAO found that some organizations that oppose DOE have effectively used social media to promote their agendas to the public, but that DOE had no coordinated outreach strategy, including social media. GAO recommended that DOE develop and implement a coordinated outreach strategy for providing information to the public on their spent nuclear fuel program. DOE generally agreed with GAO's recommendation.

Chairman Shimkus, Ranking Member Tonko, and Members of the Subcommittee:

I am pleased to be here today to discuss our work on issues related to transportation of commercial spent nuclear fuel. Spent nuclear fuel—used nuclear fuel that has been removed from the reactor core of a nuclear power reactor[1]—is an extremely harmful substance if not managed properly. Without protective shielding, its intense radioactivity can kill a person who is directly exposed to it or cause long-term health hazards, such as cancer. In addition, if not managed properly, or if released by a natural disaster or an act of terrorism, it could contaminate the environment with radiation. The nation's inventory of spent nuclear fuel from commercial nuclear power reactors—which amounts to about 72,000 metric tons— is stored at 75 sites in 33 states, generally where it was generated. The spent nuclear fuel is stored either wet in pools of water or dry in storage systems that typically consist of stainless steel canisters within protective casks. Dry storage systems are designed with thick steel and concrete walls to provide radiation shielding and passive pathways for removal of spent nuclear fuel decay heat, such as air vents in the casks. Transporting the spent nuclear fuel anywhere depends on the policy that is ultimately put into place for management and final disposition of the spent nuclear fuel.

National policy for the disposition of spent nuclear fuel dates to the passage of the Nuclear Waste Policy Act of 1982 (NWPA), which made disposal of spent nuclear fuel a federal responsibility.[2] NWPA directed the Department of Energy (DOE) to investigate sites for a permanent repository. In 1987, Congress amended the act to direct DOE to focus its

[1]Spent (or used) nuclear fuel can no longer efficiently generate power in a nuclear reactor. However, it is potentially a resource because it can be reprocessed to separate out uranium and plutonium to be used again as fuel in a reactor. Reprocessing, however, still results in high-level radioactive waste that requires disposal, and the United States does not currently reprocess spent nuclear fuel from commercial nuclear power reactors. The federal government generates spent nuclear fuel from power, research, and navy shipboard reactors. The U.S. Nuclear Regulatory Commission considers spent nuclear fuel that is accepted for disposal to be high-level radioactive waste. High-level radioactive waste also includes by-products of weapons production and other defense-related activities generated from reprocessing spent nuclear fuel. The scope of this statement only includes commercial spent nuclear fuel.

[2]Pub. L. No. 97-425 §§ 112, 113. NWPA also addressed disposal of high-level radioactive waste other than spent nuclear fuel.

efforts only on a site at Yucca Mountain, Nevada, about 100 miles northwest of Las Vegas. In 2008, DOE submitted a license application for a repository at Yucca Mountain to the Nuclear Regulatory Commission (NRC), which is responsible for regulating storage, transportation, and disposal of spent nuclear fuel from commercial nuclear power reactors. Then, in a change of policy in 2009, the Secretary of Energy said that a repository at Yucca Mountain was not a workable option and, in 2010, DOE terminated its efforts to license a repository there. In 2010, DOE chartered the Blue Ribbon Commission on America's Nuclear Future to recommend a plan for management and disposal of spent nuclear fuel. In January 2012, the Blue Ribbon Commission issued its report.[3] Among other things, the commission recommended that DOE consider consolidated interim storage of spent nuclear fuel and develop a consent-based approach to locating or establishing (or "siting") future spent nuclear fuel management facilities. In January 2013, DOE issued a strategy for managing spent nuclear fuel in response to the commission's recommendations.[4] The strategy calls for the federal government to begin accepting spent nuclear fuel for management at a pilot interim storage facility by 2021 and at a larger consolidated interim storage facility by 2025, then begin disposal at a permanent repository by 2048. According to the strategy, it represents "an initial basis for discussions among the Administration, Congress and other stakeholders on a sustainable path forward for disposal" of spent nuclear fuel and other types of high-level radioactive waste.

Over the past decade, we have issued a number of reports related to the management of spent nuclear fuel. My testimony today discusses the three key challenges related to transporting spent nuclear fuel that we have identified in our prior work. Generally speaking, challenges related to transportation fall into one of three categories: legislative, technical, or societal. I will discuss each of these categories. This testimony is based

[3]Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy (Washington, D.C.: Jan. 26, 2012).

[4]DOE, *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste*, (Washington, D.C.: January 2013).

on reports we issued from November 2009 to October 2014. [5] In particular, I will be highlighting our October 2014 report on spent nuclear fuel management. For this work, we reviewed documents and interviewed officials from DOE and NRC regarding their regulatory roles related to spent nuclear fuel management. In addition, we obtained input from experts and stakeholders in spent nuclear fuel management.[6] A detailed discussion of our scope and methodologies can be found in each of our published reports. We conducted the work that this testimony is based on in accordance with generally accepted government auditing standards. Those standards require that we plan and perform audits to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

The transportation of large amounts of spent fuel to an interim storage or permanent disposal location is inherently complex and the planning and implementation may take decades to accomplish. The actual time it would take depends on a number of variables including distance, quantity of material, mode of transport, rate of shipment, level of security, and coordination with state and local authorities. For example, according to officials from a state regional organization we interviewed and the Blue Ribbon Commission report, transportation planning could take about 10 years, in part because routes have to be agreed upon, first responders

[5]For example, see GAO, Nuclear Waste Management: Key Attributes, Challenges, and Costs for the Yucca Mountain Repository and Two Potential Alternatives, GAO-10-48 (Washington, D.C.: Nov. 4, 2009); Yucca Mountain: Information on Alternative Uses of the Site and Related Challenges, GAO-11-847 (Washington, D.C.: Sept. 16, 2011); Commercial Nuclear Waste: Effects of a Termination of the Yucca Mountain Repository Program and Lessons Learned, GAO-11-229 (Washington, D.C.: Apr. 8, 2011); Spent Nuclear Fuel: Accumulating Quantities at Commercial Reactors Present Storage and Other Challenges, GAO-12-797 (Washington, D.C.: Aug. 15, 2012); Commercial Spent Nuclear Fuel: Observations on the Key Attributes and Challenges of Storage and Disposal Options, GAO-13-532T (Washington, D.C.: Apr. 11, 2013); and Spent Nuclear Fuel Management: Outreach Needed to Help Gain Public Acceptance for Federal Activities That Address Liability, GAO-15-141. (Washington, D.C.: Oct. 9, 2014).

[6]In total, we interviewed over 90 individuals, including federal officials, who represented a wide range of viewpoints and expertise. However, our selection of experts is non-generalizable, in that opinions cannot be generalized to other experts or tallied, either within or across types of expertise.

have to be trained, and critical elements of infrastructure and equipment need to be designed and deployed.

Legislative Challenges to Transporting Spent Nuclear Fuel

As we previously reported, DOE does not have clear legislative authority for either consolidated interim storage or for permanent disposal at a site other than Yucca Mountain and, as such, there is no facility to which DOE can transport commercial spent nuclear fuel. Without clear authority, DOE cannot make the transportation decisions necessary regarding commercial spent nuclear fuel.

Specifically, as we reported in November 2009, August 2012, and October 2014, provisions in NWPA that authorize DOE to arrange for consolidated interim storage have either expired or are unusable because they are tied to milestones in the development of a repository at Yucca Mountain that have not been met.[7] DOE officials and experts from industry we interviewed in October 2014 agreed with this assessment, and noted that the federal government's ability to site, license, construct, and operate a consolidated interim storage facility not tied to Yucca Mountain depends on new legislative authority.

For permanent disposal, we reported in April 2011,[8] that developing a permanent repository other than Yucca Mountain will restart the likely time-consuming and costly process of siting, licensing, and developing such a repository and it is uncertain what legislative changes might be needed, if any, to develop a new repository. In part, this is because NWPA, as amended, directs DOE to terminate all site specific activities at candidate sites other than Yucca Mountain.

[7]GAO-10-48, GAO-12-797, GAO-15-141.

[8]GAO-11-229.

Technical Challenges to Transporting Spent Nuclear Fuel

As we reported in October 2014,[9] experts identified technical challenges that could affect the transportation of spent nuclear fuel and these challenges could be resolved with sufficient time. The three technical challenges the experts described were (1) uncertainties related to the safety of high burn-up fuel during transportation,[10] (2) readiness of spent nuclear fuel to be transported under current guidelines, and (3) sufficiency of the infrastructure to support transportation.

Before 2000, most fuel discharged from U.S. nuclear power reactors was considered low burn-up fuel and, consequently, the industry has had decades of experience in transporting it. As we reported in October 2014, various reports from DOE, NRC, the Electric Power Research Institute, and the Nuclear Waste Technical Review Board, as well as experts we interviewed, agreed that uncertainties exist on how long high burn-up fuel—used for about 10 years— can be stored and then still be safely transported. Once sealed in a canister, the spent fuel cannot easily be inspected for degradation. We reported that as of August 2014, NRC officials told us that they had analyzed laboratory tests and models developed to predict the changes that occur during dry storage and that the results indicate that high burn-up fuel will maintain its integrity over very long periods of storage and can eventually be safely transported. However, NRC officials said they continued to seek additional evidence to confirm their position that long-term storage and transportation of high burn-up spent nuclear fuel is safe. We also reported that DOE and the Electric Power Research Institute have planned a joint development project to test high burn-up fuel for degradation, but those results will not be available for about a decade.

As we reported in October 2014,[11] because the guidelines governing dry storage of spent nuclear fuel allow higher temperatures and external radiation levels than guidelines for transporting the fuel, some of the spent nuclear fuel in dry storage may not be readily transportable. For example, according to the Nuclear Energy Institute, as of 2012, only about 30 percent of spent nuclear fuel currently in dry storage is cool

[9]GAO-15-141.

[10]Reactor fuel burn-up is a measure of the energy produced by the fuel. High burn-up fuel generally has been in a reactor longer than low burn-up fuel and is defined as having a burn-up higher than 45,000-megawatt days per metric ton.

[11]GAO-15-141.

enough to be directly transportable. For safety reasons, transportation guidelines do not allow the surface of the transportation cask to exceed 185 degrees Fahrenheit (85 degrees Celsius) because the spent nuclear fuel is traveling through public areas using the nation's public transportation infrastructure. NRC's guidelines on spent nuclear fuel dry storage limit spent nuclear fuel temperature to 752 degrees Fahrenheit (400 degrees Celsius). Scientists from the national laboratories and experts from industry we interviewed suggested three options for dealing with the stored spent nuclear fuel so it can be transported safely: (1) leave it to cool and decay at reactor sites, (2) repackage it into smaller canisters that reduce the heat and radiation, or (3) develop a special transportation "overpack" to safely transport the spent nuclear fuel in the current large canisters. However, as we reported in August 2012,[12] spent nuclear fuel stored at reactor sites that had already shut down and dismantled their infrastructure may pose an even more difficult challenge because the ability to repackage the fuel or develop similar solutions may be limited without building additional infrastructure, such as a special transfer facility, or the spent fuel would need to be shipped to a site that had a transfer facility.

According to a 2013 DOE report, the preferred mode for transporting spent nuclear fuel to a consolidated interim storage facility would be rail.[13] However, as we reported in October 2014,[14] several experts from industry pointed out that not all of the spent nuclear fuel currently in dry storage is situated near rail lines; also, one of these experts said that procuring qualified rail cars capable of transporting spent nuclear fuel will be a lengthy process. Storage sites without access to a rail line may require upgrades to the transportation infrastructure or alternative modes of transportation to the nearest rail line. Constructing new rail lines or extending existing rail lines could be a time-consuming and costly endeavor. In addition, an industry official we interviewed noted that if spent nuclear fuel were trucked to the nearest rail line, the federal government would have to develop a safe method of transferring the spent nuclear fuel from heavy haul trucks onto rail cars. In September

[12]GAO-12-797.

[13]See DOE, *Office of Fuel Cycle and Research Development, A Project Concept for Nuclear Fuels Storage and Transportation*, FCRD-NFST-2013-000132 Rev. 1 (June 15, 2013).

[14]GAO-15-141.

2013, DOE completed a preliminary technical evaluation of options available and needed infrastructure for DOE or a new waste management and disposal organization to transport spent nuclear fuel from shut-down sites to a consolidated interim storage facility. According to DOE officials, there was no need to make a decision regarding how best to move forward with the study results because there was, at that time, no site and no authorization to site, license, construct, and operate a consolidated interim storage facility.[15] We also reported in October 2014 that procuring qualified railcars may be a time-consuming process, in part because of the design, testing, and approval for a railcar that meets specific Association of American Railroads standards for transporting spent nuclear fuel.[16]

Societal Challenges to Transporting Spent Nuclear Fuel

As we found in October 2014, public acceptance is key to any aspect of a spent nuclear fuel management and disposition program, including transportation. Specifically, unless and until there is a broad understanding of the issues associated with management of spent nuclear fuel, specific stakeholders and the general public may be unlikely to support any spent nuclear fuel program. In particular, a program that has not yet been developed or for which a site has not been identified may have challenges in obtaining public acceptance. This finding is not new and, in April 2011 and in October 2014 we found reports spanning several decades that identified societal and political opposition as the key obstacles to spent nuclear fuel management.[17] For example, in 1982, the congressional Office of Technology Assessment reported that public and political opposition were key factors to siting and building a repository. The National Research Council of the National Academies reiterated this conclusion in a 2001 report, stating that the most significant challenge to siting and commencing operations at a repository is societal. Our analysis of stakeholder and expert comments indicates the societal and political

[15]DOE, *Preliminary Evaluation of Removing Used Nuclear Fuel from Shutdown Sites*, PNNL-22676 Rev.1 (Sept. 30, 2013).

[16]The American Association of Railroads established the S-2043 standard that sets higher standards for transportation of spent nuclear fuel than for normal rail operations. For example, S-2043 requires on-board safety protection technology unique to spent nuclear fuel shipments and structural upgrades to accommodate the extra weight.

[17]GAO-11-229, GAO-15-141.

factors opposing a repository are the same for a consolidated interim storage facility.

Moreover, we reported in April 2011[18] and October 2014[19] that any spent nuclear fuel management program is going to take decades to develop and to implement and that maintaining public acceptance over that length of time will face significant challenges. We also reported in November 2009, that the nation could not be certain that future generations would have the willingness or ability to maintain decades-long programs we put into place today.[20] Of particular concern is having to transport spent nuclear fuel more than once, which may be required if some spent nuclear fuel is moved to an interim storage facility prior to permanent disposal. Some stakeholders have voiced concerns that because of this opposition to multiple transport events, a consolidated interim storage site may become a de facto permanent storage site.

In October 2014, we reported that according to experts and stakeholders, social media has been used effectively to provide information to the public through coordinated outreach efforts by organizations with an interest in spent nuclear fuel policy. Some of these organizations oppose DOE's strategy and the information they distribute reflects their agendas. In contrast, we reported that DOE had no coordinated outreach strategy, including social media. We concluded that in the absence of a coordinated outreach strategy by DOE, specific stakeholders and the general public may not have complete or accurate information about the agency's activities, making it more difficult for the federal government to move forward with any policy to manage spent nuclear fuel. We recommended that DOE develop and implement a coordinate outreach strategy for providing information to specific stakeholders and the general public on federal activities related to managing spent nuclear fuel—which would include transportation planning. DOE generally agreed with our recommendation.

[18]GAO-11-229.

[19]GAO-15-141.

[20]GAO-10-48.

Chairman Shimkus, Ranking Member Tonko, and Members of the Subcommittee, this concludes my prepared statement. I would be pleased to respond to any questions you may have at this time.

GAO Contact and Staff Acknowledgments

If you or your staff members have any questions about this testimony, please contact me at (202) 512-3841 or ruscof@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this testimony. Karla Springer (Assistant Director), and Antoinette Capaccio, Robert Sánchez, and Kiki Theodoropoulos also made key contributions to this testimony.

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Mr. SHIMKUS. Last but not least, we have got Mr. Kevin Kamps, Radioactive Waste Watchdog with Beyond Nuclear. You are recognized for 5 minutes. Welcome.

STATEMENT OF KEVIN J. KAMPS

Mr. KAMPS. Thank you, Chairman Shimkus, Ranking Member Tonko, and members of the subcommittee. My name is Kevin Kamps. I serve as Radioactive Waste Watchdog at Beyond Nuclear based in Takoma Park, Maryland.

Our country needs to avoid radioactive waste wrecks, both figurative of policy, as well as literal on our roads, rails, and waterways. We need to just say no to unwise irradiated nuclear fuel transport, storage, and disposal schemes that have more to do with offloading nuclear utilities' liabilities onto the public than on protecting health, safety, and the environment.

Transporting high-level radioactive waste by truck, train, and barge through 45 States and the District of Columbia to the unsuitable Yucca Mountain, Nevada, site would take unnecessary risks and violate consent-based and environmental justice principles.

Yucca is the worst site ever studied for high-level radioactive waste disposal. It has been kept alive by double standards. When Yucca can't meet the standards, they are either weakened or gotten rid of. Yucca is an earthquake and volcanic zone. If radioactive waste is ever buried there, it will leak massively into the groundwater, creating a large nuclear sacrifice zone downstream.

Nevada has not consented to being railroaded into becoming this country's radioactive waste dump. The Western Shoshone Indian Nation who live downstream have accused Federal officials of environmental racism.

Consolidated interim storage also makes no sense. Take private fuel storage targeted at the Skull Valley Goshutes Indian reservation in Utah. If that de facto permanent parking lot dump had ever opened and imported 4,000 casks of radioactive waste, they would have been returned to sender when Yucca was cancelled. Fifty casks from Maine would have traveled 5,000 miles roundtrip for nothing.

High-level radioactive waste shipments are potential mobile Chernobyls. Risks include long-lasting high temperature fires, as NAS acknowledged in 2006, which could breach shipping containers and release disastrous amounts of hazardous radioactivity in heavily populated areas.

Barge shipments on the Great Lakes, California's Pacific coast, the waters of New Jersey, and numerous other rivers and seacoasts, including in New York, are potential floating Fukushimas, risking radioactive contamination of vital drinking water supplies and the food chain, and even deadly nuclear criticality accidents if submerged.

A quality assurance meltdown in industry and at NRC revealed by whistleblowers and accidents adds to the risks of shipments. Calling into question, as but one example, Holtec casks' structural integrity sitting still, let alone traveling 60 miles per hour or faster on the rails.

NAS also emphasized that risks of terrorist attacks need to be addressed. A 1998 test of a TOW anti-tank missile on a shipping

container conducted at the U.S. Army's Aberdeen Proving Ground showed that casks are potential dirty bombs on wheels. Combined with an incendiary device, such breaches could cause a large-scale radioactivity release.

Incredibly, DOE is throwing caution to the wind, proposing unprecedented liquid high-level radioactive waste truck shipments from Chaulk River, Ontario, to Savannah River, South Carolina, with little to no environmental assessment. Even after the Blue Ribbon Commission heard many calls for environmental justice, it nonetheless kept Native American communities on the target list for centralized interim storage. But as Keith Lewis of the Serpent River First Nation put it, there is nothing moral about tempting a starving man with money.

As President Obama honored Grace Thorpe for helping 60 Native communities, six-zero, Native communities, fend off DOE's parking lot dumps, such radioactive racism must stop.

Through sheer luck, the Los Alamos barrel that burst in the WIPP underground do not do so while being shipped, or astronomically costly and hazardous radioactive releases to the environment and worker or public alpha inhalation doses could have been much worse. Waste control specialists in Texas, a lead contender for a parking lot dump, hastily hosted similar potentially explosive barrels in the open air, which could put not only the Ogallala Aquifer at risk, but also the radioactive waste storage targeted at that site.

Savannah River site and Dresden Nuclear Power Plant in Illinois are also inappropriate targets for parking lot dumps, as they are already heavily burdened by radioactive contamination and large-scale radioactive waste storage.

So if Yucca and parking lot dumps are bad ideas, what are some solutions? We should phase out nuclear power, stop the generation of high-level radioactive waste, and replace the electricity and jobs with renewables and efficiency. For the high-level radioactive waste that already exists, 200 groups representing all 50 states have been advocating hardened onsite storage for well over a decade. Vulnerable pools need to be emptied into quality dry casks that are built to last, safeguarded against accidents and natural disasters, and fortified against attacks.

Thank you.

Mr. SHIMKUS. Thank you very much.

[The prepared statement of Mr. Kamps follows:]

Statement of

Kevin J. Kamps
Radioactive Waste Watchdog
Beyond Nuclear

At the Hearing on
"Transporting Nuclear Materials:
Design, Logistics, and Shipment"

Before the Subcommittee on
Environment and the Economy,
U.S. House of Representatives,
Energy & Commerce Committee,
Washington, D.C.

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Beyond Nuclear aims to educate and activate the public about the connections between nuclear power and nuclear weapons and the need to abandon both to safeguard our future. Beyond Nuclear advocates for an energy future that is sustainable, benign and democratic.

Avoiding Radioactive Waste Wrecks: Just Say No to Unwise Irradiated Nuclear Fuel Transport, Storage, and Disposal Schemes

Dr. Mary Sinclair of Don't Waste MI warned 25 years ago that high-level radioactive wastes, piled up on the shores of the Great Lakes, and the other drinking water supplies of our nation, are an unacceptable threat that certainly can't stay there forever.

The same can be said of radioactive wastes stored on-site at ocean side reactors, as rising sea levels pose worsening risks as time goes on.

But even Dr. Sinclair recognized that such risks do not justify unwise high-level radioactive waste transportation programs on our nation's roads, rails, and waterways in most states. Bound for destinations that make no good sense, hasty and unnecessary shipments would only increase risks. Thus, she urged her Members of Congress to vote against the proposed Yucca dump in 2002.

Yucca Mountain: Unsuitable, Non-Consensual, Environmental Racism

As Dr. Arjun Makhijani of the Institute for Energy and Environmental Research (IEER) has said, Yucca Mountain, Nevada is the worst site ever studied for high-level radioactive waste geologic disposal. U.S. Department of Energy (DOE) studies more than 30 years ago showed the site's geologic unsuitability, a scientific conclusion that has been confirmed, and bolstered, time and again by Yucca's infamous "double standard standards": when Yucca can't meet the standards, they are either weakened, or gotten rid of altogether, in a desperate bid to keep the unsuitable dumpsite project alive.

If waste were ever buried in that corrosive earthquake and volcanic zone, it would leak massively into the groundwater (and air), creating a nuclear sacrifice zone over an extensive region downstream (and downwind), as well up the food chain, and down the generations.

Just as bad, Yucca fails the consent-based requirement set by the Blue Ribbon Commission on America's Nuclear Future (BRC) in 2012. The Western Shoshone Indian Nation, whose land Yucca is, as acknowledged by the U.S. government in the "peace and friendship" Treaty of Ruby Valley of 1863, certainly does not want high-level radioactive waste and irradiated nuclear fuel dumped there. As recently reported in the *Las Vegas Review Journal*, Western Shoshone Indians have accused U.S. federal agencies, such as NRC, of forcing radioactive waste dumping at Yucca Mountain, against the tribal nation's will, and being guilty of environmental racism.(1)

In a bipartisan way, the people and State of Nevada, and its congressional delegation, led by U.S. Senate Democratic Leader Harry Reid, has also made it very clear, for three decades now, that they do not consent to being railroaded.

And many folks in the 45 states, as well as the District of Columbia, that would see high-level radioactive waste trucks, trains, and barges roll through, bound for the unsuitable Yucca dump, have come to realize that when it comes to nuclear waste transportation, we all live in Nevada.

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(1) http://www.reviewjournal.com/politics/american-indians-accuse-nrc-environmental-racism

Regional Equity, Versus East Dumps on West

Too many politicians have joined the nuclear utilities and their lobbyists in embodying NIMBY-ism (Not In My Back Yard), by advocating YIYFY-ism (Yes In *YOUR* Front Yard). Nevada, after all, has no atomic reactors, and hence no high-level radioactive waste, within its borders.

Why is it that 90% of the atomic reactors are east of the Mississippi, but most of the targeted dumpsites have been west of the Mississippi? Where's the regional equity in that? One nation, under God, indivisible – until it comes to radioactive waste, then it's East versus West, every state for themselves!

The Rush Toward De Facto Permanent Parking Lot Dumps, for No Good Reason

The BRC and DOE's calls for a consolidated interim storage pilot site as early as 2021, for storing so-called orphaned or stranded waste, and a full-scale centralized interim site by 2024, are bad ideas, especially if those interim sites are entirely uncoupled from a permanent repository. That risks turning consolidated interim storage sites into *de facto* permanent parking lot dumps.

First of all, long time watchdogs living in the shadows of the high-level radioactive waste still stored at permanently closed, and even decommissioned, atomic reactors – such as Big Rock Point, Michigan and Yankee Rowe, Massachusetts – have said not "not in our name." The high-level radioactive waste risks should not be transferred onto trucks, trains, and barges, and relocated to other communities, for no good reason.

It seems that some ulterior motive is driving this process. Could it be that nuclear utilities' desire to offload liability for the high-level radioactive wastes they have generated, onto taxpayers, could be the real underlying motivation, not public health, safety, security, environmental protection, or returning radioactively contaminated, decommissioned nuclear power plant sites back to "unrestricted reuse."

But another serious risk is that high-level radioactive waste would be shipped to a parking lot dump, only for it to have to be shipped back in the direction from which it came in the first place, if and when a permanent repository is finally opened. This risk is not far-fetched.

Private Fuel Storage, LLC, targeted at the Skull Valley Goshute Indian Reservation in Utah, came the closest yet to opening a parking lot dump. If opened, PFS would have shipped 4,000 rail casks, containing 40,000 metric tons of commercial irradiated nuclear fuel, to the tiny Native American community (with just over 100 adult members), over a 20-year period, for surface storage. PFS was intended to serve as a stepping-stone to Yucca, located right next door in Nevada. But being merely interim storage, PFS planned to "return to sender" if Yucca never opened. Thus, if PFS had ever operated, Yucca's cancellation would have meant that 50 high-level radioactive waste casks from Maine Yankee would have travelled 2,500 miles west, only to turn around and return to the New England. 50 risky rolls of the dice, 5,000 round trip miles, accomplishing absolutely nothing. Thank goodness that senseless risk taking didn't happen.

Just Say No to Radioactive Racism

PFS also raises the serious issue of environmental justice, as does Yucca. PFS targeted the Skull Valley Goshutes Indian Reservation.(2) The Yucca dump targets Western Shoshone Indian land.

Before Skull Valley, the Nuclear Waste Negotiator at DOE targeted Mescalero Apache in NM, after having sent letters of inquiry to every single federally recognized tribe in the U.S., and then focusing on 60 in particular.(3)

But Grace Thorpe (daughter of "Athlete of the Century" Jim Thorpe, and later a NIRS board member) made short shrift of any notion that her Sauk and Fox Indian Reservation in Oklahoma would become a high-level radioactive waste parking lot dump. Just days after her tribal council expressed interest in DOE's proposal, Thorpe led the effort to oust them from office. She then toured the country, helping other targeted tribal communities fend off parking lot dumps.

Most appropriately, President Obama honored her, right up there with the likes of Rachel Carson, in his "Women Taking the Lead to Save Our Planet" Women's History Month Proclamation of March 2009:

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(2) http://www.nirs.org/radwaste/scullvalley/skullvalley.htm
(3)http://www.nirs.org/radwaste/scullvalley/historynativecommunitiesnuclearwaste06142005.pdf

"...Grace Thorpe, another leading environmental advocate, also connected environmental protection with human well-being by emphasizing the vulnerability of certain populations to environmental hazards. In 1992, she launched a successful campaign to organize Native Americans to oppose the storage of nuclear waste on their reservations, which she said contradicted Native American principles of stewardship of the earth. She also proposed that America invest in alternative energy sources such as hydroelectricity, solar power, and wind power."(4)

The honor should be extended to Rufina Marie Laws and Margene Bullcreek as well, the leaders of the successful efforts at Mescalero Apache, NM and Skull Valley, UT, respectively, that fended off radioactive waste parking lot dumps targeted at their communities.

Tragically, however, President Obama's own BRC and DOE continue to contemplate parking lot dumps on Native American reservations.(5) Such environmental injustice is unacceptable, and must be stopped.

"Whoops" at WIPP: Billion-Dollar Barrel Burst?!

But DOE sites are also being targeted for parking lot dumps, including the Waste Isolation Pilot Plant (WIPP) in New Mexico.

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(4) https://www.whitehouse.gov/the-press-office/womens-history-month-2009
(5) http://www.beyondnuclear.org/radioactive-waste-whatsnew/2012/1/26/brc-report-continues-shameful-history-of-targeting-native-am.html

It's ironic that the subcommittee included the following paragraph in its Background Memo about this hearing today:

DOE disposes of transuranic (TRU) waste, which consists of contaminated items such as clothing, rags, or tools, in the Waste Isolation Pilot Project (WIPP). Since 1999, DOE has overseen over 90,000 cubic meters and 12,000 shipments for disposal at WIPP. The experience of WIPP demonstrates key aspects of a system to transport nuclear materials, including coordination with the Department of Transportation (DOT) on hazardous cargo regulations and cooperation with State, local, and tribal governments on emergency responder training and route identification.

After all, WIPP has been effectively shut down since an underground fire, and a barrel burst, within days of each other in February 2014. The barrel burst contaminated not only the underground, but also caused a radioactive release into the surface environment, which fell out downwind, contaminating the soil. Around two-dozen workers were exposed to hazardous alpha-emitting radioactive particle inhalation doses, increasing their risk of latent lung cancer. DOE has estimated the recovery cost for the barrel burst will be $500 million; the *L.A. Times* has predicted that cost will double.

But the barrel that burst underground at WIPP had been transported there in the first place from Los Alamos National Lab. Thank goodness the barrel didn't burst during the shipment, or during transfer operations at WIPP's surface, or else the environmental radioactivity release could have been even worse.

(A collision involving a transuranic waste shipment from Idaho National Lab (INL) to WIPP several years earlier resulted in airborne plutonium contamination inside the transport container. Even though the shipment had already travelled nearly a thousand miles, and was very close to WIPP when the accident occurred, the decision was made to "return to sender" at INL, so as not to risk radioactively contaminating the WIPP surface facilities by opening the internally-contaminated shipping container there. The 1,000-mile return trip to Idaho had the increased risk of involving an internally-contaminated shipping container.)

Other Private, DOE, and Commercial Nuclear Power Plant Targets for Parking Lot Dumps, and Unprecedented Liquid High-Level Radioactive Waste Transport Proposals

Another top contender for the country's first commercial irradiated nuclear fuel parking lot dump is Waste Control Specialist (WCS) in Andrews County, Texas. The dumpsite already puts the Ogallala Aquifer at risk from shallow disposal of so-called "low" level radioactive wastes. Compounding the risks is the fact that, after the barrel burst at WIPP, Los Alamos rushed a large number of barrels, potentially containing similar reactive ingredients, to WCS for surface storage. If one or more of those barrels were to burst, adjacent to commercial high-level radioactive waste centralized interim storage, the hazardous contamination repercussions could be very serious, as well as costly.

As with the national transportation impacts associated with the Yucca dump proposal, a parking lot dump at WCS would initiate high-level radioactive waste shipments through many states.(6)

Another DOE site being targeted for centralized interim storage is Savannah River Site (SRS), South Carolina. But this site is already heavily burdened with radioactive waste and contamination, including the adjacent, leaking Barnwell "low" level radioactive waste dump, and numerous SRS underground storage tanks containing high-level radioactive waste sludge that will, if abandoned, someday likely leak their contents into the Savannah River, in violation of the Safe Drinking Water Act.(7)

Astoundingly, DOE is also seriously considering importing *liquid* high-level radioactive waste from Chalk River, Ontario, Canada to SRS. Solid high-level radioactive waste transport is already risky enough. Liquid high-level radioactive waste shipments – unprecedented in North American history – would be significantly more risky still. This dangerous precedent should be nipped in the bud. DOE has done little to no meaningful environmental assessment on the proposal. If it had, the realization would be quickly reached that re-solidification of the liquid high-level radioactive waste on-site at Chalk River, is the most sensible first step, before undertaking the risks of transport.

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(6) See projected transport routes for high-level radioactive waste bound for centralized interim storage at WCS, by viewing the map posted at:
http://www.nirs.org/radwaste/hlwtransport/mobilechernobyl.htm
(7) http://ieer.org/resource/reports/nuclear-dumps-riverside-threats/

But commercial nuclear power plants are also on the target list for BRC and DOE's parking lot dumps. An Oak Ridge study has singled out Exelon's Dresden nuclear power plant in Morris, IL as a top target. But Dresden is already heavily burdened with one of the single largest concentrations of high-level radioactive waste in the entire continent. Already, around 3,000 metric tons of irradiated nuclear fuel is stored at Dresden's three atomic reactors, as well as the General Electric ISFSI (Independent Spent Fuel Storage Installation) storage pool next door. Morris has also suffered a childhood cancer cluster, with deep concern amongst impacted local residents that Dresden could have contributed. (Unfortunately, the NRC-commissioned NAS study on cancer incidence at Dresden, and six other nuclear power plant and nuclear fuel fabrication sites around the U.S., was just cancelled by NRC.)(8)

Risky Radioactive Waste Transportation Should Not Be Entered into Lightly(9)

As Dr. Sinclair warned decades ago, high-level radioactive waste cannot remain stored next to the fresh drinking water supplies of our country forever, nor can it remain vulnerable to rising sea levels. However, radioactive waste transportation cannot be entered into for the wrong reasons, nor rushed.

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(8) http://www.beyondnuclear.org/home/2015/9/11/nuclear-agency-squandered-350-million-on-redundant-building.html
(9) This section is adapted from a selection from "RADIOACTIVE WRECK: The Unfolding Disasters of U.S. Irradiated Nuclear Fuel Policies," by NIRS nuclear waste specialist Kevin Kamps, published in *NUCLEAR MONITOR* No. 643 (March 17, 2006), a publication of World Information Service on Energy (WISE) and the Nuclear Information & Resource Service (NIRS) (Pages 5-6; posted online at: http://www.nirs.org/mononline/nm643.pdf)

Along with making sure that radioactive waste can be monitored and retrieved, a long held consensus of the national environmental movement has been storage of high-level radioactive waste, as safely as possible, as close to its point of generation as possible.

At various points in time, the Yucca Mountain Project proposed launching over 50,000 truck shipments, and/or 10,000 rail shipments, and/or 1,600 barge shipments, of high-level radioactive waste.(10) Such proposals dwarf the total number - 2,500 to 3,000 - of irradiated fuel shipments that have taken place in the U.S. since the dawn of the Atomic Age 63 years ago. Even the limited experience of such shipments in the U.S. has seen numerous incidents and accidents, including radioactive leaks beyond the vehicle, as well as over 50 instances of shipments radioactively contaminated on the exterior of the shipping container, endangering not only workers, but also the general public.(11)

Shipping is one of the weakest links in the entire chain of irradiated nuclear fuel management. Waste going zero miles per hour in pools or dry casks is dangerous enough, but waste going 60 miles per hour or faster on the roads and rails introduces new and greater accident risks. Severe crashes, or long-lasting, high-temperature fires - all too common in real world accidents - could breach the shipping containers, releasing catastrophic amounts of radioactivity. Underwater submersion - involving a sunken barge or a shipment plunging off a bridge - could lead to contamination of drinking water, or

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(10) DOE, FEIS for Yucca, Appendix J, Transportation, Table J-27 (Barge shipments and ports) and Table J-93 (Estimated transportation impacts for the State of Nevada), February 2002.
(11) Robert Halstead, "Reported Incidents Involving Spent Nuclear Fuel Shipments, 1949 to Present," May 6, 1996, at http://www.state.nv.us/nucwaste/trans/nucinc01.htm

even an accidental nuclear chain reaction due to leakage of neutron-moderating water into the fissile radionuclides still present in the waste.(12) The National Academy of Sciences has advised that fiery accident scenarios need more study.(13)

In addition, while irradiated fuel is almost never stored in downtown metropolitan areas (with the exception of a small number of research reactors at certain universities), during transport high-level atomic waste would travel right through the heart of hundreds of cities. This presents would-be attackers with a high profile opportunity to cause a catastrophic radiation release in a population center.

A 1998 test at the U.S. Army's Aberdeen Proving Ground in Maryland showed that high-level radioactive waste shipping casks are vulnerable to anti-tank weapons. A TOW anti-tank missile, fired at a German CASTOR storage/transport cask, blew a sizable hole through the cask's 15-inch thick die-cast iron wall.(14) Combined with an incendiary, such a breach could release disastrous amounts of volatile Cesium-137 from irradiated nuclear fuel within a high-level radioactive waste shipping container in a major metropolitan area.

Conservative estimates (accounting for only the five radioactive cesium isotopes alone; nearly 300 additional radioactive isotopes exist in high-level radioactive waste) reveal

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(12) http://www.nirs.org/radwaste/hlwtransport/caskfactsheet.pdf
(13) NAS, "Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States," Committee on Transportation of Radioactive Waste, National Research Council January 2006.
(14) http://www.nirs.org/factsheets/nirsfctshtdrycaskvulnerable.pdf

that each truck cask on the highways would carry up to 40 times the long-lasting radioactivity released by the Hiroshima atomic bomb. Rail and barge casks, six times larger, would carry over 200 times the long-lasting radiation released at Hiroshima.(15) Release of even a fraction of this cargo would spell unprecedented radiological disaster.

A study of a real world transport accident - a train fire in a tunnel beneath downtown Baltimore that burned, initially at very high temperatures, for several days in July 2001 - revealed that if just one train car load of irradiated nuclear fuel had been aboard, its shipping container would have failed and large amounts of radioactivity would have escaped for miles downwind in the billowing smoke clouds. Hundreds of thousands of Baltimore residents would have been exposed to the escaping radioactivity. Nearly $14 billion would have been required for clean up, or else thousands would have died from cancer after living amidst the contamination for just one year; living amidst the fallout for 50 years would have resulted in over 30,000 latent cancer fatalities.(16)

Thus, given the potential for severe accidents or attacks, these shipments represent "Mobile Chernobyls" and "dirty bombs on wheels" and "Floating Fukushimas" rolling through our communities. These risks are made all the worse because emergency responders nationwide - especially volunteer fire departments along vast stretches of the

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(15) These figures have been provided by Dr. Marvin Resnikoff of Radioactive Waste Management Associates.
(16) Matthew Lamb and Marvin Resnikoff, "Radiological Consequences Of Severe Rail Accidents Involving Spent Nuclear Fuel Shipments To Yucca Mountain: Hypothetical Baltimore Rail Tunnel Fire Involving SNF," Radioactive Waste Management Associates, September 2001, viewable at: http://www.state.nv.us/nucwaste/news2001/nn11459.htm.

interstates and railways across the country - are neither adequately trained nor equipped to deal with radiological releases. Although the federal Yucca Mountain plan involved a token, inadequate funding mechanism to pay for such emergency preparedness, the industry's PFS plan did not even contain that.

But even "incident-free" shipments are like mobile x-ray machines that cannot be turned off. NRC regulations allow for irradiated nuclear fuel shipping containers to emit 10 millirems per hour of gamma radiation (the equivalent of a chest x-ray) to persons standing six feet away; casks are permitted to give off 200 mrem/hr (equal to 20 chest x-rays) at their surfaces.(17) Thus, nuclear workers, truck drivers, locomotive engineers, railroad workers, inspectors, toll booth attendants, gas station employees and customers, innocent bystanders at rest areas, residents living along transport routes, and unsuspecting passersby on the highways all face radiation doses if they come too close to such shipments. If casks are externally contaminated with radioactivity, as has been documented scores of times in the U.S., and hundreds of times during shipments in Europe, then "routine" doses to the general public will be even worse. In 1997 and 1998, activists and investigative reporters revealed that 20-37 percent of all shipments into France's reprocessing facility were externally contaminated above regulatory limits - many emitting 500 times the permissible dose, and one emitting 3,300 times the permissible dose!(18) The National Academies of Science's BEIR VII report (Biological

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(17) 10CFR71.47, Title 10 (Energy, Chapter I Nuclear Regulatory Commission) Code of Federal Regulations Part 71.47 "External radiation standards for all packages."
(18) Mycle Schneider, WISE-Paris, Bulletins, Newsletters, "Transport Special - Plutonium Investigation n°6/7," News! Figure of the Month, June 1998, 16 pages, viewable at http://www.wise-paris.org/; Robert Halstead, "Reported Incidents Involving

Effects of Ionizing Radiation) in 2005 re-affirmed that any dose of radiation, no matter how small, could inflict a negative health impact.(19)

Due to such shipping dangers, as well as resistance to proposed dumps, large-scale popular protests have erupted against irradiated fuel shipments. In Germany, tens of thousands have come out to block transports, sitting in roads and locking themselves to train tracks. In 1997, the German government deployed 30,000 police to guard a convoy of just six casks, costing US$100 million.(20) Such protests are likely in the U.S. should proposed high-level waste dumps be opened and large-scale waste transports begin.

Findings and Recommendations by NAS in 2006

In response to the 2006 publication of the National Academy of Sciences (NAS) report *Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States,* Public Citizen published an analysis entitled "Challenging Prerequisites for Safe Transport of Irradiated Nuclear Fuel Identified in NAS Study."(21)

The analysis helpfully digested the 339-page long, dense NAS study. Public Citizen

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Spent Nuclear Fuel Shipments, 1949 to Present," May 6, 1996, at http://www.state.nv.us/nucwaste/trans/nucinc01.htm; Francois Harari, Director of Transnucleaire at COGEMA's La Hague reprocessing facility in France, oral presentation at the Packaging and Transportation of Radioactive Materials (PATRAM) conference in Chicago, Illinois, September 2001 (notes taken by Kevin Kamps, NIRS).
(19) NAS, "Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2," Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation, National Research Council, 2005.
(20) See http://www.nirs.org/mononline/germanwastetransport.htm.

(21) Posted online at: http://www.citizen.org/documents/NASTransportStudy.pdf

highlighted NAS's emphasis that significantly more research is needed before an unprecedented, large-scale transport program is launched, including: full-scale crash testing of transport packages under severe accident conditions; a study of security issues; and a study of very-long-duration, high-temperature fires.

Public Citizen highlighted NAS's conclusion that DOE may not be up to the task (a position later taken by BRC in 2012, when it called for the establishment of a new entity). NAS found that DOE should avoid an extended truck transportation program and should not begin large-scale transport of waste until measures for mostly rail shipments are in place. NAS found that DOE should make public its preferred routes for transporting waste as soon as possible to support state, tribal, and local planning, especially for emergency response. NAS found that DOE should fully implement its decision to use dedicated trains before beginning the large-scale shipment of waste. NAS urged DOE to negotiate with utilities to ship older fuel first. And NAS concluded that DOE should immediately carry out its emergency responder preparedness responsibilities required by the Nuclear Waste Policy Act, including technical assistance and funding to states and tribes.

Public Citizen reported that other government bodies must also be involved, in addition to DOE, and "in strict adherence to regulations." For example, DOE, DHS, DOT, and NRC should promptly develop consistent and reasonable criteria for protecting sensitive information about waste shipments and commit to publicly sharing and providing timely access to information that does not require protection.

Although NAS warned that "Implementation of DOE's transportation program for Yucca Mountain will be a daunting task," and that "the challenges of sustained implementation should not be underestimated," remarkably, DOE has largely to entirely failed to act on NAS's recommendations in the past decade.

As the Subcommittee on Environment and the Economy's notice for today's hearing itself acknowledged, "Expert reports, including a 2006 National Academy of Sciences report, have found DOE must take steps to adequately plan for a national spent fuel transportation campaign and engage with stakeholders. ***But nearly a decade later, many of the report's recommendations have yet to be implemented.***" (emphasis added)

Risks to Our Surface Waters from High-Level Radioactive Waste Barges

A major flaw in the NAS 2006 study, in my opinion, was its arbitrary conclusion in footnote #12 on page 60, which stated: "Package immersion is not discussed at much length in this chapter because the committee judges it to be of a lower concern than the thermomechanical conditions generated during truck and train accidents."

Perhaps the BP Gulf of Mexico oil spill catastrophe of 2010; the Kalamazoo River Enbridge Tar Sands crude oil disaster of 2010; the ongoing Fukushima Daiichi nuclear catastrophe's radioactivity releases to the Pacific Ocean from 2011 till now, with no end in sight; 2014's shut off of drinking water supplies in West Virginia due to a toxic spill, and in Ohio due to artificially enhanced toxic algae blooms; and the 2015 Animas River toxic spill -- would now, in 20/20 hindsight, better sensitize NAS to the importance of toxic chemical and radioactive contamination of surface waters?

High-level radioactive barge shipment risks are very significant. Consider these aspects of DOE's Yucca Mountain Project transport proposals, contained in its 2002 Final EIS: up to 312 high-level radioactive barge shipments on California's Pacific coast, from Pacific Gas & Electric's Diablo Canyon nuclear power plant to the Oxnard's Port of Hueneme;(22) up to 453 barge shipments of high-level radioactive waste on the waters of Lake Michigan, from Wisconsin's commercial atomic reactors, as well as Entergy Nuclear's Palisades atomic reactor in southwest Michigan, into the ports of Milwaukee and Muskegon;(23) and up to 211 barge shipments of high-level radioactive waste on the waters of NJ, NY, and CT surrounding New York City.(24)

DOE also proposed barge shipments of high-level radioactive waste on the Chespeake Bay; Virginia's James River; Delaware Bay; Cape Cod Bay, Massachusetts Bay, and

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(22) Table J-27, Barge shipments and ports, page J-83: Figure J-9, Routes analyzed for barge transportation from sites to nearby railheads, page J-80. Map and table taken from U.S. Department of Energy, "Final Environmental Impact Statement for Yucca Mountain," Appendix J ("Transportation"), Feb. 2002. Posted online at: http://www.nirs.org/factsheets/cabargefactsheet92804.pdf
(23) Table J-27, Barge shipments and ports, page J-83. Figure J-9, Routes analyzed for barge transportation from sites to nearby railheads, page J-80. Posted online at: http://www.nirs.org/factsheets/mibargefactsheet92804.pdf
(24) Table J-27, Barge shipments and ports, page J-83. Figure J-9, Routes analyzed for barge transportation from sites to nearby railheads, page J-78 and J-81. Map and table taken from U.S. Department of Energy, "Final Environmental Impact Statement for Yucca Mountain," Appendix J ("Transportation"), Feb. 2002. Posted online at: http://www.nirs.org/factsheets/nybargefactsheet92804.pdf

Boston Harbor; the Mississippi River; the Tennessee River; the Missouri River; and Florida's Atlantic sea coast.(25)

The concern with high-level radioactive waste barge shipment is that accidents happen. But what if high-level radioactive waste is involved? U.S. Nuclear Regulatory Commission (NRC) design criteria for atomic waste transport containers are woefully inadequate. Rather than full-scale physical safety testing, scale model tests and computer simulations are all that is required. The underwater immersion design criteria are meant to "test" (on paper, at least) the integrity of a slightly damaged container submerged under 3 feet of water for 8 hours. An undamaged cask is "tested" (on computers, at least) for a 1 hour submersion under 656 feet of water. But if a cask were accidentally immersed under water, or sunk by terrorists, is it reasonable for NRC to assume that the cask would only be slightly damaged, or not damaged at all? Given that barge casks could weigh well over 100 tons (even up to 140 tons), how can NRC assume that they could be recovered from underwater within 1 hour, or even within 8 hours? Special cranes capable of lifting such heavy loads would have to be located, brought in, and set up. (And what about the fact that Lake Michigan is deeper than 656 feet at locations not far from DOE's proposed barge shipment routes?)

The dangers of nuclear waste cask submersion underwater are two fold.

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(25) See the corresponding figures and tables, posted online at http://www.nirs.org/radwaste/hlwtransport/mobilechernobyl.htm, under the chronological entry September 28, 2004.

First, radioactivity could leak from the cask into the water. Each container would hold 200 times the long lasting radioactivity released by the Hiroshima atomic bomb. Given high-level atomic waste's deadliness, leakage of even a fraction of a cask's contents could spell unprecedented catastrophe in the source of drinking water for tens of millions of people – Lake Michigan – or other sources of drinking water for millions of people, such as the rivers listed above. (Even ocean ecosystems could be ruined by such a radioactive release: radioactivity bio-concentrates up the food chain, as in sea food, for example.)

Second, enough fissile uranium-235 and plutonium is present in high-level atomic waste that water, with its neutron moderating properties, could actually cause a nuclear chain reaction to take place within the cask.

Such an inadvertent criticality event in Sept. 1999 at a nuclear fuel factory in Japan led to the deaths of two workers; many hundreds of nearby residents, including children, received radiation doses well above safety standards. The Tokai-mura fatal nuclear accident was considered the worst commercial nuclear power disaster in Japanese history, before the Fukushima Daiichi nuclear catastrophe that began on 3/11/11.

Given all this, the 2006 NAS study's flippant disregard of such significant barge shipment risks is inexplicable.

Public Citizen concluded its analysis of the 2006 NAS study by emphasizing that "public concerns are legitimate":

The study clearly states that opposition to a transportation program and questions about its safety and competence are completely rational and cannot be dismissed as an unreasonable fear of radiation. According to the report, "most people recognize that transportation programs are run by fallible institutions and that institutional and human error play a large role in determining transportation risks." The committee concluded that an important failing of DOE is its lack of understanding about the social impacts that could result from a transportation program.

QA Meltdown

NAS advocated for "strict adherence to regulations," which includes safety-significant quality assurance (QA). However, Commonwealth Edison/Exelon whistleblower Oscar Shirani showed, as early as 2000, that Holtec storage/transport casks violated QA in numerous ways, from their design, to their fabrication and deployment. Shirani questioned the structural integrity of Holtec casks sitting still at reactor sites, let alone traveling 60mph or faster on railways.(26) Shirani was backed up in his criticism of Holtec QA adherence by the top dry cask storage inspector in NRC's Midwest "Region 3," Dr. Ross Landsman.(27) The Holtec's QA violations have never been corrected, despite the courageous whistleblowing of Shirani and Landsman. The episode serves as a cautionary tale for other high-level radioactive waste transport cask models, for QA

(26) http://www.nirs.org/radwaste//atreactorstorage/shiranialleg04.htm
(27) http://www.nirs.org/radwaste/atreactorstorage/nrc_holtec.pdf

violations are blatant amongst other dry cask systems, such as the VSC-24 design (Ventilated Storage Casks holding 24 pressurized water reactor irradiated nuclear fuel assemblies, as deployed at Palisades, MI, Point Beach, WI, and Arkansas Nuclear One). QA violations with VSC-24s were so bad, that fires and explosions resulted.(28) NRC's QA safety regulation enforcement seems to have been broken for a very long time, whether due to agency incompetence, or outright collusion with industry.

In 2012, the Japanese Parliament concluded that collusion between nuclear regulator, nuclear industry, and government officials was the root cause of the Fukushima Daiichi nuclear catastrophe, the reason the atomic reactors were so catastrophically vulnerable to the natural disasters that destroyed them.

Some Solutions: Stop Making Irradiated Nuclear Fuel; for What Already Exists, Hardened On-Site Storage

Dr. Judith Johnsrud, founder of Environmental Coalition on Nuclear Power, NIRS, and Beyond Nuclear, posited that high-level radioactive waste may very well be a "trans-solutional problem" – that is, ironically, a man-made dilemma, beyond human technical capacity to solve.

As Beyond Nuclear board member Kay Drey of St. Louis has written regarding the "lethal legacy of the Atomic Age":

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No permanent, safe location or technology has ever been found to isolate even the first cupful of radioactive waste from the biosphere. And yet we continue to generate more and more – a mountain of waste 70 years high. It's time to stop making it.(29)

Or, as Michael Keegan of the Coalition for a Nuclear-Free Great Lakes put it in 1993: "Electricity is but the fleeting byproduct from nuclear power. The actual product is forever deadly radioactive waste."

That said, it may very well be that the only safe, sound, moral solution to the radioactive waste problem is to not make it in the first place. It's creation is a curse on all future generations, an intergenerational injustice.
So what's to be done in the interim, with the high-level radioactive wastes that hav already been created?

In 2002, at a national event organized by Citizens Awareness Network of the Northeast, held at Wesleyan University in Middletown, CT, as an alternative to the unsuitable Yucca Mountain geologic proposal, Dr. Makhijani of IEER coined the phrase and concept of HOSS, short for Hardened On-Site Storage.

In Jan. 2003, Dr. Gordon Thompson of the Institute for Resource and Security Studies (IRSS), put "flesh on the bones" of the HOSS concept, with his CAN-commissioned

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(29)http://static1.1.sqspcdn.com/static/f/356082/16107103/1326916854883/Waste_70YearsHigh_2012.pdf?token=taXXIucu7d6cjpWRqsz8pTI8x68%3D

study entitled "Robust Storage of Spent Nuclear Fuel: A Neglected Issue of Homeland Security."(30)

"The Statement of Principles for Safeguarding Nuclear Waste at Reactors" was first hammered out in September 2006, and unveiled at a U.S. House Energy and Commerce Committee, Subcommittee on Energy and Air Quality hearing by Michele Boyd of Public Citizen, on behalf of well over 100 environmental and public interest organizations, representing all 50 states.(31)

In 2010, the Statement was updated, with additional signatories joining, bringing the number of endorsing organizations to well over 200.(32)

The HOSS principles were presented to the BRC at each and every public meeting between 2010 and 2012. However, the BRC only agreed to apply HOSS at consolidated interim storage sites, thereby entirely missing the point. HOSS is meant to safeguard and secure irradiated nuclear fuel where it is stored now – at the reactor sites – not to serve as window dressing, or a bargaining chip, in an attempt to persuade the national environmental and public interest movement to support unnecessary and unwise parking lot dumps.

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(30) http://www.nirs.org/reactorwatch/security/sechossrpt012003.pdf
(31) http://www.citizen.org/documents/TestimonyHouseWasteSept2006.pdf
(32) http://ieer.org/wp/wp-content/uploads/2010/03/HOSS_PRINCIPLES_3-23-10x.pdf

Mr. SHIMKUS. Now I will open the round of questions. I will start by recognizing myself for 5 minutes.

And I would like to start with Mr. Horn, of course, from the great State of Illinois. Your testimony notes that the Nuclear Waste Policy Act authorized the Department of Energy to provide technical assistance and funds to States for training of public safety officials. Is DOE providing the funding as the law directs?

Mr. HORN. Mr. Chairman, the way the 180(c) of the Nuclear Waste Policy Act states is that once a site is determined and states have the opportunity to analyze routing through their states and determine how affected their state will be, then they can submit to the DOE a funding mechanism asking for money under 180(c). So to date, since we do not have a facility to ship to, states and regional groups are not getting money under 180(c).

Mr. SHIMKUS. What additional recommendations do you have for DOE with respect to implementing the provision?

Mr. HORN. Once the 180(c) money and we as States and affected communities have the ability to petition the Federal Government for funding, it is the regional office's belief that the Nuclear Waste Policy Act should mirror that of the Land Withdrawal Act.

And in my written and oral testimony, I alluded to that. If we looked at the Land Withdrawal Act, we see that states have a comprehensive ability to look at their programs and determine more than just training issues. We have the ability to provide first responders with equipment. We have the ability to reach out and do public outreaches to communities along the affected shipment routes. Where under the Nuclear Waste Policy Act, 180(c), all we can do is train those first responders. And although we find that to be very helpful, it does not get us to where we need to be.

Mr. SHIMKUS. Would further congressional direction assist organizations such as yours to be fully prepared for the transporting of spent fuel?

Mr. HORN. As I stated in my oral testimony, my comments here today are strictly for informational purposes. However, with that stated, I would direct you to the Blue Ribbon Commission study and Section 9.4, which has some very well-thought-out recommendations, and they took a lot of those recommendations from state testimony.

Mr. SHIMKUS. Thank you very much.

Mr. Kouts, advocates for interim storage often neglect to acknowledge the complicated efforts associated with a national transportation campaign. Given your professional experience at the Department of Energy, if Congress were to pass a bill authorizing interim storage of used fuel, what is the earliest that DOE could adequately develop a routing, procure the rail cars, and ship commercial spent fuel to an interim storage site?

Mr. KOUTS. Well, that is a fascinating question, Mr. Chairman. And thank you for it. I actually used to do those kinds of estimates when I was at the Department, and I will—we used to develop success-oriented schedules. And I will walk you through the steps in that schedule very quickly. I am going to make some assumptions about the legislation you pass because that will be critical in determining the timeframe.

Let's assume for the first piece about the siting of the facility that Congress would need to approve the site and also approve any benefits agreement associated with that site because that would require appropriated funds to be given to the localities around the site or the State. My sense is that that would be probably, if we are going at warp speed here, probably at a 4-year process.

To find the site, and the rage these days is consent-based siting, to negotiate with them, to get an agreement, to get it to Congress, and get the Congress approve it. So we are probably 4 years away from identification from a site.

The next step would be, this is a major Federal action, it would require an EIS. And since this would be a very controversial facility, as you can tell from some of the comments from the panel here, my sense is that warp speed to do a major EIS would probably be about 4 years. So you are up to eight right there.

During that same timeframe you could be doing the design of the facility, you could be doing the preparation of a license application. And I am going to assume that the legislation also requires the NRC to review the license.

So at the end of the 8-year period you submit the license application. I am also going to assume that the legislation will limit the amount of time that NRC has to review the license, just as it did with Yucca Mountain. So let's say there is a 3-year process that the NRC is given, or a 3-year timeframe. You are up to 11 years.

At that point, assuming that the licensing goes well, you begin to build the facility. At that point it is probably a 2- to 3-year construction period. Probably 2 years to construct it if everything is ready to go on day one, and about a year to shake it down to make sure everythingis good. So basically you are at 13 to 14 years, 14 years into the future.

Now let me just say this about these kinds of facilities. Nothing goes as planned. Back when the people were drafting the Nuclear Waste Policy Act in 1982, they assumed that we would have an operating repository by January 31, 1998. They thought 16 years was plenty of time to do a repository. OK. So that turned out to be wrong. And had Yucca Mountain continued, the earliest we could have started would have been 2021. So basically there is going to be schedule drift. And since interim storage facilities are simpler, if you will, than repositories, I would say you are at least, let's say, a 50 percent schedule drift. So you are anywhere between 14 and 21 years assuming you had legislation today, before that facility would begin to operate.

Mr. SHIMKUS. My time is expired.

Now I will turn to the ranking member of the subcommittee, Mr. Tonko, for 5 minutes.

Mr. TONKO. Thank you, Mr. Chair.

Nuclear waste transport is an essential component of any long-term waste management strategy. Although some on this panel have suggested that this practice is well established and understood, large-scale transportation required under a long-term strategy will pose serious challenges. We must ensure that this transportation can be done and done safely.

Mr. Rusco, GAO identified several technical challenges for transporting spent nuclear fuel in its recent study. Would you please

briefly explain some of the remaining technical challenges involved in repackaging spent fuel from storage casks to transportation casks?

Mr. RUSCO. So much of the spent nuclear fuel now is stored in dry casks that themselves are designed to be temporary, and to sit on these pads until an interim site is found, developed, and then they will have to be re-casked, for shipment. And while there are casks that have shipped spent nuclear fuel before, there are different kinds of spent nuclear fuel. As we get more high burned up fuel that has different characteristics, it will have to be casked differently than the other fuel.

One of the main issues is that to re-cask something you have to have a facility to re-cask it in. And you could use a wet pool that is on a nuclear power plant facility. But as time passes and these nuclear facilities close, then they will start decommissioning. Those pools will be shut down, and at some point you are going to have to then build a re-casking facility in order to move these things. These are all things that can be dealt with, but the clock is ticking, and so the longer it takes to start that process, the more fuel will be out there without a ready place to re-cask it.

Mr. TONKO. Thank you.

In recent years, some reactor operators have used fuel that is burned longer in the reactor which results in that high burn up fuel. This spent fuel is both hotter and more radioactive than other forms of nuclear waste. Are there outstanding technical questions about how to safely transport that fuel element, the high burn up fuel?

Mr. RUSCO. In our most recent report, we talked to a number of experts, and they said that there were remaining technical issues that needed to be resolved. Everyone thinks that they can be resolved. But no oneis going to invest the amount of money to do so until there is an actual reason to do it.I21Mr. TONKO. And do you have additional concerns about the sufficiency of current infrastructure to support transportation?

Mr. RUSCO. Certainly there will need to be enhancements to the rail infrastructure if we are to transport fuel from many of the sites where it currently resides because there is not sufficient rail infrastructure there at the time. Again, these are challenges that can be addressed, but they will take time and money.

Mr. TONKO. Thank you.

In 2006, the National Academies released a report on safe transport of nuclear waste and raised concerns about severe accidents which may involve long-duration fires. Mr. Kamps, is that a theoretical concern or are long-duration train fires a real possibility?

Mr. KAMPS. It is a very real world possibility. So one example was July of 2001 there was a train without radioactive waste onboard traveling through the Howard Street Tunnel downtown Baltimore that caught fire and burned for days. And the beginning of that fire was very hot. There were toxic materials that fueled that fire. And a study that was commissioned by the State of Nevada Agency for Nuclear Projects afterwards looked at the potential what if, hypothetical question, what if a Holtec transport container with high-level radioactive waste had been in the middle of that fire? And the results were shocking and concerning.

Radioactivity would have breached out of that container over a course of hours, and would have entered that smoke that was pouring out both ends of the tunnels. Would have inevitably exposed people at the baseball stadium, living in downtown Baltimore. And let's see if I can remember the figures. The latent cancer fatalities that would have been inevitable would have been counted in the many hundreds. If people continued to live in contaminated areas in downtown Baltimore for a year, the number of latent cancer fatalities would have then grown to something like 1,500.

And this is very expensive to clean up. Billions of dollars. In fact, $13 billion was the figure for the cleanup that would have been required. And then if people continued to live in that contamination for 50 years, five-zero, the casualties were over 30,000 latent cancer fatalities. And that is an accidental severe fire.

The fire standards that are applied to these casks go back many decades. They have never been updated in all those decades. It is a 30-minute fire at around 1,500 degrees Fahrenheit. Less than that. This fire burned hotter than that for a longer period of time. So it is a very serious issue that the NAS itself documented.

Mr. TONKO. And I would assume that DOE needs to ensure that transportation casks can withstand such fires?

Mr. KAMPS. Well, one would hope. Right now the Nuclear Regulatory Commission requirements do not require that casks survive more than 30 minutes in a relatively low-temperature fire. So real world accident conditions are much more severe than what these criteria call for.

Mr. TONKO. Thank you. I have gone beyond my time. I appreciate the chair being tolerant, and with that I yield back.

Mr. SHIMKUS. The gentlemen yields back his time.

The chair now recognizes the gentleman from Ohio, Mr. Latta, for 5 minutes.

Mr. LATTA. Thank you, Mr. Chairman. And thanks for holding today's hearing. And to our panelists, thanks very much for being here.

Mr. Hamberger, if I could start with you, assuming a permanent repository such as Yucca was given the green light today, how long do you think it would take to transport the nuclear waste in the United States to that site in which it was supposed to store?

Mr. HAMBERGER. In conversation before the hearing began, I believe the plan from DOE was to move 3,000 tons a year. So I don't know how many years it would take to move.

Mr. KOUTS. If I could help you with that——

Mr. LATTA. Yes, Mr. Kouts.

Mr. KOUTS [continuing]. Congressman. Basically, it would take approximately 24 years to ship all the waste, up to the statutory limit, which is the 70,000 metric ton limit that exists in the act today. So the plan was the shipping campaigns would take 24 years. It would be about two to three train shipments per week.

Mr. LATTA. OK. Thank you.

Mr. Hamberger, if I could also follow up with that, does the rail industry today have the cars available to transport that much right now?

Mr. HAMBERGER. I believe that the standard that we adopted almost 10 years ago, S–2043, is still in development.

So I believe it would be several more years before the car meeting that standard would be available.

Mr. LATTA. OK, Mr. Quinn, the Department of Energy recently stated it will need at least 7 to 9 years to design and procure a fleet of rail cars for the spent nuclear fuel shipment. Again, how long do you estimate it would take for the DOE to procure those necessary components, do you think, for the testing and everything else to get that done? Mr. Quinn?

Mr. QUINN. Oh, sorry. As far as the transportation casks themselves, which is what I do for a living, once we have the specification from the Department of Energy of what casks they want, it would be about a 1.5- to 2-year effort to get them designed and to get the safety analysis report and license application ready to submit to NRC.

It is about another 1.5 to 2 years to get that approval. So we are up to 3 to 4 years and then we can begin to construct the casks. Typical casks take about a year to fabricate. So depending on the size of the fleet that is required, it could take 2 to 3, or 4 years.

Mr. LATTA. Do we have the manufacturing capacity out there right now to be able to do that?

Mr. QUINN. Yes, there are fabricators in the U.S. and overseas who have the capability to fabricate these casks.

Mr. LATTA. OK, thank you. Mr. Rusco, I found kind of interesting in your statement that you were talking about the DOE has no coordinated outreach strategy including social media. And there is a question it sounds like they are losing the information war out there in your research, and when you were looking at this, why is that? Did you ask the question, "why is that?" when you were talking to the folks?

Mr. RUSCO. I think DOE feels that it doesn't have the authority to really take on this issue. They feel like they don't want to get too far down the path of discussing any specifics about a strategy until they have a consensus with Congress about where to go with it.

Mr. SHIMKUS. Will the gentleman yield?

Mr. LATTA. Yes, absolutely, to the chairman.

Mr. SHIMKUS. So is it true to say to say that DOE doesn't feel that they have the backing to comply with the law as it is written today?

Mr. RUSCO. I am not sure that is how they would put it, but——

Mr. SHIMKUS. That is how I would put it, so I yield back.

Mr. LATTA. Thank you very much. Reclaiming my time.

Mr. Kouts, if I could go back to you. DOE has five major computer-based tools to assist in integration and analysis of spent nuclear fuel storage and transportation programs. Are you aware if any of these tools has been integrated from the DHS' highly-developed risk-informed routing model?

Mr. KOUTS. I have been briefed on some of the DOE models that exist, and I don't know the answer to your question. The model I was briefed on was a tool for stakeholders to route shipments from point A to point B. And I think it had some work that still needed to be done, but in terms of the other models, I really can't comment on.

Mr. LATTA. OK, thank you. And Mr. Hamberger, in the last bit of time that I have, can you discuss the logistics of transporting nuclear waste by way of rail across the country from the East Coast or the Midwest to Yucca?

Mr. KOUTS. I don't have the specifics of what that route would be. I would prefer to answer that for the record if I might.

Mr. LATTA. OK. Well, thank you very much, and Mr. Chairman. My time is expired and I yield back.

Mr. SHIMKUS [presiding]. The gentleman yields back his time. The chair recognizes the gentleman from California, Mr. McNerney for 5 minutes.

Mr. MCNERNEY. I thank the chairman. I just want to follow up on the chairman's comment about the DOE not having the backing. But the DOE needs the Federal resources allocated and appropriated by Congress to do that.

Mr. Hamberger, you mentioned about a pretty sophisticated network to ship nuclear waste including casks and monitoring the trains and all that. How long would it take if you had the mandate—would the rail take to do that, how much would it cost, and would it have to share a cost with the Federal Government?

Mr. HAMBERGER. I do not have the cost of the S–2043 car. I was told in preparation of this hearing it would be several hundred thousand dollars for each car, but I can, again, try to get that more specific.

Mr. MCNERNEY. Well, how long would it take to develop that technology? You had a whole network of——

Mr. HAMBERGER. Two to three years.

Mr. MCNERNEY. Two to three years. Well, that is pretty fast. That is a lot faster than we could be ready in terms of a disposal site.

Mr. Rusco, I want to ask a couple of rhetorical questions, but you mentioned how important it is for the public acceptance of the implementation of a relocation plan and the selection of relocation sites, and routes, and so on. You just affirmed that those require public acceptance?

Mr. RUSCO. Yes, I think a lot of the delays that we have seen that have gone past the expected completion in past strategies, particularly with the Yucca Mountain, much of that was the result of the lack of public acceptance, and I think transporting nuclear fuel through communities will, you know, engender some——

Mr. MCNERNEY. It is going to take transparency, I think as the chairman mentioned. Also, what steps do you think the DOE should take to build that acceptance? What would it take if we started today with the DOE? What steps should it take?

Mr. RUSCO. Obviously, as many of the witnesses have said today, we have been shipping nuclear radioactive waste for a number of decades. And to start with, one would want to examine that record and to make public what that record is, and how do we deal with the risks. To identify what the risks are, to be transparent about them, and to effectively transmit a strategy for mitigating those risks and stating, you know, how they will be mitigated.

Mr. MCNERNEY. And it is going to take a certain amount of resources to do that. Are we talking about just putting stuff on Web

sites, or advertising on billboards, or how would you go about making the public aware?

Mr. RUSCO. I don't have a specific strategy for them. We really recommended that they develop a strategy for that, and we are not particularly specific on exactly how.

Mr. MCNERNEY. Well, transportation of nuclear waste is going to take acceptance at the Federal and at the state level. Mr. Horn, what do you think the States' role should be in implementing an outreach strategy?

Mr. HORN. As I stated, the States when material is ready for transport and we know what routes are going to be affected, and those communities that are going to be affected, the States are going to be the intermediary between the Federal Government and the stakeholders, those local communities.

So we ask that DOE and the Federal Government work in a cooperative, consultative manner with the states, and the states can be that intermediary between the two and we can go out and work with the local communities and do the training, the public outreach. We could be that tool that allows that message to be conveyed.

Mr. MCNERNEY. That is a pretty good role. States have better acceptance than the Feds in many communities. That is for sure.

Let's see. Mr. Kamps, I had a question. You referred to a cruise missile test against a shipping container. Is that publicly available information, or is it classified information?

Mr. KAMPS. It was not a cruise missile. It was a TOW antitank missile and the test was in June of 1998 at Aberdeen Proving Ground in Maryland. It was kept quiet for a long time, but it came out right about the time of the Yucca Mountain votes in 2002.

There was video that ABC News played and the specific results were that a hole about as big around as a grapefruit was shot through the side of a German CASTOR cask which is 15 inches of die cast iron, which is much thicker than our U.S. shipping casks. That would have been the release pathway for a disastrous amount of radioactivity combined with an incendiary fire that would have driven the radioactivity out of the fuel.

Mr. MCNERNEY. So that might be our biggest threat in terms of shipping is a terrorist attack?

Mr. KAMPS. And the NAS, in 2006, said they did not have access to the classified and restricted information about the terrorism aspects of nuclear waste shipping. But yes, very much so, there are, I believe, thousands of TOW antitank missiles on the black market worldwide, and these train shipments would go through places like downtown Chicago within a quarter mile of the Art Institute. And I know that there is talk of dedicated trains bypassing major metropolitan cities, but they are still going to pass through the major population centers of our country.

Mr. MCNERNEY. OK, thank you, Mr. Chairman.

Mr. SHIMKUS. Thank you. Let me, without objection, just—a TOW missile is a tube-launched optically-tracked wire-guided missile that was really developed about 20 years ago and I fired one. They are very difficult and they are guided by a wire.

So if you have a moving target that is moving like on a train track, it would be very, very difficult. So I know there is new weapons in development today, but——

Mr. KOUTS. If I could also just supplement something.

Mr. SHIMKUS. I am taking my colleague's time and if one of my colleagues would like to follow up, I would do that. But the chair now recognizes the gentleman from Texas Mr. Flores for 5 minutes.

Mr. FLORES. Thank you, Mr. Chairman. Mr. Hamberger, I have a quick question for you. You have testified that the use of dedicated rail trains is essential to the safe operation—excuse me, the safe transportation of radioactive materials. In fact, this conclusion was affirmed in a recent Department of Transportation report in 2005, also in a 3-year study by the National Academy of Sciences in 2006, and also in the Nuclear Regulatory Commission response to the National Academy of Science's report in 2008.

However, while the Department of Energy stated in 2005 that it planned to use dedicated trains for shipment to Yucca Mountain, the agency has neither proposed nor adopted a regulation requiring dedicated trains for high-level waste and spent nuclear fuel. This appears to leave open the possibility that the DOE could ship these materials in regular mixed freight trains in the future.

And so my question is this: Do you believe that the DOE should adopt a formal requirement and regulation calling for the use of dedicated trains?

Mr. HAMBERGER. Absolutely, Mr. Flores. I am pleased that they did announce that that was their policy for Yucca, but I think it would be important to make it a formal policy for all shipments.

Mr. FLORES. OK, thank you. Mr. Horn, a question for you. The Nuclear Waste Technical Review Board recently recommended that DOE expedite its effort to finalize and publish documentation supporting its integration and planning tools associated with the transportation of spent nuclear fuel, and release a modeling tool to the public to "increase their understand of the constraints of routing options for the transportation of spent nuclear fuel."

Will you please describe how DOE is engaging with regional organizations as they develop the required routing models?

Mr. HORN. Yes, sir. For about the past 10 to 15 years, DOE, through the cooperative agreements with the State organizations, Council of State Governments being one of them, has been working on rail routing issues and highway routing issues together. And just recently, DOE has been formulating a new routing model called START. It stands for Stakeholder Tool for Assessing Radioactive Transportation; not a whole lot known to the general community about this tool right now.

However, I will say that I have a meeting with DOE next week where I am going to be for the first time, introduced to this tool and will sit down and look at it. And I will be able to take that information back and share it with my State—our organizational groups as a whole.

Mr. FLORES. OK, I appreciate that. If you have any observations after you have looked at that tool if you would like to share those with us, that might be helpful.

Mr. HORN. I would love to, sir, thank you.

Mr. FLORES. Thank you, Mr. Chairman, I yield back.

Mr. HARPER [presiding]. The gentleman yields back. I will now recognize myself for questions for 5 minutes. Thanks to each of you for being here. This is such a critically important topic.

First, and this question will be directed to Mr. Quinn and Mr. Kouts, the Nuclear Waste Policy Act states that the Secretary of Energy shall utilize by contract private industry to the fullest extent possible in each aspect of spent nuclear fuel transportation. And the Secretary shall use direct Federal services for such transportation only upon a determination of the Secretary of Transportation in consultation with the Secretary of Energy that private industry is unable or unwilling to provide such transportation services at reasonable cost. And so this would be to Mr. Kouts, or Mr. Quinn. Are you aware if that determination has been made, Mr. Kouts?

Mr. KOUTS. I have no idea what sections of the Nuclear Waste Policy Act DOE still believes are applicable to its activities. They seem to pick and choose what they want to utilize and/or accept, if you will, but I really don't have the answer to that question, and again, that guidance is for NWPA shipments.

And I think the Department would want other authority other than under the NWPA, but if there is new authority given to DOE, I think that would be an excellent section to put in there because all of the expertise, if you will, of moving these materials resides with private industry.

Mr. HARPER. Mr. Quinn.

Mr. QUINN. I am not aware that any determination to that effect has been made. And as a member of an industry that actively transports nuclear materials today, we stand ready, willing, and able to do so when DOE comes and asks.

Mr. HARPER. So we would really like to have DOE come and ask. Would that be a fair statement and assessment, Mr. Kouts?

Mr. KOUTS. Yes, it is.

Mr. HARPER. OK. Mr. Quinn?

Mr. QUINN. Yes, sir.

Mr. HARPER. OK. Given your experience, are there actions that private industry is unable or unwilling to undertake, Mr. Kouts.

Mr. KOUTS. In terms of the movement of these materials, no. I think there will be an issue in terms of if there is public concern, whether or not you want to talk to the contractor. I think ultimately DOE will be the responsible entity or whatever entity there is for implementing this.

But ultimately, I think there needs to be some Federal presence. So if someone has a problem, they would go to the Fed as opposed to going to a contractor. But in terms of all of the movements——

Mr. HARPER. So you believe private industry is ready, willing, and able to move forward given the proper instructions?

Mr. KOUTS. I have high confidence they are.

Mr. HARPER. Mr. Quinn?

Mr. QUINN. I will categorically state that industry is ready, willing, and able.

Mr. HARPER. And Mr. Kouts, if I could ask you a follow-up here. Where in the transportation planning process should DOE provide funding to states for training of its first responders and other personnel for spent fuel shipments?

Mr. KOUTS. When I was running the program, we looked at a time period of about 3 to 5 years before shipments when we would identify routes and provide funding, which would be supplemental to the already existing funding for existing training for State and local officials and Indian tribes.

Mr. HARPER. OK. Mr. Rusco, if I could ask you. As a part of a national transportation campaign, when is it appropriate for DOE to make funding available for training?

Mr. RUSCO. I am sorry, I just don't have an answer for that.

Mr. HARPER. OK. All right. Anybody want to reply to that, sir?

Mr. HORN. Could you repeat that question real quick?

Mr. HARPER. Yes. The question was, as part of a national transportation campaign, when is it appropriate for DOE to make funding available for training?

Mr. HORN. Again, if we go back and look at the Nuclear Waste Policy Act, it stipulates that 180(c) funding will be let 4 years prior to the first shipment. So as a state and regional group, we are going to need more lead time than that, want to analyze those routes that we are going to have to train to, and then to have more outreach with affected communities along those routes.

So we are looking probably a total 7 to 10 years, somewhere in that timeframe before the first shipment moves because we are going to have to analyze the routes, go out and determine which communities need to be trained, and then that will drive our funding mechanism to apply for funding. And then once we receive that funding, then we can effectively start that.

Mr. SHIMKUS. Would the gentleman yield?

Mr. HARPER. I yield to Chairman Shimkus.

Mr. SHIMKUS. Mr. Horn, would the state approve a route next to the Art Institute of Chicago?

Mr. HORN. We would not, sir. We would highly oppose it.

Mr. SHIMKUS. Thank you very much.

Mr. HARPER. And reclaiming my time. I now recognize the gentleman from Ohio Mr. Johnson for 5 minutes of questioning.

Mr. JOHNSON. Thank you, Mr. Chairman, I appreciate it. And Gentlemen, thank you for joining us today.

Mr. Hamberger and Mr. Kouts, your testimony discusses the development and use of the Rail Corridor Risk Management System, which is a sophisticated statistical routing model designed to help railroads analyze and identify the overall safest and most secure routes for transporting highly hazardous materials. Has the Department of Energy communicated with the Department of Homeland Security to discuss whether this model would be adequate for the shipment of spent nuclear fuel?

Mr. HAMBERGER. I will defer to the former member of DOE.

Mr. KOUTS. I really am not a member of the Department and I can't say at this point what the Department is doing in that area. I think that would be an excellent suggestion. But again, I have no information as to whether or not the Department is doing that or not doing that.

Mr. HAMBERGER. When we developed that, Mr. Johnson, it was under contract with the—we had an advisory committee of 15 different agencies. I believe the Department of Energy was one of those. It is a 27-factor model. And so they are aware of it. It is un-

clear to us whether in developing what Mr. Horn was just referring to, the START program, whether that had any cross-pollenization or not.

Mr. JOHNSON. OK, so, well then I think I heard Mr. Kouts say it would be a good idea. Would you recommend that DOE use the DHS model?

Mr. HAMBERGER. I certainly would recommend that they use it if they want to add on to it, or if there are additional things that they want to use. But yes, it took a great deal of effort to come up with that. We used it for all of our hazardous material shipments.

Mr. JOHNSON. OK, Mr. Kouts, the Department of Energy has five major computer-based tools to assist in the integration and analysis of spent nuclear fuel storage in transportation programs. So are you aware if any of these tools have been integrated with DHS' highly-developed risk-informed routing model?

Mr. KOUTS. I have only been briefed on one of those tools and I don't believe that was, but that was a stakeholder tool. The others I really can't comment on.

Mr. JOHNSON. OK. All right. Mr. Kouts, a final question for you. The Department of Energy planned for a 70-year, $20 billion transportation campaign for Yucca Mountain. If Congress authorizes DOE to pursue interim storage, do you have any idea what the cost implications for having to ship spent fuel more than once would be?

Mr. KOUTS. Well, it will be $20 billion plus; whatever it takes to move that fuel to your interim facility, if you will, and then moving that fuel to an ultimate destination which would be—it could be Yucca Mountain, it could be another repository. But it would be an added cost, and——

Mr. JOHNSON. Would you say that cost would be significant?

Mr. KOUTS. Significant depends on the amount of fuel that is sent to the interim storage facility. If you are sending 10- to 15,000 tons, yes, it would be very significant.

Mr. JOHNSON. OK. All right, Mr. Chairman, I yield back.

Mr. SHIMKUS. The gentleman yields back his time. I want to thank you for coming and appreciate your response to our questions. The question period will be open for 10 legislative days. Members will be able to submit questions for the record in writing. We would ask that you respond to those within 10 business days of receiving any additional questions.

Having said that, again, I want to thank the witnesses for being here. With that, I am going to adjourn the hearing.

[Whereupon, at 12:12 p.m., the subcommittee was adjourned.]

[Material submitted for inclusion in the record follows:]

FRED UPTON, MICHIGAN
CHAIRMAN

FRANK PALLONE, JR., NEW JERSEY
RANKING MEMBER

ONE HUNDRED FOURTEENTH CONGRESS

Congress of the United States

House of Representatives

COMMITTEE ON ENERGY AND COMMERCE

2125 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515–6115
Majority (202) 225–2927
Minority (202) 225–3641

October 29, 2015

Mr. Kelly Horn
Section Head, Environmental Management
Bureau of Radiation Safety
Illinois Emergency Management Agency
1035 Outer Park Drive
Springfield, IL 62704

Dear Mr. Horn:

Thank you for appearing before the Subcommittee on Environment and the Economy on Thursday, October 1, 2015, to testify at the hearing entitled "Transporting Nuclear Material: Design, Logistics, and Shipment."

Pursuant to the Rules of the Committee on Energy and Commerce, the hearing record remains open for ten business days to permit Members to submit additional questions for the record, which are attached. The format of your responses to these questions should be as follows: (1) the name of the Member whose question you are addressing, (2) the complete text of the question you are addressing in bold, and (3) your answer to that question in plain text.

To facilitate the printing of the hearing record, please respond to these questions with a transmittal letter by the close of business on Thursday, November 12, 2015. Your responses should be mailed to Will Batson, Legislative Clerk, Committee on Energy and Commerce, 2125 Rayburn House Office Building, Washington, DC 20515 and e-mailed to Will.Batson@mail.house.gov.

Thank you again for your time and effort preparing and delivering testimony before the Subcommittee.

Sincerely,

Joan Shimkus
Chairman
Subcommittee on Environment and the Economy

cc: The Honorable Paul Tonko, Ranking Member, Subcommittee on Environment and the Economy

Attachment

IEMA
Illinois Emergency Management Agency

James K. Joseph, Director

Thursday November 12, 2015

The Honorable John Shimkus
Chairman, Subcommittee on Environment and the Economy
Committee on Energy and Commerce
2125 Rayburn House Office Building
Washington, D.C. 20515

Dear Congressman Shimkus,

On behalf of the State of Illinois and the Council of State Governments Midwest Radioactive Materials Transportation Committee please find below my answer to your follow up question as presented in your letter dated October 29, 2015. You will also find follow up information for Congressman Flores.

The Honorable John Shimkus

1. The Blue Ribbon Commission highlighted the role of state organizations in DOE's spent fuel transportation planning efforts. It stated after the Yucca Mountain Project was cancelled, the Department Of Energy and Nuclear Regulatory Commission provided reduced funding levels to the state regional groups. Is this still the case?

It's important to understand that all four of the multistate organizations exist for other purposes – their radioactive waste transportation projects are an important but small part of their many activities they undertake to bring states together for the purpose of finding multistate solutions to common problems.

Having said that, it is true that, following the cancellation of the Yucca Mountain Project in 2010, all of the state regional groups lost the funding they had previously received from the Office of Civilian Radioactive Waste Management. The Nuclear Regulatory Commission stepped in with a small amount of funding to help the transportation projects continue, but that funding only lasted a year or two.

Fortunately, in 2012, after the Blue Ribbon Commission released its final report, the DOE Office of Nuclear Energy re-established the regional cooperative agreements. In fact, all four regions are currently in Year 4 of our four-year agreements, so the organizations are now having discussions with DOE regarding the renewal of these agreements for another four years. In the Midwest, the funding we have received to date has been sufficient. Our project is staffed by approximately 1.5 FTEs, and we're able to get quite a lot of work done. As the pace of progress accelerates, however, we will likely need to add staff to the project to keep up with all the work.

A. If so, given the required lead time to ship spent fuel, are you concerned that DOE's inadequate funding of your organizations may hinder any efforts to meet DOE's goal of operating an interim storage site by 2021?

Our funding has been adequate to date and we're hopeful the level of funding will be maintained in the new four-year agreement. But certainly, if we did receive inadequate funding, I would be concerned about our region being able to fully engage in consultative, cooperative transportation planning with DOE and our state and tribal partners.

The Honorable Flores

In my testimony, I answered Congressman Flores' below question and stated I would provide follow up information after meeting with the Department of Energy.

1. Mr. Horn, the Nuclear Waste Technical Review Board recently recommended that DOE expedite its efforts to finalize and publish documentation supporting its integration and planning tools associated with the transportation of spent nuclear fuel, and release a modeling tool to the public, to "increase their understanding of the constraints on routing options for the transportation of spent nuclear fuel." Will you please describe how DOE is engaging with regional organizations as they develop the required routing models?

After my October 1, 2015 testimony, I had the opportunity to attend a DOE presentation regarding many "system analysis and crosscuts" tools. These tools, which are still under development, are being designed to provide a system-wide analysis for the current and future inventories of spent fuel. My initial impression is that once fully developed these tools will be of great benefit to both the DOE and states to make the most informed decisions possible with regards to shipping spent fuel.

Another tool that has just been introduced to the stakeholders is the "Stakeholder Tool for Assessing Radioactive Transportation," or START. This tool is a route identification and analysis tool that will allow the DOE and stakeholders to work collectively to identify the best possible routes for spent fuel transportation. This tool works independently of other routing and risk analysis tools such as the Rail Corridor Risk Management System software tool.

Sincerely,

Kelly Horn
Head of Environmental Management,
Illinois Emergency Management Agency
Co-Chair, CSG Midwest/Radioactive Materials
Transportation Committee

FRED UPTON, MICHIGAN
CHAIRMAN

FRANK PALLONE, JR., NEW JERSEY
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Minority (202) 225-3641

October 29, 2015

Mr. Robert D. Quinn, P.E.
Vice President, Cask and Container Technology
EnergySolutions
2105 South Bascom Avenue, Suite 230
Campbell, CA 95008

Dear Mr. Quinn:

Thank you for appearing before the Subcommittee on Environment and the Economy on Thursday, October 1, 2015, to testify at the hearing entitled "Transporting Nuclear Material: Design, Logistics, and Shipment."

Pursuant to the Rules of the Committee on Energy and Commerce, the hearing record remains open for ten business days to permit Members to submit additional questions for the record, which are attached. The format of your responses to these questions should be as follows: (1) the name of the Member whose question you are addressing, (2) the complete text of the question you are addressing in bold, and (3) your answer to that question in plain text.

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Thank you again for your time and effort preparing and delivering testimony before the Subcommittee.

Sincerely,

John Shimkus
Chairman
Subcommittee on Environment and the Economy

cc: The Honorable Paul Tonko, Ranking Member, Subcommittee on Environment and the Economy

Attachment

ENERGYSOLUTIONS

The Honorable John Shimkus
Chairman, Subcommittee on Environment and the Economy
US House of Representatives
2125 Rayburn House Office Building
Washington, DC 20515-6115

Letterbook No.: CAMCA-15-019

November 11, 2015

Subject: Response to Additional Questions for the Record

Reference: Letter from the Honorable John Shimkus, US House of Representatives, to Robert Quinn, EnergySolutions, October 29, 2015

Dear Mr. Shimkus,

On behalf of Energy*Solutions* and the Spent Fuel Transportation Task Force of the Nuclear Infrastructure Council, I am pleased to provide responses to the additional questions for the record per reference request. Responses are provided in the attachment to this letter.

Thank you for the opportunity to testify and to provide the requested additional information. If any clarification or further information is needed, please feel free to contact me at (408) 558-3517 or rdquinn@energysolutions.com.

Sincerely,

Robert D. Quinn
Vice President, Cask & Container Technology
Energy*Solutions*

cc: The Honorable Paul Tonko, Ranking Member, Subcommittee on Environment and the Economy

Attachment

2105 South Bascom Ave., Suite 230 • Campbell, California 95008
408.558.3500 • Fax 408.558.3518

Committee on Energy and Commerce
Subcommittee on Environment and the Economy
Hearing titled, "Transporting Nuclear Material: Design, Logistics, and Shipment"
on October 1, 2015

Responses to: Additional Questions for the Record, dated October 29, 2015

Prepared and Submitted by: Robert Quinn
Vice President Cask and Container Technology, EnergySolutions
and
Chair, U.S. Nuclear Infrastructure Council, Spent Fuel Transportation Task Force

Questions from: The Honorable John Shimkus

Question: The National Academies 2006 report "Going the Distance" included a recommendation that NRC perform additional analyses of very long fire duration scenarios. To your knowledge, has NRC performed such additional analysis, and if so, what was the outcome of the analyses?

Response: As discussed in the cited National Academies' report, NRC evaluation of two additional packages were planned for the conditions of the Baltimore Howard Street tunnel fire, in addition to the package evaluated and presented by NRC to the National Academies committee. The evaluation and results of NRCs assessment of all three packages for this fire is provided in NUREG/CR-6886 R2. The summary section of this report states, "The results of this evaluation also strongly indicate that neither spent nuclear fuel (SNF) particles nor fission products would be released from a spent fuel transportation package carrying intact spent fuel involved in a severe tunnel fire such as the Baltimore tunnel fire. None of the three package designs analyzed for the Baltimore tunnel fire scenario (TN-68, HI-STAR 100, and NAC LWT) experienced internal temperatures that would result in rupture of the fuel cladding. Therefore, radioactive material (i.e., SNF particles or fission products) would be retained within the fuel rods."

NRC has performed additional analyses, and a summary of these additional analyses and the results thereof are documented in the latest update of NUREG-2125, "Spent Fuel Transportation Risk Assessment" (published January 2014). This NRC report concludes that the existing regulatory requirement for thermal test is adequate for NRC-approved packages to survive these long duration fires.

It should be noted that these fires, such as the Baltimore Howard Street tunnel fire, are in part the result of additional fuel sources that are co-mingled in the commercial train shipment. As noted in the testimony on October 1, 2015, the spent fuel rail shipments as planned by the DOE will be on dedicated trains, so there would not be rail tanker cars with additional fuel sources to feed such a fire. In addition, the Association of American Railroads has revised its operating standards to preclude passing in tunnels when a spent fuel shipment is underway. This would preclude flammable contents from a separate commercial rail shipment from being in a tunnel at the same time as a dedicated train carrying spent fuel.

Question: What is being done to address the concerns with transport of high burnup spent fuel, and how long will it be before it is possible for NRC to license a cask for such transportation?

Response: Physical testing and analytical work performed by the Electric Power Research Institute, and reviewed by the NRC, show that high burnup fuel can in fact be transported safely, and it is no more vulnerable to the motions and vibrations incident to transport than lower burnup fuels. As noted on in a fact sheet on high burnup spent fuel on NRC's web site ("Backgrounder on High Burnup Spent Fuel," Updated 9/30/2015), "the NRC is conducting tests at Oak Ridge National Laboratory on high burnup fuel samples under stresses greater than the loads expected during normal transport. These tests have already shown that high burnup fuel is very strong. This information further confirms that long-term storage and eventual transportation of high burnup fuel is safe."

With respect to NRC licensing of casks for transport of high burnup fuel, the NRC has already certified cask designs for storage and transportation of high burnup spent fuel. For example, the NRC issued a certificate of compliance to AREVA TN for their NUHOMS®-MP197HB transportation cask (NRC CoC 9302 Rev. 7) to transport high burnup spent fuel in April 2014.

Additional confirmatory testing and study of high burnup fuel is being planned by industry to continue to advance the state of knowledge, particularly as related to long term effects of storage on high burnup fuels. As noted in the aforementioned NRC fact sheet, this testing is expected to confirm the current understanding of the behavior of high burnup spent fuel.

Question: Can you provide any additional information on the Aberdeen TOW missile test?

Response: Although detailed information regarding this test is not readily available for public review, what is known is that the test was performed for a company that wanted to sell missile shields for casks. It should also be noted that the CASTOR cask chosen for the test is fabricated of nodular cask iron. Such material is known for being brittle. No casks made of this material are licensed for transportation in the US.

NRC witnessed the tests, and the NRC conclusion was the resulting breach was so small that any radiation dispersal would be minimal and very localized. Based on the test results, the NRC determined that protective shields would not be required for SNF shipments in casks certified by the Commission. Licensed transport casks are made of ductile steels, which are significantly more resilient to impact.