February 15, 2018

By Electronic Mail (*mlyons@iso-ne.com*)

Peter Brandien, Vice President, System Operations
Marc Lyons, NEPOOL Reliability Committee Secretary
ISO-New England, Inc.
1 Sullivan Rd
Holyoke, MA 01040

Re: Request for Modification to ISO New England Operational Fuel-Security Analysis Assumptions and Analysis of Additional Scenarios

Dear Peter and Marc,

We, the undersigned NEPOOL Members and interested parties (together the "Joint Requesters") appreciate the opportunity to provide ISO-NE with our requests for additional analysis in conjunction with ISO-NE's Operational Fuel-Security Analysis issued for discussion on January 17, 2018 ("OFSA"). We request that ISO-NE include in the next draft of the OFSA report and associated presentation materials these additional scenarios. The full parameters of all requests summarized below are listed in detail for each request on the attached ISO-NE "Operational Fuel Security Analysis Assumption Request Form" ("Form").

Modification of Assumptions in Reference Case: The Joint Requesters request that ISO-NE modify the OFSA Reference Case. Because ISO-NE designed the Reference Case to "serv[e] as a baseline for comparison with other scenarios,"[1] it is vitally important that it accurately reflect "likely levels" of relevant system variables "if the power system continues to evolve on its current path."[2] As indicated below, and again in the Form (item 1), each of the following Reference Case variables should be modified as noted to reflect "levels that can reasonably be expected to materialize in New England given current trends"[3] if ISO-NE is to meet its stated standard for the study's baseline:[4]

- LDC Gas Demand growth = 0.7%/yr
- Electric EE = Use 2018 EE Forecast
- Gross Load forecast = Use draft 2018 CELT
- Active DR = 500 MW
- Imports = 3,500
- LNG Cap = 1.25 Bcf/day

[1] *See* OFSA at p.8 ("The study includes . . . 1 reference case [that] incorporates likely levels of each variable if the power system continues to evolve on its current path, serving as a baseline for comparison with other scenarios.").
[2] *Id.*
[3] *Id.* at 22 ("The study's reference case incorporated each of the five key variables at levels that can reasonably be expected to materialize in New England given current trends.").
[4] To the extent ISO desires to analyze the effects of any of these system variables not reaching the reasonably expected levels indicated in this request, the Joint Requesters suggest ISO examine any such shortfall as an additional sensitivity from the updated Reference Case.

- PV = 4,990 MW
- Onshore Wind = 1,453 MW
- Offshore Wind = 430 MW

OFSA with Updated Reference Case + New Scenarios: After updating the Reference Case to include the modified variables indicated above (item 1), the Joint Requesters request that ISO-NE re-run all 23 scenarios (the Reference Case and 22 others) included in the Preliminary OFSA. In addition, the Joint Requesters ask that ISO also run the ten new Single-Variable and Combination Case scenarios listed on the Request Form (items 2-11) against the Updated Reference Case.

Alternative Approach: Only if ISO determines it cannot re-run the OFSA using the Updated Reference Case described above, the Joint Requesters ask that ISO-NE create and run a new "Business As Usual" ("BAU)" Case that modifies the draft reference case variables as requested for the Corrected Reference Case (item 1). Should ISO-NE proceed in this manner, the Joint Requesters ask that ISO-NE also run the fifteen new BAU-related cases listed on the Request Form (items 2-11 plus items 12-16) in addition to a new BAU Case.

General Information Requests: On the Form, Joint Requestors also list requests for the report to be clarified or additional information to be provided in 12 areas relevant to ISO-NE's development of the Preliminary OFSA. The Joint Requestors thank ISO-NE in advance for providing these clarifications and requested information which will help the Joint Requestors better understand the OFSA and which the Joint Requestors believe will maximize the value of the OFSA for all NEPOOL stakeholders.

Thank you for considering this request. Questions regarding this request should be directed to the Joint Requesters by contacting Sarah Bresolin (sarah.bresolin@state.ma.us; 617.963.2407) or Abigail Krich (607-227-8100; krich@boreasrenewables.com).

Sincerely,

MASSACHUSETTS ATTORNEY GENERAL'S OFFICE

//s//

Sarah Bresolin
Assistant Attorney General

NEW HAMPSHIRE OFFICE OF THE CONSUMER ADVOCATE

//s//

D. Maurice Kreis
Consumer Advocate

RENEW NORTHEAST

//s//

Francis Pullaro
Executive Director

CONSERVATION LAW FOUNDATION

//s//

David Ismay
Senior Attorney

BROOKFIELD RENEWABLE

//s//

Aleks Mitreski
Senior Director, Regulatory Affairs –
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THE CAPE LIGHT COMPACT

//s//

Margaret Downey
Administrator

ENVIRONMENTAL DEFENSE FUND

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Liz Delaney
Program Director

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Director of Regulatory Affairs - Northeast

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//s//

Cynthia Arcate
President and CEO

ACADIA CENTER

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Amy Boyd
Senior Attorney

SIERRA CLUB

//s//

Mark Kresowik
Deputy Regional Director

UNION OF CONCERNED SCIENTISTS

//s//

Mike Jacobs
Senior Energy Analyst

VERMONT ENERGY INVESTMENT CORPORATION

//s//

David C. Westman
Director, Regulatory Affairs

<table>
<tr><th colspan="4">Operational Fuel-Security Analysis Assumption Request Form</th></tr>
<tr><th>Scenario Number
Or Input Description
(i.e. – Reference Case, Scenario #1-23, Specific Input Variable, Other Request)</th><th>Commenter
(Name/Organization)</th><th>Detailed Request for Change Input or Key Assumption
(i.e. – what is the requested input value)</th><th>Rationale or Basis
for Detailed Request</th></tr>
<tr><td colspan="4">New Case Requests</td></tr>
<tr><td>1.
Update the reference case with these modified assumptions and re-run all 23 cases based on the updated reference case. Additionally, run the below cases numbered 2-11 that <u>do not include</u> an asterisk, modifying the noted assumptions from the updated reference case. (Note that cases 12-16 below with an asterisk are not needed if the reference case is updated and all of the original 23 cases are re-run.)

-or-

In the alternative, create a new “Business as Usual (BAU)” case as shown here and run the additional cases 2-16 below (both those that do and do not include an asterisk).</td><td>Joint Requesters</td><td>Update the following assumptions from the ISO’s reference case:

LDC Gas Demand growth = 0.7%/yr

Electric EE = Use 2018 EE Forecast

Gross Load forecast = Use draft 2018 CELT

Active DR = 500 MW

Imports = 3,500

LNG Cap = 1.25 Bcf/day

PV = 4,990 MW

Onshore Wind = 1,453 MW

Offshore Wind = 430 MW</td><td>LDC Gas Demand Growth – Use recent growth rates as future projection
An analysis of recent EIA gas data since 2010, normalized for weather, appears to show an annual LDC gas use growth rate in recent years of approximately 0.7%/yr, reduced from the 1.26% used in ISO’s draft reference case. There does not appear to be sufficient evidence to support a near doubling of this growth rate in the coming years.

Electric EE – Use 2018 forecast
Draft 2018 EE forecast, using updated methodology, shows energy demand reduction from passive EE increased substantially as compared with the 2017 forecast as shown in the following table. ISO should use their own most current information.
Incremental energy savings from PDR in New England (GWh)
<table>
<tr><th></th><th>CELT 2017
(final May 2017)</th><th>CELT 2018
(draft Feb 2018)</th></tr>
<tr><td>Through 2017</td><td>11,903</td><td>-</td></tr>
<tr><td>2018</td><td>1,376</td><td>(per 2017 CELT)</td></tr>
<tr><td>2019</td><td>1,632</td><td>2,690</td></tr>
<tr><td>2020</td><td>2,127</td><td>2,568</td></tr>
<tr><td>2021</td><td>2,403</td><td>2,498</td></tr>
<tr><td>2022</td><td>2,218</td><td>2,306</td></tr>
<tr><td>2023</td><td>2,024</td><td>2,104</td></tr>
<tr><td>2024</td><td>1,825</td><td>1,898</td></tr>
<tr><td>Total</td><td>25,508</td><td>27,343</td></tr>
</table>
Gross Load Forecast – Use 2018 forecast
The 2018 draft load forecast resulted in a significant decrease in the gross load based on more recent system trends as discussed at the 2/13/2018 RC (A7, slide 10 shows 2022 summer peak is reduced by 2.1% in draft 2018 forecast compared with 2017 forecast). ISO should use their own most current information.

Active DR – Use quantity based on FCA 12
FCA 12 concluded with 458 MW existing active DR, 51 MW new Active DR, just over 500 MW</td></tr>
</table>

			in total. ISO should base this assumption on the most current information available from FCA 12. While Active DR typically shed much of its CSO following the FCA in the early years of the FCM, this does not appear to be the case in recent years. The Feb 2018 COO report on pp. 54-57 shows that the amount of CSO for Active DR appears to be holding fairly steady at the level requested here for some time. **Imports** – The MA 83D solicitation will procure resources able to deliver approximately 1000 MW on average, whether from imports or another clean energy resource type, for delivery beginning by 2022. Though there is uncertainty right now about which project will ultimately receive a contract, there is very little uncertainty that one of the 46 bids received in the solicitation will move ahead and be in service by 2024. Including this in the business as usual case is consistent with the ISO's premise for requiring that CASPR be in place for FCA 13. **LNG Cap** ISO has seen 1.25 Bcf/day flow, and a future that envisions retirement of nuclear, oil, and coal units may require more LNG. The LNG providers have shown that they can flow this amount. **PV – Use 2018 forecast** Draft 2018 PV forecast released 2/5/2018 shows 4,990 MW in 2024, increased from 4,432 MW in 2017 PV forecast. ISO should use their own most current information. **Onshore Wind** 2017 CELT report shows 1300 MW onshore wind operating as of 1/1/2017. Interconnection queue shows another 53 MW achieved COD between in 2017. Assume an additional 100 MW added for total of 1453 MW. **Offshore Wind** - With above renewables assumptions, approximately 400 MW new offshore wind is needed to meet the growth in RPS requirements between now and the study year (approximately 5.1 TWh, see further explanation on assumed capacity factors below). This is a reasonable, achievable projection given the ongoing MA 83C offshore wind solicitation. **Capacity Factors – The above MW numbers assumed to meet the growth in RPS requirements are based on the following annual CF assumptions:** **Onshore Wind** – 32%, as used by ISO in the FCA 12 ORTP calculation **Offshore Wind** – 44.5%, as used by ISO in the 2015 economic study of offshore wind **PV** – 14.4%, as used by ISO in the 2017 PV forecast (Note, the average winter CF from Dec – Feb is shown to be about 7.64%)
2. **Create "BAU + Higher LDC Gas Demand Growth" case**	**Joint Requesters**	**Increase LDC gas demand forecast value to the 1.26%/yr**	**Show impact of changing single-variable of LDC gas demand growth to the higher value of 1.26%/yr assumed in ISO's draft Reference case.** The draft report, page 25, says that LDC gas demand growth is assumed to grow from 515 Bcf/yr in 2014 to 591 Bcf/yr in 2025. That is an annual growth rate of 1.26%.
3. **Create "BAU +**	**Joint Requesters**	**Increase Thermal EE by reducing**	**Show impact of changing single-variable of LDC gas demand growth. This slower growth rate could result from more aggressive thermal EE programs.**

Increased Thermal EE" case		**annual LDC gas demand growth from 0.7%/yr in Business as Usual to 0.5%/yr.**	
4. Create "BAU + Accelerated Renewables" case	**Joint Requesters**	**PV = 5,442 MW** **Offshore wind = 1,630 MW** **Onshore wind = 2,553 MW** **Other Renewables = 960 MW**	**Show impact of changing the single variable of renewables development accelerated to 2024 compared with the BAU case. (Total 10585 MW total)** **PV** – Pre-discounted ISO-NE 2018 PV forecast for 2024 is 5,442 MW **Offshore Wind** – Assumes full MA 83C solicitation for 1,600 MW built on accelerated schedule by 2024. **Onshore Wind** – Assumes existing 1,353 MW increased by 1,200 MW, the size limit of a single Maine cluster. **Other Renewables** – Leave at existing levels
5. Create "BAU + Increased Electric EE" case	**Joint Requesters**	**Increase Electric EE from Business As Usual case by 1180 MW**	**Show impact of changing single-variable of electric demand on BAU case.** The 2016 Economic Study (NEPOOL Scenario Analysis) Scenario 3 value for EE in 2025 was 5,663 MW. This is 1,180 MW higher than ISO's draft 2018 CELT value of 4,483 MW. This represents a 26% increase in EE peak demand reduction.
6. Create "BAU + Battery Storage" case	**Joint Requesters**	**Add 250 MW/500 MWh battery storage with 89% round trip efficiency to Business as Usual case**	**Show impact of changing single-variable of adding battery storage.** **This level of storage is expected to be developed in the next 2-3 years, and is a conservative assumption for what might be built by 2024 but would show directionally the impact that storage might have.** • **MA is mandated to have 200 MWh battery storage installed by 2020.** • **Solar Massachusetts Renewable Target (SMART) is expected to drive the development of a larger quantity of storage alongside the PV developed under that program.** • **Advancing Commonwealth Energy Storage program has awarded grants to 26 storage projects totaling 25 MW/59 MWh.** **Model storage as a resource of last resort to be discharged prior to load shedding and charged at the next opportunity when gas/LNG is available. While this is different from how these first storage installations are likely to operate, it will provide an indicator of the level of support short-term storage may be able to provide towards achieving greater winter grid resiliency.** **Assume 89% round trip efficiency (the efficiency of the currently available Tesla 4-hour Power Pack).**
7. Create "BAU + Increased Security	**Joint Requesters**	**BAU with the Accelerated Renewables,**	**Show the impact of the combination of changes that increase system security based on BAU assumptions**

Combination" Case		**Increased Electric EE, Increased Thermal EE, Battery Storage, more dual fuel tank refills, and More LNG**	

8. Create "Accelerated Renewables + CASPR Success" Case	**Joint Requesters**	**Assume increased retirements of 2849 MW above BAU case, corresponding to summer capacity value of new renewables and imports added in Accelerated Renewables Case**	**CASPR and the FCM should generally cause the market to keep a balance between retirements and new sponsored policy resource additions if they work as intended. Assume that the FCA qualified capacity value of the new renewables and imports added to the system in the Accelerated Renewables case are offset by retirements totaling the same capacity value.**
			• 5,443 MW total – 2400 MW existing = 3,042 MW new PV
			  o 30% qualified capacity = 913 MW new PV capacity
			• 1,630 MW total – 30 MW existing = 1,600 MW new offshore wind
			  o 45% qualified capacity = 720 MW new offshore wind capacity
			• 2,553 MW total – 1,353 MW existing = 1,200 MW new onshore wind
			  o 18% qualified capacity = 216 MW new onshore wind capacity
			• 3,500 MW total – 2,500 MW existing = 1000 MW new imports
			  o 100% qualified capacity = 1000 MW qualified capacity value
			• Total new capacity = 2849 MW.
			Assume additional retirements of 2849 MW.

9. Create "BAU + Add'l Retirements" Case	**Joint Requesters**	**BAU with same number of MWs of retirements as in the CASPR success case (2849 MW increase over BAU), but without the increased renewables**	**Show impact of changing single-variable on BAU assumptions**
10. Create "BAU + Add'l Retirements + Add'l LNG" Case	**Joint Requesters**	**BAU with same number of MWs of retirements as in the CASPR success case (2849 MW increase over BAU), but without the increased renewables, and LNG cap increased to 1.5 Bcf**	**Show impact of changing increasing LNG cap on the add'l retirements case.**

11. Create "BAU + Compressor Outage + Counteracting Changes"	**Joint Requesters**	**BAU with compressor outage, 1.5 Bcf LNG, 3 dual fuel tank refills, accelerated renewables, Increased Electric and Thermal EE**	**Shows impact of compressor outage with counteracting changes to system**
12.* Create "BAU + More LNG" Case	**Joint Requesters**	**Increase LNG Cap in Business as Usual case to 1.5 BcF**	**Show impact of changing single-variable of increased LNG injection cap.** Note: If the reference case is updated, the "More LNG" case (original case #3 in the draft OFSA) would add 0.25 Bcf/day to the LNG cap as in the original Case #3, resulting in a new cap of 1.5 Bcf in the updated Case #3. A new More LNG case would only be needed if the reference case is not updated.
13.* Create "BAU + More Dual Fuel Replenishment"	**Joint Requesters**	**BAU plus 3 dual fuel tank fills instead of 2**	**Show impact of changing single-variable of dual fuel tank fills.**
14.* Create "BAU – Imports" Case	**Joint Requesters**	**Decrease imports from BAU case to 2500 MW**	**Show impact of changing single-variable of imports remaining at today's levels rather than increasing to the BAU level.** Note: If the reference case is updated to include 3500 MW imports, the "less imports" case (original case #7 in the draft OFSA) would be run with 2500 MW imports rather than 2000 MW imports.
15.* Create "BAU + Max Retirements" Case	**Joint Requesters**	**BAU with 5400 MW retirements**	**Show impact of changing single-variable on BAU assumptions**
16.* Create "BAU + Compressor Outage"	**Joint Requesters**	**BAU with compressor outage, 1.5 Bcf LNG, 3 dual fuel tank refills**	**Shows impact of compressor outage, coupled with increased LNG and dual fuel tank refills as in ISO draft study scenario 22.**
General Requests			
Clarification of how model uses annual and peak LDC gas demand assumptions	**Joint Requesters**		Page 25 of the draft report (and slide 25 of the January presentation) notes that the ICF study forecasted peak LDC gas demand rising from 4.4 Bcf/day in 2014 to 5.45 Bcf/day in 2025. This is a 24% overall growth (2% annually). Please clarify why the assumption that peak gas demand would grow 24% while the annual gas demand grows 14.7% is reasonable. Please clarify how the ISO's model utilizes the annual and peak day gas demand values of 591 Bcf/yr and 5.45 Bcf/day. If it is taking a gas demand profile from the winter of 2014/15 (if so, where does that profile come from), how is ISO scaling that up to match both the annual demand and also the peak

			demand?
Clarification on annual LDC gas demand growth	**Joint Requesters**		The draft ISO report, page 25, says that LDC gas demand growth is assumed at "just under 2%", growing from 515 Bcf/yr in 2014 to 591 Bcf/yr in 2025. That is an annual growth rate of 1.26% and total growth of 14.7%. This should be clarified as it was widely interpreted to mean that ISO had assumed a 2% annual growth rate, or 24% total growth from 2014 to 2025. It should be clear that a 1.26% annual growth rate was assumed rather than saying "just under 2%".
Update PV and onshore wind profiles used in models to correspond to load profile	**Joint Requesters**	**Update PV and onshore wind profiles**	Load profiles are driven by weather conditions, just as PV and wind profiles are. By using PV and wind profiles from a different year than the load profile year, ISO has removed the correlation between these profiles and the common weather driving them all. ISO has access to hourly meter data for the onshore wind and registered PV projects operating in the winter of 2014/2015 and should use those profiles, scaled up to the quantities envisioned in these assumptions, rather than using wind and PV profiles from a different year than the load profile used in the study.
Update characterization of onshore wind	**Joint Requesters**		There are 1353 MW of onshore wind resources currently operating on the system. ISO's materials incorrectly represent 1200 MW as the quantity operating in 2017 and should be updated (e.g., the following quote from page 26). Page 26 of the draft report says "Some scenarios assumed higher levels of offshore wind and behind-the-meter solar because these resources appear to have the greatest growth potential, driven by state policies and incentive programs. Onshore wind was held at the current level throughout the study timeline, given the transmission expansion that would be required to develop more onshore wind farms." This study, as represented by ISO, is not intended to cast judgments on the probability of any particular outcome. Similarly, this language should be revised so as not to represent that certain resource types have greater growth potential than others, as this is not necessarily the case.
Correct BTM PV references	**Joint Requesters**		The PV numbers come from the PV forecast which is an aggregate forecast for all types of PV development in New England, not just BTM PV which is a subset. References to BTM PV should be updated to reflect this.
Rename "Max Renewables" assumption "High Growth Renewables"	**Joint Requesters**		The assumptions used in this case are not the maximum quantity of renewables that could be developed by 2024/25 and the name of this assumption is therefore misleading. "High Growth Renewables" would be more appropriate. Similarly, update all references in the materials to these cases representing all or more than the renewables that could result from existing or future clean energy initiatives of the New England states (page 53 in particular). These scenarios do not represent more renewables than could be developed based upon current or possible future state initiatives.
No probabilities, even for boundary cases.	**Joint Requesters**		Make clear throughout the report and materials that there are no probabilities associated with any of these cases and that selecting a variety of cases that show negative outcomes does not indicate that the system is trending in a dangerous direction but simply that if this situation were to occur it could be problematic. Similarly, remove commentary related to the boundary cases being the only ones that are "unlikely to materialize" (Figure 4 and pages 37, 44, 48, 51, 53).

Re-characterize boundary cases	**Joint Requesters**		For the boundary cases, change the description from the "best and worst outcomes" on page 37 of the draft report to "most and least secure" or some other more objective description.
Clarify transmission expansion comments	**Joint Requesters**		The draft report materials (slide 13 of presentation) seem to state that expansion of the transmission system would be required for the renewables cases assumed by ISO when in fact, no significant transmission buildout requirement would be expected for these cases. Only the addition of the 1000 MW of imports shown in the BAU/More Imports cases and the 1200 MW of additional onshore wind shown in the accelerated case here, would require significant transmission expansion.
Copper sheet	**Joint Requesters**		Clarify in the report that the model assumed a copper sheet (i.e., no transmission constraints) for the transmission system and therefore no specific locations for new additions or retirements were assumed.
Update commentary on NY pipeline expansions	**Joint Requesters**		The draft report notes on page 15 that further construction of additional pipeline in NY, which frees up incremental capacity into New England, will likely prove difficult and therefore assumes none will happen. However, the ICF study from October 2016 that ISO used as the basis for its pipeline capability assumptions noted that other projects under development appeared to be proceeding. Though opposition to specific NY pipeline expansions has been substantial (for the Constitution project in particular), it has not been universal and three such additional expansions in NY have now been built or approved. These three should be included in the assumptions for the system that will exist in 2024/25. These are: • New Market Project (already in service) - 112 MMcf/d • Millennium Eastern System Upgrade - 200 MMcf/d • Northeast Supply Enhancement - 400 MMcf/d
Caveats	**Joint Requesters**		Page 20 of the draft report says "While this study doesn't directly consider fuel costs or prices, it does assume that the electricity and fuel markets send price signals sufficient to make full use of the existing electricity and fuel infrastructure as needed." Given the study's reliance on past LNG injections rather than LNG injection capability should the pricing signal be right, for example, it is not clear that the study actually does assume that the infrastructure is fully used.