Gordon van Welie
President and Chief Executive Officer

October 10, 2014

Dr. Ernest Moniz
Secretary, US Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Dear Secretary Moniz:

Thank you for the opportunity to provide final comments on the US Department of Energy's Quadrennial Energy Review (QER). I commend the work being done by you and the entire Department of Energy to examine the challenges and opportunities we have as a nation in the energy sector, and I look forward to any recommendations or conclusions that the QER may provide.

As you know, the power system in New England continues to undergo a significant transformation. The electric grid and the power generation fleet in New England look very different than a decade ago, and we expect it to look substantially different a decade from now. As New England becomes more reliant on natural gas for power generation, additional pressure is being placed on an already-constrained natural gas pipeline system. In addition, a significant number of coal- and oil-fired generators have retired (or are nearing retirement), while greater levels of variable energy and demand-side resources are coming online.

This transformation was discussed at length at DOE-led QER meetings in New England in April, and I was pleased to present at the meeting in Hartford[1]. In addition, in August ISO New England provided QER-related comments to the Institute of Electrical and Electronics Engineers[2]. I hope you find these comments useful in your efforts to better understand the challenges facing New England.

Changes in New England's Energy Mix

In New England, the percentage of our electricity generated from natural gas has grown from 15% in 2000 to 46% in 2013. During that time, coal- and oil-fired units transitioned from producing 40% of our electricity to less than 7% (with oil-fired units at less than 1% over the overall total). An abundance of domestically-produced, lower-cost natural gas has largely displaced older, less-efficient coal- and oil-fired generation. Renewable energy such as wind and solar represents a small, but growing

[1] http://iso-ne.com/static-assets/documents/pubs/pubcomm/pres_spchs/2014/van_welie_statement_4_21_14.pdf
http://iso-ne.com/static-assets/documents/pubs/pubcomm/pres_spchs/2014/van_welie_interdependencies_4_21_14.pdf
[2] http://iso-ne.com/static-assets/documents/2014/08/2014_08_15_ieee.pdf

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percentage of our electricity generation, owing to state policies in New England that encourage the rapid development of these resources.

ISO New England's interconnection queue suggests that this shift toward natural gas and renewable energy resources will continue. In September 2014, the list of generation projects showing interest in being built in New England and connecting to our electric grid is comprised of two major fuel types: Natural gas (55%) and wind (44%). Developers are proposing over 5,000 megawatts (MW) of natural gas-fired resources and over 3,000 MW of wind resources (nameplate capacity). New England's electric grid will remain heavily dependent on natural gas and will see a growing level of renewable energy -- requiring a flexible fleet to balance the variability of those renewable resources.

Generator Retirements

At the same time, older, oil- and coal-fired power plants (many of which are more than 50 years old) that for many years served as baseload generators are beginning to retire. In the 2012 generator retirements study, more than 8,000 MW of resources were identified as being "at-risk" for retirement in the coming years[3]. Plants that have already retired, or that are expected to retire by June 2017, include:

- Brayton Point Station, Southeast Massachusetts (1,535 MW -- oil & coal)
- Mount Tom Station, Western Massachusetts (142 MW -- coal)
- Norwalk Harbor Station, Southern Connecticut (342 MW -- oil)
- Salem Harbor Station, Northeast Massachusetts (749 MW -- oil & coal)
- Vermont Yankee Station, Southeast Vermont (604 MW -- nuclear)

A clear indication of these retirements was seen during the last Forward Capacity Auction (FCA) held in February 2014. None of the five units listed above (totaling over 3,000 MW or approximately 10% of our regional capacity) opted to receive a capacity supply obligation during the auction, which covers the capacity commitment period from June 1, 2017 to May 31, 2018. As a result, the auction finished 143 MW short of the 33,855 MW installed capacity requirement. This turnover quickly shifted the region from a capacity surplus to a deficit – resulting in an increase in capacity prices.

The impact of these changes on electric grid operations is significant. The region continues to transition away from a system that has relied on resources with on-site fuel inventory (e.g. coal, oil, and nuclear) toward a system much more dependent on "just-in-time" fuel delivery and weather-dependent resources (e.g. wind and solar).

Need for Natural Gas Pipeline Infrastructure

In regions that have an abundance of natural gas pipeline infrastructure, additional demand for natural gas for power generation may not be a concern. However, in New England, increasing pressure on an already-constrained natural gas infrastructure is our most pressing and urgent challenge. As the demand for natural gas for power generation continues to grow, the region has not seen the commensurate and necessary growth in the pipeline infrastructure. As a general rule, gas pipelines are built on the assurance of long-term contracts for pipeline capacity, and in New England, those contracts are signed

[3] http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/mtrls/2012/dec132012/retirements_redacted.pdf

almost exclusively by local distribution companies (LDCs) providing home heating services. For years, New England's gas pipelines had excess capacity, which adequately served the needs of natural gas generators because they used the LDCs released capacity to operate reliably. However, that is no longer the case.

The natural gas pipeline constraints are particularly acute during cold weather. During the winter months, the firm capacity taken by LDCs severely limits the natural gas supply available to power generators and reduces their output to minimal levels. As an example, on January 28, 2014, of the more than 11,000 MW of generation that can only utilize natural gas, only about 3,000 MW were generating during the peak hour. These natural gas resources are particularly important because they are fast-ramping resources that can balance an increasingly variable resource profile in New England (which I discuss below) and fill shortages left by older, less efficient resources that are at times unable to operate. In addition, these circumstances will only worsen in upcoming summers as the gas pipelines remove facilities from service for maintenance and, more significantly, for the already planned expansion outages that are supported by LDC contracts.

There are a number of potential solutions being discussed in New England, including states and stakeholders working to expand pipelines or fuel storage in the region. However, it is unclear whether, and if so how quickly, the market may see investment in pipeline infrastructure or if the states individually or collectively will act to guarantee the investment. This illustrates perhaps the more significant challenge facing New England: Who will enter into the long-term contracts necessary to construct additional gas pipelines to meet the growing demand from power generators?

Impact on Cold Weather Electric Grid Operations

Pipeline Constraints and the Winter Reliability Program
As discussed, New England's pipeline infrastructure is inadequate to serve demand by local distribution companies (for home heating) and power generators in the winter period. This constraint has led to significant electric reliability challenges.

Because the pipelines are constrained, last winter ISO New England designed and implemented a program approved by the Federal Energy Regulatory Commission (FERC) to improve electric system reliability during winter 2013-2014[4]. The Winter Reliability Program created incentives for the region's oil-fired generators to procure adequate levels of inventory, the development of dual-fuel capability, and demand response resources.

The resources and inventory procured through the 2013-2014 Winter Reliability Program were vital to electric grid operations during stretches of extremely cold weather. The region relied heavily on oil-fired generators last winter—burning through 1.6 million of the 1.9 million megawatt-hours of oil procured through the Program.

ISO-NE proposed and received FERC approval for another Winter Reliability Program for the upcoming winter (2014-2015)[5]. This year's Program again provides incentives for generators to procure oil inventory going into the winter, but also provides new incentives for resources to enter into

[4] http://www.iso-ne.com/regulatory/ferc/orders/2013/sep/er13-1851-000_9-16-2013_winter_rel.pdf
[5] http://iso-ne.com/static-assets/documents/2014/09/er14-2407-000_9-9-14_order_accept_winter_reliability.pdf

contracts for liquefied natural gas. The Program also includes a demand response component and incentives for gas-fired generators to commission their dual-fuel capability.

Other Factors
While the use of oil-fired generation is generally low throughout most of the year, it increases substantially during the winter when natural gas pipelines are constrained, creating additional challenges. The supply chain for oil is fragile and unable to respond quickly during adverse weather conditions or when demand for oil is particularly high. Imported Canadian hydropower is also limited during very cold weather because it is being used to generate electricity and meet consumer demand for its domestic winter-peaking system. New England is very vulnerable to the loss of large non-gas generators, like nuclear units, during cold weather. Finally, emissions have increased in the winter because pipeline constraints and economics require the dispatch of the system to shift from natural gas to oil and coal resources. These challenges result in the region entering the next few winters under very precarious operating conditions.

Pipeline Constraints Impact Wholesale Electricity Prices

Natural gas pipeline constraints have significant economic consequences beyond power system reliability. The prices of both natural gas and wholesale electricity have demonstrated the scarcity of natural gas for power generation during the winter months. In the three-month period December 2011 to February 2012, when New England's pipeline system was less constrained, natural gas prices averaged $4.39/MMBtu. During that same three-month period during the Winter 2012-2013, the price jumped to $11.28/MMBtu and kept rising during the Winter 2013-2014 to $19.33/MMBtu ($24.19/MMBtu in January 2014). And the significant increase in the price of natural gas was reflected in the price of wholesale electricity. In calendar year 2012, the electric energy market in New England cleared $5.2 billion. In the period from December 1, 2013-February 28, 2014, the same market cleared $5.05 billion. Without new pipeline infrastructure to meet the growing demand for natural gas from power generators, we expect to see similar results this winter season and in future periods of high gas demand.

Market Changes Focused on Resource Performance

Several years ago, ISO New England and regional stakeholders began efforts to address a decline in overall resource performance and to assure that resources with an obligation to serve had the appropriate incentives to perform. One of the most significant changes is being made to the Forward Capacity Market (FCM). These changes, known as "Pay for Performance" (PFP), better align payments through the FCM with the obligation of a generator to provide energy to consumers during stressed system conditions. Put simply, resources that meet their obligations will be paid for providing electricity and those that do not will lose a portion of their capacity payments. The FERC approved the Pay for Performance proposal in May 2014. The new incentives will drive resources to make arrangements—such as securing adequate fuel resources—to ensure performance during critical periods. The new design will be in effect in 2018 (the ISO will run the first Forward Capacity Auction using these incentives in February 2015). The upcoming auction also will incorporate a sloped demand curve that is intended to smooth out the boom-and-bust cycle of investment when the region is either just short, or just long, on capacity.

The FERC also has approved near-term changes to the wholesale electricity markets to improve resource performance going into this winter. As part of the PFP order, FERC approved increases in the prices that the markets will pay to resources that provide energy during stressed system conditions. The ISO will implement these changes (known as Reserve Constraint Penalty Factors) in December 2014.

Forecasted Growth in Energy Efficiency and Renewable Energy

As New England continues to transition away from coal and oil and toward natural gas to generate electricity, state policies are also promoting renewable resources and energy efficiency. The ISO has been proactive in working with our stakeholders to integrate these resources into the power system. However, the variable nature of wind and solar energy, as well as the infrastructure needed to connect remote renewable resources, presents challenges for New England and the reliability of the regional power system.

From 2009 to 2012, New England invested approximately $2.3 billion in a variety of energy efficiency (EE) programs, and it is estimated that $6.3 billion will be invested in EE from 2017 to 2023. Several years ago, ISO New England began to forecast the impact that energy efficiency would have across the entire region as well as in individual states. From 2014-2023, energy efficiency improvements are expected to slow the rate of growth of annual energy usage in New England to 0.1% and slow the rate of growth of peak demand as well. ISO New England continues to work with both the states and stakeholders (particularly EE program administrators) on an ongoing basis to create an annual energy efficiency forecast, and I would be happy to share more on the EE forecast at your request[6].

In 2009, the New England governors released their *Renewable Energy Blueprint*[7], a study that noted in part that New England has the potential to tap over 10,000 MW of wind energy. In the last few years, ISO New England has completed a pair of studies including a 2010 *New England Wind Integration Study*[8] and a 2011 economic study to examine the transmission constraints that may bottle up wind in various development areas[9]. Earlier this year, the ISO began to publish daily and weekly wind forecasts to improve our situational awareness and to take full advantage of the intermittent wind resources.

This work has coincided with a growth in wind energy in New England. In 2005, the region had two MW of wind energy on the bulk power system, which has now grown to over 800 MW (nameplate capacity). There is an additional 3,700 MW of wind in the ISO New England interconnection queue—most of which is located onshore in northern New England. The location of these resources is important because currently the lack of transmission to carry wind energy from remote areas is limiting the output of existing wind resources. Significant transmission investment is needed to support existing wind resources and integrate new resources to serve load reliably.

New England is also seeing a strong demand for distributed generation (DG) resources, much of which is solar/photovoltaic resources often installed on the distribution network to directly benefit individual customers. These "behind the meter" resources are not visible to the ISO as the operator of the bulk electric system, but in aggregate, these resources are likely to make a significant impact in the load profile in New England. Similar to our energy efficiency forecast, we recently began an effort to

[6] http://www.iso-ne.com/committees/planning/energy-efficiency-forecast
[7] http://www.nescoe.com/Blueprint.html
[8] http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/reports/2010/newis_report.pdf
[9] http://iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/reports/2014/2011_eco_study_final.pdf

quantify and forecast the growth of DG resources in New England[10]. Our interim forecast, finalized in April 2014, predicts a growth from 500 MW (nameplate capacity) of DG at the end of 2013 to 1,800 MW by 2023. ISO New England will continue to refine and improve the DG forecast moving forward. It is clear that there will continue to be a strong growth in demand-side resources like DG—increasing the variable renewable resources on our system.

The Challenges Ahead

In the coming years, I believe that New England will become a "hybrid" electric grid. This hybrid grid is likely to have increasing demand for natural gas generation and variable, renewable energy resources, and electricity customers who will want greater control over their energy use through demand-side programs (e.g. energy efficiency and behind-the-meter distributed generation).

However, New England needs to solve the challenge of how to develop adequate natural gas infrastructure. Unlike the regulatory framework for electric transmission (which is designed to serve peak demand), additional pipeline infrastructure will not be built without customers entering into long-term contracts for firm capacity. It remains to be seen if the wholesale electricity and natural gas markets will drive the necessary investments in pipelines or if individual or a collection of states will act. How successfully the region and its stakeholders meet this challenge will determine the strength of the electric grid for many years, as well as the ability to successfully integrate greater levels of renewable energy and distributed resources.

Thank you again for the attention you have given to infrastructure challenges in New England during your QER outreach process. Please contact me if I can provide further information on any of these issues.

Sincerely,

Gordon van Welie
President and Chief Executive Officer

[10] http://www.iso-ne.com/committees/planning/distributed-generation