NPRE ILLINOIS

DEPARTMENT OF NUCLEAR, PLASMA, AND RADIOLOGICAL ENGINEERING

Nuclear Power: What it means in Illinois

A host of state and national policy leaders outline the sustainability and economic impacts of nuclear energy in Illinois in light of proposed closures of nuclear generation plants in the state. Co-sponsored by the Department of Nuclear, Plasma, and Radiological Engineering at Illinois, the AFL-CIO, and North America's Building Trades Unions.

Tuesday, Oct. 18, 2016 • C600 Bilandic Building • Chicago, Illinois

Nuclear Power: What it means in Illinois

The Department of Nuclear, Plasma, and Radiological Engineering at the University of Illinois at Urbana-Champaign, the American Federation of Labor and Congress of Industrial Organizations, and North America's Building Trades Unions, co-sponsored the informational forum, "Nuclear Power: What it means in Illinois," on Tuesday, October 18, 2016, in Chicago's Bilandic Building.

A host of national policy leaders outlined the sustainability and economic impacts of nuclear energy in the state, particularly in light of recent proposed closures of Illinois-based nuclear generation plants. A video of the forum in its entirety is available at https://www.youtube.com/watch?v=NXDpeOTMchc . Viewing of the event as it took place was made possible through a live webcast at http://www.ilga.gov/. The forum was partially supported by the NSF PIRE: "Nuclear Energy Systems and Materials under Extreme Conditions."

The event was part of NPRE's Leadership Speaker Series, intended to provide a forum for global leaders to present policies and platforms that shape the sciences of nuclear, plasma and radiological disciplines. The Leadership Speaker Series, an effort of NPRE and its sponsoring alumni group, the Constituent Alumni and Industry Advisory Board, carries impact across the University of Illinois and beyond. This also fits with the major initiative on the University of Illinois campus to develop strong leadership in the areas of sustainable energy and environment.

Executive Summary

The impact of imminent nuclear power plant closures in Illinois was the focus of a major forum with the participation of bipartisan elected officials, government, labor, university and local citizen contributions. In all previous cases, nuclear plant closures are seen to have had major negative impacts in both the near term and in the long term. Near term impacts include the loss of jobs, particularly skilled labor positions; loss of local and State revenue and tax streams; the loss of Illinois' ability to ensure it can meet future electricity demand and controllable prices; and the loss of an important source of carbon-free electricity generation, including the ability to meet the coming commitments to the Clean Power Plan. The impetus for the plant closures is a short-term economic problem due to the competition with other, currently cheaper (but carbon-emitting) energy sources. Other low- or non-polluting energy sources, particularly wind and solar, enjoy production credit subsidies which leads to market distortion. These economic pressures and the current electricity auction structure have forced Exelon Corp. to consider plant closures. However, the decision to close nuclear power plants, all with excellent operational and safety records, based on short-term electricity prices, will have major negative impacts immediately and for generations to come.

Cheri Bustos, Lonnie Stephenson, and John Kotek

Some states, New York in particular, have developed a mechanism to address the financial mismatch between carbon-free nuclear power and other currently cheaper electricity sources. They have accomplished this through a measured action of the New York Public Service Commission. They have implement this action to meet their Clean Energy Standard which recognizes the major contribution of nuclear power to carbon-free electricity production. Other states, in particular Vermont, have allowed a

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plant closure despite its benefits and felt a major negative impact of the plant closure including job loss and rising cost of electricity. The general position of the participants in this forum was that the best approach to preserving a major base-load energy resource in Illinois is to place it on competitive footing with other energy resources. This would preserve the current economic and environmental advantages these plants provide. One major avenue to making this happen is through the action and support of the State Government, similar to steps supported by the Governor of New York and taken by the New York Public Service Commission.

Introduction

This document reports on the presentations and outcomes of the Nuclear Power: What it means in Illinois meeting on October 18, 2016. The meeting and all of the presentations can be viewed in full at https://www.youtube.com/watch?v=NXDpeOTMchc .

The meeting was organized to address the issues and impact surrounding the potential closure of two nuclear power plants owned and operated by Exelon Corp. in Illinois: the Clinton Nuclear Power Station near Clinton, Illinois; and the Quad Cities Generating Station near Cordova, Illinois. The Clinton Nuclear Power Station consists of one Boiling Water Reactor rated at 1098 MWe and the operating license was granted on April 17, 1987. The Quad Cities Nuclear Generating Station consists of two Boiling Water Reactors with a combined rating of 1880 MWe. Unit 1 was commissioned on February 18, 1973 and Unit 2 was commissioned on March 10, 1973. On June 1, 2016, Exelon Corp. announced that, pending no change in the current cost structure, the Clinton Plant would be closed on June 1, 2017, and the Quad Cities Plants would be closed on June 1, 2018.

The major issue involving the announcement of the pending closures was that, with the current electricity rate structure, these plants could not operate without financial losses. In fact, Exelon Corp. has lost $800 million over the last six years operating these plants. As a corporate entity, Exelon Corp. could not afford to continue operations of these plants at a loss.

Jeff Binder

The meeting concentrated on various types of impacts that are foreseen based on the possible plants closures. These impacts are described below. These portray the thoughts and contributions of the participants to this forum. In all cases, the participants found that there are major negative consequences foreseen from the plant closures. The closures are also known to be an irreversible process: once the closure process is started through an application to MISO or PJM, there is no turning back. Once the plants are shut down, there is no way to restart them.

Based on the outcome of the forum, a decision to close these three nuclear reactor units in Illinois would have dire economic, social, and environmental impact that would be irreversible. High-paying skilled craft and labor positions will be lost. This is put very succinctly by Illinois Senator Chapin Rose: “This is a generational decision” which will have long-term negative impacts in addition to the short-term immediate impacts on the local communities, the local labor force, and the State’s economy. This sentiment was echoed by all of the other speakers at the forum.

A program and full list of meeting participants can be found on pages 6-10.

Community and Social impact

All of the governmental representatives, labor representatives and local community representatives provided their view on the impact of plant closures on the areas they represent. This impact is not restricted to the plant employees, thought they are the most directly impacted. The whole community is impacted through the follow-on loss of employment of people in other local services, the tax base that supports the local school systems and the other businesses that locate in those areas due to the attractive local services, schools and other infrastructure. In fact, a strong local tax

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Petros Sofronis

base provides an environment that is highly attractive to other businesses because they can also count on a predictable market and tax base.

Many of these same speakers also have strong ties to workers and family members who are employees in these plants.

Labor impact

Nuclear power plants are well known as high-tech systems. Their operation and maintenance are tied to a highly skilled and highly trained workforce. Workers at these plants are part of the most skilled sector of the State and National workforce. They are also a major part of the pool of available skilled workers in Illinois.

Financial Impact

The nuclear power stations in Illinois have a history of providing substantial financial benefits to the State and to the local communities through their contributions to employee pay, through their contributions to community service, and through their contributions to the local and State tax rolls. The communities in which these power plants are located understand and appreciate the major role that these plants play in the economic well-being of their communities. Their businesses and schools depend on these benefits that often have a much broader, statewide impact on the overall State economy. The loss of these nuclear power plants would have an immediate negative impact on the communities and the State, and this impact would persist over decades as has been seen in the closures of other major facilities. It is important to note that these power plants are fully safe and operational: the possible closures are not due to outdated or non-functioning facilities. The possible closures are due to a current pricing differential between nuclear-generated electricity and electricity cost from cheaper fuels or subsidized generators.

An additional financial issue is the price stability and security of electricity in Illinois. Nuclear plant closures will reduce the electricity-generating capacity in the state, opening the door for other generators from outside the state to wheel power into Illinois to meet the current demand. With a lower internal generating capacity, there is less certainty that electricity prices will be either controllable or stable in future years. Maintaining the current full nuclear generating capacity is essential to keep Illinois in control of its energy resources. This is particularly the case in areas in the western part of the State and down-State, outside the greater Chicago area. Loss of nearly 3000 MWe of power is likely to eventually lead to an increase in electricity price, thus negatively impacting the State's economic competitiveness.

Operational and safety record

A major feature of the Clinton power station and the Quad Cities power station is that all of the reactors have set and met very high performance standards. They operate with a high availability (i.e. the fraction of time the plant is operating at full capacity) – the Clinton power station – 2015 at 92.5%; and the Quad Cities power station – 2015 at 95%. These plants are in excellent condition. These plants have also maintained an excellent safety record.

Regulatory Implications

The power requirements for the electricity distribution area served by the Quad Cities power plants are covered by PJM (originally named for the region Pennsylvania-New Jersey-Maryland) Interconnection, a regional transmission operator (RTO). The Clinton power station is covered by MISO, the Midcontinent Independent Service Operator that provides open access transmission services to the central region of the US and Canada. It also assesses the electricity generation needs to meet (peak) demand to insure there is sufficient generation capacity at the best cost. In this cost-based system, power providers must compete on cost to have their power plants included in the electricity generation base. Under the current assessment criterion, the Clinton and

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Quad Cities nuclear plants are not able to meet their operational costs under the price ceilings set by the auction process under MISO.

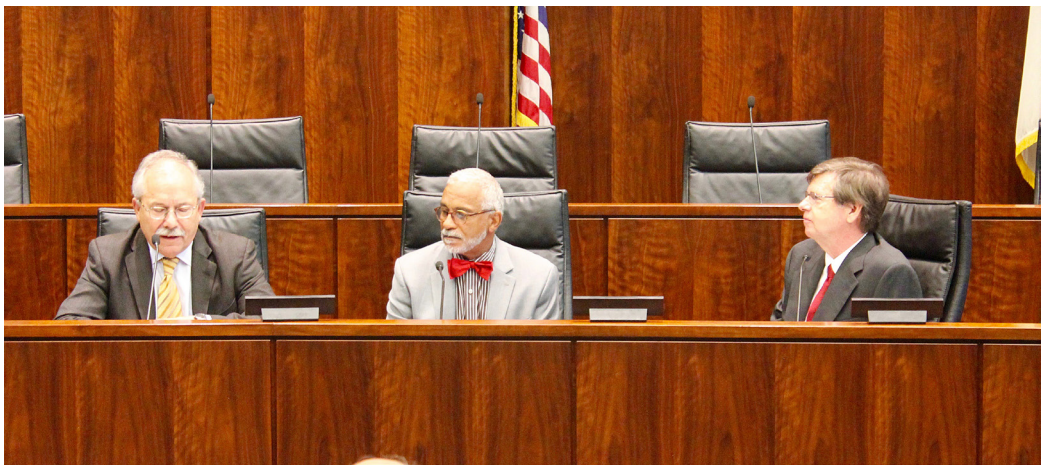
In the current process, when Exelon Corp. decides to close a nuclear power plant, it submits an application to MISO. MISO is then required to examine the impact of the closure on the regional ability to supply sufficient electricity to all points in its grid. If it is possible to provide sufficient electricity supply without the nuclear (or other) power plant, the plant may close. If is it not possible to meet peak demand without that power plant, the plant is required to stay open. Once the application for plant closure to MISO is made, there is no possibility to reverse the decision. If MISO determines that the plant is not necessary, it must close. Once the plant is closed and placed in SAFSTOR, it cannot be relicensed and reopened. The closure decision is final. A similar process would be followed with PJM in the case of the Quad Cities power plants.

Clean Power Plan and Future Needs

Under the Final EPA Clean Power Plan (CPP), Illinois will be required to reduce its CO2 emissions from a 2012 annual level of 96,106,169 short tons per year (or a rate of 2,208 lbs/net MWh) to 66,477,157 short tons per year (or a rate of 1,245 lbs/net MWh) by 2030. This reduction will directly impact the use of fossil fuels for electricity generation in Illinois. It also shows the value of the nuclear power stations which emit 0 short tons of CO2. The loss of the zero carbon-emitting nuclear power stations will place an even greater burden on other electricity generation resources to reduce or curtail emissions or embark on carbon capture and sequestration (CCS) technologies to reduce emissions. The latter approach will come at some cost and will be passed along as a part of the electricity price. Maintaining the current nuclear generating capacity in Illinois is a major value proposition for meeting future Clean Power Plan goals.

In addition to the CPP goals, there is a broader reason for Illinois to meet and surpass the 2030 goals. The recent COP21 agreement went into force on November 4, 2016. This agreement sets ambitious goals for holding CO2 emission levels below those that will result in a 2°C warming. This requires a substantial commitment by the US to exceed the Clean Power Plan goals both in amount and in time. Illinois can lead the way by keeping all of its nuclear power stations online.

In addition to the benefit to the environment through the continuing use of nuclear power in Illinois, there are other benefits to maintaining a secure electricity base-load generating capacity. In the near future, the rise of electricity use around the clock will be pushed through the expanded use of better electric vehicles, home electricity (battery) storage systems, increased use of computer server farms and systems, and increased use of robotic devices for a whole variety of applications. In all of these areas, reliable 24/7 base load power is necessary. In fact, the development of battery electric vehicles is a good example of how carbon-free electricity can be used to replace gasoline and diesel fuel to reduce emissions from the transportation sector in a major way. It is notable that carbon capture and sequestration are not viable on passenger or heavy duty vehicles, whereas nuclear-generated electricity can be used as a power source with no environmental impact. The rise of self-driving cars will further push the desire for battery electric or fuel

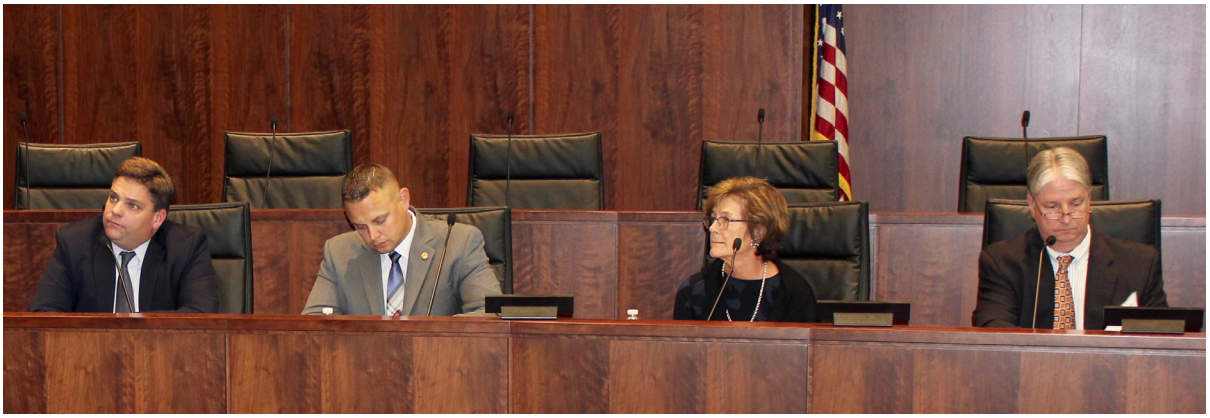


David Foster, Donne Trotter, and Jim Stubbins

Nuclear Power: What it means in Illinois

Maria Korsnick, William Hite, and Matt Bennett

Tim Followell and Henry Marquard



Chapin Rose, Neil Anderson, Susan Tierney, and David Boyd

cell electric vehicles. Similar advances are foreseen in the use of robotics to perform a variety of functions. The main energy source will be electricity and, since there is no limitation on work cycles, these systems could work equally well any time of the day or night.

Legislative Opportunities

The best approach to dealing with the short-term and long-term effects of the loss of nuclear generating capacity through the shuttering of the Clinton power station and the quad cities power station is for the Illinois state government to intervene to provide a competitive pricing structure, among other initiatives, for the Illinois nuclear fleet.

In this respect, the current Illinois State Senate Bill 1585 is a major step in this direction. Among the participants to this forum were three State Senators who have drafted and endorsed this bill. Based on the comments of nearly all of the speakers at this forum, there is wide-spread support for this approach and an acknowledgement that action must be taken quickly to prevent the loss of important carbon-free electricity resources in Illinois.

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PROGRAM

Welcome

1:00 p.m. – James F. Stubbins, NPRE Department Head

Opening Addresses

1:10 p.m. – Lonnie Stephenson, International President, International Brotherhood of Electrical Workers
1:30 p.m. – Cheri Bustos, U.S. Representative from Illinois, 17th Congressional District
1:50 p.m. – John Kotek, Acting Assistant Secretary for the Office of Nuclear Energy, U.S. Department of Energy

Panel 1 - Impact of Closures

2:15 p.m. – *Moderator*, Dr. Jeffrey Binder, Director, Applied Research Institute, University of Illinois at Urbana-Champaign
David Foster, Senior Advisor, Office of the U.S. Secretary of Energy
James F. Stubbins: "Energy and Environmental System Impacts on Nuclear Closures"
Donne Trotter, Illinois State Senator, 17th District

Break

Discussion

2:45 p.m. – *Facilitator*, Matt Bennett, Senior Vice President, Third Way
Maria G. Korsnick, Chief Operating Officer, Nuclear Energy Institute
William Hite, General President, United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry, United States and Canada

Panel 2 - Solutions

3:25 p.m. – *Moderator*, Prof. Petros Sofronis, Director, WPI International Institute on Carbon Neutral Research, University of Illinois at Urbana-Champaign
Dr. David Boyd, MISO External Affairs Team
Susan F. Tierney, Senior Advisor, Analysis Group
Chapin Rose, Illinois State Senator, 51st District
Neil Anderson, Illinois State Senator, 36th District

Perspective

4:00 p.m. – Tim Followell, City Administrator, Clinton, Illinois
Henry Marquard, Director of Government Affairs, Quad Cities Chamber of Commerce

Conclusion

4:30 p.m. – James F. Stubbins

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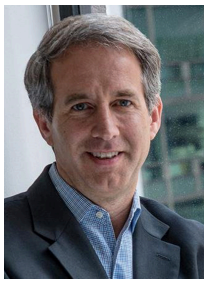
SPEAKERS

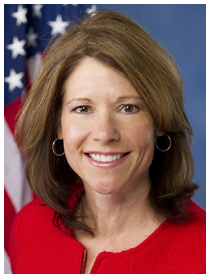
Illinois State Sen. **Neil Anderson** has co-sponsored Senate Bill 1585 with the intent of keeping open the Quad Cities Nuclear Power Station in Cordova, Illinois, located within the state's 36th legislative district that Rose represents. The Senate Bill would establish a Low Carbon Portfolio Standard (LCPS) that would help to reduce carbon emissions, increase renewable energy and maintain a stable and secure electricity supply in the state.



Matt Bennett is a co-founder of Third Way, a center-left think tank that is committed to developing and promoting policies to help in the fight against climate change. Third Way maintains that low-carbon technologies such as nuclear energy and carbon capture and storage (CCS) must be included in the mix of society's energy solutions.

Jeffrey L. Binder, an NPRE alumnus, has served as Director of the Illinois Applied Research Institute (ARI) at the University of Illinois at Urbana Champaign since November 2013. This November, he will assume a new position as Associate Laboratory Director for the Argonne National Laboratory's Energy and Global Security Directorate. Before ARI, Binder worked at Oak Ridge National Laboratory, rising to the position of Associate Laboratory Director for Nuclear Science and Engineering.

David Boyd is a lead member of the External Affairs team for MISO, a regional transmission organization that provides electric power across 15 states and the Canadian province of Manitoba. Boyd serves as MISO's primary liaison with the governors and state regulatory and legislative policymakers on footprint wide matters in the MISO region. In addition, he monitors and integrates the activities of federal regulators and legislators into MISO's overall policies.



U.S. Congresswoman **Cheri Bustos** represents Illinois' 17th Congressional District, including the location of the Quad Cities Nuclear Generating Station. She has joined other elected officials in calling on Illinois Gov. Bruce Rauner and leaders of the state House and Senate to consider legislation that would help keep the state's economically at-risk nuclear energy facilities operating.

City Administrator **Tim Followell** has had 40 years experience working for the city of Clinton, Illinois, and has been a lifelong resident.

David Foster joined the Energy Department as a senior advisor on industrial and economic policy in June, 2014. Prior to his appointment, he served eight years as the founding Executive Director of the Blue Green Alliance, a national partnership of labor unions and environmental organizations dedicated to expanding the number and quality of jobs in the clean economy.

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SPEAKERS

William Hite has been General President and chief officer of the 340,000-member United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada since December 2004. The General President represents the face of the United Association in dealings with high-level government officials, contractors, contractor associations, project owner organizations, fellow labor unions and the general public.

Maria G. Korsnick is the Chief Operating Officer of the Nuclear Energy Institute. NEI fosters the beneficial uses of nuclear technology before Congress, the White House and executive branch agencies, federal regulators, and state policy forums. Before joining NEI, Korsnick served as senior vice president of Exelon's Northeast operations and acting chief executive officer and chief nuclear officer of Constellation Energy Nuclear Group (CENG).

John Kotek, an NPRE alumnus, serves as the Acting Assistant Secretary for the Office of Nuclear Energy. The Office is responsible for conducting research on current and future nuclear energy systems, maintaining the government's nuclear energy research infrastructure, establishing a path forward for the nation's spent nuclear fuel and high-level nuclear waste management program, and a host of other national priorities.

Henry Marquard, is the Director of Government Affairs at the Quad Cities Chamber of Commerce. The Clinton and Quad Cities Nuclear Power Stations are among plants slated for closure.

Illinois State Sen. **Chapin Rose** has co-sponsored Senate Bill 1585 with the intent of keeping open the Clinton Nuclear Power Station in Clinton, Illinois, located within the state's 51st legislative district that Rose represents. The Senate Bill would establish a Low Carbon Portfolio Standard (LCPS) that would help to reduce carbon emissions, increase renewable energy and maintain a stable and secure electricity supply in the state.

Petros Sofronis, James W. Bayne Professor in the College of Engineering at UIUC, directs the International Institute for Carbon-Neutral Energy Research (I^2CNER). An international collaboration between Japan and the U.S., I^2CNER's mission is to contribute to the creation of a sustainable and environmentally-friendly society by conducting fundamental research for the advancement of low carbon emission and cost effective energy systems, and the improvement of energy efficiency.

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SPEAKERS

Lonnie R. Stephenson is International President of the 750,000-member International Brotherhood of Electrical Workers. He was elected to the position in May, after having been appointed for a year to fulfill the role. Initiated into the union in 1976 in Rock Island, Illinois, Stephenson has been extremely active in both his local and in the international organization. He has served in leadership capacities in both the local and international IBEW, and has spearheaded many efforts to help his community and to build membership.

James F. Stubbins, Donald Biggar Willett Professor in the College of Engineering at the University of Illinois at Urbana-Champaign, has served as Department Head for Nuclear, Plasma, and Radiological Engineering since 1999. His research interests are advanced energy systems and energy policy; nuclear materials; nuclear systems design and analysis; and development, analysis and application of materials, primarily for energy-related applications.

Susan F. Tierney is a Senior Advisor for Analysis Group, an economic, financial and strategy consulting firm. An expert on energy policy and economics, specializing in the electric and gas industries, Tierney has consulted to companies, governments, nonprofits, and other organizations on energy markets, as well as economic and environmental regulation and strategy. Her services have involved industry restructuring, market analyses, utility ratemaking and regulatory policy, clean energy regulatory policy, transmission issues, wholesale and retail market design, and resource planning and procurement.

Illinois State Senator **Donne Trotter** has sponsored Senate Bill 1585 to establish a Low Carbon Portfolio Standard (LCPS) that would help to reduce carbon emissions, increase renewable energy and maintain a stable and secure electricity supply in the state. Proponents believe the bill is needed to bolster Illinois' clean energy leadership, support the state's nuclear energy facilities and protect jobs, consumers and a reliable electricity supply. Trotter was elected to the Illinois Senate in 1992 after spending two terms in the House of Representatives.

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News release distributed to media

State, national policy leaders assert nuclear energy's benefits during University of Illinois forum

Speaking Tuesday, October 18, 2016, at the University of Illinois-sponsored informational forum, "Nuclear Power: What it means in Illinois," and in light of a plan to close two generating plants in the state, a host of speakers including Congresswoman Cheri Bustos advocated for nuclear energy.

Exelon Corporation has filed intent to close reactors at the Quad Cities and Clinton nuclear generating stations in western Illinois and central Illinois, respectively. Warning of job and tax base losses sustained from closures, many of the speakers extolled nuclear energy as a reliable energy source that is environmentally friendly, with zero carbon emissions.

Representing the Illinois 17th Congressional District that includes the Quad Cities, Bustos pointed out closures of the two plants would cost 4,300 direct jobs and have a negative financial impact of $1.2 billion. Bustos pressed upon Illinois Gov. Bruce Rauner and leaders of the state House and Senate to pass legislation to protect the plants. "We have until about December to make some kind of decision," she said.

Lonnie Stephenson, International President of the 750,000-member International Brotherhood of Electrical Workers, maintained nuclear energy must be part of a sustainable future. "Nuclear power is so vital," he said. "We can't as a nation keep our energy grid secure and online while reducing our carbon footprint without nuclear."

The federal government is supportive of nuclear energy's role, as well, said John Kotek, Acting Assistant Secretary for the U.S. Department of Energy Office of Nuclear Energy. "President Obama and (DOE) Secretary (Ernest) Moniz have made clear that nuclear energy is an important part of America's clean energy strategy, helping to provide dependable and affordable energy while reducing our carbon emissions."

Kotek's office is responsible for conducting research on current and future nuclear energy systems, maintaining the government's nuclear energy research infrastructure, establishing a path forward for the nation's spent nuclear fuel and high-level nuclear waste management program, and a host of other national priorities.

Speakers also included Illinois State Sens. Donne Trotter, Chapin Rose and Neil Anderson, who have sponsored Senate Bill 1585 that promotes market-based solutions to keep the plants open. The bill would establish a Low Carbon Portfolio Standard (LCPS) that would help to reduce carbon emissions, increase renewable energy and maintain a stable and secure electricity supply in the state. The senators also showed concern for consumers over the impact of the plant closures on rising electricity prices. Trotter said talks are proceeding well to move the legislation out of committee.

Held to consider the economic and environmental impact nuclear power has upon the state, as well as the consequences of limiting the resource as an energy provider, Tuesday's event was sponsored by the Department of Nuclear, Plasma, and Radiological Engineering at the University of Illinois at Urbana-Champaign, the American Federation of Labor and Congress of Industrial Organizations (AFL-CIO), and North America's Building Trades Unions.

The event was part of NPRE's Leadership Speaker Series, intended to provide a forum for global leaders to present policies and platforms that shape the sciences of nuclear, plasma and radiological disciplines.

"Illinois is the birthplace of nuclear power," said NPRE Department Head Jim Stubbins. "The state has been an international leader in the development and uses of nuclear energy. With about half of the electricity in Illinois coming from nuclear power plants, we should value and preserve them all for their major current and long-term contributions to energy and a low-carbon environment in Illinois."

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Report from Informational Forum,

October 18, 2016