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OLR Backgrounder: Millstone and the Zero Carbon Procurement

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Issue

This report describes recent legislation affecting the Millstone Power Station and the related power procurement currently underway.

Summary

Electricity generators in Connecticut sell the electricity they generate in regional wholesale markets administered by the Independent System Operator (ISO)-New England. Several nuclear plants in this region and elsewhere have recently retired or announced plans to do so, citing difficult market conditions as a primary reason for their retirement. Dominion, the company that generally owns and operates Millstone Power Station in Waterford, has argued that, absent state action, Millstone could also close and that such an outcome would have negative consequences for the state and local economy and greenhouse gas emissions, among other things.

Beginning in 2016, the legislature considered several bills addressing these nuclear energy issues before ultimately passing into law An Act Concerning Zero Carbon Solicitation and Procurement (PA 17-3, June Special Session (JSS)). The act requires the Department of Energy and Environmental Protection (DEEP) and the Public Utilities Regulatory Authority (PURA) to (1) conduct an appraisal of Millstone's current and projected economic condition and how its retirement would affect energy markets, emissions, and the economy and (2) determine whether to conduct a solicitation and procurement for nuclear power and certain other energy sources. Attachment 1 summarizes the legislative and executive actions related to this legislation.

DEEP and PURA's appraisal found that Millstone's retirement would have several negative effects, including (1) exacerbating grid reliability issues, (2) increasing greenhouse gas emissions to the extent other zero emissions energy is not procured to replace Millstone, and (3) decreasing revenue for both the state and the town of Waterford. It generally concluded that Millstone is projected to be profitable under expected market revenues through 2035 (the study's end date), but acknowledged the potential uncertainty in its findings because, among other things, the analysis relied on industry data, rather than proprietary cost data. Based on the appraisal, the agencies determined that a procurement as authorized under the act should proceed, with certain qualifications for existing resources like Millstone.

In addition to nuclear power generation facilities, the act authorizes DEEP to solicit proposals for the procurement from several types of zero emissions resources including hydropower, Class I renewable energy sources (e.g., wind and solar) and energy storage systems. According to DEEP, existing resources like Millstone would only be selected if their bid is less than forecasted market prices unless a resource provides the agencies with credible evidence that it is not profitable and will likely retire without ratepayer support. Such resources that the agencies deem "existing resources confirmed at risk" will be evaluated based on both price and non-price criteria (i.e., as is the case with new resources, they can be selected even if their bid price is higher than market forecasts). The act limits the total annual energy output of selected proposals to no more than 12 million megawatt-hours.

DEEP issued the draft RFP on June 22, 2018, and the final RFP on July 31, 2018. As part of PURA's proceeding to determine at risk status, DEEP and the Office of Consumer Council concluded that Millstone should be categorized as at risk and recommended that PURA do the same. On November 16, PURA issued a proposed interim decision concluding that Millstone is an existing resource at risk of retirement. Over 100 bids have been submitted. According to reporting, DEEP plans to select winning bidders in late 2018 or early 2019.

Background

Millstone's Nuclear Capacity

Millstone Power Station consists of two nuclear reactors located in Waterford, Connecticut (i.e., Unit 2 and Unit 3). Table 1 indicates, for each reactor, (1) the date it came online, (2) its construction cost, (3) its size in megawatts (MW), and (4) the date its operating license expires.

Table 1: Millstone Description

Unit	Online Date	Cost at Time of Construction	Size	License Expiration
Millstone Unit 2	1975	$424 million	882 MW	July 2035
Millstone Unit 3	1986	$3.8 billion	1,230 MW	November 2045

Source: DEEP and PURA Assessment, p. 5 & 6

The sizes shown in Table 1 reflect the capacity of the two units. According to Dominion, Millstone's total output is equal to just over half of all electricity consumed in Connecticut. (Because wholesale energy markets are regional, electricity produced by Millstone may be purchased to meet demand anywhere in New England and elsewhere. Comparisons of Millstone's output to Connecticut's energy consumption show the amount of the electricity produced, not where or by whom it is consumed.)

Debate Surrounding Legislative Actions to Support Millstone

Over several years, nuclear power plants in the region and elsewhere have retired, often citing difficult market conditions, including low wholesale energy prices, as a principal reason for their retirement. Citing similar concerns from Dominion, the Energy and Technology Committee held an informational forum in 2016 on the adequacy of energy supplies, including nuclear power, in the state.

In brief, those in favor of the state action to support Millstone argued that early closure would have negative economic impacts on the area surrounding the plant, including job losses. According to Dominion, the Millstone plants have approximately 1,080 fulltime employees, with an average annual salary of $99,600. Proponents also argued that the natural gas that would likely replace the nuclear generation would exacerbate issues with grid reliability and greenhouse gas emissions. Replacing a source of this size could increase costs in energy markets, which would increase electricity rates.

Opponents of state action to support Millstone argued that state support could also increase ratepayer costs to the extent it requires electric distribution companies to recover costs from their ratepayers. Opponents noted that since generation plants operate in a deregulated context, regulators do not generally have information on costs and profits to determine with certainty the likelihood of plant closure. Opponents also argued that nuclear power, while emissions free, is not a clean energy source and therefore the state should not take action to maintain such generation. They also raised safety and security concerns.

Executive and Legislative Actions

In the 2016 and 2017 regular sessions, the legislature considered but did not pass bills that would have allowed DEEP to conduct energy procurements by issuing solicitations for proposals from nuclear power plants and other types of generating facilities (e.g., Class I renewable resources).

Generally, to conduct an energy procurement, DEEP directs the electric distribution companies (i.e., Eversource and United Illuminating) to enter into long-term agreements to purchase a specified amount of energy (or related products) based on responses to DEEP's solicitation of proposals to provide various types of energy. This allows selected resources to have a constant price for their

energy over a long period of time rather than selling for fluctuating prices on the wholesale energy market or through bilateral agreements with other parties. It also allows resources to receive a higher price than they may receive on the wholesale markets to the extent that the procurement process includes consideration of non-price factors (e.g., zero emissions) when selecting bids. The electric distribution companies, which, in Connecticut do not own generation, can resell the purchased energy and recover the costs (e.g., the difference between the purchase price and the sale price) from ratepayers through a reconciling component of their bills (or, distribute the profits to ratepayers should the procured energy and related products sell for more than the purchase price). Thus, the cost or benefit of such procurements is not borne by taxpayers, but by ratepayers.

On July 25, 2017, Governor Malloy signed Executive Order 59, which required DEEP and PURA to conduct a resource assessment that examines Millstone's economic viability and related issues. In October, during a special session to pass the 2018-2019 budget, the legislature also passed PA 17-3, JSS, which similarly required DEEP and PURA to conduct an appraisal of nuclear power generating facilities. The act and the executive order contained similar and overlapping provisions for the appraisal or assessment as shown in Table 2.

Table 2: Millstone Study Requirements

	Executive Order no. 59	PA 17-3, JSS
Study	Resource assessment of Millstone and existing nuclear generating facilities	Appraisal of nuclear power generating facilities
Conducted by	DEEP and PURA	DEEP and PURA

Required contents	• Millstone's current and projected economic viability
	• The role of existing nuclear facilities and other sources in meeting the state's emission reduction targets at the least cost to ratepayers
	• Best mechanisms to ensure progress towards emissions targets and how to implement such mechanisms
		• Current and projected economic condition of nuclear generating facilities in ISO-New England's control area
		• How nuclear generating facilities retiring before June 1, 2027 would affect:
		  ○ electric markets, fuel diversity, energy security, and grid reliability;
		  ○ the state's greenhouse gas emission requirements; and
		  ○ the state, regional, and local economy.

Due	February 1, 2018	February 1, 2018
Submitted to	Governor, Energy and Technology Committee chairs and ranking members, and the Governor's Council on Climate Change	Legislature

DEEP and PURA (the agencies) submitted a report of their assessment and appraisal to satisfy requirements of both PA 17-3, JSS and Executive Order no. 59, along with an assessment of Millstone's economic viability prepared by Levitan and Associates (LAI). We summarize the report's findings below.

Millstone Study Findings

Economic Viability

The act required the appraisal to examine Millstone's current and projected economic condition. The agencies define a profitable and viable nuclear plant as one that has revenues that exceed costs over time, generating a return on investment to the plant owner that meets their business portfolio and investor needs. The LAI assessment generally concluded that Millstone is "likely to operate profitably from the early 2020s through the mid-2030s, the end date for the study," but the agencies acknowledged the potential uncertainty in this finding because, among other things, the analysis relied on industry data, rather than data on Millstone's actual costs and revenues.

According to the report, after the LAI assessment was finalized, the agencies conducted sensitivity analyses to test how the findings would change based on alternative cost assumptions. They were prompted to do so based on additional information Dominion provided, stakeholder input, and federal tax legislation. The agencies found that, under adjusted assumptions, Millstone's financial viability could be at risk, but, absent detailed, auditable financial data from Dominion, the agencies could not verify the accuracy of Dominion's asserted costs. Furthermore, according to the agencies, Dominion's requirements and expectations for Millstone's return on investment are unknown and the company could decide to retire the plant even if it generates net profits. (As explained below, during a later proceeding, DEEP and the Office of Consumer Council received additional information and determined that Millstone was at risk of retirement beginning June 1, 2023, and PURA later also determined Millstone to be at risk.)

Effects of Early Retirement

The act also required the appraisal to examine how Millstone's early retirement would affect (1) electric markets, fuel diversity, and energy security; (2) the state's greenhouse gas emissions requirements; and (3) the state, regional, and local economy.

Electric Markets, Fuel Diversity, and Energy Security. According to the agencies, Millstone's retirement would have significant negative impacts on the region's electric grid with respect to fuel diversity, energy security, and grid reliability.

To operate a functional electric grid, ISO-New England, the regional grid operator, must continuously balance electricity supply and demand, matching generator output with real-time energy use. Among other things, ISO-New England operates energy markets to buy and sell wholesale electric power and a forward capacity market to ensure system reliability over multiple years. Generally, the markets are designed to select the lowest cost resources needed to reliably meet demand without regard to fuel type.

Due to advancements in drilling technology (e.g., hydraulic fracturing or "fracking"), natural gas prices have declined and this has encouraged more gas-fired power generation in the region. Lower natural gas prices have lowered wholesale electricity prices, which in turn have lowered revenues for other generators, including Millstone, causing some to retire and be replaced by more gas-fired generation. In the winter, when natural gas pipeline capacity is used to supply heating customers, the price of natural gas can be volatile as supply becomes constrained. According to the agencies, because New England has limited natural gas pipeline infrastructure, increased dependence on gas-fired plants has exposed the region to price volatility and threats to reliability. According to the agencies, capacity procured through the wholesale markets to replace Millstone's 2,200 megawatts would likely be natural gas-fired, exacerbating these issues.

While ISO-New England is generally responsible for ensuring grid reliability, it does not have the authority to prevent a resource like Millstone from choosing to retire. In the forward capacity market, generators like Millstone contract to be available to produce or adjust their power generation if needed (similar to a retainer paid to an attorney to ensure that he or she will be available for a client). For generators participating in this market, the process to retire (or de-list) generally begins four years in advance, when the generator submits a de-list bid for ISO-New England to review, though a generator can retire earlier if it sheds its capacity supply obligations (e.g., securing agreements from another plant to operate for the time period and amount of the obligation). There are circumstances under which generators can retire conditionally based on the next auction results or choose to operate under a cost-of-service agreement with ISO-New England if there is a local reliability issue. ISO-New England describes the retirement process in more detail in its response to a data request from the agencies.

State Greenhouse Gas Emission Requirements. With regard to carbon emissions, the LAI assessment modeled three scenarios and a reference case for comparison, generally finding that bringing in more zero carbon energy to replace Millstone's energy will maintain or mitigate emissions but come with higher costs. Table 3 describes the scenarios and predicted outcomes. Costs described in the table are generally borne by ratepayers. In the "0% scenario", costs are due to an increase in wholesale energy prices, as when supply decreases and demand stays constant in that market, prices rise. In the 25% and 100% replacement scenarios, additional costs are due to procurements of other types of zero emissions resources. Generally, electric distribution companies pass on the costs of procurements to their ratepayers (and are typically required to do so by law).

Table 3: Retirement and Replacement Scenarios (see LAI Assessment Figure 79)

Scenario	Description	Outcomes compared to Reference Case	
		Emissions	Cost
Reference Case	Millstone units remain operational, without any intervention, through 2035	N/A	N/A
0% Replacement	Both Millstone units retire, the state takes no action, and Millstone's capacity is replaced through wholesale markets	From 2022 to 2035, emissions are roughly six million tons higher per year.	Costs increase to just under $200 million annually by 2022 and then decrease gradually each year after that
25% Replacement	Both Millstone units retire and the electric distribution companies procure energy to replace 25% of Millstone's output with zero emission sources (utility scale solar, energy efficiency, and passive demand response)	From 2022 to 2035, emissions are roughly five million tons higher per year.	Costs increase to just under $400 million annually by 2022 and hold steady or decrease slightly each year after that
100% Replacement	Both Millstone units retire and the electric distribution companies procure energy to replace 100% of Millstone's output with zero emission sources (same as 25% scenario plus offshore wind and Canadian hydropower)	From 2022 to 2035, emissions are similar to the reference case.	Costs increase to about $700 million annually by 2022 and then again to about $900 million by 2024, and then generally increase gradually each year after that

Source: LAI assessment, Figures 79-81

State, Regional, and Local Economy. The LAI assessment determined that Dominion's annual payroll and capital spending, including income multiplier effects, is approximately $350 million per year. Over the period from 2018 to 2040, the agencies determined Millstone's continued operation to be net beneficial in terms of in-state output by $2.7 billion when compared to a scenario where Millstone retires in mid-2021. As most of this economic impact is attributed to payroll, LAI noted that the effect is diminished to the extent laid-off Millstone workers are subsequently hired by defense contractors in the area.

Millstone pays Waterford $30 million per year, nearly a third of the town's annual budget. The LAI assessment found that Millstone's retirement would create fiscal challenges for the town.

Agency Determination on Procurement and Other Policy Options

Under the act, if the appraisal demonstrates that action is necessary with regards to Millstone, DEEP must issue solicitations and initiate a procurement process. However, the executive order also required the agencies to consider best mechanisms to ensure progress towards emissions targets. Thus, the agencies determined to proceed with a procurement but also described two other policy options: (1) zero-emission energy credits (ZECs) and (2) contracted power for retail supply.

Procurement Determination. The agencies concluded that a procurement as authorized by PA 17-3, JSS should proceed, but with separate conditions for new and existing resources. According to the agencies, new resources will be scored based on price and other factors (similar to how DEEP has conducted renewable energy procurements under two previous acts (PA 13-303 and PA 15-107)). Existing resources like Millstone will be scored on price alone (i.e., they will only be selected if their price is less than expected market prices), unless they provide the agencies with credible evidence to support a finding that the resources will likely retire without ratepayer support. Such "at-risk" resources will be scored like new resources, based on price and other factors, and the market forecast against which they are being measured will reflect what energy and capacity prices would be if such resources retired.

Zero-emission Energy Credits (ZECs). ZECs are a mechanism to monetize the emissions-free attributes of nuclear power, thereby creating a revenue source for Millstone by establishing a market for such attributes (similar conceptually to renewable energy credits and the state's renewable portfolio standard). According to the agencies, such a program could be flexibly designed to provide support only when needed and support other types of emissions-free generation like large scale hydropower.

Contracted Power for Retail Supply. The agencies also discussed the idea of contracting for retail power supply, in other words, allowing the state to seek bids from nuclear power generating facilities to supply power to Connecticut electric consumers directly (i.e., "cut out the middle man"). Because Connecticut's retail electric market is deregulated, consumers can choose their electric supplier. PA 17-3, JSS did not change retail choice nor require consumers to purchase electricity obtained by the utilities from a specific generator. Rather, a procurement under the act requires the utilities to purchase electricity that they would resell in the wholesale markets. While the state does coordinate the purchase of energy for those customers who do not choose a retail supplier (i.e., standard service or last resort service) and could theoretically use some of the energy procured from Millstone to meet that demand, customers can always switch to another retail supplier and presumably would do so to the extent that the price of power procured from Millstone exceeded other available offers.

Legislative Approval

PA 17-3, JSS allowed the legislature to reject DEEP and PURA's report by a simple majority vote in each chamber by March 1, 2018. The legislature took no action and the results were thus deemed approved.

Procurement Process

Request for Proposals

Under PA 17-3, JSS, if the agencies' appraisal demonstrated that action was necessary, the DEEP commissioner had to initiate a competitive procurement process by May 1, 2018. The act authorizes him to solicit bids from the following new and existing zero-emissions facilities:

1. eligible nuclear power generation facilities,
2. hydropower,
3. Class I renewable resources (e.g., wind and solar), and
4. energy storage systems.

DEEP issued the draft RFP on June 22, 2018 and the final RFP on July 31, 2018. Among other things, the final RFP moved the at risk time period (i.e., the earliest date an existing resource can be considered at risk) up a year to June 1, 2022. It also allows Millstone to rebut the presumption of the at-risk time period by providing evidence in PURA's proceeding to show that it is at risk before that date. According to DEEP, the at risk time period is based on capacity obligations for existing resources in ISO-New England's forward capacity market.

"At Risk" Proceeding

The agencies developed a procedure to determine "at risk" status for existing resources. Under this procedure, (1) existing resources petition PURA to begin a proceeding to make a determination of at risk status and (2) DEEP separately evaluates information submitted and makes a recommendation as a party in the proceeding. Millstone was the only entity to apply for such a determination. DEEP and the Office of Consumer Council concluded that Millstone should be categorized as at risk beginning June 1, 2023, and recommended that PURA do the same. In its proposed interim decision, PURA determined that Millstone is an existing resource at risk of retirement.

Bid Selection

Over 100 bids have been submitted in response to the RFP. The act authorizes the DEEP commissioner to select proposals he finds to be in the ratepayers' best interests, meaning that its benefits outweigh its costs to ratepayers based on whether the delivered price of sources included is less than the forecasted price of energy and capacity. The act also requires the determination to be based on:

1. impacts on electric system operations and reliability;
2. the extent to which the proposal or contract contributes to (a) ISO-New England's local sourcing requirement, (b) the state's greenhouse gas emissions requirements, and (c) the state's air quality improvement requirements;
3. fuel diversity; and
4. whether the proposal and its environmental impacts align with the state's Integrated Resources Plan and Comprehensive Energy Strategy.

If the DEEP commissioner determines any proposals meet the above criteria, the act requires him to direct the electric distribution companies (i.e., Eversource and United Illuminating) to enter into agreements for energy, capacity, and any environmental attributes (e.g., renewable energy credits) under the selected proposals. Under the act, (1) agreements are subject to PURA's review and approval and (2) electric distribution companies must file an application for agreement approval with PURA. PURA's review begins when the electric distribution company files a signed power purchase agreement. PURA must issue a decision within 180 days after the purchase agreement is filed, and if it does not do so by that date, the agreement is deemed approved.

The act limits the total annual energy output of selected proposals to no more than 12 million megawatt-hours and requires that the lengths of the agreements are (1) at least three but not more than 10 years for eligible nuclear power generation facilities or hydropower and (2) up to 20 years for Class I energy sources and storage.

According to DEEP, the agency plans to select winning bidders in late 2018 or early 2019.

Resources

Levitan and Associates, Inc. "Resource Assessment on the Economic Viability of the Millstone Generating Facilities," February 1, 2018

ISO-New England, "Operational Fuel-Security Analysis," January 17, 2018

ISO-New England, "Response to Data Request #2," September 8, 2017

DEEP, "Presentation to the Energy & Technology Committee: Informational Forum on Adequacy of Energy Supplies including Nuclear Power in the State," (PowerPoint) March 24, 2016

Dominion, "Millstone Power Station," (PowerPoint) March 24, 2016

DEEP, "RE: Docket No. 18-05-04 – PURA Implementation of June Special Session Public Act 17-3 – Brief of the Department of Energy and Environmental Protection's Bureau of Energy and Technology's Policy and the Office of Consumer Counsel," October 1, 2018

DEEP, "Draft Notice of Request for Proposals from Private Developers for Zero Carbon Energy," June 22, 2018

DEEP and PURA, "Notice of Close of Proceeding," April 30, 2018

The Day, "Millstone, Offshore Wind in Zero-Carbon Auction Mix," September 18, 2018

DEEP, "Procurement for Zero-Carbon Resources Pursuant to Connecticut General Statutes – 16a-3m: Notice of Proceeding," May 1, 2018

Attachment 1: Timeline of Legislative and Executive Actions Related to Millstone

Date	Event
March – May 2016 (2016 Regular Session)	The Energy and Technology Committee held an informational forum on the adequacy of energy supplies including nuclear power in the state. Presenters included DEEP and Dominion.
	SB 344 as amended by Senate "A" allowed DEEP to issue solicitations for certain types of generating facilities, including nuclear power plants, and direct electric distribution companies to enter purchase agreements, subject to PURA's approval. (See OLR's bill analysis for more information.) The Senate passed the bill as amended, but the House took no action on it.
June 2017 (2017 Regular Session)	SB 778 as amended by Senate "A" required DEEP to (1) conduct an appraisal of nuclear power generating facilities and (2) decide whether to select one of two competitive procurement processes permitted by the bill for nuclear power generating facilities, and in some cases, large-scale hydropower. (See OLR's bill analysis for more information.) The Senate passed the bill as amended, but the House took no action on it.
July 2017	Governor Malloy signed Executive Order 59, which requires DEEP and PURA to conduct a resource assessment that examines Millstone's economic viability and related issues.
September – October 2017 (2017 June Special Session)	SB 1501 as amended by Senate "A" requires DEEP and PURA to conduct an appraisal of nuclear power generating facilities and submit the proposal to the legislature for review. If the appraisal demonstrates a need for action, the bill allows the DEEP commissioner to issue one or more solicitations for zero carbon electricity generating resources. In September, the Senate passed the bill as amended. In October, the House also passed the bill and the governor signed it (PA 17-3, June Special Session (JSS)). OLR's public act summary describes the act's provisions.
February 2018	DEEP and PURA released their report as required by PA 17-3, JSS and Executive Order 59, accompanied by a resource assessment of Millstone's economic viability prepared by Levitan and Associates (LAI). Among other things, it recommended that the procurement proceed and existing resources like Millstone prove they are "at risk" of closure in order to have non-price factors considered in the solicitation process.
March 2018	PA 17-3, JSS allowed the legislature to reject DEEP and PURA's report by a simple majority vote in each chamber by March 1, 2018. The legislature took no action and the results were thus deemed approved.
May 2018	PURA began a proceeding to review petitions from resources seeking "at risk" status (Docket 18-05-04). (Only Millstone applied.)
June 2018	DEEP issued the draft RFP on June 22, 2018.
July 2018	DEEP issued the final RFP on July 31, 2018. According to DEEP, the agency plans to select winning bidders in late 2018 or early 2019.
September 2018	DEEP and the Office of Consumer Council filed a brief in PURA's proceeding recommending that PURA determine that Millstone is "at risk".
November 2018	In a proposed interim decision, PURA determines Millstone to be "at risk."

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